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AIR EMISSIONS AND CONTROL TECHNOLOGY FOR LEATHER TANNING AND FINISHING OPERATIONS

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**AIR EMISSIONS AND CONTROL TECHNOLOGY FOR
LEATHER TANNING AND FINISHING OPERATIONS**

CONTROL TECHNOLOGY CENTER

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**Emissions Standards Division
Office of Air Quality Planning and Standards
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Research Triangle Park, North Carolina 27711**

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LEATHER TANNING AND FINISHING OPERATIONS**

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PREFACE

The purpose of this document is to provide information to State and local agencies for use in assessing appropriate measures to control volatile organic compound (VOC) emissions from leather tanning and finishing facilities. Another objective of the report is to evaluate leather tanning and finishing processes and determine their potential to emit VOC's and hazardous air pollutants (HAP's) to the atmosphere. This document is the product of a study sponsored by EPA's Control Technology Center (CTC).

The CTC was established by EPA's Office of Research and Development (ORD) and Office of Air Quality Planning and Standards (OAQPS) to provide technical assistance to State and local air pollution control agencies. Three levels of assistance are available through the CTC. First, the CTC maintains a hotline to provide telephone assistance on matters relating to air pollution control technology. Second, engineering assistance can be provided by the Center when appropriate. And finally, the CTC provides technical assistance through publication of technical assistance documents, development of personal computer software, and presentation of workshops on control technology subjects.

This document represents the product of a CTC technical assistance effort. The CTC became interested in pursuing this project as a result of numerous calls from State and local agencies regarding control of VOC emission from leather tanning and finishing facilities. This document was developed using information obtained from available literature, information provided through Federal, State, and local air pollution control agencies, and information obtained from the leather tanning and finishing industry.

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1.0 INTRODUCTION

One of the major goals of the Clean Air Act Amendments of 1990 (CAAA) is to achieve compliance with the national ambient air quality standard for ozone. Title I of the amendments presents provisions for achieving the ozone standard. Among these provisions is a requirement that States adopt reasonably available control technology (RACT) for major sources of VOC's.

Under the amendments, a major source is defined as one with a potential to emit 100 tons or more of VOC's if that source is located in an area classified as marginal or moderate nonattainment for ozone. If the area is classified as serious nonattainment for ozone, the threshold for a major source is lowered to 50 tons per year. Further, the threshold for a major source is 25 tons per year in an area classified as severe nonattainment, and 10 tons per year in an area classified as extreme nonattainment. In addition, Section 184 of the CAAA creates the Northeast ozone transport region which includes 11 States in the Northeast corridor from Washington, DC, to Maine. In the transport region, a major source is one with a potential to emit 50 tons or more of VOC. Major sources in the transport region are subject to the same requirements as major sources in moderate nonattainment areas.

The determination of RACT can be done on a case-by-case basis, but States typically adopt RACT as defined by Control Technique Guidelines (CTG's) issued by EPA. As of 1990, EPA had issued 29 CTG documents and was in the process of developing an additional 12 documents. The CAAA requires States to adopt RACT for both major sources in industries covered by CTG's, and for major sources in industries not covered by any existing CTG.

These provisions of the CAAA have a potential impact on the leather tanning and finishing industry. Many leather tanning and finishing facilities may be reclassified as major sources under the stricter requirements of the Act. In addition, a large number of facilities are located in the Northeast transport region. The EPA has not issued a CTG for this industry and does not anticipate issuing a CTG document in the near future. Therefore, States are left with the burden of determining RACT for any major sources of VOC's in the leather tanning and finishing industry.

1.1 Objectives of the Report

The CTC has received a number of calls from State and local agencies requesting guidance on controlling VOC's from leather tanning and finishing facilities. One of the objectives of this report is to document existing emission control and reduction methods currently used in the industry. State and local agencies will use this information to help determine RACT for facilities in their jurisdiction.

Another objective of the report is to identify and characterize the emissions of HAP's from the industry. In Title III of the CAAA, Section 112(c) requires EPA to publish a list of categories of major and area sources for regulation that emit one or more of the HAP's listed in the section. Presently, leather tanning and finishing plants are not on the list of major or area sources listed for regulation. The information contained in this report will be used to determine if leather tanning and finishing should be added to the list.

1.2 Overview of the Report

The information contained in this document has been obtained from a variety of sources. Contacts were made with numerous State and local agencies that have leather tanning and finishing facilities located in their jurisdictions. These agencies supplied available emissions data and information on regulations specific to the leather tanning and finishing industry. Site visits were made to five facilities, two of which employ emission control devices. Information was also obtained from sources within the leather tanning and finishing industry. These sources included trade associations, suppliers of equipment, and suppliers of finishing chemicals. An extensive literature search was also conducted.

This report is divided into 6 chapters and 5 appendices. Chapter 2.0 provides a general description of the industry while Chapter 3.0 describes the key processes employed in manufacturing leather. Chapter 4.0 characterizes the emissions of VOC's and HAP's from the industry, and Chapter 5.0 describes applicable emission reduction technologies. Finally, Chapter 6.0 discusses current State and local air pollution regulations affecting the industry.

The appendices provide supplementary information related to specific sections of the report. Appendix A includes all emissions data obtained during the study. Appendix B is a series of case studies derived from site visits. These case studies describe emission reduction strategies currently employed by various facilities. Appendix C contains the full text of all State and local air pollution regulations affecting the leather tanning and finishing industry along with all available supporting documentation for these rules. Appendix D lists the facilities identified by various sources reviewed during the study including emissions data bases, State and local

agency emission inventories, and permitting records. Finally, Appendix E is a list of selected contacts who provided information and assistance in compiling the report.

2.0 INDUSTRY DESCRIPTION

Leather manufacturing is one of the oldest industrial processes in the world. The origins of this craft can be traced to prehistoric times. Early tanning operations were conducted in open pits using exclusively manual operations. The tanning agents were plant substances such as oak, hemlock, and chestnut barks. With the arrival of the industrial age, leather making evolved from a cottage craft to a full scale industry.

The modern tannery uses advanced chemical and mechanical processes to produce leather having hundreds of different finished characteristics. This leather is used to produce products such as footwear, upholstery, clothing, gloves, luggage, personal leather goods, and industrial parts. Production of each type of leather involves integration of a complex series of operations that must be closely monitored by experienced professionals.

A distinction can be made between the leather tanning and finishing processes. Leather tanning involves primarily wet chemical processes that produce a stable, usable product. Leather finishing involves a number of conditioning and enhancement processes that give tanned leather distinctive and desirable qualities required by end users of the material. Some facilities in the industry are only involved with leather tanning while some are exclusively leather finishers. There are also facilities that tan and finish at the same location.

The leather tanning and finishing industry has undergone a great number of changes in recent years. In 1982, there were 342 companies in the industry operating about 384 facilities. In 1991, the U. S. Industrial Outlook reported only 115 facilities of significant size that were involved with wet tanning of hides and production of leather.¹

Developing an accurate list of leather tanning and finishing facilities is difficult. Table 2-1 presents estimates of the number of leather tanning and finishing facilities in the United States using three sources of information. The 1991 International Leather Guide lists 225 leather tanning facilities and sales offices while a 1992 report prepared for EPA listed 133 leather tanning and finishing facilities.^{2,3} A review of available emissions inventories and EPA data bases revealed 79 facilities conducting leather tanning and/or finishing. Mr. Frank Rutland of the Leather Industries Research Laboratory estimates that there are about 125 total facilities in the United States

**Table 2-1. Leather Tanning and Finishing
Facilities in the United States**

STATE	NUMBER OF FACILITIES		
	ILG ^a	EPA REPORT ^b	EMISSIONS DATA ^c
ALASKA	1	0	0
ARIZONA	2	0	0
CALIFORNIA	8	4	1
COLORADO	2	0	1
CONNECTICUT	2	0	0
FLORIDA	2	2	1
GEORGIA	2	1	0
IOWA	2	1	1
ILLINOIS	8	3	3
INDIANA	1	0	0
KENTUCKY	2	2	0
LOUISIANA	0	1	0
MASSACHUSETTS	40	26	6
MAINE	9	6	5
MARYLAND	1	1	1
MICHIGAN	4	3	3
MINNESOTA	2	1	1
MISSOURI	4	2	2
NORTH CAROLINA	1	1	1
NEBRASKA	1	2	1
NEW HAMPSHIRE	5	1	0
NEW JERSEY	15	10	5
NEW YORK	64	32	24

**Table 2-1. Leather Tanning and Finishing
Facilities in the United States**

STATE	NUMBER OF FACILITIES		
	ILG ^a	EPA REPORT ^b	EMISSIONS DATA ^c
OHIO	2	1	1
OREGON	1	2	0
PENNSYLVANIA	8	5	6
SOUTH CAROLINA	1	0	0
TENNESSEE	9	4	4
TEXAS	4	3	1
UTAH	1	2	1
WASHINGTON	0	1	0
WISCONSIN	20	16	9
WEST VIRGINIA	1	0	1
	225	133	79

^a Reference 2

^b Reference 3

^c Toxic Release Inventory (1987-1990), AIRS data base, state inventories and permit information.

conducting some form of leather tanning and/or finishing, with about 85 facilities having some type of finishing operation.⁴ Most of the plants are located in New York, New Jersey, Wisconsin, and Massachusetts. A listing of the facilities identified using emissions inventories and EPA data bases is provided in Appendix D.

The discrepancies in the number of facilities identified in the United States is indicative of the changes occurring within the industry and the characteristics of the industry as a whole. Some of the facilities identified by the International Leather Guide are sales offices or specialty process support operations. For example, some smaller companies may be involved with only one process of the leather manufacturing operation such as embossing or cutting. There are also a large number of small facilities that may not be reported in all data bases.

2.1 Characterization of the Industry

When looking at the leather tanning and finishing industry as a whole, a division can be made between the larger and smaller companies. The larger companies typically have integrated tanning, finishing, and marketing operations and employ 400 to 1,000 people. These larger companies usually have in-house research and development capabilities and have some ability to develop customized coating formulations and finishing systems. The smaller companies typically have less than 100 employees and rely more heavily on chemical suppliers to provide tanning and finishing chemicals. They generally do not have the in-house capabilities to develop new coating formulations and finishing systems.⁵

Most of the facilities in the industry fall into the category of smaller companies. As indicated by the 1992 U. S. Industrial Outlook, total 1991 employment by the industry was about 11,400 people spread among 115 facilities. Therefore, the average facility has less than 100 employees. This characterization of the industry is important when considering the availability of resources needed to convert to new technologies such as water based coatings. The majority of the leather tanning and finishing facilities have limited technical capabilities.

There are literally thousands of different products that can be produced from leather. However, the two largest markets for leather are the footwear industry and the upholstery industry. In 1991, 52 percent of all leather shipments were used to manufacture footwear. Conversely, the fastest growing market for leather is the furniture and automotive upholstery industry. It is estimated that in 1991 the upholstery industry accounted for nearly 35 percent of all leather shipments by value as opposed to only 7 percent in 1982. This rapid growth is the result of changes in consumer attitudes and more demand for leather products in furniture and automobiles.

Tables 2-2 and 2-3 provide industry statistics for the cattlehide segment of the industry. Most of the leather produced in the United States is from cattlehides. As shown in the tables, production levels have remained relatively stable over the past few years.⁶

Continued product development and refinement of existing products is a standard activity in the industry. Tanneries must react to the changing demands of their customers and the tanning and finishing process must often be changed to adapt to these demands. For example, automotive upholstery manufacturers must meet a wide range of quality standards imposed by the automotive industry. These standards cover characteristics such as rubfastness, color, and heat resistance. The tannery must closely monitor all phases of the leather manufacturing process to ensure that these standards can be met.

Another example can be found in the footwear industry. Footwear styles are determined by fashion trends that are ever changing. As a result, shoe manufacturers demand that the leather they purchase match the latest trends. Therefore, tanneries producing footwear leather have to adapt their tanning and finishing systems to produce suitable leathers. Since shoe manufacturers apply their own finishes to the leather they purchase, the finished leather supplied by the tannery must also be compatible with the finishes being applied by the shoe manufacturer.

The leather tanning and finishing industry is a highly competitive industry. Competition exists not only within the United States, but also from a vast overseas leather industry. Over 50 percent of the leather imported to the United States is from the countries of Argentina, Italy, the United Kingdom, Brazil, and Thailand.⁷

Table 2-2. United States Production of Cattlehide Leather
Unit -- 1,000 Equivalent Hides

	WETTINGS	PRODUCTION	DELIVERIES
1980	14,948	14,790	14,816
1981	15,581	15,520	15,461
1982	15,105	15,028	15,053
1983	15,456	15,430	15,427
1984	14,029	14,021	13,971
1985	12,616	12,550	12,556
1986	12,598	12,497	12,603
1987	12,754	12,846	12,914
1988	11,475	11,569	11,548
1989	11,242	11,329	11,443
1990	13,018	13,175	13,291
1991	13,021	13,042	13,261

Source: U.S. Leather Industries Statistics, 1992 Edition.

Note: Wettings refer to the number of hides soaked in the wet ends process. Production refers to finished hides, while deliveries refer to the number of finished hides shipped to customers. Deliveries can exceed production in a given year if hides finished in one year are not shipped to customers until later years.

Table 2-3. Tanners' Stocks of all Cattlehide and Leathers
Unit -- 1,000 Equivalent Hides

(Stocks as of December 31)

	RAW	PROCESSED	FINISHED	TOTAL
1973	870	2,258	908	4,036
1974	990	2,362	975	4,327
1975	1,140	2,230	568	3,938
1976	1,160	2,229	745	4,204
1977	1,070	2,304	654	4,028
1978	487	2,133	672	3,283
1979	51	2,015	657	2,723
1980	356	2,162	534	3,052
1981	348	2,210	590	3,148
1982	377	2,294	535	3,206
1983	787	2,319	563	3,669
1984	928	2,328	535	3,791
1985	1,323	2,396	457	4,176
1986	1,491	2,450	406	4,347
1987	1,584	2,470	418	4,472
1988	1,638	2,318	392	4,348
1989	2,210	2,229	390	4,829
1990	3,399	2,072	397	5,868
1991	NR	2,058	413	NR

Source: U.S. Leather Industries Statistics, 1992 Edition.

Note: Inclusion of raw stocks in this summary report was discontinued in 1991 due to insufficient data.

2.2 References

1. U. S. Industrial Outlook, 1991. United States Department of Commerce, International Trade Administration.
2. 1991 International Leather Guide.
3. Science Applications International Corporation. Assisting the New England States in Implementing Reasonably Available Control Technology at Leather Finishing Plants. Final Report submitted to the U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards. July 31, 1992. Appendix B.
4. Telecon. Mitsch, B.F., Alpha-Gamma Technologies, Inc., with Rutland, F., Leather Industry Research Laboratory. March 3, 1993. Clarification of information collected regarding the leather tanning and finishing industry.
5. Reference 4.
6. U. S. Leather Industries Statistics. 1992 Edition. Leather Industries of America Inc. Washington, D. C.
7. Reference 6.

3.0 LEATHER TANNING AND FINISHING PROCESSES

Hides and skins from many animals can be tanned and finished. These animals include cattle, sheep, goats, pigs, deer, horses, and reptiles. In order to simplify the description of the tanning and finishing process, the discussion in this section focuses on cattle hides used to produce leather used for upholstery, footwear, and other fashion goods.

Production of finished leather is a complex procedure that includes many chemical and physical processes. These processes are interrelated and each can have an effect on the characteristics of the finished leather. In this section, the chemical and mechanical processes used to produce finished leather will be discussed. A process flow diagram is provided in Figure 3-1.

Leather tanning and finishing processes can be divided into wet operations and dry operations. The wet operations include all of the processes required for leather tanning. These processes include steps to purify and stabilize the collagen content of the hide. Collagen is the protein responsible for the strength and toughness of leather. Dry operations consist mostly of processes that enhance the natural characteristics of the leather. Dry operations include the leather finishing processes which are responsible for most of the VOC and HAP emissions.

Each of the major wet and dry operations are discussed below. The information provided in the following sections was drawn from three primary sources: a) the Kirk-Othmer Encyclopedia of Chemical Technology;¹ b) Ullman's Encyclopedia of Industrial Chemistry;² and c) Leather Facts.³

3.1 Wet Operations

Historically, wet operations have been divided into three phases: a) the beamhouse; b) the tanyard; and c) the coloring department which includes the retanning, coloring, and fatliquoring operations. The term beamhouse was derived from the way that hides were prepared for tanning using a beam or log to support the hide while it was hand treated. The tanning process was conducted in open pits often dug in the ground. Although modern tanneries have more advanced equipment for processing hides, the terms beamhouse and tanyard are still used. Figure 3-1 uses these terms in showing the flow through the tanning and finishing process.

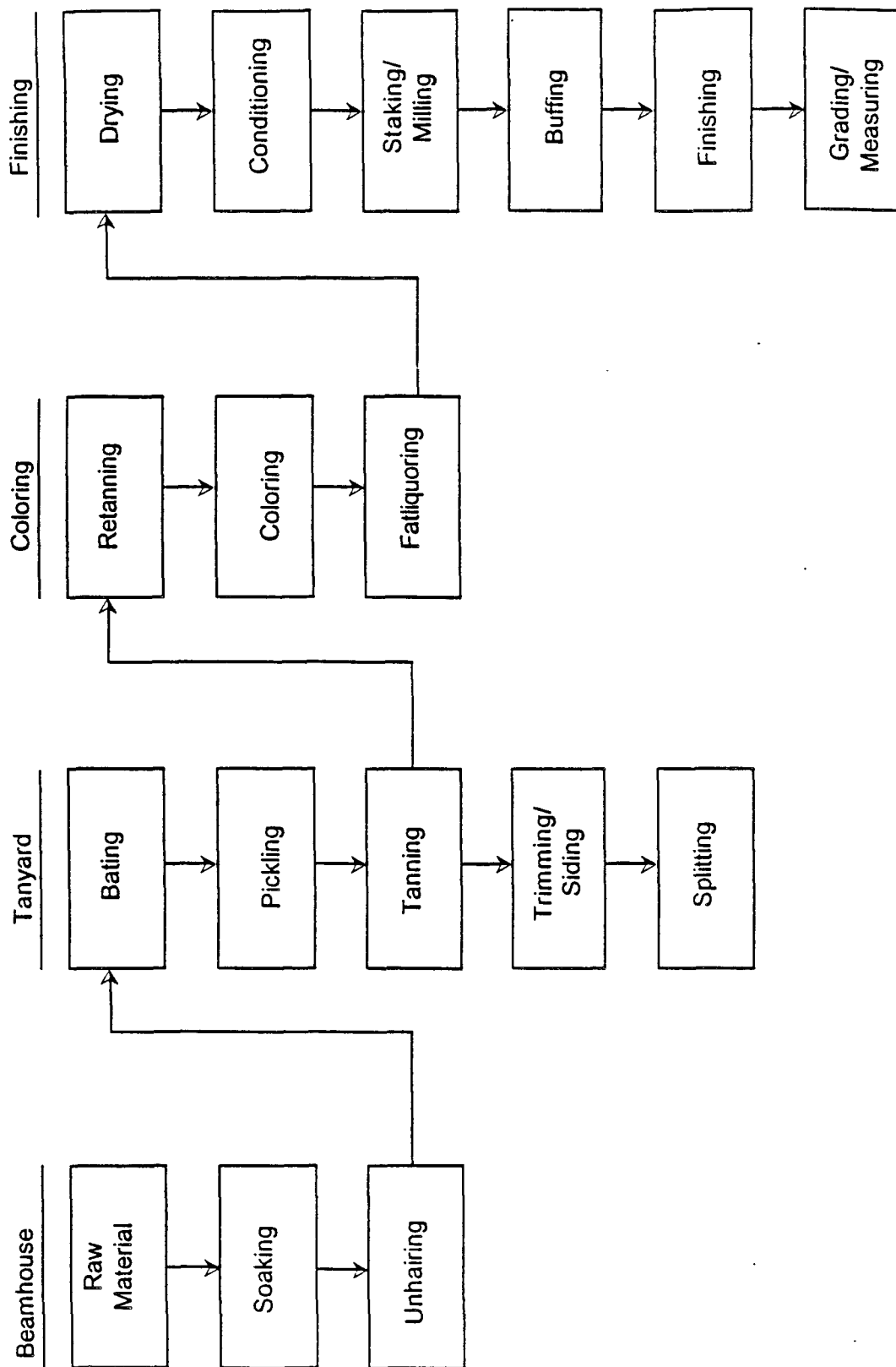


Figure 3-1. Leather Tanning and Finishing Processes - Flow Diagram

Raw cured hides arrive at a tannery from slaughter houses and meat processing plants. The hides are generally preserved following slaughter to prevent putrefaction. The most common method for preserving a hide is through brine curing. Hides are placed in large vats containing a concentrated salt solution and soaked for up to 24 hours. After the hides are removed from the vat, dry salt is added and the hides are bundled for shipment to the tannery.

Upon arrival at the tannery the hides are sorted and weighed. Most hides have been fleshed by the slaughter houses. Fleshing is the removal of excess flesh and fatty material from the hide. In cases where the hides have not been fleshed, fleshing is conducted prior to the hides entering the leather manufacturing process. This process begins with a series of wet operations.

3.1.1 Soaking

The objective of the soaking process is to remove salt and restore moisture lost as a result of salt curing. The soaking process involves placing the hides in large mixing drums containing water and chemical additives (Figure 3-2). The hides are constantly moved in the drums to ensure flexing of the hides and absorption of moisture. The chemical additives include wetting agents and disinfectants that facilitate the remoisturizing process and clean the hides.

The soaking process can take from 8 to 20 hours depending on the thickness of the hides. Following soaking, fresh water is introduced to the mixing drums while the water used for soaking is continuously removed. This wash cycle removes excess salt, dirt, and biological debris from the drums.

3.1.2 Unhairing

The unhairing process takes place in the same drums or vessels used for soaking. Unhairing is usually accomplished using chemicals. Concentrated solutions of calcium hydroxide and sodium sulfide are added to the drums containing the hides and water. The objective of the unhairing process is to remove hair, loosen the outer layer of the skin covering the grain of the hide (the epidermis), and remove soluble skin protein. Care is taken during this process to avoid damaging the collagen fibers of the hide. Collagen fibers are the essential component of leather.

The chemicals used in the unhairing process raise the pH of the hides and cause the hides to swell. Hides may swell to twice their normal thickness during unhairing.

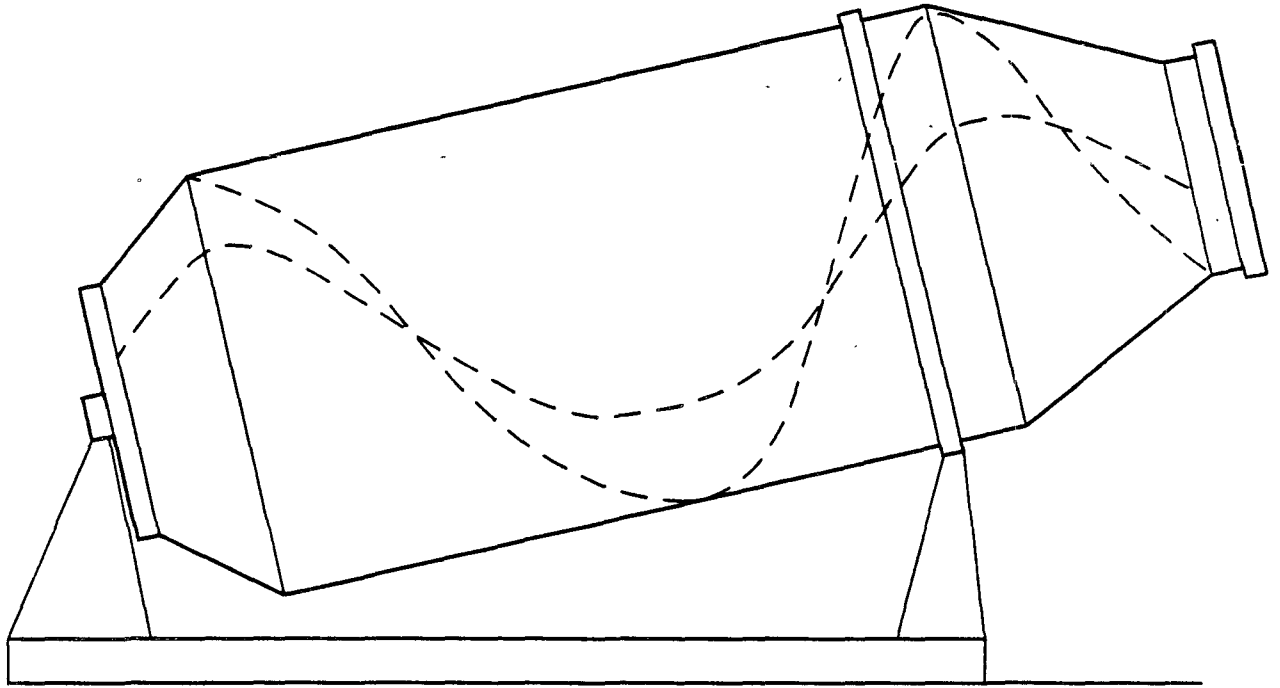


Figure 3-2. Mixing Drum Used in Soaking and Unhairing

3.1.3 Bating

Bating takes place in cylindrical drums with hollow axles (Figure 3-4). Chemicals and water are introduced through pipes inserted into the hollow axles of the drums. The objective of the bating process is to remove the alkaline chemicals that were used in the unhairing process, and remove remaining undesirable components in the hide.

Once the pH of the hide has been adjusted using chemical additives such as ammonium sulphate or ammonium chloride, animal enzymes are added to the drum. These enzymes are referred to as the bate. The enzymes act to destroy hair roots and pigments remaining in the hides. The result of the bating process is a cleaner, softer hide that is nearly ready to be tanned.

In the case of pigskin and sheepskin, an additional chemical step is employed following the bating process. Pig and sheep skins contain excess fats and greases that must be removed prior to tanning. Degreasing using solvents is one method of extracting these unwanted components of the hide. Solvent degreasing is accomplished by exposing the hides to a solution containing solvents and surfactants. Commonly used chemicals used for solvent degreasing include kerosene, stoddard solvent, nonionic and anionic surfactants, and solvents such as trichloroethylene and perchloroethylene. Since volatile compounds are used for degreasing, this process is a potential source of VOC emissions.

3.1.4 Pickling

Prior to tanning, the pH of the hides must once again be adjusted. The objective of the pickling process is to lower the pH of the hides using salts and acids. Pickling is accomplished in the same drums used for bating and usually takes only a few hours to obtain full penetration of the chemicals into the hides.

3.1.5 Tanning

The objective of the tanning process is to stabilize the collagen fibers in the hide so that they are no longer biodegradable. It is the tanning process that produces the substance known as leather. The most common method of tanning used in the United States is referred to as chrome tanning. Over 90 percent of the leather produced in this country is chrome tanned. Chrome tanning is the preferred method because it can be accomplished in shorter time periods than other methods such as vegetable tanning, mineral tanning, and resin tanning. Chrome tanning also produces leather that is highly stable and serviceable in use.

The tanning process takes place in the same drums used for bating and pickling. Tanning is complete in about 4 to 6 hours. The tanned hides are removed

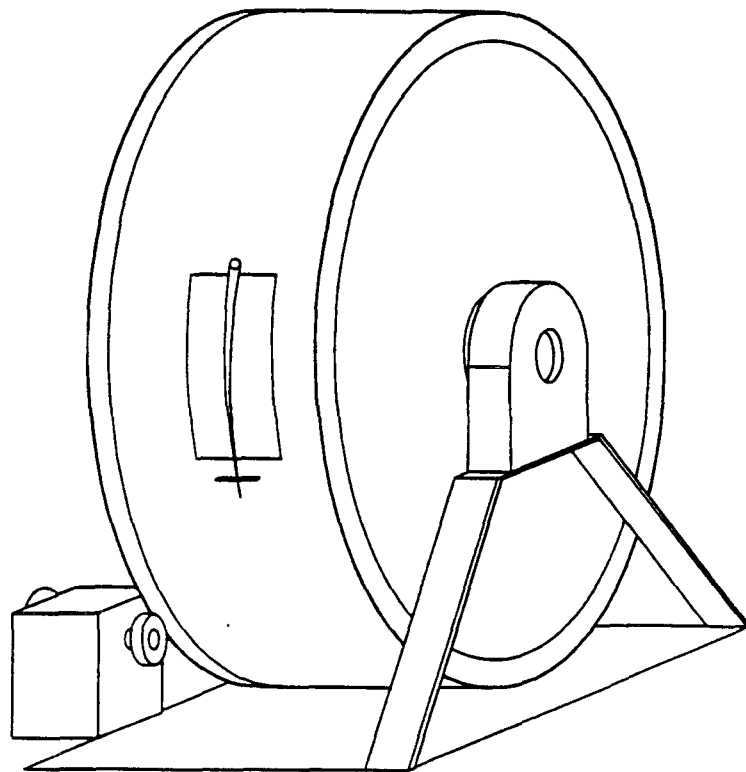


Figure 3-3. Drum Used for Bating, Pickling, and Tanning

from the drums and placed in boxes located beneath the drums. The boxes have porous bottoms that allow excess tanning solution to be drained from the hides. Hides that have been chrome tanned have a characteristic blue color, and are referred to as "blues" or "wet blues."

There are some chromium emissions generated by leather tanning and finishing. In the Toxic Release Inventory data presented in Section 4.0, some tanneries report small quantities of chromium air emissions. It is uncertain whether these emissions are generated by the actual tanning process or by subsequent operations.

3.1.6 Trimming and Siding

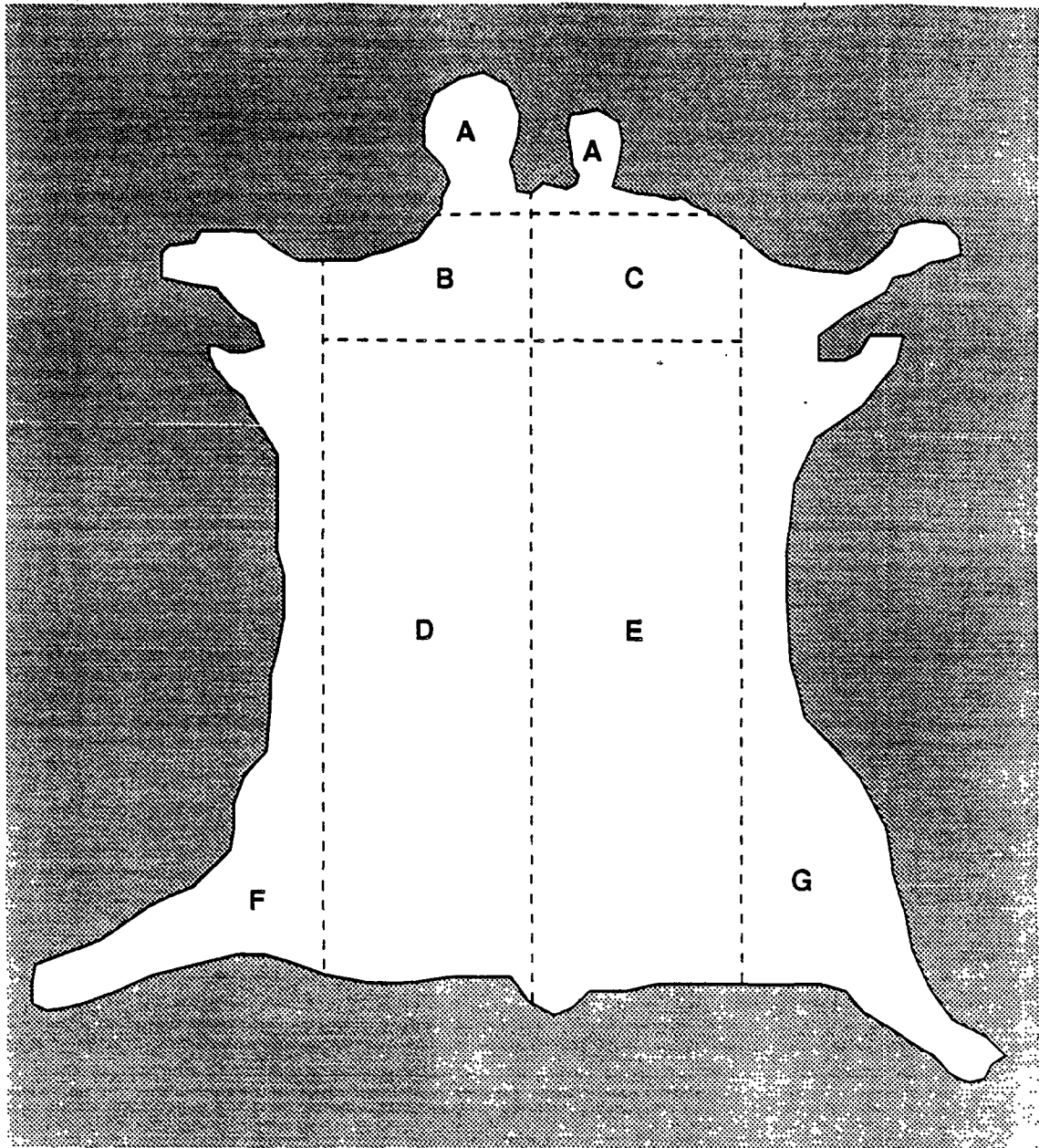
Following tanning, hides are removed from the mixing drums and prepared for additional mechanical operations. Undesirable portions of the hide are trimmed using hand knives. As shown in Figure 3-4, the head (section A) and belly portions (sections F or G) are trimmed. These areas of the hide do not make good leather and can interfere with some tanning and finishing equipment.

The siding operation involves cutting the hides mechanically from head to tail along the backbone. This creates a left side and a right side, both of which are referred to as a "side" of leather. From this point, many tanneries process sides as opposed to the whole hide. However, tanneries that produce leather for upholstery products do not cut the hide into sides. They process the whole hide. Tanneries that process sides are referred to as side leather tanneries while those that process the whole hide are referred to as whole hide tanneries. For the purposes of simplicity, the word "hide" will be used generically while discussing the remaining tanning and finishing processes in this section.

3.1.7 Splitting

Following the tanning process, excess moisture is removed from the hides using mechanical devices. Wringing machines similar to a clothes wringer are used to squeeze excess moisture from the hides. Demoisturizing can also be accomplished using vacuum presses, but this method of demoisturizing is more time consuming than using wringers.

The tanned hides are now ready to be split. The thickness of hides is highly variable. In fact, the thickness of the various parts of a single hide may vary significantly. A splitting machine is used to correct the thickness of the hides. Splitting creates a uniform thickness across an entire hide, and also allows the tannery to produce hides of different thicknesses depending on the requirements of the leather product being manufactured.



Head = A
 Shoulder = B or C
 Bend = D or E
 Belly = F or G

Side = $A+B+D+F$ or $A+C+E+G$
 Crop = $A+B+D$ or $A+C+E$
 Back = $B+D$ or $C+E$
 Croupon = $D+E$

Figure 3-4. Sections of a Cattle Hide Used for Leather Making

The splitting machine cuts the hides laterally, producing a top layer and a bottom layer. The top layer or grain portion of the hide will have a uniform thickness. This portion of the hide is the most desirable portion for producing leather. The bottom or flesh layer will have varying thicknesses and is referred to as the "split." Splits can be used to make suede leather or can be used to make products such as leather dog bones. Some tanneries sell the splits in the wet blue stage to other tanneries or manufacturing facilities that make these products. Figure 3-5 shows a splitting machine.

Following splitting, additional shaving of the hide is performed to ensure uniform thickness prior to the final wet end processes.

3.1.8 Retanning

Up to this point, most of the wet end processes are standardized throughout the industry. The wet blue hides that result from chrome tanning are sold in commodity markets throughout the world and have relatively consistent characteristics. The next three wet end processes begin to impart unique characteristics to the leather.

The first of these processes is referred to as retanning. Retanning is accomplished in the same type of drums used in the initial tanning process. Vegetable, mineral, or synthetic agents are used in the retanning process. The objective of retanning is to begin developing the end use properties of the leather. The retanning process helps to soften the leather and can bleach out the bluish color left by the initial tannage. Retanning takes about 1 to 2 hours.

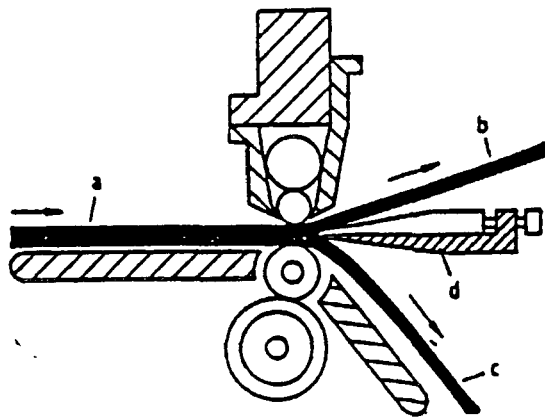
3.1.9 Coloring

Following retanning, the hides remain in the same drum and are colored using a wide range of chemical dyes. The dyes used in the coloring stage reflect the colors desired in the finished product. There are hundreds of dyes and other products that can be used to color leather.

3.1.10 Fatliquoring

The final wet chemical process is known as fatliquoring. In the fatliquoring process, animal, vegetable, and mineral fats and oils are added to the drums containing the hides. Since these substances are not soluble in water, chemical additives are used to allow dispersal. The type and amount of fatliquor influences the softness of the finished leather.

After fatliquoring, the leather is mechanically stretched, smoothed, and compressed to remove excess moisture. At this point, the hides have a moisture



- a = unsplit hide
- b = grain layer
- c = flesh layer
- d = cutting knife

Figure 3-5. Splitting Machine

content of about 60 percent and are ready for additional processing in the dry end operations.

3.2 Dry Operations

After passing through the beamhouse, tanyard, and coloring operations, the leather manufacturing process moves to the finishing room. In the finishing room, dry operations are conducted such as drying, conditioning, staking, buffing, and finishing. The objective of these dry operations is to produce a product that has uniformity, appearance characteristics, and resistance to scuffing and abrasion desired in a commercial product such as upholstery or footwear. Each of the primary dry processes are discussed below.

3.2.1 Drying

The moisture content of the leather is reduced using various methods. Typically, the drying process reduces the moisture content from about 60 percent to nearly 10 to 15 percent. Hides that have been dried are referred to as crust leather. The four commonly used methods of drying leather are hanging, toggling, pasting, and vacuum drying.

Hang drying involves hanging the leather over horizontal bars and hanging in a drying loft. In toggle drying, the leather is stretched over a frame and secured with toggles. One hide can be secured to each side of the frame, and then the frames are slid into channels in the drying oven.

In paste drying, hides are attached to flat plates using a paste solution. Operators stretch and smooth the hide to the plate using manual instruments. One hide is pasted to each side of the plate, and the plates move into the drying oven on conveyors. The drying time for hang drying, toggle drying, and paste drying is about 4 to 7 hours.

Vacuum drying is the fourth type of drying. In vacuum drying, the hide is placed on a heated steel plate then covered by a perforated steel plate wrapped by a felt or cloth. A vacuum is pulled on the hide thereby extracting the moisture. Vacuum drying takes about 3 to 8 minutes. The hides must be manually placed on the plates, and only a small number of hides can be dried at any given time. Vacuum drying is typically used as a supplement to other drying techniques.

3.2.2 Conditioning

Following the drying step, the leather is generally suitable for finishing. However, the drying operation can render leather too hard for specific uses such as footwear and garments. The objective of the conditioning step is to remoisturize the

leather by applying fine mists of water to the surface, and allowing the moisture to seep into the leather during overnight storage. The moisture content following conditioning is about 15 to 25 percent.

3.2.3 Staking and Milling

The purpose of staking and milling is to mechanically soften the leather. Staking (along with fatliquoring) is responsible for the softness of the finished leather. Staking and milling can be accomplished by two methods. The first method involves mechanical softening using an automatic machine that flexes and stretches the leather using a series of oscillating pins (Figure 3-6). The second method, referred to as dry milling, is similar to using a clothes dryer in a domestic household. Previously dried leather is placed in a large drum where it is tumbled as necessary to achieve the desired softness.

3.2.4 Buffing

The final dry process prior to finishing is the buffing operation. The objective of buffing is to smooth the grain of the leather to enhance the finishing process. Buffing is achieved using a sanding cylinder that is covered with an abrasive material similar to sandpaper. Operators control the degree of buffing for a particular type of leather. The buffing process produces leather that has a smooth, relatively uniform texture. Leathers that are not buffed are referred to as full grain leathers.

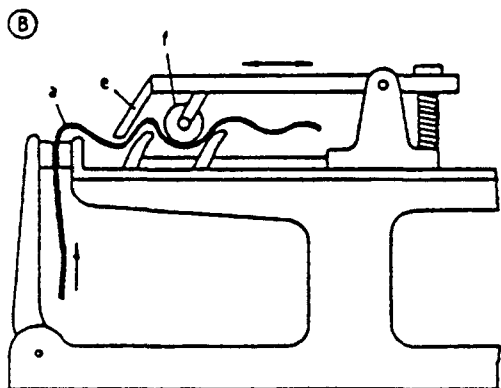
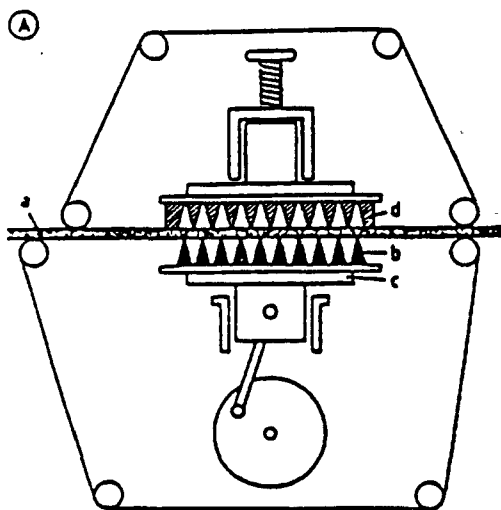
3.3 Leather Finishing Operations

Leather finishing is an additional dry operation that is discussed separately because of the significance of this process in the production of VOC and HAP emissions. The objective of leather finishing is to enhance the appearance of the leather and to impart stain and abrasion resistance qualities to the material.

Leather finishing involves an almost limitless combination of options. Depending on the specific end use of the leather, a variety of coatings can be applied during the finishing process using a number of different application methods. Typically, 3 to 5 coats of finish are applied to the leather although the actual number of coatings can vary depending on the desired characteristics of the end product.

3.3.1 Coatings Used for Leather Finishing

Coatings can be categorized into three general classes: base coats, intermediate coats, and top (or finish) coats. Characterization of all coatings into just three classes is somewhat of an oversimplification. However, these classifications are commonly used in the industry. Base coats are used to smooth out the leather surface by covering up faults in the leather grain, staining or coloring the leather, and



- a = leather
- b = metal pin
- c = vibrating plate
- d = foamed rubber plate
- e = guide lever
- f = guide roll

Figure 3-6. Staking Machine with a Vibrating Plate (A) or Lever (B)

serve as a penetrating or flow aid. Intermediate coats can also be used to impart color or stains to the leather and serve as an adhesive coating for the top coat. Top coats are responsible for protecting the leather from abrasion and give the leather desired properties such as resilience and gloss.

Coatings can also be referred to by function. Functional classifications were used in the NESCAUM report on the leather finishing industry.⁴ Functional classifications include impregnation, base coat, top coat, water proofing, stain, and antique coats. Impregnation refers to a heavy coating applied prior to the base coat that serves as a primer coating for subsequent coating applications. A water-based material is usually used for impregnation. Waterproofing is usually considered a separate process from finishing, and involves application of silicones or other water resistance chemicals. Finally, antiquing can be a manual or machine applied coating used to impart special effects on the leather.

Hundreds of coating formulations are available for base, intermediate and top coats. Each coating formulation has unique chemical and physical characteristics and is applied as needed to meet end-use requirements of the leather. Coating formulations can be classified into one of three categories: lacquers, lacquer emulsion, and water-based coatings. Although there are no strict definitions for each of these categories, it is generally accepted that lacquers are the higher VOC-laden coatings, lacquer emulsions contain a mid-range of organic solvents, and the water-based coatings contain the lowest concentrations of VOC's.

Until a decade ago, lacquers were the predominant type of coating formulation used in leather finishing. These resin-based coatings contain approximately 70-95 percent organic solvents by weight. The remaining material are solids such as pigments and additives. The pigments are finely divided organic or inorganic material that impart color. The additives, usually organic resins and polymers, serve as a binder between the pigment and the leather substrate and give the coating desired characteristics such as gloss and scuff resistance. Lacquer coatings have several unique properties such as low surface tension, excellent flow properties, and quick drying times. However, the solids-carrying capacity is considered low, usually 5 to 10 percent.

Lacquer emulsions are formulations with properties between those of lacquers and water-based coatings. These coatings are similar to lacquers as approximately 60 percent of the solution is organic solvents. However, additives such as surfactants are used to make the coating solids water-miscible. The leather finisher then dilutes the material with water in appropriate amounts and the final emulsion may contain between 20 and 30 percent water. Lacquer emulsions have about the same solids-carrying capacity as lacquers.

Water-based coatings typically contain less than 10 percent organic solvents, and have become more popular over the last decade as formulation technology has developed and the characteristics of these materials have improved. Their popularity is due in part to the reduced VOC emission characteristics, their increased solids-carrying capability, and subsequent improvements in the working environment by minimizing the use of organic solvents.

Table 3-1 shows a comparison of chemical characteristics of lacquer, lacquer emulsion, and water-based coatings.^{5,6} Table 3-2 gives a comparison of the typical composition of lacquer and water-based top coat formulations. There is a trend in the industry towards increased use of water-based coatings. Currently, most base coatings are water-based formulas and some intermediate and top coatings are also water based. Table 3-3 shows the increased sales of water-based coatings by a major coatings supplier to the leather industry.⁷ Conversations with various industry representatives confirm this trend.

Water-based coatings have the advantage of being able to hold more solids in the primary solution (water). As compared to lacquers, water-based coatings can hold about 50 percent more solids by weight. These properties are important in base and intermediate coatings where less water-based coatings need to be applied than comparable lacquers. Since gloss, resiliency and other surface characteristics are of less concern at these earlier coating applications, water-based materials are suitable for many types of leathers.

The transfer efficiency of solids also increases with the use of water-based coatings. Because of the high-solids content and low volatility of water-based coatings, the amount of coating used decreases. This can offset some of the costs associated with moving from lacquer to water-based formulations.

The reduction in VOC content has several major advantages from an environmental and safety perspective. The use of water-based coatings not only decreases VOC emissions, but usually minimizes HAP emissions associated with many lacquer formulas. Use of water-based coatings also improves the working environment by limiting the use of toxic and flammable chemicals.

Despite the advantages, water-based coatings present a variety of problems, particularly when used as top coats. The physical properties of water-based top coats affect flow control of the coating during application. This can affect the gloss, water resiliency and scuff-resistance of the final product. Many water-based top coats also require intermediate cross-linking agents to adequately bind the base coat and top coat. Several of these cross-linking agents are also toxic. Finally, the leather takes longer to dry using water-based coatings.

**Table 3-1. Comparison of Lacquer, Lacquer-Emulsion
and Water-Based Top Coat Systems**

Property	Lacquers	Lacquer Emulsions	Water-Based Coatings
Application Solids (%)	5-15	5-20	20-30+
Wt.% Solvent (as applied)	75-95	40-60	5-15
VOC (#/gal. less water supplied)	5.0-6.5	5.0-6.5	0-3.0
Gallons to Finish 100 Sides	9	7	4.5
Pounds Organic Solvent Emitted per 100 Sides	46.4-61.8	22.8-30.9	0-4.0

Table 3-2. Generic Coating Formulations

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LACQUER	WATER-BASED
	Water
Organic Solvents	Organic Solvent or Coalescents
Binders	Binders
Plasticizers	Surfactants
Pigments	Pigments
Other Additives	Other Additives
Conditioners	Leveling Agents
Silicones	Penetrators
Dulling Agents	Thickeners
Feel Modifiers	Fillers and Dulling Agents

**Table 3-3. Top Ten Products by Year and VOC Content
(Alpha-Numeric Characters Represent Product Formulations)**

1986	% VOC	1989	% VOC	1990	% VOC	1992	% VOC
D**	92.7	S	7.7	S	7.7	W	12.1
I**	88.7	W	9.9	W	9.9	X	13.0
G**	81.8	I**	88.7	I**	88.7	R	8.9
L	0.0	E**	85.4	T	11.9	O	0.0
E**	85.4	AA	48.6	B	10.0	C	8.3
V	7.2	N	4.0	AB	48.5	AC	47.8
M	0.0	O	0.0	O	0.0	Y	6.1
K	0.2	P	4.1	Q	4.0	J	0.0
F**	82.2	A	4.6	M	0.0	S	7.7
H**	95.9	M	0.0	U	11.8	Z	13.9
<i>Average VOC Content</i>	53.4		25.3		19.2		11.8
<i># of VOC-based products in top ten</i>	6		2		1		0

* Each letter or group of letters depicts a different product sold to the leather finishing industry during that year.

** Indicates Organic Solvent-Based Finishing System Component

Some of the problems experienced with water-based top coats are the result of the unique properties of water rather than the types of polymers used. For example, the surface tension of water is one factor that causes problems with water-based top coats. Table 3-4 shows the surface tensions of various solvents, with water topping the list. Figure 3-7 shows a comparison of contact angles with aqueous and with organic solvent-containing lacquers when they are applied to the leather surface. If the contact angle is less than 90 degrees, as with water, the liquid beads up and does not spread spontaneously over the surface. This property of water leads to considerable problems with spreading and levelling of aqueous-based top coats.⁸ In a recent survey conducted for EPA, the leather finishing industry indicated that poor flow characteristics were considered the number one problem of water-based coats.⁹

Drying times are also an important cost factor for leather finishing. The increased drying times resulting from the use of water-based coatings is reflected in costs such as labor, energy requirements of ovens, the number of ovens, space requirements, and inventory requirements. Finally, use of water-based top coats can present problems with meeting market demands. For example, shoe manufacturers that apply additional finishes to the shoes need to have leather finished with a coating compatible with their finish coating material. In addition, some water-based top coats do not provide the desired look and feel desired by many end-users.

3.3.2 Application Methods for Leather Finishing

There are three common methods of finishing leather. These methods are spray coating, roll coating, and flow coating. Spray coating is the most prevalent in the leather tanning and finishing industry. Spray coaters can consist of rotary sprayers, oscillating sprayers, stationary sprayers, or hand spray operations.

3.3.2.1 Spray Systems

The most commonly used spray system in leather finishing is the rotary spray machine. The rotary sprayer consists of a series of spray arms each having a spray gun located at the extremity of the arm. The spray arms are mounted on a central shaft that rotates as the leather passes underneath on a conveyor. Coatings are fed to the spray guns through a vacuum hose immersed in a drum or other vessel containing the coating.

Most rotary spray machines are controlled by optical scanners and microprocessors that minimize overspray. The leather passes through the optical scanner prior to entering the spray booth. The scanner records the outline of the hide and electronically triggers the spray guns to optimize the amount of coating that contacts the hide. Rotary spray machines can have 4, 8, or 16 guns. The 4 and 8 gun machines are typically used to spray side leather while 16 gun machines are better suited to spraying full hides.

Table 3-4. Surface Tensions of Various Solvents

SOLVENT	SURFACE TENSION (dynes/cm)
WATER	73
ETHYLENE GLYCOL	48
CYCLOHEXANONE	35
XYLENE	30
ETHYL GLYCOL	28
TOLUENE	28
METHYL ETHYL KETONE	25
MINERAL OIL	30
SILICONE OIL	23

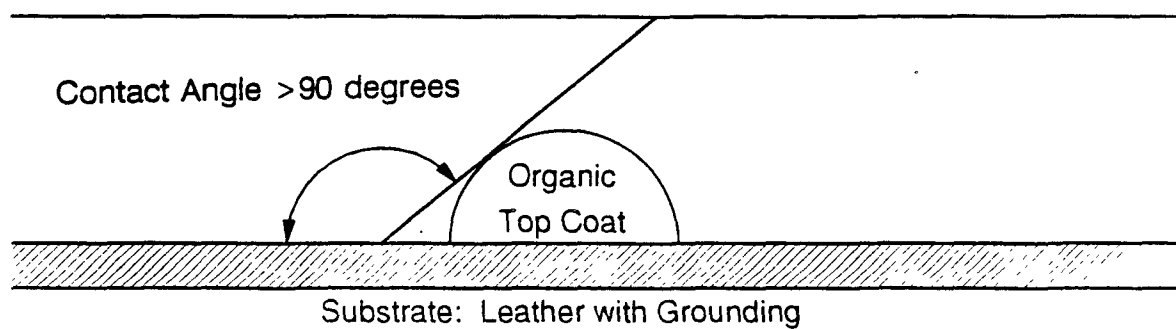
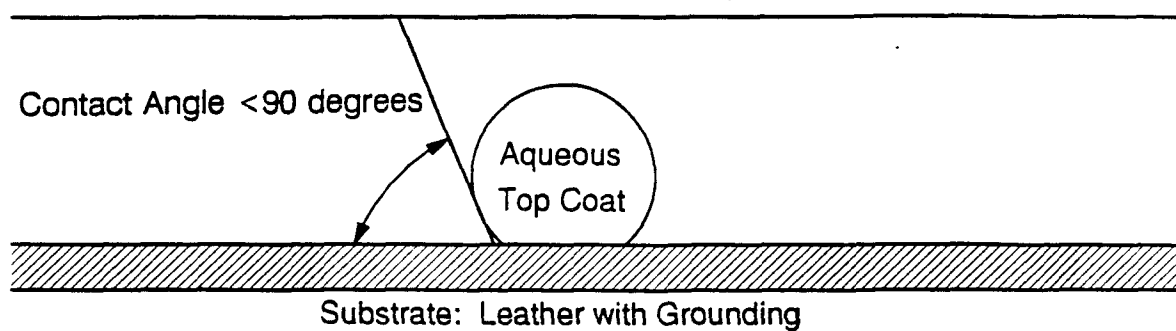


Figure 3-7. Contact Angles of Aqueous and Organic Leather Coatings on a Leather Substrate

Figure 3-8 shows a typical rotary spray booth. Drying ovens usually follow each spray booth used in the finishing system. Various types of drying ovens are used in the industry. Examples of drying ovens include catalytic ovens, steam-heated ovens, and gas-fired ovens. Both the spray booth and the drying oven are typically enclosed, either partially or fully. High volumes of air are typically exhausted from the spray booths and dryers to provide worker protection and prevent development of explosive mixtures.

Other types of spray machines used in finishing leather include the oscillating spray machine, the stationary spray machine, and the hand operated spray gun. The oscillating spray machine consists of a single arm that swings back and forth as the leather passes underneath. The angle of the spray gun can be adjusted to impart unique characteristics on the leather. Stationary spray machines consist of a series of spray guns that remain in place as the leather passes underneath. Both of these types of spray machine can also be optically controlled.

Finally, hand operated spray guns are used for various purposes in finishing leather. In larger facilities, hand operated spray guns are used for touch up, special effects, and testing of coatings for texture and color. In some of the smaller facilities, hand operated spray guns may be the primary method of finishing the leather. Spray booths used for manual spraying are usually enclosed on three sides and vented through an exhaust system.

Various types of spray guns can be used with each of the spray systems mentioned above. The design of the spray gun can influence the transfer efficiency of the coating. The types of spray guns used in leather finishing include: conventional air spray guns; airless spray guns; air-assisted airless spray guns; and high volume low pressure spray guns. These different spray guns are discussed in greater detail in Section 5.0.

All of the spray machines are usually equipped with some type of system to catch overspray and control particulate air emissions. One method used to catch overspray is the placement of a water bath or plastic sheet beneath the conveyor moving the hides through the machine. Overspray is captured by the water or plastic. In some cases, coating caught by a plastic sheet can be placed back in the coating drum and resprayed.

Water curtains are the most commonly used technique to control particulate emissions. The spray booth is kept under negative pressure and the exhaust is collected and vented through ductwork to either an additional pollution control device or the atmosphere. The exhaust passes through a water curtain that absorbs the particulates in the gas stream. Although water curtains are used by most facilities, dry filters can also be used for particulate control.

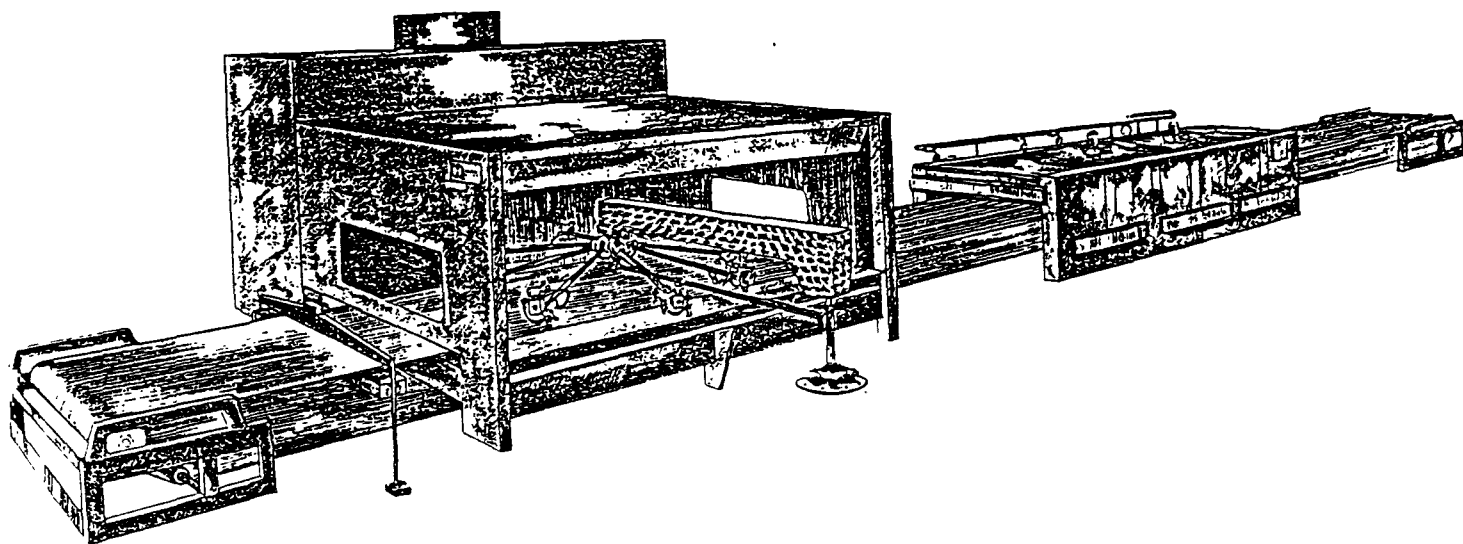


Figure 3-8. Rotary Spray Booth and Drying Oven

3.3.2.2 Roll Coating Machines

Roll coating machines have limited use in leather finishing because of the relative thickness of the coating applied by this method. Roll coating is usually used to apply base coats that are relatively thick. In roll coating, the coating is applied directly from a rubber coated or steel roller. The coating is fed to the roller using a vacuum hose connected to a reservoir of coating material. The coating is picked up by the roller and transferred to the leather.

One advantage of roll coating is that there is no overspray so transfer efficiencies approach 100 percent. The disadvantages of this technology are the potential for uneven application of the coating, lack of penetration, and bunching of the leather as it passes through the rollers.

Roll coating machines can be either direct roll or reverse roll machines. Figure 3-9 shows a typical direct roll coating machine. Figure 3-10 shows a reverse roll coating machine.

3.3.2.3 Flow Coating Machines

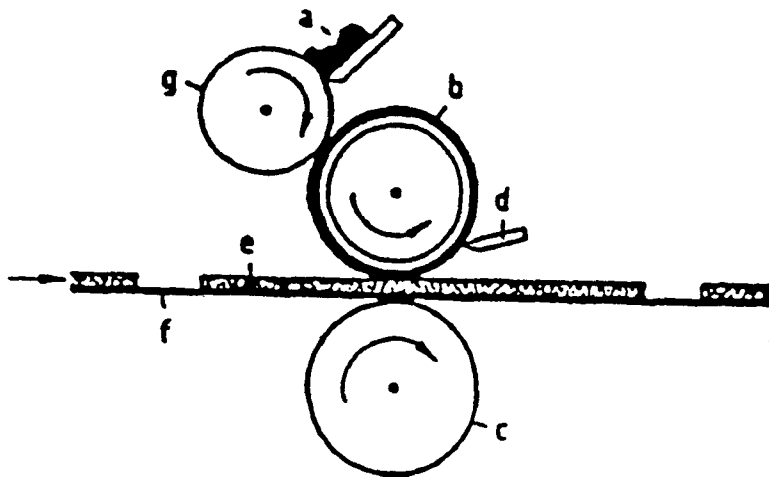
Flow coaters, or curtain coaters, can be used to deliver a heavy coating to the leather. In a flow coater, the coating is applied to the leather by controlled pouring of the coating directly to the leather surface. For example, in one type of flow coater, the coating flows from a reservoir over a thin barrier in a motion resembling a waterfall. Because of the nature of the application method, the transfer efficiency of flow coating is close to 100 percent. Figure 3-11 shows a typical flow coater.

3.4 Additional Dry Operations

Following the finishing process, there are a number of additional dry operations prior to shipping the finished leather to the end user. These additional operations include plating, grading, and measuring.

The plating process is used to either smooth the surface of the finished leather or to impart grain textures using mechanical processes. Plating is accomplished by presses capable of applying high pressure to the leather. The presses can be either manually or automatically operated. The action of the plating process is similar to that of an iron press in a commercial laundry. The high pressure applied to the leather can simply smooth out the surface of the leather or dye cast plates can be used to create patterns in the leather. Plating is used to simulate animal characteristics such as snake skin or to emboss patterns typically found in automotive leather.

Following plating, the leather is graded and measured. Leather is graded for feel, uniformity of color, thickness, and the presence of defects.



- a = coating
- b = application roll
- c = transport roll
- d = scraper
- e = leather
- f = conveyor belt
- g = roll for distributing the coating

Figure 3-9. Direct Roll Coating Machine

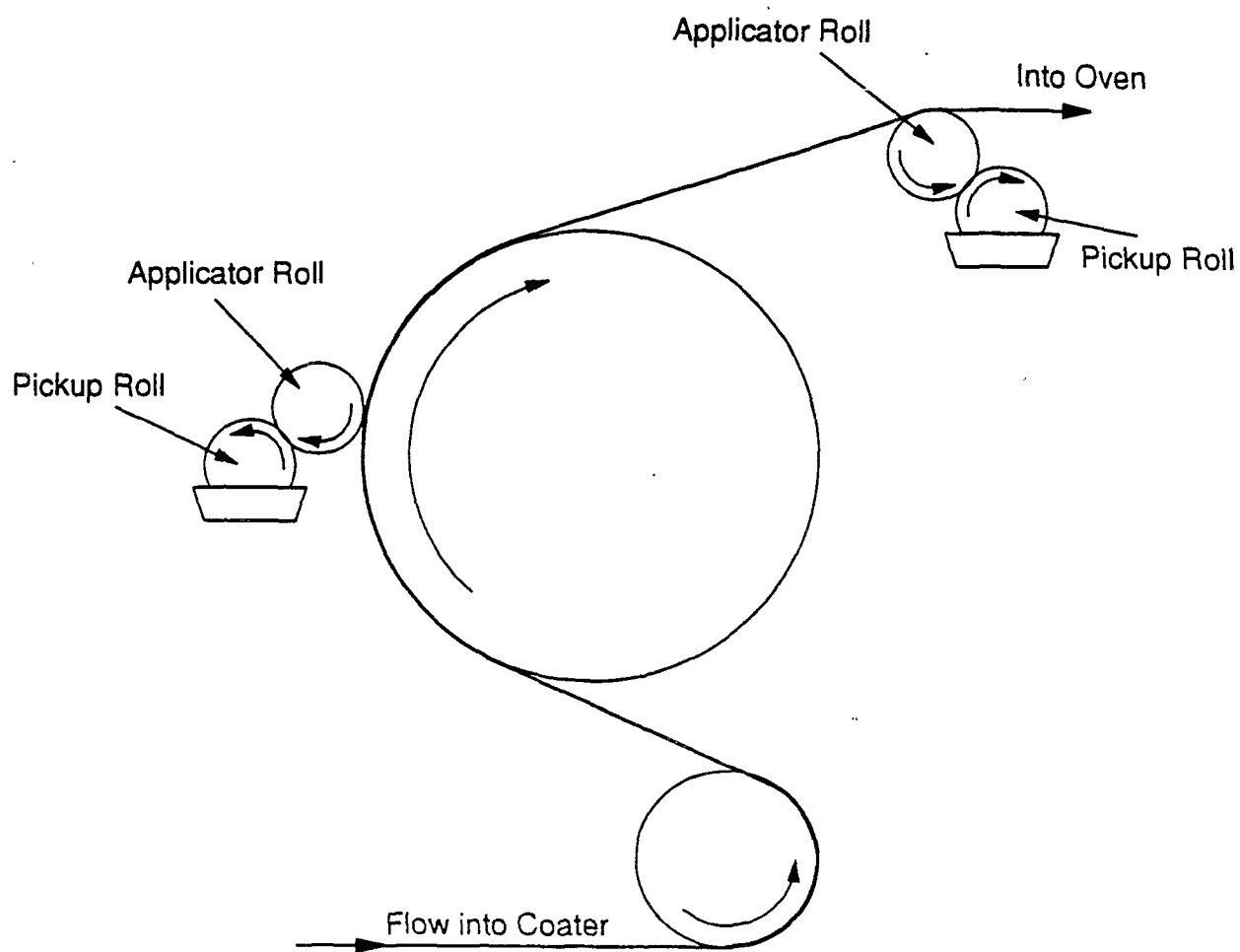


Figure 3-10. Reverse Roll Coating Machine

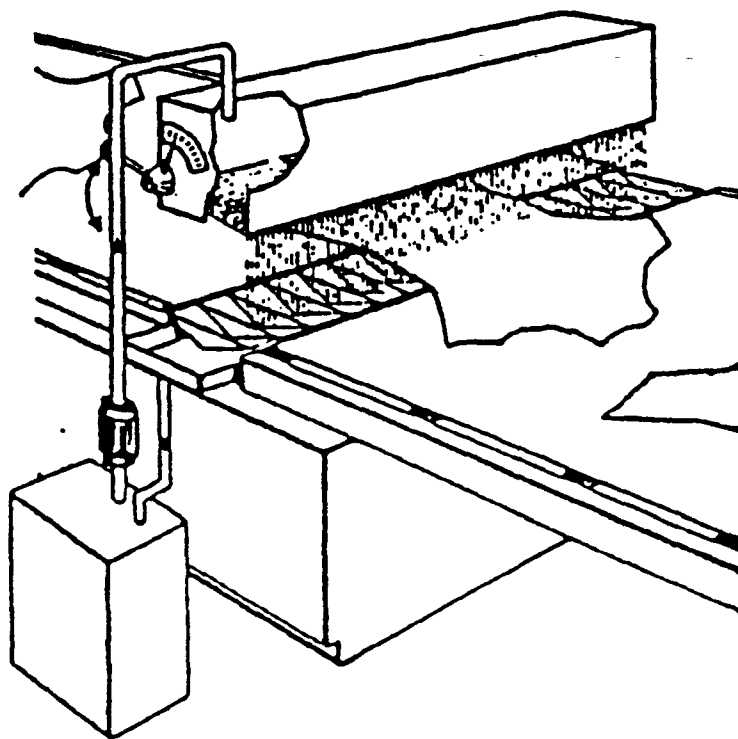


Figure 3-11. Flow Coating Machine

3.5 Waterproofing Operations

Waterproofing is treated as a process separate from typical wet and dry operations. Waterproofing is a specialty process that is used for specific products and is also a source of VOC and HAP emissions. Although the term waterproof is commonly used, there are actually three separate properties that can be imparted on the leather. These properties are water penetration resistance, water absorption, and water repellency. The methods used to achieve these properties are different.

Water penetration resistance refers to the ability of water to penetrate through the thickness of leather during flexing. This is a specific property required in military combat boots, some work boots, and recreational footwear. The only available means of achieving required levels of water penetration resistance is by silicone impregnation using a flow or curtain coater.

Water absorption properties are also required in military combat footwear as well as some domestic footwear leathers. This property can be achieved by silicone impregnation and also through the use of hydrophobic retanning in the wet end process. Depending on the degree of water absorption required, water absorption can be achieved using either technology.

Finally, water repellency is a surface phenomenon that can be achieved through conventional finishing technology. Repellency is obtained by putting a suitable barrier on the surface of the leather and is not dependent on the properties of the crust leather. All three of these technologies are used to produce different types of leather products. Often, more than one technology is used in combination.

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4.0 CHARACTERIZATION OF EMISSIONS

This section includes a discussion of the sources of VOC and HAP emissions from leather tanning and finishing and the factors affecting emissions. In addition, plant-specific and industry-wide VOC and HAP emissions are quantified using existing emissions data.

4.1 Sources of VOC and HAP Emissions

There are a number of sources of VOC and HAP emissions in the leather tanning and finishing process. The major sources of emissions are:

- a) Leather finishing operations;
- b) Waterproofing operations;
- c) Solvent degreasing operations; and
- d) Miscellaneous fugitive sources.

Table 4-1 lists the air pollutants emitted from leather tanning and finishing operations. These chemicals were identified in the Toxic Release Inventory (TRI) for the years 1987-1990, and also in data obtained from operating facilities. Both VOC's and HAP's are listed in the table. Table 4-2 shows the relative contribution of air emissions from the beamhouse, tanyard, and finishing operations.¹ With the exception of solvent degreasing, all of the major sources of emissions listed above are part of the finishing operation. As shown in the table, finishing operations are the major source of VOC's in the leather tanning and finishing industry. The data in the table also indicate that the greatest producer of VOC emissions is the spraying of VOC-laden coatings in the finishing process. Each of the major sources of VOC emissions are discussed separately below.

4.1.1 Leather Finishing Operations

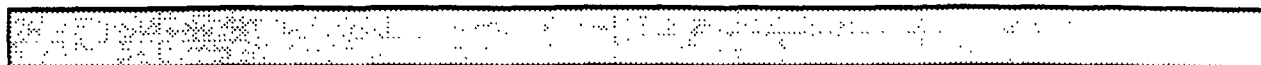
Leather finishing operations are the single largest source of emissions in the leather tanning and finishing industry. In States that have regulations impacting the industry, the regulations are directed specifically at the leather finishing operation.

Table 4-1. Air Emission Compounds from Leather Facilities*

Chemicals	Classification
Acetone	non-HAP VOC's
Cyclohexane	
Cyclohexanone	
n-Butyl Alcohol	
Ethanol	
2-Ethoxyethanol	
Isopropyl Alcohol	
2-Methoxyethanol	
Naptha	
Benzene	HAP VOC's
Cumene	
Diethanolamine	
Ethylene Glycol	
Glycol Ethers	
Formaldehyde	
Methanol	
Methyl Chloroform	
Methyl Ethyl Ketone	
Methyl Isobutyl Ketone	
Methylene Chloride	
Tetrachloroethylene	
Triethyl Amine	
Toluene	
Xylene (mixed)	
Chlorine	non-VOC HAP's
Chromium	
Chromium Compounds	
Hydrochloric Acid	
Manganese	
Manganese Compounds	

* Sources include the TRI database, chemical industry, and the leather industry.

**Table 4-2. Emissions from Leather Processing Monitored
in the United Kingdom During 1990**



Source	Pollutant	Quantity (mg/m ³)
Crust Leather Operations		
Beamhouse	Hydrogen sulfide	up to 7.1 *
	Ammonia	up to 35.5 *
Tanyard	Ammonia	up to 14.2 *
Finishing Operations		
Conveyorised Sprayer		
Water-diluted nitrocellulose	VOC	7 to 800 **
Solvent-diluted nitrocellulose	VOC	1200 to 3700 **
Finish Dryer		
Water-diluted nitrocellulose	VOC	nil to 100 **
Solvent-diluted nitrocellulose	VOC	400 to 1200 **

* Workplace levels, converted to mg/m³.

** Discharge to air via exhaust systems.

As described in Section 3.0, leather finishing involves the application of various coatings to the surface of the leather. Typically, 3 to 5 coats are applied to any one piece of leather. Various methods of application are used to apply the coatings with spray coating being the most commonly used approach. Other application methods include roll coating, reverse roll coating, and curtain coating.

Figure 4-1 shows a typical rotary spray coating booth and drying oven. Air emissions result from the solvent flashing before the coating hits the surface of the leather, overspray of the coating, and bounce back of the coating from the surface of the leather. Most spray coating booths are partially or fully enclosed. Solvent vapors are collected in the spray area and vented to the atmosphere or a control device.

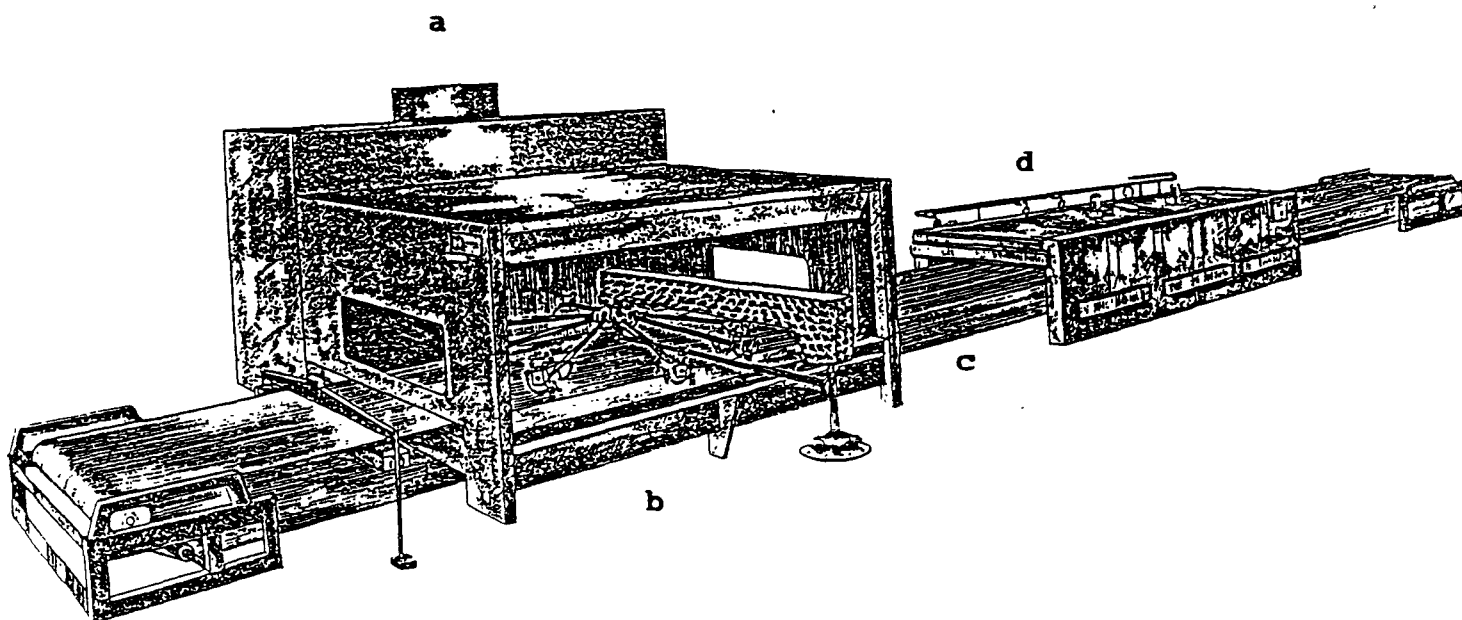
Each spray booth is usually followed by a drying oven. Additional air emissions are generated from the drying oven as a result of the drying and evaporation process. The drying ovens are partially or fully enclosed and are usually vented to the atmosphere or a control device. There is also a flash-off zone located between the spray booth and the drying oven where VOC can be released to the air. The flashoff zone between the spray booth and the drying oven may or may not be enclosed.

High volumes of air are typically exhausted from the spray booths and the drying ovens. Dilute quantities of VOC's are present in the exhaust. Two plants visited during the course of this study vented the exhaust from the rotary spray booths and drying ovens to a thermal incinerator. Emissions testing conducted on the inlet air to the incinerators showed VOC emission rates ranging from 120 and 370 pounds per hour.^{2, 3}

Other types of spray booths are also sources of air emissions. Hand spray booths and oscillating spray booths produce emissions due to overspray, flash-off, and bounceback. Roll-coating machines and flow coating machines produce less emissions because the transfer efficiency of the coating material is much higher. Transfer efficiencies and a comparison of emissions potential of these spray machines are discussed further in Section 5.0.

4.1.2 Waterproofing Operations

Waterproofing is considered a separate operation from leather finishing. Waterproofing involves treatment of the leather with a waterproofing agent such as silicone or a fluorocarbon. Waterproofing agents are often applied using a curtain coating process that dispenses the agent in a solution having an organic solvent. Emissions result from flashoff of the solvent during application and drying. Air from the waterproofing operation is typically collected and exhausted to the atmosphere.



- a = exhaust fan
- b = fugitive emissions from spray booth
- c = flash off zone
- d = fugitive emissions from drying oven

Figure 4-1. Rotary Spray Coating Booth and Drying Oven Showing Emission Points.

The emissions potential of the waterproofing process is high because of the large amounts of organic solvent used to dispense the silicone material. Data obtained from industry sources indicate that VOC emissions from waterproofing range from 12.3 to 27.8 pounds of VOC per 1,000 square feet of leather processed.⁴

4.1.3 Solvent Degreasing

Solvent degreasing operations are used in a small segment of the industry in the wet end processing of sheep and pig skins. In solvent degreasing, solvents such as perchloroethylene are used to reduce the skin grease content to desired levels and evenly distribute the residual grease prior to tanning. Emissions of VOC result primarily from evaporation as the degreasing drums are drained and the skins unloaded.

A study conducted in the United Kingdom generated emission estimates for the degreasing operation. Measurements in the working area showed VOC concentrations ranging from 600 to 700 mg/m³. Measurements of exhaust air from the degreasing system during the airing off cycle (draining and unloading of skins) showed VOC concentrations ranging from 16,000 to 19,000 mg/m³.⁵ Data provided by the U. S. leather industry show emissions resulting from the degreasing operation to be about 12.4 pounds of VOC per 1,000 square feet of leather processed.⁶

Typically, solvent degreasing operations are closed loop systems where the solvent is recovered. Condensation recovery systems can reduce solvent loss by about 90 percent compared to systems not having a recovery process. Carbon adsorption systems are also used to recover solvent.⁷

4.1.4 Miscellaneous Fugitive Emissions

There are a number of sources of fugitive emissions in the leather tanning and finishing industry. These sources include:

- a) Mixing rooms - the mixing room used to formulate the various leather coatings is a source of air emissions. Drums of coatings that are left open can emit VOC and HAP emissions through volatilization of the compounds. In addition, normal handling, pouring, pumping, and mixing of the coatings can cause air emissions. Most leather finishing operations use a designated room to mix finish coatings. One facility estimates emissions from the mixing room to be about 10 tons per year, representing less than 0.5 percent of the overall facility emissions.⁸
- b) Coating drums - drums or other containers for the coating material are placed next to the spray booths or roll coaters during the finishing process. The coatings are drawn from drums or other containers to the

spray guns or rollers using vacuum pumps. These coating containers can be a source of fugitive emissions since they are often partially or fully open to room air. Emissions enter the atmosphere with the normal building exhaust air.

- c) Wastewater - wastewater can become contaminated with VOC and HAP laden material in a number of locations throughout a tanning and finishing plant. Water curtains and water baths are used for particulate control and for catching overspray in the spray booths. Volatile organic compounds present in the wastewater can be emitted when wastewater is exposed to the ambient air in the collection and treatment system. One facility has measured the organic content of the wastewater generated by the plant. Total organic carbon (TOC) measurements were less than 10 mg/L.⁹
- d) Cleanup operations - spray guns can be cleaned using solvents containing VOC's. The emissions potential of spray gun cleaning depends on whether the guns are cleaned in a closed container or an open area.
- e) Hand application of coatings - some finishing facilities apply coatings using hand application procedures. An example of a hand application operation is the antiquing process used to impart special effects on the leather. Application of the coatings is usually conducted in an open space. Fugitive emissions result from this operation due to volatilization of the coatings during application. Emissions enter the atmosphere through the building exhaust system.
- f) Drying operations - leather that has been finished is set out to dry prior to packing and shipping. Residual evaporation and volatilization of VOC can occur during the drying process. Again, emissions of VOC can enter the atmosphere through normal ventilation of the building air.

4.2 Factors Affecting VOC and HAP Emissions

There are both chemical and physical factors affecting emissions of VOC and HAP from leather tanning and finishing. The primary factors affecting emissions are the following:

- a) The VOC and/or HAP content of the leather coating;
- b) The physical properties of the individual VOC or HAP such as vapor pressure and boiling point;

- c) The method of coating application (spray coating, roll coating, surface coating, type of spray guns) as it affects transfer efficiency;
- d) Operator training; and
- e) Maintenance and housekeeping procedures.

The most important factor affecting emissions is the VOC/HAP content of the coatings used to finish the leather. Significant reductions in emissions have been reported through substitution of solvent coating systems with water based coatings. A detailed discussion of the emission reductions achievable through the use of water-based coatings is provided in Section 5.0.

There is very little quantitative data available to document the effects of most of the other factors affecting emissions. Estimates have been made of the difference in transfer efficiencies between spray coating systems and roll and flow coatings systems. The transfer efficiency of roll and flow coating systems is close to 100 percent while efficiencies of spray coatings systems are estimated to be as low as 40 percent.

In regards to spray coating systems, there is also a wide range of estimates regarding the effects of different types of spray guns on transfer efficiency. As will be discussed in Section 5.0, the transfer efficiency of various spray guns can range from 15 to 90 percent. Accurate quantification of actual effectiveness of the various guns is difficult because of the numerous factors that can effect transfer efficiency. Among these factors are operator training and the solids content of the coating.

Other factors that can affect transfer efficiency of spray systems include the type of spray controls used for the spray system (optical eye, pneumatic, or mechanical controls), the number of spray guns, and the velocity of the rotary spray arms and conveyor belt passing through the spray booth. One study indicates that the use of optical eye spray controls can increase transfer efficiency by about 32 percent.¹⁰ Conversations with industry personnel indicate that transfer efficiency is affected by the number of spray guns operating on a rotary arm. The more spray guns, the slower the rotor speed, and the greater the transfer efficiency. A 16-gun rotary sprayer can be more efficient than an 8 or 4-gun machine.¹¹

Another factor in improving transfer efficiency is keeping the spray directed vertically to the leather. Rotary spray machines that are rotating too fast can cause the spray to "arc," creating a greater chance for bounceback. The speed of the conveyor can also have a similar effect.

Adequate operator training can optimize the effectiveness of the coating operation. A skilled operator can detect problems with spray guns, rotors speeds,

and conveyor speeds. Timely identification of inefficiencies with the coating operation can minimize the amount of coating used and, therefore, reduce emissions.

Finally, good maintenance and housekeeping practices can reduce emissions. Examples of these practices include keeping containers of solvent closed, maintaining spray equipment to optimize operation, and closely monitoring overspray and other waste of material.

4.3 Volatile Organic Compound Emissions

Data were collected from a number of sources in order to quantify the potential of leather tanning and finishing facilities to emit VOC. These sources include the Aerometric Information Retrieval System (AIRS), State emission inventories and permitting information, site visits, and information collected by the leather industry trade association. Table 4-3 presents VOC emission factors for various facilities within the industry.

The range of emission factors presented in the table is indicative of the diversity within the industry. Emission potential varies from facility to facility depending on the type of leather being manufactured. Emissions potential also varies among facilities producing the same type of leather because of variations in the actual product mix and the techniques used by each facility to meet the specifications of their customers. Specialty operations such as waterproofing and solvent degreasing also increase the emissions potential of individual facilities.

Appendix A includes all of the VOC emissions data collected during the study. These data were obtained from EPA data bases, State and local agency inventories, and permitting information. As shown in the Appendix, annual VOC emissions from leather tanning and finishing facilities are extremely variable. A small facility may emit less than 1 ton per year while larger facilities may emit in excess of 500 tons per year. Table 4-4 shows the VOC emissions from a representative number of facilities.

4.4 Hazardous Air Pollutant Emissions

One of the objectives of this study was to quantify and characterize the emissions of HAP's from the leather tanning and finishing industry. The CAAA require EPA to publish a list of major and area sources for regulation that emit one or more of the HAP's listed in Section 112(c) of the Act. A major source of HAP's is defined by Section 112(a)(1) of the CAAA as being a source that "emits or has the potential to emit considering controls, in the aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants."

**Table 4-3. Representative Emission Factors for
Leather Tanning and Finishing Facilities**

TYPE OF FACILITY	EMISSION FACTOR lbs VOC/1000 sq. ft.
Upholstery	3.2 - 4.8
Footwear	8.1 - 36.1
Upholstery	9.1
Upholstery	47.7
Waterproofed Leather	12.3 - 27.8*
Sheepskin	12.4**

* Represents emissions from waterproofing operation only.

** Represents emissions from solvent degreasing operation only.

Source: Industry data. Identification of facilities withheld for proprietary purposes.

**Table 4-4. VOC Emissions from Representative
Leather Tanning and Finishing Facilities**

FACILITY	VOC EMISSIONS (tons per year)
Acme Sponge & Chamois	13.3
Horween Leather	26.6
Salem Suede	11.4
WD Byron & Sons	235.2
Prime Tanning	529.3
Lackawanna Leather (NC)	253.4
JBF Industries	4.0
Conneaut Leather	6.1
Garden State Tanning	364.0
Eagle Ottawa Leather	130.0*
Seton Company (PA)	120.0*

Note: Except as indicated, all data are for 1990. The source of the data is public records obtained from State agencies or other sources.

* 1992 estimated data provided by the facilities.

The most comprehensive data available for determining industry-wide HAP emissions is found in the TRI. For the leather tanning and finishing industry, the TRI data can be considered *relatively accurate information*. In most cases, the emissions data reported to TRI are based on solvent purchases and usage. A material balance approach is the most common method of determining emissions of HAP's. Assuming that the record-keeping practices of the facilities reporting to TRI are reliable, the TRI data provide a reasonably accurate summary of HAP air emissions from the industry.

Seventeen major sources of HAP's have been identified in the industry. Table 4-4 lists the major sources of HAP's. It is estimated that the actual number of major sources existing in 1993 is less than 17. The trend in the industry is to convert to water-based coatings in the leather finishing process and to reformulate coatings to eliminate hazardous constituents. The emphasis on water-based materials began in 1989, and many of the reductions achieved by the transition are not reflected in the 1990 TRI data. Information obtained during site visits, telephone conversations, and through review of current literature indicates that HAP emissions are being reduced industry wide.

Figure 4-3 shows the trends in nationwide HAP emissions from 1987 to 1990. The upper line in the graph represents data from all facilities reporting to TRI in each year (33 facilities). The lower line represents data for only those facilities that reported emissions in each of the four years from 1987 to 1990 (23 facilities). Although the upper line shows a substantial increase in HAP emissions nationwide, it is primarily the result of more facilities reporting to the data base. The lower line is more indicative of the actual trend in emissions production since it represents data for a fixed set of facilities.

**Table 4-5. Leather Tanning and Finishing Industry
Major Sources of Hazardous Air Pollutants
(Tons/year)**

FACILITY	STATE	TOL	XYL	MET	MIK	MEK	GLY	CR	CYC	TET	HCL	TOTAL HAP
Acme Sponge	FL									13.32	0.003	13.32
Cudahy Tanning	WI						38.9					38.9
Eagle Ottawa	MI	391.01	76.09		86.34	364.9	39.13	0.13				957.62
Garden State	PA	139.77	26.89		70.34	99.91	18.6					355.51
Gebhardt Vogel	WI						25.6					25.6
Horween	IL						26.63					26.63
Irving Tanning	ME	7.2	52.0	10.89	5.75		123.5					199.3
Lackawanna Lthr	NC	70.03			16.31	73.45			63.72			223.51
Lackawanna Lthr	NE	64.55	19.84			26.92	8.19					119.5
Pan American	NY						26.6					26.6
Pfister & Vogel	WI	5.1	23.3	2.29	14.2		27.85	0.40				73.14
Prime Tanning	ME						529.3					529.3
Seton Co Leather	PA	19.67	26.89		12.04	11.25	34.3					84.79
Seton Co Leather	NJ	151.78	17.28		85.08	96.38	3.5					354.0
SB Foot Tanning	MN	14.35	12.59		18.69		31.70	0.08				77.41
Volunteer Leather	TN		10.63				12.13					22.76
WD Byron & Sons	MD	100.09	10.05		49.86	59.86	10.73					230.59

CR = chromium compounds
 CYC = cyclohexane
 GLY = glycol ethers
 HCL = hydrochloric acid
 MEK = methyl ethyl ketone
 MET = methanol
 MIK = methyl isobutyl ketone
 TET = tetrachloroethylene
 TOL = toluene
 XYL = xylene

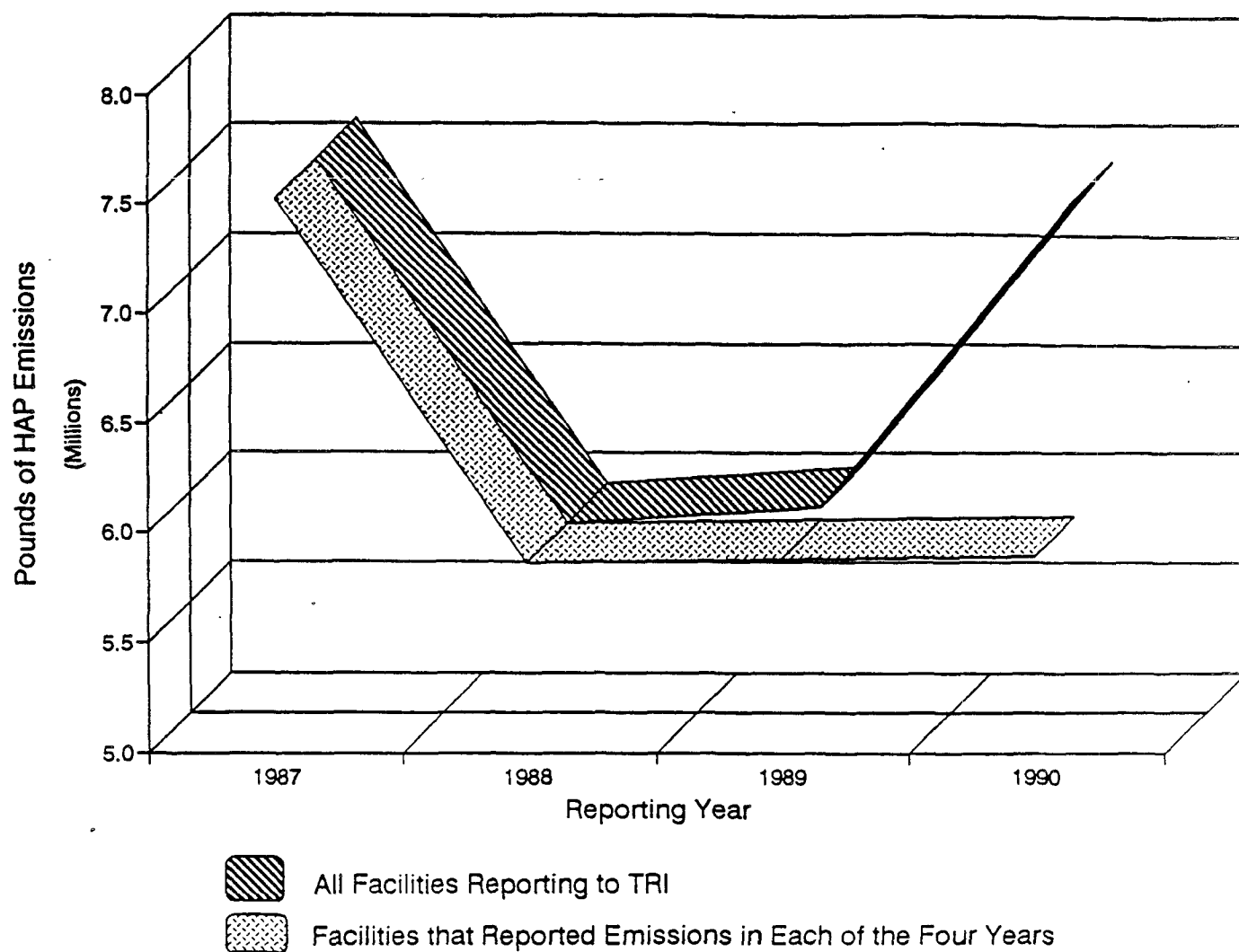


Figure 4-3. Trends in Nationwide HAP Emissions for All Reporting Facilities (1987-1990) and Facilities Reporting for All Four Years.

4.5 References

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4. Letter from Rutland, F.H., Leather Industries of America, Inc. to Mitsch, B.F., Alpha-Gamma Technologies, Inc. February 24, 1993. Letter providing emissions data collected by the leather industry.
5. Reference 1.
6. Reference 4.
7. Reference 5.
8. Reference 2.
9. Reference 3.
10. Stockman, George. "Determination of Spray Machine Transfer Efficiency for Leather Finishing." Journal of the American Leather Chemists Association, Volume 83. 1988.
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5.0 EMISSION REDUCTION AND CONTROL TECHNIQUES

This section provides a discussion of the options available to reduce and control VOC and HAP emissions from leather tanning and finishing operations. These options originate from a wide variety of sources including State and local regulatory agency documents, EPA documents, emission inventories and surveys, and visits to several leather processing facilities.

Under the Pollution Prevention Act, it is national policy that pollution be prevented or reduced at the source whenever feasible. Where pollution cannot be prevented, it should be recycled in an environmentally safe manner. In the absence of feasible prevention and recycling opportunities, pollution should be treated. Collectively, this technique of pollution prevention is called life cycle assessment, or cradle-to-grave analysis. This is certainly the strategy that should be employed in reducing emissions from leather tanning operations.

This section includes a presentation of source reduction technologies as well as treatment technologies. Source reduction techniques available to leather finishing operations and the associated emission reductions tend to be very site-specific. For this reason, the more universally applicable treatment technologies are discussed first. Control technologies are discussed in Section 5.1 and emission reduction technologies are discussed in Section 5.2.

5.1 Emission Control Techniques

This subsection provides a description of various abatement control technologies applicable to VOC and gaseous HAP emissions from leather finishing operations. This discussion includes generally applicable technologies applied in similar industries, as well as those present in the leather finishing industry. The only known abatement devices currently employed within the domestic leather finishing industry are regenerative thermal incinerators which are presently operated at two facilities. Both of these facilities were visited as part of this study, and this section includes a presentation of performance data obtained from these sites.

As discussed in Section 4.0, the bulk of emissions resulting from leather finishing operations are from the spray booth and the associated dryer. There is little data available to quantify what portion of total emissions occur between the spray booth and the exit of the associated dryer. As discussed in Section 4.0, other points

of emission are the mixing room, fugitive emissions associated with supplying coatings to the spray guns (often includes open drums of virgin material), clean up operations, secondary emissions from the contaminated water wash, and solvent evaporation after the drying operation. The most significant of these sources is likely to be emissions associated with clean up, and most of these emissions can be captured by operating the spray booth exhaust during gun cleaning. Since the bulk of emissions occur between spray application and drying, this is the portion of the leather finishing operation where abatement control technologies are most applicable.

Effective overall control of VOC and HAP emissions requires both the effective capture of emissions and the effective removal or destruction of the VOC and HAP. The overall control efficiency is the product of capture efficiency of the system and the control device removal or destruction efficiency. The EPA has established a total enclosure as the highest level of capture, and the capture efficiency of a structure meeting EPA's criteria for a total enclosure is deemed to be 100 percent. The applicability of total enclosures to leather finishing operations is discussed in Section 5.1.1. It is generally recognized that air pollution control devices such as thermal incinerators, catalytic incinerators, and carbon adsorbers are capable of providing control efficiencies of greater than 95 percent for VOC and gaseous HAP. A description of these devices and their respective control efficiencies is provided in Section 5.1.2

Although control cost analysis is beyond the scope of this document, it is important to note that there is also an economic component of effective capture. Exhausts from spray booths and dryers are generally high volume streams with dilute VOC concentrations. Methods to reduce the exhaust volume should be evaluated prior to determining the required size of the control device. Methods for reducing the volume of spray booth and dryer exhausts are discussed in Section 5.1.3

5.1.1 Total Enclosure for Effective Capture of VOC and Gaseous HAP

The first element of effective abatement control is the effective capture of emissions. As indicated above, the capture efficiency is considered to be 100 percent, if the source of VOC is totally enclosed (e.g., meets the EPA criteria for a total enclosure). A total enclosure is a structure that completely surrounds a source of emission such that all VOC emissions exhaust through a duct to a control device. The EPA has established the following criteria for verifying that an enclosure is a total enclosure:¹

- a) Any natural draft opening (NDO) is at least 4 equivalent opening diameters from each VOC emitting point. An NDO is defined as any permanent opening in the enclosure that remains open during operation of the facility and is not connected to a duct in which a fan is installed.

- b) The total area of all NDO's does not exceed 5 percent of the surface area of the enclosure's four walls, floor, and ceiling.
- c) The average facial velocity (FV) of air through all NDO's is at least 3,600 meters per hour (200 ft/min). The direction of air through all NDO's is into the enclosure.
- d) All access doors and windows whose areas are not included in number 3 are closed during routine operation of the process.

Procedures for determining NDO's and FV are provided in the Method and in the EPA enabling document, The Measurement Solution, Using a Temporary Total Enclosure for Capture Efficiency Testing.²

A total enclosure may be set up over an individual booth or oven, or over an entire finishing line. Alternatively, an entire finishing room may function as a total enclosure.

Establishing a total enclosure over an entire finishing line is achievable on automated spray finishing lines. In fact, one of the leather finishing facilities currently equipped with a regenerative thermal incinerator has demonstrated a total enclosure for the controlled lines.³ In this case, the new lines were installed with an enclosure over the entire line. NDO's are located at the front of each spray booth and at the exit of each dryer where the hides enter and exit the line. These openings are narrow slots 5 to 7 inches high and about 76 inches long. In addition, each spray booth is equipped with one NDO about 30 inches by 60 inches to provide access to the spray guns. This opening is covered with a heavy, plastic curtain. The curtain has small openings that represent less than 0.5 ft² of total opening. The total area of all NDO's on each of two lines are 1 percent or less of the total area of the enclosure. For determination of equivalent opening diameters, the center of the rotary spray wheel in each booth was considered the VOC emitting point.

Establishing a total enclosure over an entire line may not be practical in some retrofit situations. But, much of the necessary enclosure naturally exists in automated leather finishing operations. The most common spray equipment in medium and larger operations is fully or partially enclosed rotary spray booths. These systems are more fully described in Section 4.0. Following application of the coating in a rotary spray booth, the leather travels on a mechanical conveyor through a flash off area and on to a heated drying oven. Emissions captured by the spray booths and dryers are already exhausted through ducts for protection of the workers.

In manual or hand spray operations, establishing a total enclosure over individual finishing lines is much more difficult. In these situations, an entire finishing room could function as a total enclosure. All booths and ovens could be exhausted to

a VOC control device with no other exhaust points from the room. The room would have to be maintained at a slight negative pressure. In this case, any open doors or windows would be considered NDO's.

5.1.2 Control Devices

This subsection provides a description of three types of add-on control technologies applicable to the control of VOC and gaseous HAP emissions from leather finishing operations. These are thermal incineration, catalytic incineration, and carbon adsorption.

As indicated above, the only known add-on control technology currently employed within the leather tanning and finishing industry is regenerative thermal incineration. This control technology was installed at two new leather finishing facilities and both were visited as part of this CTC effort. Case study accounts of the findings at each of these leather finishing facilities are provided in Appendix B. Information on the operation and performance of these systems is included below in the discussion of regenerative thermal incineration.

5.1.2.1 Thermal Incineration

Thermal incineration is a process by which waste gas is brought to adequate temperature, and held at that temperature for a sufficient residence time with sufficient oxygen for the organic compounds in the waste gas to oxidize. Since the compounds emitted from leather finishing operations are generally hydrocarbons consisting of carbon and hydrogen, the products of thermal oxidation are carbon dioxide and water vapor. Based on performance tests conducted at leather finishing facilities, VOC destruction efficiencies of greater than 98 percent can be achieved for emissions from leather finishing operations.^{4,5} In addition, EPA studies indicate that a well designed and operated commercial incinerator can achieve at least 98 percent destruction efficiency (or an outlet concentration of 20 ppm or less) of organics. This destruction efficiency corresponds to incinerators that are operated at 1600°F with a nominal residence time of 0.75 seconds.⁶

A schematic diagram of a typical thermal incineration unit is provided in Figure 5-1. Primary components of the thermal incineration unit include a fan, a heat recovery device, the combustion chamber, and the exhaust stack. The heat recovery device is used to preheat the incoming waste stream so that less auxiliary fuel is required in the combustion chamber. This type of heat recovery is known as primary heat recovery and can be further categorized as either recuperative or regenerative. The waste gas preheater shown in Figure 5-1 would be referred to as a recuperative heat exchanger. As shown in this figure, a heat exchanger is used to transfer heat from the hot incinerator exhaust stream to the incoming waste stream. This is a continuous steady state process. Types of heat exchangers typically used for

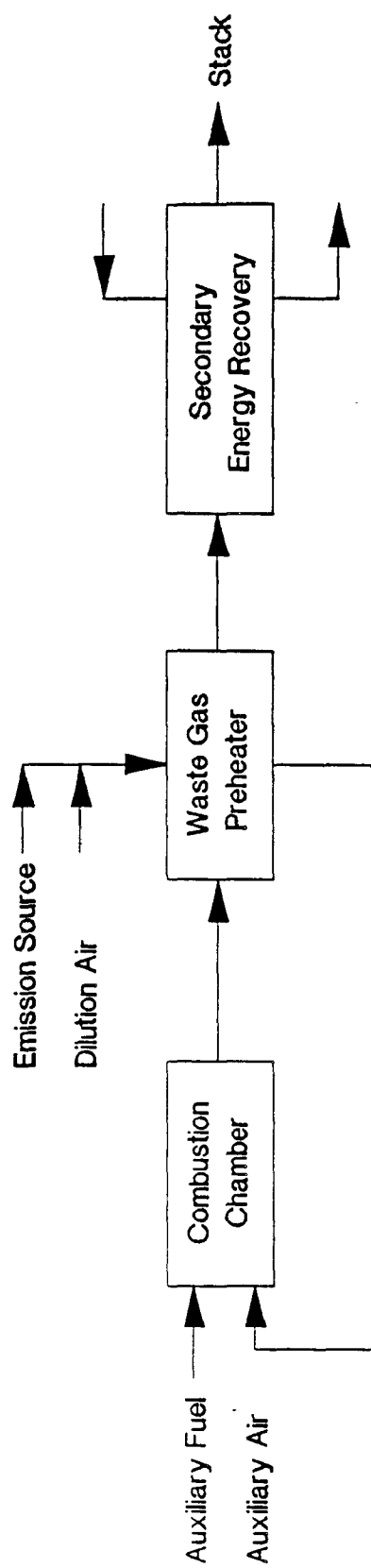


Figure 5-1. Thermal Incinerator Unit.

recuperative heat recovery include plate-to-plate and shell-and-tube. Recuperative heat recovery can provide up to 70 percent recovery of the heat in the exhaust stream, thereby reducing fuel use, the primary operating cost, by up to 70 percent.

Regenerative heat recovery is accomplished by cycling the incinerator exhaust gas through a ceramic bed. An incinerator employing regenerative heat recovery is presented in Figure 5-2. As indicated in the figure, the waste gas stream first passes through a hot ceramic bed, thereby heating the waste stream. The ceramic bed in turn, is cooled. The heated waste stream is introduced into the combustion chamber where it is combusted, thus releasing energy. The exhaust from the combustion chamber is then routed through another ceramic bed, heating the ceramic material in the bed. When the ceramic bed reaches the desired temperature, the process flows are then switched, and the waste gas flow is fed to the hot ceramic bed. Regenerative heat recovery systems can recover up to 95 percent of the energy in the incinerator exhaust gas, with a comparable reduction in fuel, the major operating expense.^{7,8}

The choice of thermal incineration with regenerative versus recuperative heat recovery or no heat recovery is driven by economics. Regenerative heat recovery represents substantially more capital cost, but offers the long-term savings of reduced auxiliary fuel costs.

As indicated above, two leather finishing facilities currently operate regenerative thermal incinerators for the control of VOC emissions. Both sites were visited as part of this study to observe and discuss the operation of these VOC control devices. The design and operating characteristics of each unit are presented in Table 5-1. The VOC destruction efficiency of each unit has been demonstrated to be greater than 98 percent using EPA Methods. The results of these tests are also presented in Table 5-1. As indicated in the table, the unit located at Plant A is designed to provide control of VOC emissions from three eight-gun rotary spray booths and the three associated dryers. The rated capacity of this unit is 30,000 cfm and the reported capital cost is \$1.5 million (1989).⁹ The unit located at Plant B is designed to provide control of VOC emissions from two sixteen-gun rotary spray booths and the two associated dryers. The rated capacity of this unit is 24,000 cfm and the reported capital cost is \$800,000 (1989).¹⁰

At Plant B, operation of the associated leather finishing line is two 8-hour shifts, seven days per week. Additionally, the flow to the incinerator varies periodically from 0 cfm to 12,000 cfm (one booth) to 24,000 cfm (two booths). Based on discussions with plant personnel, the regenerative thermal incineration system is able to handle this wide variation with ease. At the end of the second shift, the incinerator is set to go through a 3-hour cool down where the combustion chamber temperature drops from 1500°F to 500°F. To minimize operating cost, the combustion chamber temperature is maintained at 500°F during the idle period (when the spray booths are not being

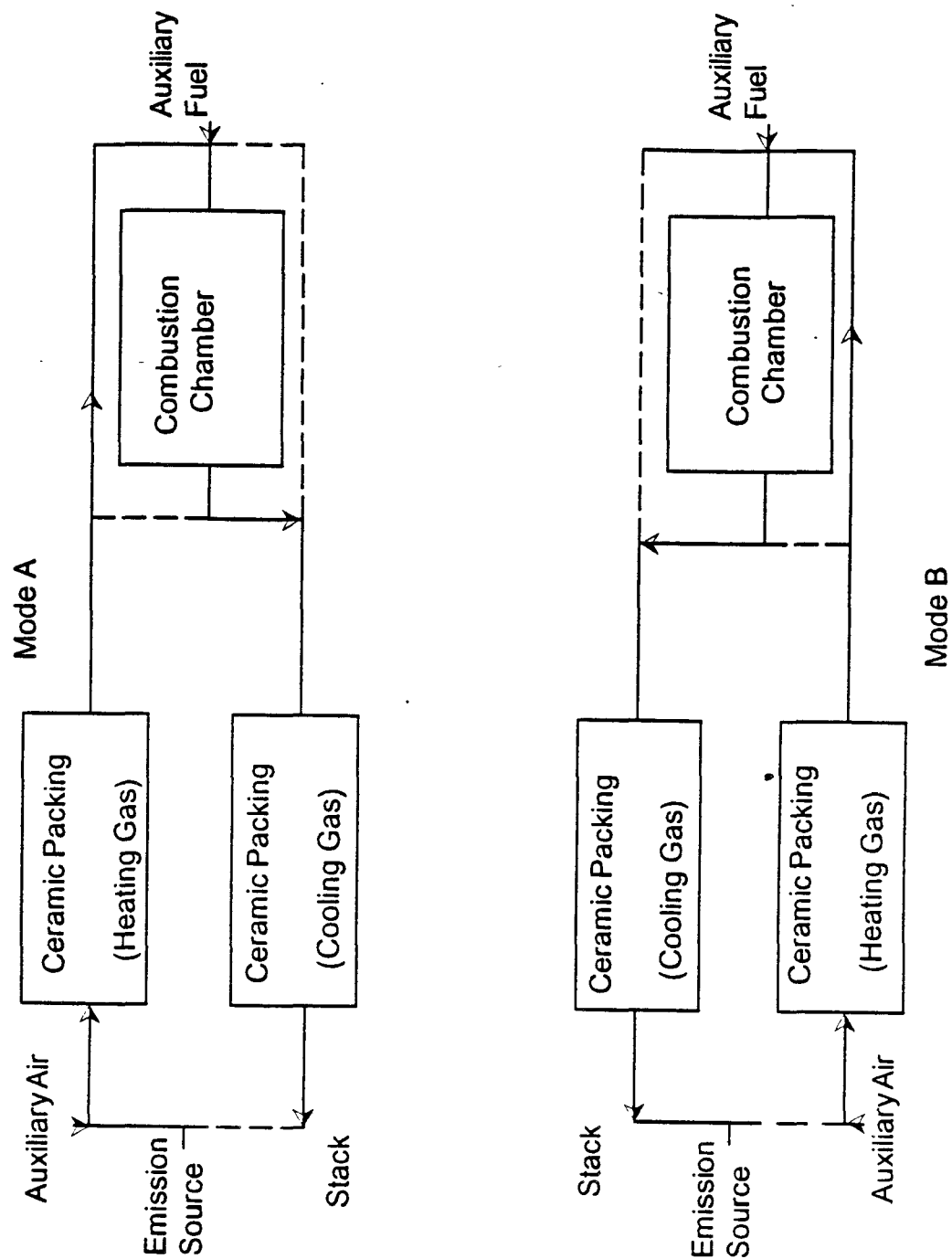


Figure 5-2. Regenerative Heat Recovery Unit.

**Table 5-1. Design and Operating Characteristics of Existing
Regenerative Thermal Incinerators**

	Plant A	Plant B
Design Flow Rate (cfm)	30,000	24,000
Combustion Temperature (°F)	1,450	1,500
Inlet Concentration (ppmv) ^a	660	1,540
VOC Destruction Efficiency (%)	99.5 ^b	98.6 ^b
Reported Capital Cost (1989\$)	1,500,000	800,000
Sources Controlled	3 - Spray Booths 2 - Catalytic Dryers 1 - Steam Heated Dryer	2 - Spray Booths 2 - Dryers
Reported Capture Efficiency of Collection System	100 ^c	91 ^d

^a As propane.

^b Based on performance test using EPA Method 25A on inlet and outlet of thermal incinerator.

^c Based on the criteria for a total enclosure.

^d Based on a material balance using coating consumption rate, coating VOC content, and Method 2A/25A measurements. The accuracy of such determinations is suspect.

operated). Then prior to the start of the first shift, the incinerator is set to go through a three-hour warm up, where the combustion chamber temperature is raised from 500°F to 1500°F. When both booths are operating, operation of the thermal incinerator is self-sustaining, i.e., there is no auxiliary fuel requirement.¹¹

Both of the existing thermal incinerator systems were installed on new leather finishing facilities. Plant B was an entirely new facility that began operation in 1989. At Plant A, a new finishing facility was added on to an existing plant. Installation of the thermal incinerator systems are considered lowest achievable emission rate (LAER) technology. Retrofitting this technology on an existing finishing facility may be more difficult and expensive than for a new facility.

5.1.2.2 Catalytic Incineration

Catalytic incineration is similar to thermal incineration in that VOC's are heated to a temperature sufficient for oxidation to occur. However, with catalytic incineration, the temperature required for oxidation is considerably lower than that required for thermal oxidation because a catalyst is used to promote oxidation of the contaminants. The catalyst is imposed on a large surface containing many active sites on which the catalytic reaction occurs. Platinum is the most widely used catalyst while palladium is also commonly used.¹² Because these metals are expensive, only a thin film is applied to the supporting substrate. A commonly used substrate is ceramic.

A well designed and operated catalytic incineration unit can achieve destruction efficiencies of 98 percent, comparable to thermal incineration units. However, the destruction efficiency decreases in the presence of catalyst poisons and particulates.¹³

The catalyst bed in catalytic incinerators generally operates at temperatures ranging between 300°F and 900°F, with temperatures rarely exceeding 1000°F. The contact time required between the contaminant and the catalyst, so that complete oxidation occurs, is normally 0.3 seconds. The excess air requirements for catalytic incineration units are only 1 to 2 percent higher than the stoichiometric requirements.^{14,15} Catalytic incinerators can be designed to control waste gas flow rates up to about 50,000 ft³/min. The VOC content of the waste stream may be in the part per million range up to 25 percent of the lower explosive limit (LEL).

A schematic of a typical catalytic incineration system is presented in Figure 5-3. As indicated in this figure, components of the system include a fan, a preheat burner, a combustion chamber, a waste gas preheater (recuperative), a secondary heat recovery, and a stack. The preheat burner is used to heat the incoming waste stream to the required oxidation temperature, usually between 300°F and 900°F for catalytic incineration.¹⁶ The catalyst bed may be a fixed-bed or a fluidized bed consisting of individual pellets enclosed in a screened unit. The recuperative heat recovery device,

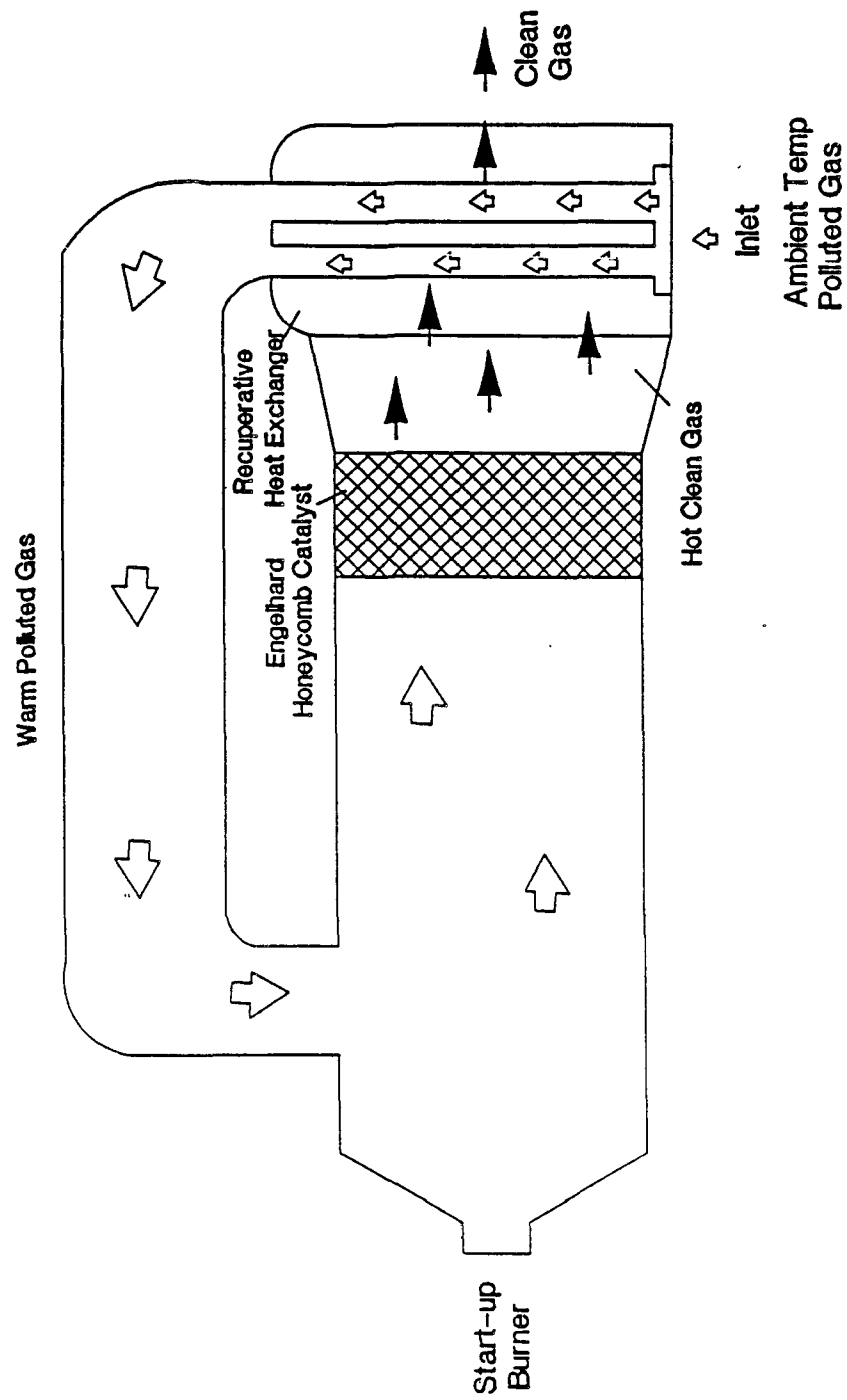


Figure 5-3. Catalytic Incinerator System.

if included, is a shell-in-tube or plate-to-plate heat exchanger. Recuperative heat recovery is incorporated if supplemental fuel requirements are expected to be high.

Many factors affect the performance of a catalytic incineration system. The primary factors include operating temperature, space velocity (inverse of residence time), VOC concentration and species, and catalyst type and susceptibility to contaminants. The optimum operating temperature is dependent on the type of catalyst, as well as the concentration and type of VOC's. Space velocity is defined as the volume of the gas entering the catalyst bed divided by the volume of the catalyst bed. Space velocity is very dependent on operating temperature. However, in general, as space velocity increases, destruction efficiency decreases. The amount and type of VOC determine the heating value of the waste stream, and thus the amount of supplemental fuel required to maintain the desired operating temperature.¹⁷

The type of catalyst selected is based on the VOC compounds in the waste stream. Particulates and catalyst poisons in the waste stream can affect the efficiency of the catalyst, and its lifetime. Some materials that are considered catalyst poisons include heavy metals (mercury, lead, iron, etc.), silicon, sulfur, halogens, organic solids, and inert particulates. Particulates and poisons reduce the activity of the catalyst site, minimizing sites available for the oxidation reaction. These materials can also mask, plug, or coat the catalyst surface.¹⁸

5.1.2.3 Carbon Adsorption

Carbon adsorption recovery efficiencies of 95 percent and greater have been demonstrated to be achievable in well designed and well operated units.^{19,20,21,22} Fixed bed carbon adsorption units have been sized to handle flow rates ranging from several hundred to several hundred thousand ft³/min. There is no obvious practical limit to flow rate because multi-bed systems operate with multiple beds in simultaneous adsorption cycles. The VOC concentrations of the waste streams controlled by carbon adsorption units can range from the part per billion level to as high as 20 percent of the LEL. Adsorption systems typically operate at ambient pressure and temperatures ranging between 77 and 104°F.²³

The carbon adsorption process used to control VOC emissions from waste gas streams can be divided into two sequential processes. The first process involves the adsorption cycle, in which the waste gas stream is passed over the adsorbent bed for contaminant removal. The second process involves regeneration of the adsorbent bed, in which contaminants are removed using steam or hot gas, so that the carbon can be reused for contaminant removal.

Adsorption is the capture and retention of a contaminant (adsorbate) from the gas phase by an adsorbing solid (adsorbent). Activated carbon is the most widely used adsorbent for air pollution control.²⁴ Both the internal and external surfaces of

the carbon are used as adsorption sites. Diffusion mechanisms control the transfer of the adsorbate from the gas phase to the external surface of the carbon, from the external surface of the carbon to internal pores, and finally to an active site in the pores. Adsorption depends on a mass transfer gradient from the gas phase to the surface. Van der Waal forces attract the adsorbate to the carbon. Because adsorption is an exothermic process, some method of heat removal from the carbon may be necessary, depending on the amount of contaminant being removed from the gas phase.²⁵

Regeneration is the process of desorbing the contaminants from the carbon. Regeneration of the carbon bed is usually initiated prior to breakthrough. Breakthrough is that point in the adsorption cycle when the carbon bed approaches saturation and the concentration of organics in the effluent stream begins to increase dramatically. If the carbon bed is not regenerated, the concentration of VOC's in the effluent will continue to increase until it is equal to that of the inlet, i.e., the carbon is saturated.²⁶ The most common method of regeneration is through steam stripping. Another regeneration method is the use of hot, inert gas or hot air. With either steam or hot air regeneration, the desorbing agent flows through the bed in the direction opposite to the waste stream. This desorption scheme allows the exit end of the carbon to remain contaminant free.²⁷

In a regeneration process, some adsorbate, known as the heel, may remain in the carbon after regeneration. The actual capacity of the carbon is referred to as the working capacity, and is equal to the total capacity of the carbon less the capacity taken by the heel.²⁸

Adsorption units that are commonly used for contaminant removal from waste gas streams include:

- a) Fixed, or rotating, regenerable carbon beds;
- b) Disposable/rechargeable carbon beds;
- c) Traveling bed carbon adsorbers;
- d) Fluid bed carbon adsorbers; and
- e) Chromatographic baghouses.

Of the five adsorption systems listed above, the first two are most commonly used for air pollution control. The disposable/rechargeable canisters are used for controlling low flow rates (less than 100 cubic feet per minute) and would not be used to control the high volume flow rates typical of leather finishing operations. Only the fixed bed, regenerable carbon adsorption system is discussed in this section.

A fixed bed, regenerable carbon adsorption system is presented in Figure 5-4. The components of the carbon adsorption system include (1) a fan (to convey the waste gas into the carbon beds), at least (2) two fixed-bed carbon adsorption vessels,

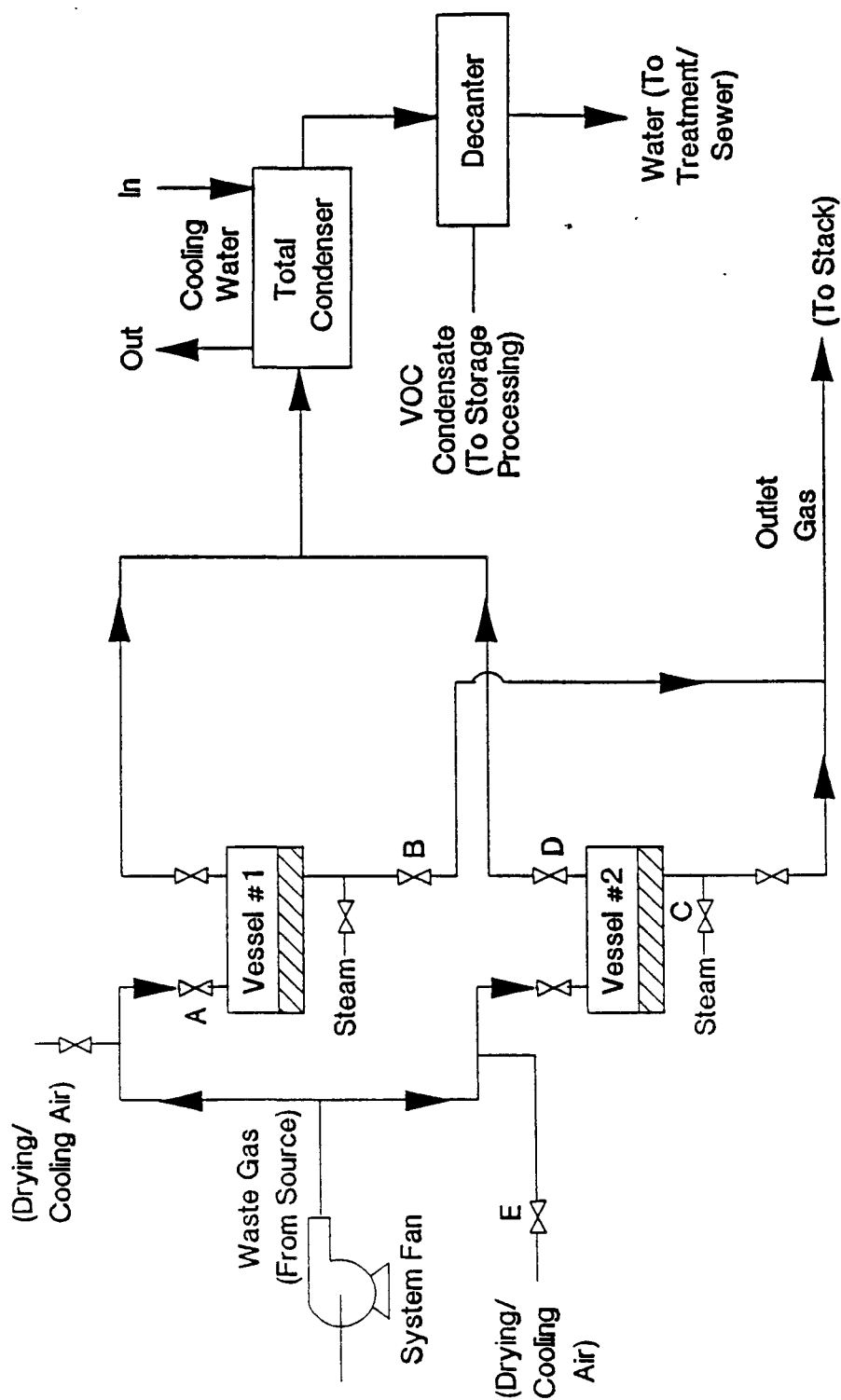


Figure 5-4. Carbon Adsorption System.

(3) a stack for the treated waste gas outlet, (4) a steam valve for introduction of desorbing steam, (5) a condenser for the steam/contaminant desorbed stream, and (6) a decanter for separation of the VOC condensate and water. In the system depicted in Figure 5-4, one carbon vessel is being used for adsorption while the other is being regenerated. Both vessels will alternate in the adsorption and regeneration modes. The steam is used to regenerate a vessel, and is then sent to a condenser. The condensate is a water/VOC mixture. The decanter can be used to separate the condensate into a water stream and a condensate stream. Depending on its measured toxicity, the water may be treated or discharged to the sewer. The condensed organics can be recycled (if usable), used as a fuel, or disposed.

Several factors affect the amount of material that can be adsorbed onto the carbon bed. These factors include type and concentration of contaminants in the waste gas, system temperature, system pressure, humidity of waste gas, and residence time.²⁹

5.1.3 Methods of Minimizing Control Costs -- Volume Reduction

Exhaust streams from leather finishing operations are generally high volume, dilute concentration, streams. To minimize the size and cost of the abatement control device, volume reduction measures should be evaluated. Such a volume reduction can provide several economic benefits including: (a) reduced air flow to the add-on device reducing capital costs; (b) a more concentrated stream for treatment reducing capital and operating costs of the add-on control device; and (c) reduced makeup air reducing plant heating and cooling costs.

The first volume reduction measure that should be considered is recirculation of booth and dryer exhausts. Recirculation of booth and/or dryer exhausts could provide substantial volume reduction of the abatement stream. The amount of air that can be recirculated is limited by the maximum VOC concentration allowed in the booth or dryer. In automatic spray booths such as the rotary spray booths used in the leather finishing industry, insurance companies usually require that the VOC concentration in the booth be less than 25 percent of the LEL. The same is true for dryers. Additionally, the National Fire Protection Association (NFPA) requires an LEL monitor if the VOC concentration is expected to exceed 20 percent of the LEL.³⁰

Recirculation is much easier to address in the case of a new installation since it may require substantial modification of the spray booth and dryer design. But considering the potential economic benefits, recirculation should be evaluated in retrofit applications as well as new installations.

Whether or not recirculation is currently used at leather finishing facilities is not known. However, recirculation has been used in both manual spray booths and

mechanical spray booths in other industries which are similar to those used in the leather finishing industry.³¹ In addition, studies have also been conducted by EPA to ascertain the feasibility and safety of recirculation.^{32,33} Those studies conclude that recirculation can safely and effectively be used in spray booths.

There are also several emerging technologies specifically targeted at reducing the volume of air that must be exhausted through manual spray booths. Since a side draft velocity of 100 ft/min must be maintained across the worker to meet OSHA requirements, the potential reductions in air volume are limited without completely changing the design of manual spray booths. Two emerging technologies that show great promise for reducing the volume of air that must be exhausted, while maintaining an adequate level of operator protection, are the Classic Systems Campbell Spray Booth and the Mobile Zone system.

Classic Systems indicates that its Campbell Spray Booth can reduce the volume of exhaust air by approximately 80 percent.³⁴ The basic design of this spray booth involves the use of air curtains. The worker stands outside of the booth and sprays through the air curtain. The air curtain provides a barrier between the worker and the solvent emissions inside the booth, resulting from spraying the coating. The booth design can also include an adjacent, enclosed flash tunnel. As with the spray booth, air curtains separate the air inside the flash area from the outside air. The design is such that the exhaust from the flash tunnel can be recirculated back to the spray booth. By incorporating this recirculation, makeup air requirements are further reduced.

Mobile Zone Associates has developed a device that enables the worker to spray coatings from a partially enclosed mobile work platform.³⁵ The worker stands inside of a moving cab. The movement of this cab is controlled by the worker. Within the Mobile Zone cab, fresh ventilating air passes across the worker from an open moving window at his rear. The remaining section of the mobile work platform is ventilated using recirculated air. The Mobile Zone design contrasts with a conventional spray booth, in which the entire length of the booth is supplied with fresh ventilating air. Through the use of the moving window, the ventilating air requirements for the worker are greatly reduced. In one EPA sponsored test of this system in a paint spray operation, the Mobile Zone design allowed a 90 percent reduction in the spray booth exhaust rate.³⁶

5.2 Emission Reduction Techniques

The largest source of VOC and HAP emissions from the leather tanning and finishing industry is the finishing operation. Because of the disproportional impact finishing operations have on emissions, they are the primary focus for emission reduction measures. Efforts to reduce emissions from leather finishing can be categorized by: a) use of lower VOC or water-based coatings; b) improved transfer

efficiency of the coatings application process; and c) improved housekeeping practices and employee training.

5.2.1 Use of Lower VOC and Water-Based Coatings

As discussed in Section 3.0, coating formulations can be classified by VOC content. These classifications include lacquers, lacquer emulsions, and water-based coatings. Table 5-2 illustrates the differences in VOC content among these coating classifications. In addition to reduced VOC content, water-based coatings have higher solids-carrying capabilities, which usually translates to reduced volumes of coatings needed to finish the leather.

The leather industry has made progress in the use of lower VOC coatings over the past few years. This trend has been hastened by increased pressure to lower VOC emissions to meet State and local air quality regulations. In addition, the leather industry recognizes there are several other benefits to using lower VOC coatings. These benefits include improved working conditions and employee safety, reduced costs in treating and disposing of hazardous wastes, and, improvement in local public relations. The potential exists for water-based coatings to be used in all finishing coats with subsequent reductions in VOC emissions.

From discussions with major coating suppliers, there are indications that many leather manufacturers are converting to water-based coatings.³⁷ As presented in Table 3-3, one chemical supplier has seen a shift from solvent-based coatings to lower VOC coatings in its top ten selling products to leather finishers. It should be noted that although the predominant formulations may be water-based, some applications will require the addition of penetrator and leveling agents which contain VOC's. Still, the shift to lower VOC coatings is apparent.

The VOC reductions achieved by switching to water-based coatings can be dramatic. For example, one facility that was able to fully convert from solvent coatings to water-based coatings reduced VOC and HAP emissions by 95 percent.³⁸ The use of water-based coatings still presents numerous difficulties to the leather finisher, but most of these difficulties have been overcome with regards to base and intermediate coatings. In fact, water-based coatings are now typical for base and intermediate coats in much of the industry. However, the use of water-based coatings is still difficult in other applications, particularly the top coats. Situations that can prevent the conversion to low VOC coatings include:

- a) The conversion to water-based coatings can require substantial research and development efforts. The conversion process is generally not as simple as substituting a water-based coating for a solvent coating. Changes must often be made in the retanning and fatliquoring process to ensure compatibility of the leather with the coatings;

Table 5-2. Comparison of Lacquer, Lacquer-Emulsion and Water-Based Top Coat Systems

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Property	Lacquers	Lacquer Emulsions	Water-Based Coatings
Application Solids (%)	5-15	5-20	20-30+
Wt.% Solvent (as applied)	75-95	40-60	5-15
VOC (#/gal. less water supplied)	5.0-6.5	5.0-6.5	0-3.0
Gallons to Finish 100 Sides	9	7	4.5
Pounds Organic Solvent Emitted per 100 Sides	46.4-61.8	22.8-30.9	0-4.0

- b) In situations where the look and feel of the leather are key characteristics, it may be impossible to produce the required esthetics that customers demand with water-based coatings; and
- c) In shoe leather, additional coatings are applied to the leather by the shoe manufacturers. As a result, finishes applied by the leather finisher must be compatible with the finishes applied by the shoe manufacturer.

5.2.2 Emission Reductions From Improved Transfer Efficiency

Several advances have been made in the application techniques used for leather finishing operations. These advances include the use of higher efficiency spray guns, use of optically controlled spray guns, and use of alternative application techniques such as roll coating. In addition, the potential for using radiation to cure top coats is also being explored by the industry. A discussion of the emissions reduction potential offered by each of these technologies is provided below.

5.2.2.1 High Efficiency Spray Guns

In all spray coating operations, some coating solids either miss or bounce off the material thereby reducing the transfer efficiency of the spray system. Transfer efficiency is the ratio of the solids that adhere to the material divided by the solids directed, or sprayed, at the material. Conventional spray systems have low transfer efficiencies ranging from 10 to 30 percent. These low transfer efficiencies are attributed to excessive bounce-back and overspray. Bounce-back is that portion of the finish coating which impinges on the leather surface but does not stick. Overspray can be defined as the portion of the spray pattern which falls outside the area of the material coated. The resulting loss in solvents and coating material can be in excess of 75 percent.

Bounce-back and overspray are problems generally associated with spray guns. The various spray guns used to finish leather differ in the manner in which they break up (atomize) the coating. Some methods are associated with inherently better transfer efficiencies than others as shown in Table 5-3. However, these transfer efficiencies are only estimates and are dependent on many other factors which are discussed below. Spray guns can be divided into several basic types including:

- a) Conventional air spray - Conventional air spray has been the traditional method of applying coatings. Compressed air is supplied through an air hose to a spray gun that atomizes the paint into a fine spray. The pressure supplied to the fluid controls the paint delivery rate with typical pressures ranging from 5 to 25 pounds per square inch (psi). The air pressure controls the degree of atomization and is usually 30 to 90 psi. One of the major problems with conventional air spray is the bounce-

Table 5-3. Transfer Efficiencies of Different Spray Techniques*

Product Type	Transfer Efficiencies** (in percent)
Conventional Air Spray	15-30
Airless Spray	20-40
Air Assisted Airless Spray	25-45
Electrostatic Air Assisted Airless	55-85***
High Volume Low Pressure Spray	55-90

* Based on manufacturer claims for various spray equipment products.

** Transfer efficiency is defined as the net amount of coating solids deposited on a part, divided by the total coating solids sprayed, and expressed as a percentage:

$$TE = \frac{W_c}{\%S \times Q \times T} \times 100\%$$

Where:

TE = Transfer Efficiency

W_c = Weight of coating solids added to material, after drying

%S = Percent of coating sprayed that is solids

Q = Coating Flow Rate, weight per time unit

T = Time coating is flowing

*** Electrostatic modifications to spray equipment is not considered effective for leather finishing operations.

back and overspray caused by the high volume of air required to achieve atomization. This results in relatively poor transfer efficiency.

- b) Airless spray - With airless spray, a pump forces the coating through an atomizing nozzle at high pressure (1,000 to 6,000 psi) instead of using compressed air to atomize the material. Due to its high pressure, airless spray is ideal for rapid coverage of large areas and when a heavy film build is required. The size of airless spray droplets are larger, the spray cloud is less turbulent, and the transfer efficiency is typically superior to conventional air spray. However, airless spray leaves a rougher, more textured surface and is generally used when appearance is not critical.
- c) Air-assisted airless spray - An air-assisted airless system combines the benefits of conventional air spray and airless spray. The system consists of an airless spray gun with a compressed air jet to atomize the coating. These systems use lower fluid pressures than airless spray and lower air pressures than conventional air spray (5 to 20 psi versus 30 to 90 psi). This fluid/air pressure combination delivers a less turbulent spray than conventional air systems and applies a more uniform finish than airless systems. However, due to the lower air pressure, the amount of time needed to apply the coating is greater when using the air-assisted airless system.
- d) High Volume Low Pressure Spray - A modification of conventional air spray is high volume low pressure (HVLP) spray which uses large volumes of air under reduced pressure (10 or less psi) to atomize the coatings. Because of the lower air pressure, the atomized spray is released from the gun at a lower velocity. Overspray has been reported to be reduced 25 to 50 percent over conventional air spray. The air source for the HVLP can be a turbine or a standard air supply, both of which can handle multiple spray guns. Manufacturers have constructed fluid passages out of stainless steel or plastic so that these guns are compatible with a full range of solvents and water-based materials. Many of the HVLP spray systems are designed to atomize high, medium, or low solids coatings.

Some states have mandated that all coating operations be converted to use more efficient spray equipment.³⁹ However, as stated in other previous EPA studies on surface coating, the degree of increased transfer efficiency is dependent on many factors.⁴⁰ These include coating characteristics, types of spray equipment, types of spray booths, and operator training. While the actual transfer efficiency values may be controversial, it is generally accepted that switching to HVLP or other current-generation spray systems will reduce coating usage. This in turn leads to reductions in the use of VOC laden solvents and subsequent reductions in VOC emissions.

5.2.2.2 Optical Eye/Microprocessor Controls on Spray Equipment

All of the spray guns described above can be attached to automated machines. These machines range from horizontal reciprocating machines which maneuver the spray guns back and forth, to the more common rotary spray machines which rotate between four and sixteen spray guns over the surface to be coated. Either type of spray system has the potential for a large amount of overspray resulting in VOC and HAP emissions.

Because of this inefficiency, microprocessor controls coupled with electronic eyes are being used in tandem with the various spray machines. The efficiency of this equipment was tested in one experiment where a copper-containing pigment was sprayed on leather as the topcoat using equipment with and without microprocessor controls. As Table 5-4 shows, the use of microprocessor controls improved the net transfer efficiency of copper by 66 percent.⁴¹

Because of their relative low-cost, the return-on-investment in these systems can be realized within the first year.^{42,43} Recent industry surveys indicate that various forms of this technology are used in over 70 percent of the leather finishing facilities using automated spray equipment.⁴⁴

5.2.3 Housekeeping Practices

In addition to the emission reduction techniques mentioned above, VOC emissions can be minimized through diligent housekeeping practices. For example, fugitive emissions can be minimized by storing fresh and spent solvents in containers designed to minimize evaporative losses. Coating waste can be minimized by mixing only as much coating as is needed to complete finishing jobs. Cleaning solvents should be used in enclosures and systems which minimize the volume needed and evaporation. And waste coatings, spent solvents, and sludge from gun cleaners and in-house distillation units should be disposed of properly by transfer to designated hazardous waste management facilities. Implementation of in-house training programs can provide workers with guidance regarding practices that can reduce emissions.

5.2.4 Degreasing Operations

Sheep skin and pigskin tanneries often use solvent degreasing operations in the leather manufacturing process. The hides of these animals contain high quantities of inter-fiber fat that must be removed prior to tanning. Solvent degreasing involves placing the hides in drums containing solvents such as trichloroethylene or perchloroethylene, along with surfactants.⁴⁵ Solvent recovery systems are usually used when hydrocarbons or solvents are used for degreasing. However, a substantial amount of solvent can be lost from the system because of inefficient condensation or by diffuse evaporation as skins are drained or inspected.

**Table 5-4. Demonstration of Increased Transfer Efficiency Using
Optical Eye Spray Control Systems.**

	Without Controls	With Controls
Total Cu Offered (10 Sides)	3.24 g	2.46 g
Net Cu Taken Up (10 Sides)	0.872 g	1.098 g
Transfer Efficiency	26.9%	44.6%

Note: Copper (Cu) is a trace metal in the dye used to study the transfer efficiency differences in using optical eye spray control systems. The total copper dispensed with the dye was measured against the copper found in the coated leather.

Most of the organic solvents used in the degreasing process are hazardous materials. Therefore, tanneries have been investigating the use of aqueous degreasing systems. There are many commercial aqueous degreasing products available to the tanner. These products are most commonly based on blends of nonionic surfactants.⁴⁶

Aqueous degreasing systems are not common in the United States. Solvent degreasing systems are preferred because they have been proven to be effective. Ongoing research indicates that aqueous systems using nonionic surfactants are still less effective in degreasing fat-laden sheepskins than solvent systems. Therefore, substitution of solvent systems with aqueous systems is not presently a viable emission reduction technique for tanneries processing sheep and pig skins.⁴⁷

5.2.5 Emission Reductions and Waterproofing Operations

As discussed in Section 3.0, waterproof finishing is considered separate from finishing operations. Waterproof is actually a term that collectively describes three finished leather properties: a) water penetration resistance; b) water absorption; and c) water repellency. These properties are desirable in various leather products and particularly in footwear.

Silicones are the most efficient means of increasing water penetration resistance. The backbone of silicone polymers consists of repeating siloxane units. The stability of the link is responsible for the unique properties of these polymers which include stability at high temperatures and good resistance to chemicals. As a result of silicone treatment, the water penetration resistance of footwear can be nearly 100 percent. Because of the high degree of water penetration resistance that silicones impart on the leather, leather industry customers such as the Department of Defense usually require that leather be treated with silicone.

Silicones are normally applied using organic solvents, many of which contain HAP's. At present, there is no known substitute for solvent-based silicone coatings that can achieve the desired water penetration resistance qualities demanded by customers.⁴⁸ Therefore, emission reductions cannot be achieved through substitution with water-based coatings.

Water absorption properties are also desirable on many leather footwear products. Water absorption can be achieved by silicone impregnation and also through hydrophobic retanning in the wet ends process. The hydrophobic retanning process does not produce any air emissions. Therefore, depending on the degree of water absorption needed, either technology can be used. When hydrophobic retanning can be used rather than silicone impregnation, reductions in air emissions can be achieved.

Water repellency can be achieved using conventional finishing technology. Some top coats impart water repellency characteristics on the leather. Reduction of the VOC content of these top coats can result in some reductions in emissions.

5.2.6 Radiation Curing of Top Coats

Radiation curing is a relatively new technology and is just emerging as a potential technique for finishing leather. As such, economic viability and market demand for this technique are unproven. However, these coating formulations contain materials which are 100 percent reactive, and polymerize to form a coating without emitting volatile organic compounds. Radiation curing of leather topcoats has been used in limited production in Europe and may prove to be an alternative leather finishing process with low or no solvent emissions.

Radiation curing is the polymerization of a chemical system by interaction with incident radiation, specifically ultraviolet (UV) or electron beam (EB). The chemical system is usually composed of acrylate monomers and oligomers (intermediate length polymers) that contain reactive carbon-carbon double bonds. The oligomers provide the basic film-forming properties of the cured coating. The monomers are used to adjust the viscosity of the coating for application and to impart additional properties to the cured film. In the presence of a photo initiator and UV irradiation, the monomers and oligomers are converted to a solid polymer with properties that frequently surpass those of conventional solvent-borne coatings.⁴⁹

There are several disadvantages associated with this technology. First, the monomers and UV initiators required by the process are toxic. Second, there is concern about the ability of UV light to penetrate heavier pigmented coatings. And finally, there are costs associated with development of the process and purchase of equipment. The initial capital expenditures may exceed \$100,000 for a multi-lamp UV system. An EB system may cost several times this amount and these costs do not include changes in coating equipment needed for either technology. Coating formulation costs for UV/EB systems are expected to be higher than their conventional counterparts with the photo initiators being the most expensive components.^{50,51}

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6.0 STATE AND LOCAL REGULATIONS AFFECTING THE LEATHER TANNING AND FINISHING INDUSTRY

Six existing or proposed State and local regulations affecting the leather tanning and finishing industry have been identified. The existing regulations are in the States of New Jersey, New York, and Wisconsin. Regulations have been proposed in Illinois and Massachusetts and in the Monterey Bay Air Unified Air Pollution Control District.

All of these State and local regulations are targeted at leather finishing operations. Of the 6 regulations identified, 4 impose limits on the VOC content of the coating materials. One of the regulations establishes emission limits based on the amount of VOC emitted per unit of leather finished. And one regulation includes characteristics of both formats - a limit on VOC content of the coating and a limit on emissions based on VOC emitted per unit of leather finished. Table 6-1 summarizes the emission limitations established by these regulations.

Each of these regulations is discussed below. Appendix C contains copies of the full texts of each regulation. The full technical justification for the Wisconsin rule is also included in the appendix.

6.1 Regulations limiting VOC content of the finishing coatings

Three of the State and local regulations identified limit the VOC content of the finishing material. These regulations are found in New Jersey, New York, and Massachusetts. New Jersey was the first State to adopt this type of regulation, and New York and Massachusetts adopted the New Jersey rule.

6.1.1 State of New Jersey

The New Jersey rule for leather finishing is found in the New Jersey Administrative Code (N.J.A.C), Title 7, Chapter 27, Subchapter 16, Section 5. This section addresses surface coating and graphic arts operations as well as miscellaneous surface coating operations. The full text of N.J.A.C. 7:27 is provided in Appendix C.

For leather finishing operations, the maximum allowable VOC content per volume of coating (minus water) is 5.8 pounds per gallon (0.70 kilograms per liter). This limit was derived by determining the equivalent reduction achievable by reducing

Table 6-1. Summary of Existing and Proposed State/Local Regulations

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State	VOC Limitations
Illinois	3.5 lbs of VOC's per gallon of base and intermediate coats; 38 lbs VOC emissions per 1000 sq. ft. for top coats; 10 tons of VOC per year for stain coatings.
Monterey Bay	7.5 lbs of VOC per gallon of coating (minus water) for stain and oil coatings; 1.3 lbs per gallon for resins, and 4.0 lbs per gallon for top coats.
Massachusetts	27.4 lbs of VOC per gallon of solids applied.
New Jersey	5.8 lbs of VOC per gallon of coating (minus water).
New York	5.8 lbs of VOC per gallon of coating (minus water).
Wisconsin	38 lbs of VOC per 1000 sq. ft. of finished leather.

the VOC content of the coating as compared to emission reductions achievable using add-on controls. A number of assumptions were used by the State of New Jersey in developing this limit.

First, it was assumed that the typical coating formulation used by the leather industry contains 7 pounds of organic solvent per gallon and that the average solvent density is 7.36 pounds per gallon. Reasonably available control for this type of operation was expected to involve capture and venting to an incinerator. A capture efficiency of 85 percent was assumed along with a destruction efficiency of 95 percent. Using a solids-applied equation, it was determined that the VOC content of the coating must be reduced to 5.8 pounds per gallon to achieve the equivalent 81 percent reduction obtainable using capture and add-on controls.

The 5.8 pounds per gallon limit must be met on a daily basis. If more than one coating is used, a daily mean VOC content is determined using a formula provided in the rule. If coatings having VOC contents higher than 5.8 pounds per gallon are applied, control equipment must be used to reduce VOC emissions to a specific overall control efficiency. Quarterly reporting requirements are also specified.

6.1.2 State of New York

The New York State regulation for leather finishing is found in Title 6, Part 228 of the State code. Specific reference to leather coating lines is found in Section 228.9 of this part. Section 228.9 contains a table that itemizes limits on various processes including leather coating lines. The limit for leather coating is identical to that found in New Jersey, 5.8 pounds of VOC per gallon of coating minus water.

Discussions with State of New York representatives indicate that New York adopted the New Jersey rule in total. The rule was initially applicable only in the New York City metropolitan area. However, most of the leather finishing facilities are located in the central part of the State and were not impacted by the rule. The establishment of the Northeast transport region by the Clean Air Act has caused the State to expand the rule to cover major sources statewide. Since New York is in the transport region, a major source is one that emits 50 tons per year or greater of VOC's. Some of the facilities located in upstate New York may now be impacted by the rule.

6.1.3 State of Massachusetts

The State of Massachusetts proposed a regulation to limit emissions from leather finishing facilities as part of State Implementation Plan (SIP) revisions needed to comply with the Clean Air Act Amendments. Public hearings were being held on the proposed regulation in the Fall of 1992.

The State is in the process of setting RACT emissions limitations on 7 industrial categories not covered by their existing regulation, with leather surface coating being one of the 7 categories. The RACT limitations will be imposed on all stationary sources having the potential to emit 50 tons of VOC per year. The 50 ton limit is in response to the Northeast transportation provision of the Act.

Massachusetts is proposing a limit of 27.4 pounds of VOC per gallon of solids applied. This format parallels those of New Jersey and New York, but relates emissions directly to solids application as opposed to gallons of coating minus water.

6.1.4 Monterey Bay Unified Air Pollution Control District

The Monterey Bay Unified Air Pollution Control District (MBUAPCD), located in Northern California, has proposed a rule to limit VOC emissions from leather processing operations. The rule is expected to be promulgated in the Fall of 1993.

The MBUAPCD rule requires sources that emit greater than 250 tons per year of VOC to use control technology that achieves a combined efficiency of 85 percent. For sources that emit less than 250 tons per year, limits on the VOC content of the coating material have been specified. These limits are: a) 7.5 pounds per gallon of material (minus water) for stain coatings; b) 7.5 pounds per gallon of material (minus water) for oil coatings; c) 1.3 pounds per gallon of material (minus water) for resin coatings; and d) 4.0 pounds per gallon of material (minus water) for top coats. It is expected that these limits will become stricter in later years.

In addition to the limits on VOC content of the coatings, the rule also specifies application methods and equipment to be used for leather finishing. For example, roll coating is required for oil application and photoelectric controls are required for spray guns used to apply other VOC-containing treatments.

6.2 Regulations limiting emissions to unit of product finished

The State of Wisconsin regulation limits VOC emissions by the square footage of leather finished. The Wisconsin rule was promulgated on March 1, 1990. Development of the regulation involved an extensive effort by Wisconsin's Department of Natural Resources over a 6 year period. In developing the rule, Wisconsin focused on the tanneries located in the Southeast Wisconsin nonattainment area. The Department surveyed four tanneries in this area and solicited information on the VOC content of coatings used by each facility.

The emission limit developed by Wisconsin is based on the coatings formulation data obtained from the tanneries. The State recognized the diversity of coatings used in finishing leather, and divided the coatings into five functional classes. These functional classes are impregnation, stain, base, effect, and final finish.

Table 6-2 shows the VOC emission rates identified for these functional classes for three types of application methods.

Based on the emission rates identified, Wisconsin determined that the 16th percentile in each spray coating range (frequency distribution) represented RACT. The emission limit was determined by adding the RACT level for each functional class: 6.0 pounds per 1,000 square feet for impregnation; 19 pounds per 1,000 square feet for stain; 2 pounds per 1,000 square feet for base; 4 pounds per 1,000 square feet for effect; and 7 pounds per 1,000 square feet for finish. Adding the emission limits for each functional class yielded an overall emission limit of 38 pounds of VOC per 1000 square feet of finished leather.

Determination of compliance is based on a formula that takes into account the total VOC's emitted during the day as compared to a prorated surface area of leather finished. In order to determine compliance, the plant must keep detailed records of all coating formulations and the amount of each coating needed to finish each type of leather product. These records are kept on a daily basis and require computer capabilities to effectively monitor coating usage and surface area of leather finished.

A copy of the technical support document developed to support the Wisconsin rulemaking is provided in Appendix C.

6.3 The State of Illinois

The State of Illinois proposed regulation incorporates components of both the New Jersey rule and the Wisconsin rule. As part of their strategy to comply with the Clean Air Act Amendments, Illinois is developing rules to implement RACT for all major sources. In the Chicago area, which is a severe nonattainment area for ozone, a major source is 25 tons per year.

The Federal Implementation Plan (FIP) in effect in Illinois established RACT for 100 ton non-CTG sources to be either 3.5 pounds of VOC per gallon of coating (minus water) or an overall emission reduction of 81 percent. In evaluating smaller non-CTG sources such as leather finishing plants, Illinois determined that the 3.5 pounds/gallon limit was too strict.

Based on a survey of the leather finishing industry conducted for EPA,¹ the State determined that the 3.5 pounds/gallon limit was achievable for base and intermediate coatings. However, top coats and stains used in specialty leathers cannot meet this limit. Illinois has proposed using Wisconsin's RACT limitation of 38 pounds per 1,000 square feet of finished leather for these specialty leathers. In addition, a limit of 10 tons per year of VOC emissions from stains other than those used in specialty leathers is in the rule.

Table 6-2. State of Wisconsin - Emission Rates Identified by Finishing Application Method^a

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Application Method	Coating Type	VOC Emission Rate (kg/100 m²)
Flow	Oil Impregnation	2.39-9.76
Air Atomized Spray	Stain	7.81-14.16
Air Atomized Spray	Middle	0.33-6.41
Air Atomized Spray	Emulsion	3.42 ^b
Air Atomized Spray	Top Coat	1.95-12.7
Air Atomized Spray	Top Coat	2.44-16.11
Roll	Oil Impregnation	2.93 ^b
Roll	Stain	1.12-2.93

^aBased on information received from Amity Leather Products Company, Gebhardt-Vogel Tanning Company, and Pfister-Vogel Tanning Company during November 1985 - April 1986.

^bOnly one value presented from the above listed leather finishers.

A technical document was prepared by one source impacted by these limits as part of Illinois' rulemaking process. Copies of that report are not available at this time due to proprietary reasons.

6.4 References

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APPENDIX A

EMISSIONS DATA

A.1 Introduction to Appendix A

This appendix contains all of the emissions data collected during the course of the project. Data were obtained from EPA data bases such as the Aerometric Information Retrieval System (AIRS) and the Toxic Release Inventory (TRI). Additional data were obtained from State agencies and from plant sites.

Seventy-nine facilities are listed in the appendix. For many facilities, emissions are not reported (NR). The emissions from these facilities are either below the reporting threshold for the TRI or were not reported in any other available data base.

List of Tanning and Finishing Facilities in the United States

KEY: TRI - Toxic Release Inventory

AIRS - Aerometric Information Retrieval System

Facility	City	State	Source of Emission Data
Calnap Tanning	Napa	CA	AIRS
Salz Leathers, Inc.	Santa Cruz	CA	TRI, AIRS, Mont. Bay
Western Tanning, Inc.	Delta	CO	TRI
ACME Sponge & Chamois Co. Inc	Tarpon Springs	FL	TRI
Oshkosh Tanning Co., Inc.	Boone	IA	TRI
Gutman and Company	Chicago	IL	AIRS
Horween Leather Company	Chicago	IL	TRI, AIRS
Huch Leather Company	Chicago	IL	AIRS
Carr Leather Co.	Lynn	MA	TRI
Barnet Corporation	Peabody	MA	AIRS
Bond Leather Co., Inc.	Peabody	MA	TRI
Salem Suede, Inc.	Salem	MA	TRI
Richard Tanning Co.	Salem	MA	AIRS
W.D. Byron & Sons Inc.	Williamsport	MD	TRI
Prime Tanning Co., Inc	Berwick	ME	TRI, AIRS
Camden Tanning Corporation	Camden	ME	AIRS
Irving Tanning Company	Hartland	ME	TRI
Rockland Leathers, Inc.	Rockland	ME	AIRS
Wilton Tanning Company	Wilton	ME	AIRS
Eagle Ottawa Leather Co.	Grand Haven	MI	TRI
Whitehall Leather Company	Whitehall	MI	TRI
S.B. Foot Tanning Company	Red Wing	MN	TRI, AIRS
Blueside Companies, Inc.	Saint Joseph	MO	TRI
Hermann Oak Leather Company	St. Louis	MO	TRI
Lackawanna Leather Co.	Conover	NC	TRI, AIRS
Lackawanna Leather Co.	Omaha	NE	TRI
Schwartz Leather Company	Carlstadt	NJ	TRI
New Jersey Tanning Co., Inc.	Newark	NJ	TRI
Seton Company	Newark	NJ	TRI, NJ permits
UDO Finishing Co	Newark	NJ	NJ permits
American Leather	Rahway	NJ	AIRS, NJ permits
Androme Leather Corp	Gloversville	NY	NY data
Colonial Tanning Corp.	Gloversville	NY	TRI
Fashion Tanning Co., Inc.	Gloversville	NY	TRI, NY data

List of Tanning and Finishing Facilities in the United States

KEY: TRI - Toxic Release Inventory

AIRS - Aerometric Information Retrieval System

Facility	City	State	Source of Emission Data
Framglo Plant	Gloversville	NY	NY data
Independent Leather Mfg. Corp.	Gloversville	NY	TRI
JBF Industries Inc.	Gloversville	NY	TRI, NY data
Leather Agent Inc	Gloversville	NY	NY data
Pan American Tanning Corp.	Gloversville	NY	TRI, NY data
Twin City Leather CO., Inc.	Gloversville	NY	TRI
Wood & Hyde Leather co Inc	Gloversville	NY	NY data
Moench Tannning Company	Gowanda	NY	TRI
Adirondac Leather Inc	Johnstown	NY	NY data
Allied Split Corp.	Johnstown	NY	TRI, NY data
Arrow Leather Finishing Co	Johnstown	NY	NY data
Carville National Leather Co	Johnstown	NY	NY data
Classic Leather corp	Johnstown	NY	NY data
Gordon Finishing Co Inc	Johnstown	NY	NY data
H & J Leather Finishers Inc	Johnstown	NY	NY data
Karg Brothers, Inc.	Johnstown	NY	TRI, NY data
K-lynn Split Inc	Johnstown	NY	NY data
Pearl Leather Finishers Inc	Johnstown	NY	TRI
Peerless Tanning Co Inc	Johnstown	NY	NY data
Simco Leather Corp.	Johnstown	NY	TRI, NY data
Townsend Leather Co	Johnstown	NY	NY data
Conneaut Leather Inc.	Conneaut	OH	TRI
Howes Leather Co., Inc.	Curwensville	PA	TRI, AIRS
Garden State Tanning	Fleetwood	PA	TRI, AIRS
Mercersburg Tanning	Mercersburg	PA	TRI
Garden State Tanning	Reading	PA	TRI
Seton Company	Saxton	PA	TRI
Westfield Tanning Company	Westfield	PA	TRI, AIRS
Volunteer Leather Company	Milan	TN	TRI, AIRS, TN permits
Lannom Tannery	Tullahoma	TN	ILG, TN permits
Tennessee Tanning Co.	Tullahoma	TN	TRI, TN permits
Coey Tanning Co., Inc.	Wartrace	TN	TRI, TN permits
S.B. Foot Tanning Co.	Cactus	TX	TRI
Fox Valley Leathers, Inc.	North Salt Lake	UT	TRI

List of Tanning and Finishing Facilities in the United States

KEY: TRI - Toxic Release Inventory

AIRS - Aerometric Information Retrieval System

Facility	City	State	Source of Emission Data
Berlin Tanning Co.	Berlin	WI	TRI
Cudahy Tanning Company	Cudahy	WI	TRI
A.F. Gallun & Sons Co.	Milwaukee	WI	TRI
Blackhawk Tanning Co.	Milwaukee	WI	AIRS
Gebhardt-Vogel Tanning Co.	Milwaukee	WI	TRI
Gebhardt-Vogel Tanning Co.	Milwaukee	WI	TRI
Paul Flagg Inc	Milwaukee	WI	AIRS
PFister & Vogel Tanning Co.	Milwaukee	WI	TRI
Theile Tanning Co.	Milwaukee	WI	TRI
Paul Flagg Leather Corp.	Sheboygan	WI	TRI
Howes Leather Co., Inc.	Frank	WV	TRI

Total Number of Facilities Reporting 79

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Cal Nap Tanning Napa, CA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Salz Leathers, Inc. Santa Cruz, CA	1987	250	37000	37000	250
	1988	250	33214	33214	250
	1989	250	NR	NR	250
	1990	250	NR	NR	250
Western Tanning, Inc. Delta, CO	1987	500	250	NR	250
	1988	250	NR	NR	250
	1989	250	NR	NR	250
	1990	5	NR	NR	5
ACME Sponge & Chamois Tarpon Springs, FL	1987	NR	NR	NR	NR
	1988	31850	31850	NR	NR
	1989	42000	42000	NR	NR
	1990	26644	26638	NR	6
Oshkosh Tanning Co., Inc. Boone, IA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Gutman and Company Chicago, IL	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Horween Leather Compan Chicago, IL	1987	31000	31000	NR	NR
	1988	47000	47000	NR	NR
	1989	14950	14950	NR	NR
	1990	53250	53250	NR	NR
	1991	NR	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Huch Leather Company Chicago, IL	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Carr Leather Co. Lynn, MA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Barnet Corp. Peabody, MA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Bond Leather Co., Inc. Peabody, MA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Rex Finishing Inc. Peabody, MA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Richard Tanning Co. Salem, MA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Salem Suede, Inc. Salem, MA	1987	16750	16750	NR	NR
	1988	8610	8610	NR	NR
	1989	26074	26074	NR	NR
	1990	22884	22884	NR	NR
W.D. Byron & Sons Inc. Williamsport, MD	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	461183	470332	9149	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Prime Tanning Co., Inc Berwick, ME	1987	460750	682500	222000	250
	1988	434957	527805	92848	NR
	1989	881296	970872	89576	NR
	1990	1058585	1058585	NR	NR
Camden Tanning Corporat Camden, ME	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Irving Tanning Company Hartland, ME	1987	676350	1241070	564720	NR
	1988	495981	1486742	990761	NR
	1989	261863	277635	15772	NR
	1990	398886	398886	NR	NR
Rockland Leathers, Inc. Rockland, ME	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Wilton Tanning Company Wilton, ME	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Eagle Ottawa Leather Co. Grand Haven, MI	1987	2820000	3570000	750000	NR
	1988	2730000	3360000	630000	NR
	1989	2618000	2977000	359000	NR
	1990	1915231	2154210	239234	255
Whitehall Leather Compan Whitehall, MI	1987	4500	4500	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
S.B. Foot Tanning Compa Red Wing, MN	1987	309468	349606	41000	862
	1988	284979	317008	32891	862
	1989	260866	318293	58289	862
	1990	154811	185952	31306	165

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Hermann Oak Leather Co St. Louis, MO	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Blueside Companies, Inc. Saint Joseph, MO	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	250	250	NR	NR
Lackawanna Leather Co. Conover, NC	1987	628195	674752	46557	NR
	1988	372390	670988	298598	NR
	1989	551025	728647	177622	NR
	1990	319586	506759	187173	NR
Lackawanna Leather Co. Omaha, NE	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	239005	318962	79957	NR
Schwartz Leather Compan Carlstadt, NJ	1987	NR	NR	NR	NR
	1988	250	250	NR	NR
	1989	NR	NR	NR	NR
	1990	255	255	NR	NR
New Jersey Tanning Co., I Newark, NJ	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Seton Company Newark, NJ	1987	1678500	1678500	NR	NR
	1988	609310	608810	NR	500
	1989	658750	658250	NR	500
	1990	1359991	1359991	NR	NR
UDO Finishing Newark, NJ	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
American Leather Rahway, NJ	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	30994	56031	25037	NR
Androme Leather Corp Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Colonial Tanning Corp. Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Fashion Tanning Co., Inc. Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Framglo Plant Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
JBF Industries Inc. Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	7900	7900	NR	NR
Independent Leather Mfg. Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Leather Agent Inc. Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Pan American Tanning Co Gloversville, NY	1987	28000	28000	NR	NR
	1988	42250	42250	NR	NR
	1989	67750	67250	NR	500
	1990	53750	53250	NR	500
Twin City Leather CO., Inc. Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Wood & Hyde Leather Co Gloversville, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Moench Tanning Compa Gowanda, NY	1987	285000	285000	NR	NR
	1988	158145	158145	NR	NR
	1989	157041	157041	NR	NR
	1990	146261	159716	13455	NR
Adirondac Leather Inc Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Allied Split Corp. Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	250	NR	NR	250
Arrow Leather Finishing C Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Carville National Leather C Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
	1991	NR	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Classic Leather Corp Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Gordon Finishing Co Inc Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
H & J Leather Finishers Inc Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Karg Brothers, Inc. Johnstown, NY	1987	12000	12000	NR	NR
	1988	20250	20250	NR	NR
	1989	15750	15250	NR	500
	1990	13574	13074	NR	500
	1992	NR	NR	NR	NR
K-Lynn Split Inc Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Pearl Leather Finishers Inc Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Peerless Tanning Co Inc Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Simco Leather Corp. Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Townsend Leather Compa Johnstown, NY	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Conneaut Leather Inc. Conneaut, OH	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	55298	68092	12794	NR
	1990	7522	12277	4755	NR
Howes Leather Co., Inc. Curwensville, PA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Garden State Tanning Fleetwood, PA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	699089	727987	28898	NR
Mercersburg Tanning Mercersburg, PA	1987	148900	204000	55100	NR
	1988	225800	236850	11050	NR
	1989	49500	109050	60050	500
	1990	46700	81250	35050	500
Garden State Tanning Reading, PA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	10	NR	NR	10
Seton Company Saxton, PA	1989	NR	NR	NR	NR
	1990	169444	NR	NR	NR
	1991	265994	NR	NR	NR
	1992	267623	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Westfield Tanning Compa Westfield, PA	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Volunteer Leather Compa Milan, TN	1987	66000	85000	19000	NR
	1988	81000	115000	34000	NR
	1989	64500	75750	11250	NR
	1990	45500	45500	NR	NR
Lannom Tannery Tullahoma, TN	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Tennessee Tanning Co. Tullahoma, TN	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Coey Tanning Co., Inc. Wartrace, TN	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
S.B. Foot Tanning Co. Cactus, TX	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Fox Valley Leathers, Inc. North Salt Lake, UT	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Berlin Tanning Co. Berlin, WI	1987	250	14250	14250	250
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Cudahy Tanning Compan Cudahy, WI	1987	161050	160800	NR	250
	1988	99250	99000	NR	250
	1989	77950	77700	NR	250
	1990	78050	77800	NR	250
A.F. Gallun & Sons Co. Milwaukee, WI	1987	250	NR	NR	250
	1988	250	NR	NR	250
	1989	250	NR	NR	250
	1990	NR	NR	NR	NR
Blackhawk Tanning Co Milwaukee, WI	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Gebhardt-Vogel Tanning Milwaukee, WI	1987	500	NR	NR	500
	1988	250	NR	NR	250
	1989	250	NR	NR	250
	1990	45	NR	NR	45
Gebhardt-Vogel Tanning Milwaukee, WI	1987	40750	54750	14250	250
	1988	48600	65100	16750	250
	1989	20000	31000	11250	250
	1990	51280	51200	NR	80
Paul Flagg Leather Milwaukee, WI	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
PFister & Vogel Tanning C Milwaukee, WI	1987	159022	193100	34100	22
	1988	171018	256600	85600	18
	1989	111090	129650	19700	1140
	1990	146260	172070	26600	790

1987-1990 VOC and HAP Emissions from Tanning Operations

Facility	Year	Total HAP Emissions (lbs/yr)	Total VOC Emissions (HAP & nonHAP) (lbs/yr)	Total NonHAP VOC emissions (lbs/yr)	Total HAP nonVOC emissions (lbs/yr)
Theile Tanning Co. Milwaukee, WI	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Paul Flagg Leather Corp. Sheboygan, WI	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	NR	NR	NR	NR
Howes Leather Co., Inc. Frank, WV	1987	NR	NR	NR	NR
	1988	NR	NR	NR	NR
	1989	NR	NR	NR	NR
	1990	10	NR	NR	10

APPENDIX B

LEATHER TANNING AND FINISHING PLANTS - CASE STUDIES

B.1 Introduction to Appendix B

Appendix B includes case studies for five leather manufacturing facilities. The information included in the case studies was obtained during site visits to the respective plants. All information claimed as confidential has been removed from the case studies.

PLANT A

A. General

Plant A is a retanning and finishing facility that produces leather used for manufacturing shoes, handbags, and belts. These products tend to be leathers with heavy, oily finishes.

The raw materials used at the plant are wet blue, or crust leather, that has been chrome tanned at another leather tannery. The primary supplier of the wet blues is a tannery located in another State. The wet blues are retanned prior to being finished. The crust leather has already been retanned and is simply finished by Plant A.

Most of the finishing is conducted in the newest section of the plant that houses three leather coating lines, two of which are vented to an incinerator to control VOC emissions. Older finishing lines are located in the original plant buildings and are primarily used for specialty finishing. For example, one gun spray booths are used to create shadowing and antiquing effects on the leather by altering the angle of the spray.

Plant A is capable of producing hundreds of product lines. This includes variations in color, texture, feel, and grain thickness. Over 370 different chemicals and additives are used to produce coatings applied during the leather finishing process. All coatings are custom formulated on site, and coating formulations and usage are closely tracked by the plant. The major suppliers of coating components are Stahl, BASF, Rohm & Haas, and Mobay.

B. Process Description

The primary purpose for visiting Plant A was to observe the operation of the newer finishing lines that are vented to a control device. Most of the time spent at the facility was focused on this part of the operation. However, some wet-end processes are performed at Plant A prior to finishing. The leather arrives at the plant in the wet blue or chrome tanned condition. The wet blue hides are retanned at the plant, and some mechanical operations are performed prior to the leather being finished. These operations include drying, softening and splitting of the leather. Plant A primarily finishes the grain portion (top half) following splitting, but they occasionally finish some splits (the fleshy, or bottom half of the hide).

Leather finishing is conducted using old and new technology. In the older sections of the plant, one-gun finishing machines and four-gun finishing machine are used for most of the leather finishing. The one-gun spray equipment observed during the visit is not controlled by optical eye or mechanical sensors, and the degree of overspray was noticeably greater than optically controlled equipment. The emissions from these spray booths are uncontrolled. Most of the coating used in this section of the facility are solvent-based coatings. Although Plant A is in the process of moving most of their finishing processes to the new spray facilities, these older machines are used to apply special effects to the leather. For example, the spray nozzle of a one-gun machine can be angled to achieve a shadowing effect on the leather.

In the new section of the plant, modern finishing technology is used to finish the leather. Three finish lines are used in the new part of the plant and all of the spray booths use eight-gun rotary sprayers that are optically controlled. The optical controls help to minimize overspray. Typically, three types of coatings are applied to the leather: a base coat, an intermediate coat, and a top coat.

C. Sources of Emissions

The leather finishing operation is responsible for nearly all of the VOC and hazardous air pollutant (HAP) emissions from the facility. There are little, if any, VOC emissions from the wet-end processes or from associated operations such as the wastewater treatment system. Wastewater samples have been analyzed for total organic compounds and the concentrations were less than 10 mg/L.

In the older part of the plant, all of the finishing operations are uncontrolled for VOC's. Emission control measures are in place for particulate control. Over half of the total VOC emissions from the facility are emitted from this section of the plant.

The new section of the plant was built in 1990 and is used for the majority of the leather finishing. There are three finishing lines located in this plant addition and they are identified as Lines A, B, and C by the State permitting authority. At the plant site, Line C consists of two spray booths, designated as machines 9B and 9C by the plant, three drying ovens, and one stick dryer. Line C also has a manual coatings operation that is identified by the plant as machine 9A. The manual operation involves application of coatings for special effects using hand spray guns.

Line C is an uncontrolled finishing line that is used to apply water-based coatings only. There is a VOC emissions limit of 20 tons per year for this line, along with limitations on the VOC content of coatings applied during finishing. The limitation on the base coatings is 3.5 pounds of VOC per gallon (minus water) and the limitation on intermediate coatings is 2.8 pounds of VOC per gallon (minus water).

Line A consists of two eight-gun spray booths (machines 1A and 1B) and two catalytic dryers. Line B (machine 2) consists of one eight-gun spray booth and one stream dryer. As stated in the permit, VOC emissions from these two lines are limited to 35 tons per year.

All of the spray booths and dryers on lines A and B are vented to a regenerative thermal oxidizer (RTO) supplied by Salem Engelhard. The rated capacity of the RTO is 30,000 standard cubic feet per minute. VOC destruction efficiencies of greater than 99 percent were determined by the tests. The incinerator is supplemented with natural gas to maintain combustion temperatures. However, when two spray booths are operating in tandem and applying solvent-based coatings, the RTO temperatures can be maintained with little supplemental fuel.

Emissions data for the plant were provided following the plant visit. As noted above, the new addition to the plant and the incinerator were built in 1990. The emissions data given below were recorded prior to emissions testing of the RTO. A 95 percent destruction efficiency was assumed for the incinerator in estimating emissions from the incinerator outlet.

1988	Total Plant VOC	276 tons
1989	Total Plant VOC	136 tons
1990	Total Plant VOC	154 tons
	Line C	10.03 tons
	VOC to RTO	54 tons
	VOC out of RTO	2.7 tons
1991	Total Plant VOC	119 tons
	Line C	2.2 tons
	VOC to RTO	41 tons
	VOC out of RTO	2.0 tons

The specific VOC emission points from the finishing operation are the vents from the spray booths and dryers, the uncovered areas of the conveyers carrying the leather from the spray booths and dryers, fugitive emissions from the partially covered drums containing coating, and fugitive emissions from the finished leather. There is also a small mixing room that is a source of fugitive emissions. The largest single emission point in the plant is the vent to the RTO.

D. Emission Reduction Measures

The installation of the incinerator is the major emission reduction measure employed by the plant. The system cost about \$1.5 million dollars in 1989. The purpose of installing the incinerator to control emissions from the plant modification was to allow for expansion of production without exceeding any State emission limitations. Plant A was also anticipating increased business in producing military leather. Military leather has to be waterproofed using high VOC-based sealing systems.

Other than the incinerator, Plant A is under little pressure to look for additional VOC reductions. The transition to more water-based coatings will only be made when water-based technology is capable of producing the same quality leather as the solvent-based systems. Plant A believes that solvent-based coatings are still essential to producing leather to meet their customers specifications. The coatings applied to their leathers must be compatible with the finished coatings used by the shoe manufacturers. As the water-based technology improves, solvent-based coatings may be phased out.

Plant A has made progress in limiting emissions of some HAP's. In the 1990 Toxic Release Inventory, Plant A reported emissions of 5 HAP's: 6.38 tons of toluene; 3.48 tons of xylene; 4.63 tons of methyl ethyl ketone (MEK); 8.6 tons of glycol ethers; and 0.25 tons of chromium. According to information provided by the plant, emissions of toluene and MEK were eliminated in 1991 and emissions of xylene and glycol ethers have been reduced. 1991 emissions of xylene were reported to be 2.4 tons and emissions of glycol ethers were reported as 5.75 tons per year. These emission reductions were the result of new coating formulations.

E. Regulatory Compliance

When Plant A decided to modify the existing facility by adding the new finishing lines, they entered into negotiations with the State. At the time, the area was an unclassified air quality management district. However, for the purposes of permitting, the facility was considered to be in a non-attainment area and, therefore, subject to a lowest achievable emission rate (LAER) determination. Part of the reason for setting the emission limit of 35 tons on the new spray lines was to avoid new source review.

PLANT B

A. General

Plant B produces automotive upholstery leather. The leather production process is divided between two facilities. Raw hides are processed and tanned at another facility and then shipped to Plant B. The tanned leather is referred to as crust leather at this stage in the leather tanning and finishing process. Plant B is strictly a finishing and cutting plant. The final product is cut automotive upholstery parts.

Plant B is a new facility that began operations in 1989. In 1992, all of the finishing operations were transferred to this location with the exception of some minor finishing processes that are still performed at the old site. The State has set an emission limit of 250 tons per year (on a rolling monthly average) for the Plant B. The area in which Plant B is located was designated as an ozone attainment area when the facility was constructed. The 250 ton per year limit was set to avoid prevention of significant deterioration (PSD) review. This source appears in the Best Available Control Technology/Lowest Achievable Emission Rate (BACT/LAER) Clearinghouse. However, the source did not actually undergo PSD review. Rather than proceed through the review process, Plant B applied for a non-PSD permit with a 250 ton per year limit.

B. Process Description

Plant B operates five finishing spray lines at this facility. All of the equipment was supplied by Hampton Machine Company. Initially, four spray lines were permitted by the State, with the fifth spray line added in 1992.

Plant B is equipped with five spray lines. Four of these spray lines are vented to a Reeco Incinerator. The spray booths and dryers on each of these lines are totally enclosed. The fifth spray line is not vented to the incinerator. Lines 1, 2, and 5 are arranged in a row and can operate in series. Lines 3 and 4 are also in-line and can be operated in series.

Both water-based and solvent-based coatings are applied to the leather. The spray lines are designed so that solvent-based applications can be vented to the incinerator, while water-based applications are vented to the atmosphere. Line 1 is used to apply exclusively water-based coatings. The spray booth and dryer on this line are not vented to the incinerator. Lines 2 and 4 are used to apply either water or

solvent-based coatings. When solvent coatings are applied on these lines, the spray booth and dryer exhaust are vented to the incinerator. When water-based coatings are applied on these lines, the spray booth and dryer exhausts are vented to the atmosphere. Lines 3 and 5 are used exclusively for applying solvent-based coatings, usually topcoats. In general the leather receives a total of three coatings. Occasionally, the leather receives a fourth coating.

Whenever a solvent based coating is applied on any line, the spray booth and dryer exhaust are routed to an incinerator. The incinerator is designed to handle a maximum flow of 24,000 cubic feet per minute (cfm). At any given time, two spray lines can be vented to the incinerator. The exhaust flow from each finishing line is approximately 12,000 cfm. Theoretically, all five lines can be operating at one time if only two are applying solvent based coatings.

There is no process wastewater discharged from the plant. All process wastewater is treated on site and then reused. The water treatment system is located inside the building. Any emissions resulting from the treatment (volatilization of organic contaminants) of wastewater are exhausted through the building ventilation. A filter cake is generated from the waste water treatment which is disposed of as hazardous waste.

C. Sources of Emissions

The major source of emissions at the plant is the incinerator stack. Four of the 5 finishing lines can potentially be vented to the incinerator when solvent-based coatings are being applied. At any given time, a maximum of two lines can be vented to the unit. All of the spray booths and dryers are totally enclosed. Capture efficiency testing has been conducted on two occasions and capture efficiencies of 65 to over 90 percent have been estimated. Based on test results, there are some fugitive emissions from the drying ovens, and also some emissions from spray booths not vented to the incinerator.

An additional source of VOC emissions is the mixing room. Plant B estimates emissions from the mixing room to be approximately 10 tons per year. This estimate is based on analysis of grab samples taken from the mixing room ventilation system, personnel monitoring in the mixing room, and mixing room ventilation rates.

Plant B maintains a detailed tracking system of product usage and VOC emissions. In all spray booths using water-based coatings, all overspray is collected and reused or disposed. Plastic sheets are placed on the bottom of the spray booths. The water-based coating is collected on the plastic and placed in buckets. The buckets are weighed before the product is reused or disposed. Some coating remains on the plastic sheets, and these sheets are disposed as solid waste. Prior to disposal, all wastes are analyzed and the off-site disposal of VOC and individual toxics

are quantified. Plant B accounts for any volatile component that leaves the plant in solid or liquid waste in determining their air emissions.

Plant B also attempts to account for any organic compounds that stay in the product. Based on analysis of finished leather products, Plant B has determined that significant quantities of high boiling volatiles remain in the finished leather. This is based on analysis of finished leather samples up to a year after they are finished. In the case of water-based coatings this becomes significant in that a major portion of the VOC's are often high boiling compounds.

Four of the 5 spray booths have water curtains for control of particulate emissions. The water used for the curtains is recycled until saturated, treated on site, and then reused. The newest spray booth (Line 5) is a "dry" booth that does not have a water curtain. A dual bank of dry filters control particulate emissions.

D. Emission Reduction Measures

Plant B has implemented two strategies to reduce VOC emissions. First, the incinerator was installed as part of the initial startup of the facility. The incinerator is a Reeco Re-therm, Model #VF-C-24000-85, with a capacity of 24,000 cfm. The installed capital cost of this unit was about \$800,000 in 1989. Efficiency tests have been conducted on the incinerator and VOC destruction efficiencies of greater than 98 percent have been documented. The operating temperature of the incinerator is maintained at about 1500 degrees fahrenheit. Supplemental fuel is used to maintain the combustion temperature and to preheat the combustion chambers prior to venting of the spray booths. When two spray booths are operating with applications of solvent-based coatings, the incinerator does not require any supplemental fuel.

The Reeco incinerator is equipped with three ceramic packing beds to recoup heat from the combustion flue gas. Heat energy is transferred from the hot combustion flue gas to the ceramic packing and then transferred to the incinerator feed. At any time, the combustion chamber flue gas is being routed through one bed to heat the packing, the inlet stream to be incinerated is being passed through a heated bed, and the third bed is idle.

Plant B is currently operating two shifts. Prior to starting production on the first shift, the incinerator goes through a two hour warm up period to take the combustion chamber temperature from 500 F up to the 1500 F operating temperature. At the end of the second shift, the incinerator goes through a 3 hour cool down, from 1500 F to 500 F, and remains at an idle temperature of 500 F while the spray booths are not being operated.

Plant B has also initiated a program to introduce water-based coatings wherever possible, and to find formulations that reduce emissions of VOC and HAP's.

For example, one base coat that previously had a VOC content of 10 percent along with some HAP's, now has a VOC content of 1.74 percent with no HAP's. Conversely, there are other coatings for which Plant B has been unable to find a suitable water-based substitute. Antique coatings have VOC contents greater than 95 percent, while most of their topcoats have VOC contents greater than 85 percent. At present, Plant B feels that switching to all water-based coatings is not technically or economically feasible. The performance of most water-based top coats evaluated is not adequate to meet their client specifications. Additionally, Plant B estimates that the application of some water-based coatings currently being considered could result in higher emissions than applications of the controlled solvent-based coating. In the case of top coats, the VOC content of water-based alternatives can be as high as 20 percent. Through calculations, Plant B demonstrated that the use of such a top coat could actually result in higher emissions than using a solvent based coating and routing the spray booth and dryer exhaust to the incinerator. In the case of base coats, the water-based coatings used by Plant B typically have 2 to 3 weight percent VOC in their formulation.

Another effort to minimize VOC emissions is optimization of the spray booth design and operation. Plant B continues to experiment with their spray booths to maximize transfer efficiencies and minimize the loss of material through overspray and bounce back. All of the spray booths are optically controlled. The leather passes over infrared sensors that record the outline of the hide passing on the conveyor belt. The spray guns turn off and on according to the outline of the hide.

Other factors also influence the efficiency of the spray booth. These factors include conveyor speed, speed of the rotary spray arm, spray gun efficiency, and operator training. Plant B continues to experiment with approaches to optimize transfer efficiency, including the use of high-volume-low-pressure (HVLP) spray guns. The rotary spray equipment at Plant B is equipped with 16 guns as opposed to 8 used by many other companies.

E. Regulatory Compliance

As mentioned earlier, Plant B has taken a VOC limit of 250 tons per year to avoid PSD review. Plant B is required to maintain annual VOC emissions on a rolling 12 month basis. For the calendar year 1992, Plant B indicated that VOC emissions were about 120 tons.

F. Additional Information

In one state, the company is required to comply with a limit of 5.8 lbs of VOC per gallon. Most of the operations personnel at Plant B have been relocated from this state to another location and in some cases they are still involved in the remaining finishing operations. They were quick to point out the hinderance on operating

flexibility posed by the state leather finishing rule. Instances where production was dictated by compliance with the 5.8 lbs VOC per gallon on a daily basis were cited. In some instances production schedules were modified so that a water-based finish was applied on a given day to offset the use of solvent-based material.

Plant B personnel pointed out that, as a company overall, they have reduced VOC emissions from about 900 tons in 1989 to about 125 tons in 1992, with a doubling in production. They also estimated that VOC emissions on a per hide basis have dropped from 1.2 to 0.4 lbs/hide.

PLANT C

A. General

Plant C supplies finished leather to the automotive industry. According to Plant C personnel, automotive upholstery is one of the most demanding leather products to manufacture. The automotive industry requires that the leather meet strict quality standards. These quality standards include specifications for color, rubfastness, light resistance, and various durability requirements. The finished product typically must meet 20-25 specifications. Plant C produces about 400-500 different leather upholstery products, taking into account the variety of colors, textures, and other specialty leathers produced at the plant.

B. Process Description

Raw cattle hides are first treated to remove hair and other undesirable elements. Following this initial treatment, the hides are laterally split into two layers. The top half is the grain side (or top side) while the bottom half is the flesh side or split. Plant C processes the full hide as opposed to many leather finishing operations that process sides (a full hide cut into longitudinal halves). The upper portions of the split hides (top grain or full grain) are used to make upholstery leather while the splits are sold as secondary products. Many of the splits produced at Plant C are used to make raw hide dog bones.

From this point in the process, only the grain side of the hide is processed. Following splitting, the hides are chrome tanned and then demohisturized. The tanned hides are then mechanically treated to adjust the thickness of the raw material, and then sorted by quality. Higher quality hides have fewer natural defects such as holes and scratches. Plant C does not purchase hides that have been branded.

After the hides are sorted, they are retanned using dyes and fatliquors. The dyes used at this stage form the base color for the final product. Before the leather is finished, a number of intermediate steps are taken to dry, soften, and condition the leather. At this point, the leather is ready for finishing. The finishing process involves the application of coatings to enhance the quality of the leather and provide protection of the product.

Plant C has a number of leather finishing lines used for both regular coating operations and for research and development purposes. At present, all of the finishing

lines use rotary spray coating applicators. Optical eye technology is used to minimize overspray. The leather to be finished passes under an optical eye that reads the outline of the leather. The rotary spray applicators are controlled by computer and turn off and on according to the pattern of the leather.

C. Sources of Emissions

The sources of VOC emissions are primarily from the leather finishing process. All leather coatings are mixed on-site using components purchased from various suppliers. Although there is potential for some fugitive emissions from the mixing process, Plant C uses mostly water based materials. The coatings mixing room was observed during the site visit and there was little, if any, evidence of solvent odors in the room.

Coatings are applied using rotary spray application equipment. Typically, three finish coats are applied to each piece of leather. The actual number of coatings will vary according to the requirements of individual leather products. The rotary spray equipment is housed in a partially enclosed chamber. Coatings are applied from airless spray guns located above the leather which moves through the spray chamber on a conveyer belt. The conveyer belt is actually made up of a series of parallel wire coils. A water bath is located below the conveyer belt and captures some of the overspray.

VOC emissions from the leather finishing operation result from overspray, "bounce-back" of coating from the leather, and from fugitive sources. Some emissions may also result from the open mixing drums that feed coating to the spray guns, and from wastewater generated by the water baths.

One additional source of VOC emissions at similar facilities could be the leather retanning process. At Plant C, very little, if any VOC laden materials are used for retanning. However, retanning may be a source of VOC in facilities that use VOC containing oils for retanning. In addition, wastewater produced by the retanning process could be a source of VOC, if VOC laden products are used in this process.

D. Emission Reduction Measures

Plant C has spent a great deal of resources in reducing the amount of VOC used in their leather finishing process. As a result, the facility has reduced their VOC emissions and emissions of hazardous air pollutants dramatically since 1988.

Conversion to water based coatings is the primary emission reduction measure implemented by Plant C. Plant C claims that the transition to water based finishes has reduced VOC emissions by 98 percent from 1988. In addition, there have been similar

reductions in HAP emissions. Most of the toluene and xylene emissions reported in the 1990 Toxic Release Inventory have been eliminated.

Data provided by Plant C indicate that total VOC emissions have been reduced from 5.3 million pounds per year in 1988 to an estimated 0.26 million pounds for 1992. Emissions data are also given in terms of pounds of VOC per 1,000 square feet of processed hide, and for individual HAP's.

Plant C plans to continue to look for additional reductions in VOC emissions. However, any additional reductions will be relatively minor compared to the reductions achieved thus far. It will become more difficult to find further ways to reduce the amount of VOC used in the coatings. There are applications where some VOC is needed in the coating. Plant C has also started to use roll coating machines to supplement the rotary spray coating machines. The roll coating machines are expected to have a higher transfer efficiency than the spray coating machines, thereby reducing emissions resulting from overspray and bounce-back. However, there are some limitations with the use of roll coating in producing automotive leather upholstery. Roll coating usually imparts a thinner coating than desired in most leather upholstery applications.

E. Regulatory Compliance

Plant C is located in a moderate non-attainment area for ozone. Currently, Plant C is permitted as a major source of VOC. There is no specific rule for leather finishing operations in the State. The State is in the process of developing a site-specific rule for Plant C in the form of a consent order with the company.

PLANT D

A. General

Plant D produces finished leather to be used primarily for footwear and other fashion related products. The raw material is cattle hide, and approximately 50,000 sides of leather are processed weekly. A side of leather is a longitudinal half of a full hide. The full hides are cut in two to facilitate processing. The raw hides are tanned and finished at the site.

A wide range of finished leather is produced by Plant D. Accounting for the differences in color, weight, physical characteristics, and grain textures, Plant D produces about 8,000 products. The finishing process for each of these products is specific, thereby making it difficult to characterize one specific leather finishing process at the plant. All of the finishes used at the facility are mixed on-site using varying combinations of pigments, dyes, binders, solvent, and other materials.

B. Process Description

Raw hides are first treated to remove hair and undesirable fats and oils using water based chemicals. The hides are pickled and then chrome tanned to stabilize the collagen fibers vital for leather production. Following these processes, the hides are wrung out, cut into two sides, and split. The bottom or fleshy part of the split (referred to as the "split") is sold to other manufacturers and the top part (referred to as the top or full grain) is processed further. Following a mechanical demisting process, the hides are retanned and dyed using soluble dyes and fat liquor. The hides are then placed in drying ovens to remove moisture and sent through mechanical operations to soften the leather prior to finishing.

The finishing process varies according to the type of leather being produced. In general, each side receives a base coat, a middle coat, and a top coat or finish coat. At Plant D, the base and middle coats are mostly water based, while some of the finish coats are solvent based coatings or emulsions. Some of the water based finishing materials contain some VOC's, usually less than 10 percent by weight. The water based emulsions contain higher VOC concentrations than the water based coatings. The company is attempting to convert most of their finishing processes to water based coatings. However, some product lines require a solvent based coating or an emulsion to achieve the desired properties in the finished leather.

C. Sources of VOC Emissions

The primary source of VOC emissions at the facility is the leather finishing process. Emissions result from the application of coatings using various types of coating technology. For example, rotary spray machines consist of multiple spray guns that apply finishes to the leather as it passes on a conveyer belt. Emissions result from the solvent flashing before the coating hits the surface of the leather, and overspray of material (including bounce-back from the surface of the leather). The rotary spray coating machines at Plant D are partially enclosed in a water wash booth under negative exhaust pressure. Solvent vapors are collected in the spray areas and exhausted to the outside ambient air. There are no vapor control systems on vents to the ambient air.

Small quantities of VOC emissions also result from mixing and formulating of coatings, fugitive losses prior to application of the coatings, equipment cleaning, and wastewater disposal. The mixing and formulation process was not observed during the site visit. However, it seems probable that small losses occur during the mixing of the coatings. Once a coating is mixed, it is transferred to the applications area in 30 gallon drums. The coating material is pumped from the drums to the spray guns. The drums are equipped with covers. However, the drums can remain partially or fully open to the atmosphere during the coating process thereby creating the potential for small emissions of VOC's.

Located beneath the conveyer belt that carries leather through the spray area is a water bath. Some of the overspray of the coatings is deposited in this water which is recirculated and then discharged as wastewater. This wastewater can be a secondary source of VOC emissions.

Another source of air emissions is the tanning process. This process produces small quantities of hydrogen sulfide and ammonia. However, this part of the operation is not a significant contributor of VOC.

Leather finishing is accomplished using 8 roll coaters, 6 rotary spray coaters, and one flow coater. All of the coatings are mixed on-site. The individual components of the coatings are purchased from suppliers such as Rohm & Haas, Stahl, BASF, Ciba-Geigy, and Prime Leather Finishes. Depending on the product, different coating formulations are used. Each leather finishing process has a distinct formula that is kept in a computerized file. Plant D uses this information to calculate the amount of solvent used on a daily basis. Use of all toxic chemicals is tracked by Chemical Abstract Service (CAS) number on a daily and annual basis.

Plant personnel estimate that 90 percent of the bottom and middle coats are water based coatings. Most of the coatings containing the higher VOC quantities are used in the top (or finish) coat.

Toxic Release Inventory (TRI) data indicate that Plant D emitted over 45 tons of hazardous air pollutants (HAP's) in 1990. Plant personnel verified this value, but indicated that their emissions of both HAP's and VOC have been reduced since 1990. All emission estimates at the facility are based on solvent usage. Emissions testing has not been conducted.

D. Emission Reduction Measures

Reduction of VOC emissions has been achieved primarily through introduction of water based coatings and process changes over the past several years. Process changes have included substitution of a roll coating machine for a curtain spray machine and the application of oil coatings using heated oil. The use of heated oil has enabled Plant D to use an oil coating having a lower VOC content. In addition, optical eye spray technology is used to minimize overspray and use of coating material.

Specifically, one coating process in the plant was responsible for an estimated 35-40 percent of the total VOC emissions. In this process, solvents were used to facilitate oil penetration of the leather during coating. Plant D changed from a high solvent based coating to a lower solvent based coating that was preheated prior to application to lower viscosity. Plant personnel reported that these changes reduced VOC emissions from this process by about 90 percent.

Plant D also has a policy of not allowing development of any leather product that will exceed the daily limit set by the State. Any further reduction in VOC emissions will be achieved through use of additional water based coatings.

E. Regulatory Compliance

Plant D is subject to the State rule for leather finishing operations. This rule limits VOC emissions from leather coating facilities to 18.6 kilograms per 100 square meters (38.0 pounds per 1000 square feet) of coated product calculated on a daily average. Plant D meets this limit by using an "internal offset" system whereby products requiring high VOC coatings are produced on the same day as those requiring low VOC, or water based coatings. Since the limit is based on a summation of total VOC's emitted during the day divided by the prorated surface area of leather coated during the same day, Plant D can meet the limit on a daily basis by monitoring the types and amount of products produced on a given day.

Compliance with the State regulation requires extensive recordkeeping. Plant D keeps daily records of solvent usage and square footage of leather processed.

Plant personnel indicated that the State regulation was conducive to computerized tracking of coatings formulations and production. They are in favor of the production based limit because it allows them to use the internal system of offsetting to meet the

regulation. This enables the company to produce a greater variety of products, including some that require high VOC finishes, and allows Plant D to remain responsive to the needs of the fashion industry.

PLANT E

A. General

Plant E is exclusively a leather finishing plant. The finished leather produced at Plant E is sold primarily to the furniture manufacturing industry.

B. Process Description

Tanned cattle hides are shipped to Plant E from the company's tannery, located in another state. The hides are in the crust stage, having been chromed tanned, retanned, colored, and dried at the tannery. After arrival, the hides are conditioned by introducing controlled amounts of moisture. They are then softened in large dryers and mechanically treated to achieve desired properties prior to finishing.

The finishing process involves application of 3 to 7 coats of finish on each hide, depending on the desired characteristics of the specific product line. Plant E is equipped with eight rotary spray booths for leather finishing. Each spray booth is followed by one or two drying ovens. All of the spray booth and drying oven machinery was manufactured by the Hampton Machine Company. Each of the spray booths is equipped with optical eye controls to minimize overspray. Some of the spray booths are equipped with 16 spray guns while others are eight gun booths. Only 8 guns are operating at any given time in the 16-gun booths. Both high-volume-low-pressure (HVLP) and air assisted spray guns are used at Plant E. One of the base coat booths is currently equipped with HVLP guns. The other booths are equipped with air assisted airless guns.

Of the eight spray booths, five are used exclusively for applying water-based coatings. One spray booth is used for both water and solvent-based coatings, and two booths are used only for application of solvent-based coatings. The water-based coating booths and the solvent-based coating booths are segregated in the plant for safety reasons. The dryers used with the solvent-based spray booths are explosion proof.

There are five additional spray booths at the plant. Two of the spray booths are for hand spraying of finishes and three booths are hand spraying operations for testings coatings and touch-up.

Following application of the base coats and top coats, the leather is moved to a finishing room. In the finishing room, the leather can be embossed using high pressure machinery and/or put through additional softening and conditioning operations. In

addition, some leather are antiqued in the finishing area through hand application of special coatings. Following all of the finishing operations, the leather is measured and packed for shipping.

C. Sources of Emissions

All leather coatings are mixed on-site using components purchased from vendors. The mixing room is a source of fugitive VOC emissions. Plant E has not attempted to quantify emissions from the mixing room.

Coatings are applied using rotary spray application equipment. Typically, three to five finish coats are applied to each piece of leather, with seven coatings being the maximum number applied by Plant E. The actual number of coatings varies according to the requirements of individual leather products. The rotary spray equipment is housed in enclosed chambers. Coatings are applied from airless and/or HVLP spray guns located above the leather which moves through the spray chamber on a parallel cable conveyor.

VOC emissions from the leather finishing operation result from overspray, bounce-back of coating from the leather, and from fugitive sources. Most of the VOC can be expected to flash-off in the spray booths or in the drying ovens. All of the spray booths and ovens are vented to the atmosphere. Source sampling was conducted on two spray booths in 1989 in preparation for a prevention of significant deterioration (PSD) permit application. This permit application effort was abandoned. There are no air pollution control systems on the building ventilation system.

Plant E has a small distillation unit in the plant to recover solvent from waste coatings and cleanup solvents. These waste streams and the plant wastewater are segregated. Little, if any, VOC emissions are generated from the wastewater system.

Additional sources of fugitive emissions are the partially covered coatings drum located at each spray booth, and the antiquing process in the finish room. The antiquing process consists of manual application of a solvent based coating to the leather to achieve an antique appearance.

D. Emission Reduction Measures

The only emission reduction strategy being employed by Plant E to control VOC's is the transition to more water-based coatings. Plant E began using water-based coatings in 1990. Prior to that time, most of their coating formulations were solvent-based. The reductions from 1987 to 1990 were most likely a result of formulation changes by the suppliers. According to plant personnel, the plant did not make a concerted effort to use water-based materials until 1990.

VOC emissions per hide began to increase following 1990. This increase was a result of quality problems resulting from use of water-based coatings. Plant E was forced to use more solvent-based materials to satisfy customer requirements. Plant personnel noted that it is often difficult to achieve the aesthetic feels needed for furniture leather with water-based materials. However, water-based technology is improving, and Plant E is moving back to water-based materials, particularly for their Spring 1993 product line. According to plant personnel, the driving force behind the move to water-based materials is from within the industry itself. Minimization of solvent usage improves the working environment in regards to both aesthetics and safety. Some of the water-based coatings have 1.5 to 5 percent VOC in the formulations, while the largest percentage of water-based coatings have no VOC.

Other emission reduction efforts focus on optimization of the coatings application process. Plant E has noticed some improvements in coating efficiency with the HVLP guns, but this improvement is not documented. Currently, HVLP guns are used only on the water-based lines.

Emissions data provided by the plant for 1991 show some reduction in emissions of hazardous air pollutants (HAP's) compared to 1990. The 1990 Toxic Release Inventory (TRI) indicated that Plant E emitted 223.5 tons of HAP's during that year: methyl ethyl ketone (MEK)(73.5 tons); toluene (70.03 tons); methyl isobutyl ketone (MIK)(16.31 tons; and cyclohexane (63.72 tons). According to plant data, 1991 emission of HAP's were about 185 tons: MEK (6.83 tons); xylene (35.1 tons); MIK (49.31 tons); and toluene (93.75 tons). Cyclohexane emissions were below the reporting threshold for 1991.

E. Regulatory Compliance

Plant E is located in an attainment area for ozone. Their current permit limits total plant emissions to 702.3 tons per year on a rolling twelve month average. Emissions estimates are based on consumption records kept by the plant. The current emissions limit is the result of steps taken in 1989 to avoid PSD. When modifications were proposed in that year, 39.9 tons per year was added to the existing annual emission limit. The plant also complies with the State regulations by using solvent mixtures that are not photochemically reactive as defined by the code.

APPENDIX C

STATE AND LOCAL REGULATIONS AFFECTING LEATHER TANNING AND FINISHING FACILITIES

C.1 Introduction to Appendix C

This appendix contains the full text of existing and proposed regulations affecting leather tanning and finishing facilities. Regulations from these six State and local agencies are included: a) New Jersey; b) New York (with proposed amendments); c) Wisconsin; d) Massachusetts (draft rule); e) Illinois (draft rule); and e) the Monterey Bay Unified Air Pollution Control District (draft rule).

For the Wisconsin rule, the full text of the technical support document for the regulation is included in the appendix. This document provides a detailed rationale for the format of the rule.

State of New Jersey

NEW JERSEY STATE DEPARTMENT OF ENVIRONMENTAL
PROTECTION AND ENERGY

NEW JERSEY ADMINISTRATIVE CODE

TITLE 7, CHAPTER 27

SUBCHAPTER 16

CONTROL AND PROHIBITION OF AIR POLLUTION BY
VOLATILE ORGANIC COMPOUNDS

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(a) No person shall cause, suffer, allow, or permit the use of any surface coating operation unless:

1. The VOC content of any surface coating formulation as applied does not exceed the maximum allowable VOC content as specified in Table 3A, 3B, 3C, 3D or 3E; or
2. If more than one surface coating formulation subject to the same maximum allowable VOC content limit as set forth in the applicable table is applied by a single surface coating operation, the daily weighted mean of the VOC content of the coatings as applied does not exceed the maximum allowable VOC content as set forth in Table 3A, 3B, 3C, 3D or 3E, as calculated using the following equation:

$$\text{Daily mean VOC content} = \frac{\sum_{i=1}^n (c_i)(v_i)}{\sum_{i=1}^n (v_i)}$$

where n = number of coatings, subject to the same maximum allowable VOC content standard, applied in one day;

i = subscript denoting an individual surface coating formulation;

c_i = maximum actual VOC content per volume of each coating (minus water) applied in one day, in pounds per gallon or kilograms per liter; and

v_i = volume of each coating (minus water) applied in one day, in gallons or liters; or

3. If the surface coating operation is served by VOC control apparatus:
 - i. The control apparatus prevents no less than 90 percent by weight of the VOC content in the surface coating formulation as applied each hour from being discharged directly or indirectly into the outdoor atmosphere; or
 - ii. The VOC emissions from the surface coating operation are controlled by the control apparatus so that the operation results in an hourly VOC emission rate no greater than the maximum allowable hourly emission rate calculated on a solids as applied basis in accordance with the following equation:

$$\text{Maximum allowable hourly rate} = (1-y/d)(z)(x)/(1-x/d)$$

where x = maximum allowable VOC content per volume of coating (minus water), in pounds per gallon (lb/gal) or kilograms per liter (kg/l) as set forth in Table 3A, 3B, 3C, 3D, or 3E of this section;

d = density of the VOC of the applied surface coating formulation, in pounds per gallon (lb/gal) or kilograms per liter (kg/l);

y = VOC content of the applied surface coating formulation (minus water) in pounds per gallon (lb/gal) or kilograms per liter (kg/l); and

z = volume of the coating (minus water) applied per hour, in gallons per hour (gal/hr) or liters per hour (l/hr); or

- iii. For a surface coating operation that applies more than one surface coating formulation subject to the same maximum allowable VOC content limit as set forth in the applicable table, the control apparatus collects and prevents VOC from being discharged into the outdoor atmosphere so that the actual daily emissions are less than the allowable daily emissions as calculated below:

$$\text{Actual daily emissions} = (1 - \eta_c \eta_d)(\text{VOC}_a)(V)$$

where: VOC_a = daily mean VOC content of the surface coating formulations as calculated by 2 above;

V = total daily volume of the surface coating formulations, as applied;

η_c = capture efficiency, i.e. the ratio of the VOC collected by the control apparatus to the VOC in the surface coating formulations as applied, as determined by a method approved by the Department and EPA; and

η_d = destruction efficiency of the control apparatus, i.e. the ratio of the VOC prevented from being discharged into the outdoor atmosphere to the VOC collected by the control apparatus, as determined by a method approved by the Department and EPA; and

$$\text{Allowable daily emissions} = (1-\text{VOC}_a/d)(V)(x)/(1-x/d)$$

where x = maximum allowable VOC content per volume of coating (minus water), in pounds per gallon (lb/gal) or kilograms per liter (kg/l) as set forth in Table 3A, 3B, 3C, 3D, or 3E of this section;

d = density of the VOC of the applied surface coating formulations in pounds per gallon (lb/gal) or kilograms per liter (kg/l);

V = total daily volume, in gallons or liters, of the surface coating formulations (minus water) as applied per day; and

VOC_a = daily mean VOC content of the applied surface coating formulations as calculated by 2 above; or

4. Until March 28, 1994, the surface coating operation is included in a mathematical combination of sources which was approved by the Department prior to March 28, 1992.
- (b) No person shall cause, suffer, allow, or permit the installation of any surface coating or graphic arts operation to apply a surface coating formulation which does not contain water deliberately added in a planned proportion unless a coating application system having a transfer efficiency of 60 percent or greater, or as otherwise approved by the Department, is used.
- (c) The provisions of (a) and (b) above and (f), (g), and (h) below shall not apply to any individual surface coating or graphic arts operation in which the total surface coating formulations containing VOC are applied:
 1. Prior to June 15, 1990, at rates not in excess of one gallon per hour and five gallons per day;
 2. As of June 15, 1990 and continuously thereafter, at rates not in excess of one half gallon per hour and two and one half gallons per day; or
 3. For the purpose of developing new coatings or new coating equipment, or for the purpose of performing research preceding such development provided such formulations are applied at rates not in excess of two gallons per hour and three gallons per day.
- (d) Any person responsible for any automobile or light duty truck surface coating operation may, as an alternative to complying with the provisions of Table 3A, comply with the provisions of Table 3C pertaining to spray prime and spray topcoat surface coating formulations, provided that the transfer efficiency of the spray coating operation is determined in accordance with a method approved by the Department and the EPA.

TABLE 3A

MAXIMUM ALLOWABLE VOC CONTENT IN COATINGS FOR AUTOMOBILE
AND LIGHT DUTY TRUCK SURFACE COATING OPERATIONS

<u>Type of Operation</u>	<u>Maximum Allowable VOC Content per Volume of Coating (minus water)</u>		<u>Final Compliance Date</u>
	<u>Pounds Per Gallon</u>	<u>Kilograms Per Liter</u>	
Prime			
Electrophoretic dip	1.2	0.14	December 31, 1982
prime Spray prime	2.8	0.34	December 31, 1984
Topcoat			
Spray topcoat	2.8	0.34	December 31, 1986
Repair	4.8	0.58	December 31, 1986
Custom Topcoating	5.0	0.60	June 15, 1990
Refinishing			
Base coat	6.0	0.75	June 15, 1990
Clear coat	4.4	0.54	June 15, 1990
All others	5.0	0.60	June 15, 1990

TABLE 3B

- MAXIMUM ALLOWABLE VOC CONTENT IN COATINGS
FOR MISCELLANEOUS SURFACE COATING OPERATIONS

<u>Type of Operation</u>	<u>Maximum Allowable VOC Content per Volume of Coating (minus water)</u>	
	<u>Pounds per Gallon</u>	<u>Kilograms per Liter</u>
<u>Group I</u>		
Can Coating		
Sheet basecoat	2.8	0.34
Two-piece can exterior		
Two- & three-piece can interior body spray, two-piece and exterior	4.2	0.51
Side-seam spray	5.5	0.66
End sealing compound	3.7	0.44
Coil Coating	2.6	0.31
Fabric Coating	2.9	0.35
Vinyl Coating	3.8	0.45
Paper Coating	2.9	0.35
Metal Furniture Coating	3.0	0.36
Magnet Wire Coating	1.7	0.20
Large Appliance Coating	2.8	0.34
Miscellaneous Metal Parts and Products		
Clear coating	4.3	0.52
Air-dried coating	3.5	0.42
Extreme performance coating	3.5	0.42
All other coatings	3.0	0.36
Flat Wood Paneling		
Printed hardwood plywood panels and particleboard panels	2.7	0.32
Natural finish hardwood plywood	3.3	0.40
Hardboard panels	3.6	0.43
<u>Group II</u>		
Leather Coating	5.8	0.69
Urethane Coating	3.8	0.45
Tablet Coating	5.5	0.66
Glass Coating	3.0	0.36

TABLE 3C

ALTERNATIVE MAXIMUM ALLOWABLE VOC CONTENT IN COATINGS WITH MINIMUM
TRANSFER EFFICIENCIES REQUIRED FOR SPRAY COATING OPERATIONS

Maximum Allowable VOC Content per Volume of Coating (minus water)		Minimum Transfer Efficiency Required
<u>Pounds per Gallon</u>	<u>Kilograms per Liter</u>	
3.0	0.36	34
3.2	0.38	37
3.4	0.41	42
3.6	0.43	47
3.8	0.46	52
4.0	0.48	58
4.2	0.50	65

NOTE: Each combination of VOC content and transfer efficiency in Table 3C is equivalent to a daily emission of 15.1 pounds of VOC per gallon of solids deposited, minus water. Verification of this equivalent emission rate using the methods prescribed in the "Protocol for Determining the Daily Volatile Organic Compound Emission Rate of Automobile and Light Duty Truck Topcoat Operations" (EPA 450/3-88-018) shall satisfy compliance with Table 3C.

TABLE 3D

MAXIMUM ALLOWABLE VOC CONTENT IN COATINGS
FOR GRAPHIC ARTS SOURCE OPERATIONS

<u>Basis</u>	<u>Control Criterion</u>
For formulations that contain water:	Maximum Allowable volume percent VOC in volatile fraction of coatings (VOC plus water) as applied.
	<u>Volume Percent</u> 25.0

or

For formulations that do not contain water:	Maximum Allowable VOC Content per volume of formulation (minus water)
	<u>Pounds per Gallon</u> <u>Kilograms per Liter</u>
	2.9 0.35

TABLE 3E

MAXIMUM ALLOWABLE VOC CONTENT IN COATINGS FOR
WOOD FURNITURE SURFACE COATING OPERATIONS

<u>Type of Surface Coating Formulation</u>	<u>Maximum Allowable VOC Content per Volume of Coating (minus water)</u>	
	<u>Pounds per Gallon</u>	<u>Kilograms per Liter</u>
Semitransparent stain	6.8	0.82
Wash coat	6.1	0.73
Opaque stain	4.7	0.56
Sealer	5.6	0.67
Pigmented coat	5.0	0.60
Clear topcoat	5.6	0.67

- (e) Any person responsible for any metal furniture or large appliance surface coating operation may, as an alternative to complying with the applicable maximum allowable VOC content limits per volume of coating (minus water) set forth in Group I of Table 3B, pursuant to (a)1 above, apply to the Department for an alternative maximum allowable VOC content limit per volume of coating, provided such person can demonstrate to the satisfaction of the Department and the EPA that the surface coating formulation is applied at transfer efficiency of greater than 60 percent.
- (f) Any person responsible for a rotogravure, flexographic, or fabric printing operation may, as an alternative to complying with the requirements set forth in Table 3D, pursuant to (a)1 above, install and use control apparatus which:
1. Collects at least 75 percent by volume of the source gas emitted from a rotogravure printing operation, including associated dryers, and prevents from being discharged into the outdoor atmosphere at least 90 percent by volume of the VOC collected on an hourly basis;
 2. Collects at least 70 percent by volume of the source gas emitted from a flexographic printing operation, including associated dryers, and prevents from being discharged into the outdoor atmosphere at least 90 percent by volume of the VOC collected on an hourly basis; or
 3. Collects at least 70 percent by volume of the source gas emitted from a fabric printing operation, including associated dryers, and prevents from being discharged into the outdoor atmosphere at least 90 percent by volume of the VOC collected on an hourly basis.
- (g) Notwithstanding the provisions of (a)3.ii and (a)4 above, any person responsible for a tablet coating operation that uses a surface coating formulation that does not comply with the maximum allowable VOC content limits per volume of coating (minus water) set forth in Table 3B, Group II, shall install and use control apparatus which prevents no less than 90

percent by weight of the VOC content in the surface coating formulation as applied each hour from being discharged directly or indirectly into the outdoor atmosphere.

(h) Any person responsible for a wood furniture surface coating operation shall comply with the following requirements:

1. At a facility emitting less than 50 tons (45.36 megagrams) of VOC per year, each surface coating formulation specified in Table 3E shall be applied using airless, air-assisted airless, or heated airless spray techniques, or another application method approved by the Department and the EPA as having a transfer efficiency of at least 40 percent; or
2. At a facility emitting 50 tons (45.36 megagrams) of VOC or greater per year, each surface coating formulation specified in Table 3E shall be applied using airless, air-assisted airless, heated airless, electrostatic spray techniques, or flat line processes, or another application method approved by the Department and the EPA as having a transfer efficiency of at least 65 percent.

(i) Any person responsible for an automobile or light duty truck surface coating operation subject to a VOC content limit for custom topcoating or refinishing set forth in Table 3A of this section shall comply with the following schedule:

1. By July 1, 1989, a plan must be submitted to the Assistant Director, Enforcement Element, New Jersey Department of Environmental Protection, CN 027, Trenton, NJ 08625, for approval describing the measures which will be applied in order to achieve compliance. The plan submittal shall include:
 - i. Completed applications for all "Permits to Construct, Install, or Alter Control Apparatus or Equipment" and "Certificates to Operate Control Apparatus or Equipment" required by N.J.A.C. 7:27-8; and
 - ii. Documentation of the rates of application of surface coating formulations in surface coating operations excluded under the provisions of (c) above and (k) below; and
 - iii. Details of production rate changes or process modifications for which no "Permits to Construct, Install, or Alter Control Apparatus or Equipment" are required.
2. By July 1, 1989, and by the first day of every fourth month thereafter, persons subject to an emission limitation for custom topcoating or refinishing using surface coating formulations as a measure for complying with the provisions of (a) above shall submit detailed reports describing the progress being made with specific coating manufacturers and suppliers toward the development of suitable formulations. The reports shall be sent to the Assistant Director, Enforcement Element, at the address in (i)1 above.
3. By no later than six months prior to the applicable final compliance date set forth in Table 3A, construction or installation of equipment

and control apparatus, in accordance with the approved plan, shall commence.

4. By the applicable final compliance date set forth in Table 3A, compliance with this Section shall be achieved.
- (j) Any person responsible for a surface coating operation subject to a VOC content limit set forth in Table 3B, Group II for leather coating, urethane coating, tablet coating, glass coating; in Table 3D for fabric or urethane printing operations; or in Table 3E for wood furniture coating, shall comply with the following schedule:
1. By January 30, 1987, a plan must be submitted to the Department for approval describing the measures which will be applied in order to achieve compliance. The plan submittal shall include:
 - i. Completed applications for all "Permits to Construct, Install, or Alter Control Apparatus or Equipment" and "Certificates to Operate Control Apparatus or Equipment" as required by N.J.A.C. 7:27-8;
 - ii. Completed applications, if relevant, for the mathematical combination of source gases;
 - iii. Documentation of the rates of application of surface coating formulations in surface coating operations excluded under the provisions of (c) above; and
 - iv. Details of production rate changes or process modifications for which no "Permits to Construct, Install, or Alter Control Apparatus or Equipment" are required.
 2. By January 1, 1987 and by the first day of every fourth month thereafter, persons using surface coating reformulation as a measure for complying with the provisions of (a) or (h) above shall submit detailed reports describing the progress being made with specific surface coating manufacturers and suppliers toward the development of suitable formulations.
 3. By May 1, 1987, construction or installation of equipment and control apparatus, in accordance with the approved plan shall commence.
 4. By December 31, 1987, compliance with this section shall be achieved.
- (k) The provisions of this section shall not apply to:
1. The surface coating of aircraft and marine vessels, exclusive of parts coated prior to installation or assembly.
 2. The refinishing of automobiles, if coating use is less than 50 gallons (189 liters) per week;
 3. The customized topcoating of automobiles and trucks, if coating use is less than 48 gallons (182 liters) per week; and

4. The on-site coating of assembled structures such as, but not limited to, equipment used for manufacturing processes, storage tanks, bridges, and swimming pools.
- (1) Any person responsible for the emission of any VOC from any surface coating operation subject to this section applying only surface coating formulations which are subject to and conform with the applicable VOC content limit set forth in Table 3A, 3B, 3C, 3D, or 3E shall maintain records of the VOC content of each surface coating formulation (minus water) as applied, in pounds of VOC per gallon of coating or kilograms of VOC per liter of coating; the percent by weight of any exempt organic substance; and the daily volume of each surface coating formulation applied.
 - (m) Any person responsible for any surface coating operation, which is subject to this section and which uses one or more surface coating formulations which do not conform with the applicable VOC content limit set forth in Table 3A, 3B, 3C, 3D, or 3E, shall maintain the following records:
 1. On a daily basis, specification of the following for each surface coating formulation as applied:
 - i. The number of hours applied;
 - ii. The volume applied;
 - iii. The density of the formulation;
 - iv. The density of the VOC in the formulation;
 - v. The percent by weight of the VOC in the formulation;
 - vi. The percent by weight of any exempt organic substance in the formulation; and
 - vii. The percent by weight of any water in the formulation;
 2. For any surface coating operation that has a thermal oxidizer used to control the emission of VOC, record on a continuous basis or at a frequency approved in writing by the Department the operating temperature at the exit of the combustion chamber and the carbon monoxide concentration in the flue gas emitted to the outdoor atmosphere;
 3. For any surface coating operation that has a control apparatus using carbon or other adsorptive material to control the emission of VOC:
 - i. Record on a continuous basis or at a frequency approved in writing by the Department the concentration of the total VOC in the flue gas emitted to the outdoor atmosphere; or
 - ii. Record the date and time the carbon or other adsorptive material used in the control apparatus is regenerated or replaced; and maintain any other information required to document whether the control apparatus is being used and maintained in accordance

with the manufacturer's recommended procedures. The manufacturer's recommendations for use and maintenance are to be readily available on the operating premises, and the person responsible for the surface coating operation shall provide these to the Department upon request; and

4. Upon request of the Department and at a frequency specified by the Department, record any other operation parameter relevant to the prevention or control of air contaminant emissions from the surface coating operation or control apparatus.
- (n) All or part of the information documenting the composition of a surface coating formulation as required by (l) or (m) above may be in the form of standard formulation sheets, material safety data sheets, the results of analytical tests, or another form provided that the required information can be readily extracted.

State of New York

THIS DOCUMENT IS BASED ON THE PROPOSED AMENDMENTS INCLUDED IN THE EXPRESS TERMS APPROVED BY THE ENVIRONMENTAL BOARD ON 1-29-93.
(3-30-93:JRC)

PART 228
SURFACE COATING PROCESSES

228.1 Applicability and compliance
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Section 228.1 Applicability and compliance. (a) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 or in table 2 of section 228.8 of this Part and which meets the current applicability criteria, must when applying for a permit to construct or a certificate to operate as required by Part 201(Permits and Certificates), include with the application for a permit to construct or certificate to operate, the method or methods which will be used to comply with the requirements of this Part.

(b) Except as provided in section 228.1(h) of this Part, any owner or operator of a facility involving a coating line described in table 1 of section 228.7 or in table 2 of section 228.8 of this Part, which is located in the New York City metropolitan area, must comply with this Part according to the following schedule.

(1) Except as provided in 228.1(b)(2), any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part which was constructed on or prior to August 23, 1979 must have demonstrated compliance with this Part not later than May 10, 1984.

(2) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part, who utilized less than five gallons per day of coating material on a facility-wide basis and had valid certificates to operate, must have demonstrated compliance with this Part not later than May 15, 1991.

(3) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part

which was constructed after May 10, 1981 must have demonstrated compliance with this Part upon start-up.

(4) Any owner or operator of a facility involving a coating line described in table 2 of section 228.8 of this Part which was constructed on or before September 1, 1988 must have demonstrated compliance with this Part not later than May 15, 1991.

(5) Any owner or operator of a facility involving a coating line described in table 2 of section 228.8 of this Part which was constructed after September 1, 1988 must have demonstrated compliance with this Part upon start-up.

(c) Except as provided in section 228.1(h) of this Part, any owner or operator of a facility involving a coating line described in table 1 of section 228.7 or in table 2 of section 228.8 of this Part, which is located in Lower Orange County metropolitan area must comply with this Part according to the following schedule.

(1) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part which was constructed on or before August 23, 1979 for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 100 tons must have demonstrated compliance with this Part not later than May 10, 1984.

(2) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part which was constructed after May, 10, 1981 for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 100 tons must have demonstrated compliance with this Part upon start-up.

(3) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 10 tons, or a coating line described in table 2 of section 228.8 of this Part, for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations at the facility equal or exceed 25 tons, must:

(i) submit a compliance plan to the Department of Environmental Conservation by November 15, 1993 which contains a schedule of the steps necessary for the facility to achieve

compliance with this Part or limit its annual potential to emit below the applicability criteria and the dates by which each step will be completed;

(ii) be in compliance with this Part or have had its permits modified to limit its annual potential to emit below the applicability criteria by June 1, 1995; and

(iii) maintain the VOC control requirements and compliance schedule included in any permit, regulation, rule, administrative order, or any judicial order, until compliance with the provisions of this Part is demonstrated to the satisfaction of the commissioner.

(4) Any owner or operator of a facility involving a coating line described in table 1 of 228.7 or table 2 of section 228.8 which is constructed after March 1, 1993 and which meets the applicability criteria specified in 228.1(c)(3), must demonstrate compliance with this Part upon start-up.

(d) Except as provided in section 228.1(h) of this Part, any owner or operator of a facility involving a coating line described in table 1 of section 228.7 or in table 2 of section 228.8 of this Part, which is located outside the New York City metropolitan area and Lower Orange County metropolitan area, must comply with this Part according to the following schedule.

(1) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part which was constructed on or before August 23, 1979 and is located in the counties of Albany, Cayuga, Columbia, Dutchess, Erie, Genesee, Greene, Livingston, Monroe, Niagara, Onondaga, Ontario, Orange (outside the Lower Orange County metropolitan area) Orleans, Putnam, Rensselaer, Saratoga (limited to the towns of Clifton Park and Halfmoon, the city of Mechanicville, and the town and village of Waterford), Schenectady, Seneca, Ulster, Wayne, Wyoming, or Yates for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 100 tons must have been in compliance with this Part not later than May 10, 1984.

(2) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 of this Part which was constructed after May 10, 1981 and is located outside the New York City metropolitan area and Lower Orange County metropolitan area for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 100 tons must have demonstrated compliance with this Part upon start-up.

(3) Any owner or operator of a facility involving a coating line described in table 1 of section 228.7 for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 10 tons, or a coating line described in table 2 of section 228.8 of this Part for which the annual potential to emit volatile organic compounds from all sources regardless of process type, but excluding combustion installations, at the facility equal or exceed 50 tons must:

(i) submit a compliance plan to the Department of Environmental Conservation by November 15, 1993 which contains a schedule of the steps necessary for the facility to achieve compliance with this Part or reduce its annual potential to emit below the applicability criteria and the dates by which each step will be completed;

(ii) be in compliance with this Part or have had its permits modified to limit its annual potential to emit below the applicability criteria by June 1, 1995; and

(iii) maintain the VOC control requirements and compliance schedule included in any permit, regulation, rule, administrative order, or any judicial order, until compliance with the provisions of this Part is demonstrated to the satisfaction of the commissioner.

(4) Any owner or operator of a facility involving a coating line described in table 1 of 228.7 or table 2 of section 228.8 which is constructed after March 1, 1993 and which meets the applicability criteria specified in 228.1(d)(3), must demonstrate compliance with this Part upon start-up.

(e) This Part previously contained a facility-wide emission reduction (bubble) plan involving processes covered by the provisions of this Part to reduce emissions to the level which would be allowed if a surface coating complied with the limits specified in table 1 of section 228.7 of this Part. Any owner or operator of a facility which has operated in accordance with a facility-wide emission reduction plan approved by the commissioner must:

(1) submit a compliance plan to the Department of Environmental Conservation by November 15, 1993 which contains a schedule of the steps necessary for the facility to achieve compliance with this Part and the dates by which each step will be completed;

(2) be in compliance with this Part by June 1, 1995; and

(3) maintain the VOC control requirements and compliance schedule included in any permit, regulation, rule, administrative order, or any judicial order, until compliance with the provisions of this Part is demonstrated to the satisfaction of the commissioner.

(f) Any owner or operator of a surface coating process, which is not regulated under this Part, shall comply with all other applicable Parts of this Subchapter.

(g) Any coating line that is subject to the provisions of this Part, will remain subject to these provisions even if the annual potential to emit volatile organic compounds from the facility later fall below the applicability criteria.

(h) This Part does not apply to the following coatings:

(1) research and development processes involving surface coating which produce a product for study rather than eventual sale;

(2) adhesives and materials used to prepare a surface for adhesion where the coating is manually applied without the use of mechanical means;

(3) sealant or filler used to seal or fill seams, joints, holes and minor imperfections of the surface where the coating is manually applied without the use of mechanical means;

(4) anti-corrosive wax and heat resistant anti-corrosive coatings used in the automobile manufacturing industry to protect door opening seam areas and floor pan areas, respectively;

(5) clear or translucent coatings, applied to clear or translucent plastic substrates which are utilized in the manufacture of backlighted outdoor signs;

(6) coatings which are applied manually with a brush, roller, or an aerosol spray can;

(7) aerospace coatings which are utilized for pretreatment, adhesive bonding primers, flight testing, fuel tanks, electric/radiation effects, space vehicles and temporary mechanical maskant/high temperature heat treatment.

(8) clear and pearlescent coatings applied to plastic fashion items such as beads, buttons, buckles or other plastic accessories used in the fashion industry;

(9) coatings which are applied to optical lens at facilities whose annual potential to emit volatile organic compounds are less than 10 tons;

(10) reflective coatings applied to highway cones;

(11) electromagnetic interference/radio frequency interference (EMI/RFI) coatings applied on plastic electronic equipment to provide shielding against electromagnetic interference, radio frequency interference, or static charge; or

(12) electric dissipating coatings that rapidly dissipate a high-voltage electric charge applied on plastic parts.

(13) low-use specialty coatings where the plantwide total annual usage is equal to or less than 55 gallons provided that:

(i) each specialty coating must be approved by the commissioner's representative prior to application;

(ii) records must be maintained on an as used basis in a format acceptable to the commissioner that document the annual usage;

(iii) the annual potential to emit from low-use specialty coatings does not exceed 5 percent of the facility's total annual potential to emit; and

(iv) the facility's permits are modified to identify any coating(s) approved by the commissioner's representative which are exempt from this Part.

228.2 Definitions. (a) For the purpose of this Part, the general definitions of Part 200 will apply.

(b) For the purpose of this Part, the following definitions also apply:

(1) Annual. Refers to a period of time based upon a calendar year commencing January 1st and terminating midnight December 31st.

(2) Capture system. All the equipment including, but not limited to, hoods, ducts, fans, booths, ovens or dryers that contains, collects, and transports an air pollutant to a control device.

(3) Clear coating. A coating which lacks color and opacity or is transparent and uses the undercoat as a reflectant base or under-tone color.

(4) Clear topcoat. The final coating which contains binders but not opaque pigments and which is specifically formulated to form a transparent or translucent solid protective film on wood furniture.

(5) Coating line. The application of one or more surface coatings, using one or more applicators, together with any associated drying or curing areas. A single coating line ends after drying or curing and before other surface coatings are applied. For any web coating line this term means an entire coating application system, including any associated drying ovens or areas located between an unwind station and rewind station, that is used to apply surface coatings onto a continuous strip or web. It is not necessary to have an oven or flash area in order to be included in this definition.

(6) Coating system. A series of surface coatings applied in subsequent layers at the same coating line for protective, decorative, or functional purposes. Each layer of the coating system must be dependent upon the previously applied to produce a marketable product. The coatings must be applied simultaneously at multiple coating stations within the same coating line.

(7) Container. Any portable device in which a material is stored, transported, or otherwise handled.

(8) Excluded VOC. Any of the compounds expressly excluded from the definition of volatile organic compound in section 200.1 of this Title.

(9) Extreme performance coating. A coating formulated for and exposed to harsh environmental conditions, including but not limited to continuous exposure to outside weather, temperatures consistently above 95° C, temperatures consistently below 0° C, solvents, detergents, abrasives, scouring agents or corrosive gases and fluids.

(10) Lower Orange County metropolitan area. The area including the towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick and Woodbury.

(11) Maximum permitted pounds of volatile organic compounds (VOC) per gallon of coating, minus water and excluded VOC, at application. The permissible quantity of volatile organic compounds per gallon of coating minus water and excluded VOC, at application as specified in tables 1 and 2 of this Part. The actual VOC content of the as applied coating is calculated as follows:

$$(VOC)a = \frac{(Dc)a ((Wv)a - (Ww)a - (We)a)}{1 - ((Vw)a + (Ve)a)}$$

where:

(VOC)a = VOC content of "as applied" coating, expressed as a mass of VOC, in pounds, per volume of coating, in gallons, minus water and excluded VOC

(Dc)a = coating density as applied, in pounds per gallon

(Wv)a = the weight fraction of total volatiles in the coating, as applied

(Ww)a = the weight fraction of water in the coating, as applied

(Vw)a = the volume fraction of water in the coating, as applied

(We)a = the weight fraction of excluded VOC in the coating, as applied

(Ve)a = the volume fraction of excluded VOC in the coating, as applied

(12) Natural finish hardwood plywood panels. Panels whose original grain pattern, frequently supplemented by fillers or toners, is enhanced by essentially transparent finishes.

(13) New York City metropolitan area. All of the city of New York, and Nassau, Suffolk, Westchester and Rockland Counties.

(14) Opaque stain. Any stain that contains pigments but which is not classified as a semitransparent stain, including stains, glazes, and other opaque materials applied to wood surfaces.

(15) Overall removal efficiency. The total reduction of volatile organic compound emissions considering the efficiency of both the capture system and of the subsequent destruction and/or removal of these air contaminants by the control equipment prior to their release into the atmosphere.

(16) Pigmented coat. Opaque coatings, applied either as an undercoat or a topcoat, that contain binders and colored pigments and are formulated to conceal the wood surface.

(17) Plastic parts. Plastic parts are parts made from a substance that has been formed from a resin through the application of heat, pressure or both. They include but are not limited to thermoplastics and thermosets such as acrylonitrile-butadiene-styrene (ABS), acrylic (AC), cellulose, nylon,

polycarbonatevinyls, xenoy, melamines, polyester (BMC), reaction injection molding (RIM), polyurethanes (PU). This also includes composites such as fiberglass-reinforced plastics (FPR), which are comprised of thermosetting or thermoplastic resins and fibers, filaments, or fine powders.

(18) Potential to emit. The maximum capacity of an air contamination source to emit any air contaminant under its physical and operational design. Any physical or operational limitation on the capacity of the facility or air contamination source to emit any air contaminant, including air pollution control equipment and/or restriction on the hours of operation, or type of material combusted, stored, or processed, shall be treated as part of the design only if the limitation is contained in enforceable permit conditions. Fugitive emissions, to the extent that they are quantifiable, are included in determining the potential to emit.

(19) Printed interior panels. Panels whose grain or natural surface is obscured by fillers and basecoats upon which a simulated grain or decorative pattern is printed.

(20) Sealer. A coating which contains binders that seal a wood surface prior to application of a subsequent coating.

(21) Semitransparent stain. Stains that contain dyes and/or semitransparent pigments and are formulated to enhance wood grain and to change the color of the surface, but not to conceal the surface; including sap stain, toner, nongrain raising stain, pad stain, spatter stain, and other semitransparent stains.

(22) Solids as applied. Utilizing the actual volume of coating solids applied, compliance is determined as follows:

$$\left\{ V(Vn)a \right\} \left\{ \left\{ (1 - \text{overall removal efficiency}) \frac{(VOC)a}{(Vs)a} \right\} - \left\{ \frac{(VOC)c}{(Vs)c} \right\} \right\} = \begin{matrix} (+) \text{ lbs. over allowable} \\ (0) \text{ compliance} \\ (-) \text{ lbs. under allowable} \end{matrix}$$

where:

V = the volume of actual coating used, gallons

(Vn)a = volume fraction solids in the actual coating

(VOC)a = VOC content of "as applied" coating,

expressed as a mass of VOC, in pounds,
per volume of coating, in gallons, minus
water and excluded VOC

(VOC)c = mass of VOC in a volume of solids and VOC
for complying coating, pounds VOC/gallon

d(VOC)a = density of volatile organic content
(total volatiles minus exempt solvents
and water) as applied, pounds per
gallon and,

$$(Vs)a = 1 - \frac{(VOC)a}{d(VOC)a}$$

$$(Vs)c = 1 - \frac{(VOC)c}{d(VOC)a}$$

(23) Solvent. A substance that is liquid at standard conditions and is used to dissolve or dilute another substance; this term includes, but is not limited to, organic materials used as solvers, viscosity reducers, degreasing agents, or cleaning agents. Any excluded VOC is not a solvent.

(24) Substrate. The surface onto which a coating is applied or into which a coating is impregnated.

(25) Surface coating. A material applied onto or impregnated into a substrate for protective, decorative, or functional purposes. Such materials include, but are not limited to, paints, varnishes, primers, sealants, adhesives, inks and maskants.

(26) Wash coat. A coating which contains binders that raise wood surfaces, prevent undesired staining, and control penetration.

228.3 Volatile organic compound emission control requirements.

(a) No person shall cause or allow the usage of coatings that exceed the allowable pounds of volatile organic compounds per gallon, minus water and excluded VOC at application specified in table 1 of section 228.7 and table 2 of section 228.8 of this Part, unless a coating system meeting the requirements of 228.3(d) is utilized or unless control equipment meeting the requirements of 228.3(b) and 228.3(c) is installed and operated.

(b) Any afterburner used as control equipment shall be energy-efficient and shall be designed and operated to provide, at a minimum, for an 80 percent overall removal efficiency of volatile organic compounds. This assumes 90 percent of the volatile organic compounds emitted are captured and

delivered to the afterburner which converts 90 percent of the volatile organic compounds to carbon dioxide and water vapor. The control equipment shall operate on minimal auxiliary fuel and provide for maximum heat recovery.

(c) Notwithstanding the control requirements specified in 228.3(b), control strategies utilizing an air cleaning device must determine the required overall removal efficiency on a solids as applied basis as per 228.2(b)(22). Using the appropriate coating parameters and VOC limits as specified in sections 228.7 and 228.8, the overall removal efficiency required is the lesser of the value calculated according to the above procedure or 85 percent.

(d) An owner or operator of a coating line which utilizes a coating system as a control strategy must comply with the following provisions:

(1) Each coating system must be approved by the commissioner's representative prior to the use of the coating system in the manufacture of a product for sale;

(2) The coatings must be applied on the same substrate and at the same coating line. Coating applied at different coating lines cannot be included in any compliance demonstration involving a coating system. In addition, due to the variability in coating application rates, coatings which are applied manually by hand held spray guns cannot be utilized in a coating system compliance demonstration.

(3) Compliance must be demonstrated using actual coating usages calculated on a solids as applied basis using the formula in 228.2(b)(22). The calculation must be performed for each coating and the aggregate of the results for all coatings applied in each coating system must demonstrate compliance;

(4) Compliance must be demonstrated instantaneously. There is no averaging period for individual coatings which are part of a coating system;

(5) The method or instrument which the source owner will accurately measure or calculate the volume of coating applied must be approved by the commissioner's representative;

(6) Collect and record all of the following information:

(i) the name or identification of each coating which is part of a coating system;

(ii) the coating parameters used to determine

(VOC)a for each coating which is part of a coating system; and

(7) Any record showing noncompliance with this Part shall be reported by sending a copy of the record to the commissioner's representative within thirty days following the occurrence.

(e)(1)The commissioner may allow surface coating processes to operate with a lesser degree of control than is required by 228.3 provided that a process specific reasonably available control technology (RACT) demonstration has been made to the satisfaction of the commissioner.. Process specific RACT demonstrations shall be submitted with the application for a permit to construct, a certificate to operate, or renewal of a certificate to operate for an existing source under the provisions of Part 201 of this Subchapter. Such process specific RACT demonstrations must be submitted to the United States Environmental Protection Agency as a revision to the State Implementation Plan and must address the technical and economic feasibility of:

(i) utilizing compliant coating(s) and/or inks;

(ii) utilizing demonstrated and proven emission control technologies which would achieve the required overall removal efficiency as determined per 228.3(c);

(iii) utilizing demonstrated and proven emission control technologies which would achieve a degree of overall removal efficiency less than required as determined per 228.3(c); and

(iv) utilizing demonstrated and proven production modification methods which would result in real, documented, and enforceable reductions in the volatile organic compound emissions from the process.

(2) Facilities with surface coating processes subject to this Part with an annual potential to emit of less than 5 tons of volatile organic compounds will only be required to comply with (d)(1)(i) and (d)(1)(iv) in order to demonstrate that a lesser degree of control is RACT for these processes.

(3) The commissioner may allow sources which use natural gas fired afterburners as control devices for processes subject to this Part, to shut down these natural gas fired afterburners from November 1st through March 31st for the purposes of natural gas conservation, provided that the commissioner has determined that this action will not jeopardize air quality. Such evidence shall be submitted with the application for a permit to construct, a certificate, or renewal of a certificate to operate for an existing source under the provisions of Part 201 of this

Subchapter.

228.4 Opacity. No person shall cause or allow emissions to the outdoor atmosphere having an opacity of 20 percent or greater for any consecutive six-minute period from any emission source subject to this Part.

228.5 Reports, recordkeeping, sampling and analysis.

(a) The owner or operator of any emission source subject to this Part must maintain and, upon request, provide the Department's representative with certification from the coating supplier/manufacturer which verifies the parameters used to determine the actual VOC content of the as applied coating, (VOC)a, as defined in section 228.2(b)(11) of this Part, for each coating used at the facility. In addition, purchase, usage and/or production records of the coating material, including solvents, must be maintained in a format acceptable to the commissioner's representative and, upon request, these records must be submitted to the Department. Any facility required to perform solids as applied calculations as defined in section 228.2(b)(22), must maintain records to verify the parameters used in the formula. Any additional information required to determine compliance with this Part shall be provided to the commissioner's representative in a format acceptable to the representative. Records must be maintained at the facility for a period of five years.

(b) Acceptable analytical methods for determining the volatile content, water content, density, volume solids of surface coatings are presented in appendix A, method 24, of 40 CFR 60 (see table 1, section 200.9 of this Title).

(c) Where the methods referenced in subdivision (b) of this section are not applicable, alternate analytical methods for surface coating may be acceptable, subject to the approval of the commissioner.

(d) Representatives of the Department of Environmental Conservation shall be permitted, during reasonable business hours, to obtain coating samples for the purpose of determining compliance with this Part.

(e) When a coating line utilizes control equipment to comply with the provisions of this Part, test methods acceptable to the Department of Environmental Conservation must be used when demonstrating the overall removal efficiency.

(i) This demonstration may be performed by directly

measuring VOC/solvent recovery and VOC/solvent usage rates where VOC/solvent recovery is the only control technique. Methods described in 228.5(b) and (c) must be used.

(ii) For control equipment other than VOC/solvent recovery, this demonstration must include provisions to determine both the efficiency of the capture system and of the subsequent destruction and/or removal of these air contaminants by the control equipment prior to their release to the atmosphere.

(f) The owner and/or operator of a surface coating process must follow notification requirements, protocol requirements and test procedures of Part 202 of this Title for testing and monitoring. Depending upon conditions at a test site, one of the following test methods from appendix A of 40 CFR 60 (see Table 1, section 200.9 of this Title) must be used when measuring volatile organic compound (VOC) concentrations of a gas stream at the inlet and outlet of a control device to determine the destruction and/or removal efficiency:

(i) Method 18, Measurement of Gaseous Organic Compound Emissions by Gas Chromatography;

(ii) Method 25, Determination of Total Gaseous Organic Emissions as Carbon; or

(iii) Method 25A, Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer.

(iv) Methods not listed above must be approved in advance by the Department's representative and the United States Environmental Protection Agency.

(g) If an air cleaning device is used, continuous monitors of the following parameters shall be installed, periodically calibrated, and operated at all times that the associated control equipment is operating:

(1) exhaust gas temperature of all incinerators;

(2) temperature rise across catalytic incinerator bed;

(3) breakthrough of volatile organic compounds on a carbon adsorption unit; and

(4) any other continuous monitoring or recording device required by the commissioner.

(h) Any facility which is not subject to the control requirements of this Part because its annual potential to

emit volatile organic compounds are below the applicability criteria, must maintain records in a format acceptable to the commissioner's representative that verify the facility's annual potential to emit VOCs. Upon request, these records must be submitted to the Department.

228.6 Prohibition of sale or specification.

(a) No person shall sell, specify, or require for use the application of a coating on a part or product at a facility with a coating line described in table 1 or 2 in section 228.8 or 228.9 if such use is prohibited by any of the provisions of this Part. The prohibition shall apply to all written or oral contracts under the terms of which any coating is to be applied to any part or product at an affected facility. This prohibition shall not apply to the following:

(1) coatings utilized at surface coating lines where control equipment has been installed to meet the allowable VOC content limitations specified in tables 1 and 2 of sections 228.8 and 228.9 of this Part;

(2) coatings utilized at surface coating lines where a coating system is used which meets the requirements specified in 228.3(d); and

(3) coatings utilized at surface coating lines that have been granted variances for reasons of technological and economic feasibility per section 228.3(e) of this Part.

(b) Any person selling a coating for use in a coating line subject to this part must, upon request, provide the user with certification of the volatile organic compound content of the coating supplied.

228.7 Table 1

Process, emission source, and description of products	Maximum permitted pounds of volatile organic compounds per gallon (minus water and excluded VOC) of coating at application
Large appliance coating lines	Residential and commercial washers, refrigerators, freezers, water heaters, dishwashers, trash compactors, air conditioners.
	2.8

Magnet wire insulation coating lines	Enameling or varnish of aluminum or copper wire for use in electrical machinery to create an electromagnetic field.	1.7
Metal furniture coating lines	Metal parts used in household, business and institutional furniture such as but not limited to tables, chairs, wastebaskets, beds, lighting fixtures, shelves, room dividers, bathroom dividers.	3.0
Metal can coating lines	Sheet basecoat - exterior and interior over-varnish	2.8
	Two-piece can exterior (basecoat and over-varnish)	2.8
	Two- and three-piece can interior body spray	4.2
	Two-piece can exterior end (spray or roll coat)	4.2
	Three-piece can side-seam spray	5.5
	End sealing compound	3.7
Fabric coating lines	Fabric coatings, such as but not limited to: rubber, used for rainwear, tents, industrial gaskets.	2.9
Vinyl coating lines	Printing, decorations or protecting coats over vinyl-coated fabric or vinyl sheets.	3.8
Paper coating lines	Paper, pressure-sensitive tape regardless of substance (including paper, fabric or plastic film) and related web coating processes on plastic film such as but not limited to: typewriter ribbons, photographic film and magnetic tape. Also metal foil gift wrap and packaging.	2.9
Automobile assembly coating lines	Automobiles and light-duty trucks, exterior and main body sheet metal parts excluding nonmetallic parts.	
	Prime coat	1.9
	Primer-surfacer	2.8
	Top coats	2.8
	Repair coat	4.8

Coil coating lines	Flat metal sheet from a coil or roll which is coated and later used for items such as but not limited to: cans, appliances, roof decks, siding, cars, gutters.	2.6
--------------------	--	-----

Coating lines for misc. metal parts and products	Large farm machinery, small farm and garden machinery, small appliances, commercial and office machinery, computer equipment, industrial machinery, fabricated metal products and any other industrial category which coats miscellaneous metal machinery, instruments or equipment, excluding all nonmetallic parts.	
--	---	--

Clear coatings	4.3
Coating application system is air dried or forced warm air dried at temperature up to 90°C	3.5
Extreme performance coatings designed for harsh exposure or extreme environmental conditions	3.5
All other misc. metal parts and products coatings	3.0

Coating lines for flat wood surface finishing	Printed interior panels made of hardwood, plywood and thin particle board	2.5
	Natural finish hardwood plywood panels	3.3
	Hardboard paneling	3.6

228.8 Table 2

Process, emission source, and description of products	Maximum permitted pounds of volatile organic compounds per gallon (minus water and excluded VOC) of coating at application
Wood coating lines	<p data-bbox="616 619 1500 810">Coated room furnishings, such as but not limited to cabinets (kitchen, bath and vanity), tables, chairs, beds, sofas, shutters, art objects and any other coated product made of solid wood composition or wood material.</p> <p data-bbox="655 846 1500 878">Semi transparent stain 6.8</p> <p data-bbox="655 880 1500 912">Wash coat 6.1</p> <p data-bbox="655 915 1500 946">Opaque stain 4.7</p> <p data-bbox="655 949 1500 981">Sealer 5.6</p> <p data-bbox="655 983 1500 1015">Pigmented coat 5.0</p> <p data-bbox="655 1017 1500 1049">Clear topcoat 5.6</p>
Tablet coating lines	<p data-bbox="616 1108 1500 1172">Formed pharmaceutical products, such as but not limited to pills, capsules. 5.5</p>
Glass coating lines	<p data-bbox="616 1236 1500 1300">Lamps, incandescent light bulbs and miscellaneous glass products. 3.0</p> <p data-bbox="616 1302 1500 1332">Fluorescent light bulbs. 4.1</p>
Leather coating lines	<p data-bbox="616 1364 1500 1459">Leather substrates, such as but not limited to clothing, furniture, automobile components. 5.8</p>
Miscellaneous plastic part coating lines	<p data-bbox="616 1491 1500 1757">Plastic parts and products such as but not limited to business and office machine parts toys, sporting goods, architectural structures such as doors and window frames, automotive interior parts; automotive exterior parts, both flexible and rigid; musical equipment housings; and other miscellaneous plastic parts.</p> <p data-bbox="719 1789 1500 1821">Color topcoat 3.8</p> <p data-bbox="719 1823 1500 1855">Clear coat 4.8</p>

Aerospace coating lines	Aerospace components, including but not limited to assembly of parts or completed unit of any aircraft, helicopter or missile.	
	Primer	2.9
	Topcoat	5.1
	Maskant for chemical processing	5.1
Motor vehicle refinishing	Automobile, truck or bus coating, including but not limited to repair coats, repainting and touch-ups, except at automobile assembly plants.	
	Repair/touchups	6.2
	Overall (coating entire vehicle)	5.0
Urethane coating lines	Urethane substrates that are more than 50 micrometers (0.002 inches) thick, except for resilient floor covering and flexible packaging.	3.8

228.9 Products regulated. The "Process, emission source, and description of products" column in tables 1 and 2 of sections 228.7 and 228.8 of this Part may not contain all possible products in each category. For any products not specifically listed, the commissioner will determine, based on inspections of the process, emission source and product to be coated, which limits in table 1 or 2 apply.

228.10 Handling, storage and disposal of volatile organic compounds(VOC). No owner or operator of a facility subject to this Part shall:

(a) Use open containers to store or dispose of cloth or paper impregnated with VOC and/or solvents that are used for surface preparation, cleanup or coating removal;

(b) Store in open containers spent or fresh VOC and/or solvents to be used for surface preparation, cleanup or coating removal;

(c) After January 1, 1994 use VOC and/or solvents to cleanup spray equipment unless equipment is used to collect the cleaning compounds and to minimize their evaporation to the atmosphere;

(d) Use open containers to store or dispense surface coatings and/or inks unless production, sampling, maintenance or inspection procedures require operational access.

This provision does not apply to the actual device or equipment designed for the purpose of applying a coating material to a substrate. These devices may include, but are not limited to spray guns, flow coaters, dip tanks, rollers, knife coaters, and extrusion coaters; or

(e) Use open containers to store or dispose of spent surface coatings, spent VOCs and/or solvents.

State of Wisconsin

NR 422.085 Leather coating. (1) **APPLICABILITY.** Effective February 1, 1987, this section applies to coating applications at leather coating facilities. This section does not apply to sources exempted under s. NR 422.03 (6).

(2) **EMISSION LIMITATIONS.** No owner or operator of a leather coating facility may cause, allow, or permit the emission of any VOCs from coating applications in excess of 18.6 kilograms per 100 square meters (38.0 pounds per 1000 square feet) of coated product calculated on a daily average basis.

Register, May, 1992, No. 437

(3) **COMPLIANCE REQUIREMENTS AND SCHEDULES.** The owner or operator of a leather coating facility shall comply with the requirements of sub. (4) and s. NR 425.03 (1), (8) and (9).

(4) **REPORTING AND RECORDKEEPING.** (a) To determine compliance with the leather coating VOC emission limit in this section, the facility shall maintain daily coating usage and leather production records in a format approved by the department. Reporting, recordkeeping and access to these records shall be in accordance with ss. NR 439.03 to 439.05.

(b) The daily VOC emission rate shall be determined by the following equation:

$$c = a/b$$

where:

c is the daily average VOC emission rate,

a is the total amount of VOCs emitted during the day, and

b is the prorated surface area of leather coated during the day, where:

$$b = \sum_{i=1}^n d_i e_i,$$

d_i is the total area of the i th batch of hides coated during the day, and

e_i is the ratio of actual VOC emissions resulting from coating any portion of the i th batch of hides during the day to the total predicted VOC emissions resulting from all coating of the entire i th batch.

(c) The facility shall measure the surface area of each piece of leather coated with a mechanism initially calibrated for minimum accuracy to the Turner Korrekt Machine or Sawyer Measurement systems. The average surface area per coated piece of leather may be used for a batch of leather provided that the average is based on a minimum of 500 pieces. Otherwise, the facility average surface area per coated leather piece shall be used. In no case may the total area allocated to production over all days from a piece of leather exceed the average area for that leather.

History: Cr. Register, January, 1987, No. 373, eff. 2-1-87; am. (2) and (3), cr. (4), Register, February, 1990, No. 410, eff. 3-1-90.

NR 422.09 Automobile and light-duty truck manufacturing. (1) **APPLICABILITY.** This section applies, subject to the provisions of s. NR 425.03 (6), to the application areas, flashoff areas, and ovens of automobile and light-duty truck manufacturing plants involved in prime, topcoat and final repair coating of metallic front end and main body parts. This section does not apply to the coating of wheels, trunk interiors, steering columns or nonmetallic parts; to sealers or nonpriming anti-rust coatings; or to sources exempted under s. NR 422.03.

(2) **EMISSION LIMITATIONS — ENAMELS.** No owner or operator of an automobile surface coating line which, prior to January 1, 1979, used an enamel coating system, may cause, allow or permit the emission of any VOCs in excess of:

(a) After December 31, 1983, 0.14 kilograms per liter of coating (1.2 pounds per gallon), excluding water, from an electrodeposition prime coat or equivalent coating line.

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DRAFT

Technical Support Document

For The

Proposed Wisconsin Administrative Code Rule To Limit
Volatile Organic Compound Emissions
From Major Leather Coating Facilities
In the Southeastern Wisconsin
Ozone Nonattainment Area

Wisconsin Department of Natural Resources
Bureau of Air Management
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August, 1986

Preface

This draft document details the Wisconsin Department of Natural Resources (WDNR) Bureau of Air Management's efforts to research and develop a proposed administrative rule that would establish volatile organic compound (VOC) emission limitations for large leather coating facilities. Large leather coating facilities are defined as emitting at least 100 tons of VOC's during a calendar year.

VOC emissions are a precursor to ambient ozone formation. The accepted general strategy to reducing ambient ozone is to lower VOC emissions.

This proposed rule would apply to approximately three major stationary sources in the southeastern Wisconsin ozone nonattainment area.

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Chapter One

Introduction

1.1 Document Purpose

This document details the Wisconsin Department of Natural Resources ("Department") Bureau of Air Management's efforts to research and develop a proposed administrative rule that would establish volatile organic compound (VOC) emission limitations for certain leather coating operations. This rule for leather coating operations is the last in a series of four rules to limit VOC emissions from certain sources in southeastern Wisconsin.

VOC emissions are precursors to ambient ozone formation. The accepted strategy to reducing ambient ozone concentrations is to reduce VOC emissions. The criteria that all these sources would have to meet for rule applicability are as follows:

- Sources that emitted 100 tons or more of VOCs during calendar year 1984 (or the most recent year for which emissions data are available);
- Sources that are located in the southeastern Wisconsin ozone nonattainment area (i.e., within the counties of Kenosha, Ozaukee, Racine, Milwaukee, Washington or Waukesha);
- Processes that are not subject to any existing DNR Reasonably Available Control Technology (RACT) VOC emission limitations; and
- Processes that are not the subject of any Control Technique Guideline (CTG) issued by the U.S. Environmental Protection Agency (U.S. EPA), which recommends Reasonably Available Control Techniques (RACT).

Following these criteria, the WDNR developed, proposed, and eventually promulgated non-CTG or "RACT IV" rules to limit VOC emission from the following applicable sources:

- Synthetic resin manufacturing
- Coatings manufacturing, and
- Aerosol can filling

At its February 1986 meeting, the Natural Resources Board adopted these rules as part of the administrative code. The rules are scheduled to take effect on September 1, 1986.

The remainder of this document addresses the technical background and basis for the proposed VOC RACT IV rule for leather coating facilities.

1.2 Ozone: Cause and Effects

Ozone (O_3) is formed in the lower atmosphere in the presence of nitrogen dioxide and sunlight. Ultraviolet radiation from the sun provides the necessary energy level to disassociate nitrogen dioxide (NO_2) into nitric oxide (NO) and a free oxygen atom which quickly combines with an oxygen molecule to form ozone. Ozone may then disassociate to form NO_2 and this photochemical process continues to repeat, always attempting to reach equilibrium.

However, if the atmosphere is polluted with VOC emissions as well as NO_2 , the equilibrium shifts towards greater concentrations of ozone. Although some organic compounds react much more rapidly than others, almost all will react with NO and both ordinary oxygen and ozone. In a series of reactions, oxygen as well as ozone react with NO to form NO_2 . Organic compounds and oxygen are replaced in the reaction with NO, causing ozone concentrations to build-up. Thus, the simultaneous presence of both nitrogen dioxide and VOC in the presence of sufficient solar radiation causes ozone to accumulate.

Since VOCs and NO_2 react in the presence of sunlight to form ozone, they are called precursors of ozone. VOC's can also unite directly with ozone to form other photochemical oxidants which are often as harmful as ozone itself.

The toxicity of inhaled ozone is well known, and the presence of this oxidant in most urban and industrial environments has made the study of its health effects important.

At ozone concentrations greater than 0.25 parts per million (ppm), irritation, headaches, decreased cardiopulmonary reserve (in healthy adults), aggravation of certain anemias, aggravation of chronic lung disease, aggravation of asthma, and increased susceptibility to acute respiratory disease have been noted.

At ozone concentrations from 0.20 ppm to 0.25 ppm, Brinkman, Kleinfeld, Remmers and Schoettlen (1957) found that aggravation of certain respiratory ailments occurred.

At ozone levels below 0.20 ppm, Wayne, Hammer, and Coffin (1967) discovered mild reactions in normal subjects, ranging from headaches without fever at 0.05 ppm to eye irritations at 0.10-0.15 ppm.

A 1982 study by the United States Congress's Office of Technology Assessment (OTA) estimates that ozone-induced damage is costing the nation between \$2 billion and \$4.5 billion per year in reduced yields for four major crops (corn, wheat, soybeans, peanuts). These estimated losses represent as much as five per cent of the nation's output.

Ozone is also a major factor in the overall deterioration of several different types of organic materials. The magnitude of damage is difficult to assess because ozone is one of many oxidizing chemicals which contribute to the "weathering" of materials. Nevertheless, ozone is known to accelerate the deterioration of rubber, textile dyes and fibers, and certain types of paints and coatings.

1.3 Regulatory Background

The U.S. EPA, based upon the most reliable data available, has established a National Ambient Air Quality Standard (NAAQS) for ozone to protect human health (primary standard) and welfare (secondary standard). For ozone the primary and secondary NAAQS are the same: 0.12 parts per million (ppm) - daily maximum 1-hour concentration. The ozone standards are attained when the expected number of days per calendar year with maximum hourly average concentrations above the designated level is equal to or less than one, as determined by the methodology of Chapter 40 of the Code of Federal Regulations, Appendix H (40 CFR 50.9, Appendix H). The WDNR has adopted this ozone NAAQS as part of Wisconsin Administrative Code section NR 155.03.

Areas where violations of any of the NAAQS exist are considered by the U.S. EPA and the affected state to be in nonattainment for that criteria pollutant for which the NAAQS exists. Officially, these nonattainment areas are deemed to contain ambient air quality that is less than what is considered safe for human health and/or welfare.

Section 110(a) of the Federal Clean Air Act, amended August, 1977 required each state to submit a revised air quality state implementation plan to the U.S. EPA by July 1, 1979 that demonstrates attainment of the NAAQS by December 31, 1982 for each pollutant that did not meet the NAAQS in any part of the state (i.e., the nonattainment areas). The WDNR Bureau of Air Management submitted a 1979 Plan for ozone attainment to the U.S. EPA for approval.

The two general strategies to reduce ozone, as proposed in the 1979 Ozone Plan, were to limit VOC emissions from new cars (The Federal Motor Vehicle Emission Control Program - FMVECP), and from certain stationary sources. The remainder of this report will be concerned with the VOC emissions and their limitations from stationary sources.

The stationary source VOC emission limitations (called VOC Reasonably Available Control Technology - RACT) that are described in the 1979 Ozone Plan were developed by the WDNR Bureau of Air Management and are contained as rules in section NR 154.13 of the Wisconsin Administrative Code. In September, 1986, these rules will be renumbered into the NR 400 series. These VOC RACT rules were adopted from U.S. EPA control technique guidelines (CTG's). The CTG's and subsequent RACT rules were issued in Group I and Group II series. Table 1 lists those VOC stationary source RACT I and RACT II categories that are currently applied in the southeastern Wisconsin ozone nonattainment area.

The 1979 Ozone Plan's general strategy to attain the ozone NAAQS was and still is to reduce VOC emissions. Based upon the analysis of the impacts of specific VOC-reducing strategies, the WDNR determined that the ozone NAAQS would not be met by December 31, 1982 for southeastern Wisconsin.

Section 129(c) (uncodified) of the Clean Air Act allowed the U.S. EPA to grant extensions for achieving ozone NAAQS attainment to December 31, 1987 to those states which could not demonstrate attainment by the end of 1982. As a condition of U.S. EPA's approving this extension, each state that applied for the extension (e.g., Wisconsin) was required to develop a motor vehicle emissions inspection and maintenance (I/M) program and additional stationary source VOC RACT rules for the ozone nonattainment areas (Section 172(a)(2) of the Clean Air Act).

Table 1

Implementation and Anticipated Full-Compliance Dates
 Stationary Source Categories Subject to .423(a) VOC Rules
 Contained in Chapters NR 419

Southeastern Wisconsin Seven Counties ^(b)

Source Category	Effective Date of Implementing the Regulation	Anticipated Date of Full Source Category Compliance
Bulk Gasoline Plants	August 1, 1979	December 31, 1981
Gasoline Loading Terminals	August 1, 1979	December 31, 1981
Service Stations (Stage I)	August 1, 1979	December 31, 1981
Industrial Coating Categories	-	-
Appliances	August 1, 1979	December 31, 1981
Automobiles	August 1, 1979	December 31, 1987
Cans	August 1, 1979	December 31, 1985
Metal Coils	August 1, 1979	December 31, 1982
Paper	August 1, 1979	December 31, 1985
Fabrics	August 1, 1979	December 31, 1979
Metal Furniture	August 1, 1979	December 31, 1982
Misc. Metals	April 1, 1981	December 31, 1987
Solvent Metal Cleaning	August 1, 1979	December 31, 1981
Cutback Asphalt Oper.	August 1, 1979	December 31, 1980
Rubber Products	April 1, 1981	December 31, 1983
Drycleaning	April 1, 1981	December 31, 1983
Graphic Arts	April 1, 1981	December 31, 1985
Petroleum-based Dry Cleaning	January 1, 1984	December 31, 1987
Synthetic Resin Manufacturing ^c	September 1, 1986	December 31, 1987
Coatings Manufacturing ^c	September 1, 1986	December 31, 1987
Aerosol Can Filling ^c	September 1, 1986	December 31, 1987

^(a) Transferred from the old NR 154.13, effective October 1, 1986.

^(b) This list of stationary source categories subject to VOC emission control regulations are for only those categories that have sources in the Southeastern Wisconsin seven counties. Additional source types subject to NR 154.13 regulations but presently not located in Southeastern Wisconsin are: Storage of petroleum liquids, miscellaneous refinery sources, petroleum refinery fugitive emissions, pharmaceutical manufacturing, gasoline tank truck leaks.

^(c) RACT IV source category.

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In March, 1983 the Department submitted to the U.S. EPA the final revision to the 1982 State Air Quality Management Implementation Plan, for ozone control in the six county southeastern Wisconsin ozone nonattainment region (Figure 1). This document, referred to herein as 1982 Ozone Plan, contains predictions of the impact that federal and Wisconsin VOC emission limitation rules would have on high ozone levels in the region in 1987 (projected attainment year) relative to concentrations in 1979-81. 1980 was the base year for this analysis.

As part of the 1982 Ozone Plan, the Department committed to developing an I/M program in the southeastern Wisconsin ozone nonattainment Area, per U.S. EPA requirements. This program commenced operation on April 2, 1984.

The Department, in its 1982 Ozone Plan, also committed to developing additional VOC RACT rules for any applicable stationary processes, per the federal requirements. This commitment included the adoption of the CTG - Group III VOC emission limitations ("RACT III") for applicable operations located in southeastern Wisconsin. The DNR has complied with this commitment by promulgating a RACT III rule for petroleum-based dry cleaning operations in the region with annual VOC emissions greater than 100 tons per year (TPY). Additional RACT III enactment will occur if and when there are applicable facilities in southeastern Wisconsin.

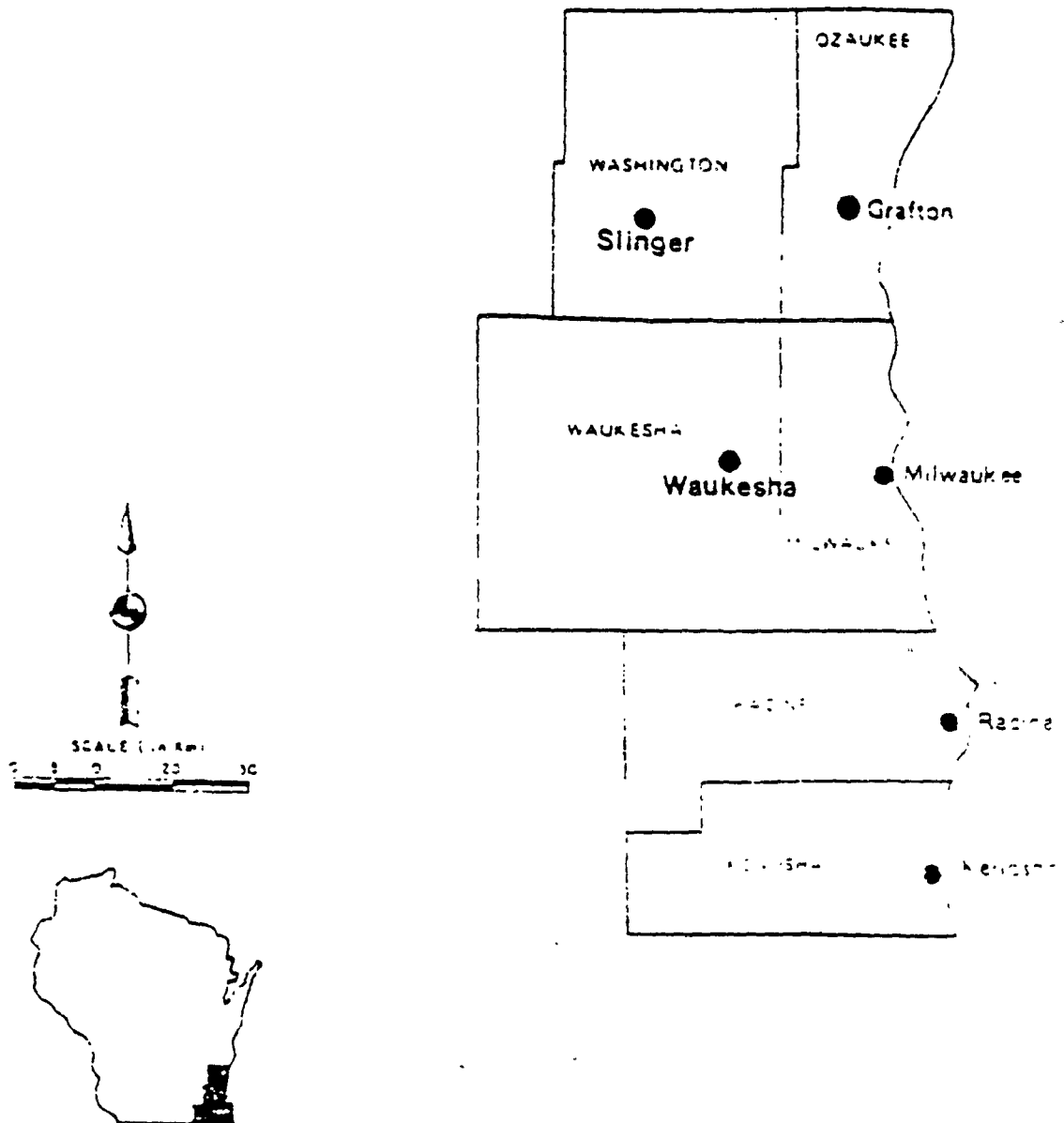
The U.S. EPA, in the January 22, 1981 Federal Register (46 FR Page 7186), also stated that the additional requirements to be a part of the 1982 Ozone Plan are to include the adoption of rules "applying RACT to ... all remaining [non-CTG] major stationary sources of VOC's" [i.e., emitting more than 100 tons per year actual emissions as defined under Section 302(j) of the Clean Air Act]. These sources are referred to as non-CTG or RACT IV VOC sources. The Department is in the process of meeting this requirement, as discussed herein.

1.4 Document Outline

In this document, the Department details its analysis of three potential leather coating RACT IV sources in southeastern Wisconsin, and how the criteria for probable RACT IV sources were established (Chapter Two). Technical support for promulgating the proposed leather coating VOC RACT IV rule is detailed in Chapter Three.

Figure 1

Southeastern Wisconsin
Ozone Nonattainment Counties



Chapter Two

RACT IV Source Investigation

2.1 Initial Potential RACT IV Listing

This phase of the project commenced by defining a potential RACT IV source, in terms of both total emissions and geographical location. Potential RACT IV processes were defined to have had the potential to emit at least 100 tons of VOCs for calendar year 1983, assuming continuous, maximum operations for the entire year. The Department's 1983 Air Emissions Inventory (AEI) was the primary source for this data survey.

Since only the ozone plan for the southeastern Wisconsin ozone nonattainment area had to be revised, it was deemed that any additional VOC control rules would apply only to appropriate sources that are located in this region (i.e., the counties of Kenosha, Milwaukee, Ozaukee, Racine, Washington, and Waukesha, Figure 1). This geographical limitation identically applies to any RACT III VOC limitation and the I/M program, which were also commitments from the 1982 Ozone Plan.

In reviewing the 1983 AEI, the Department identified twelve facilities that met the above-mentioned criteria. For each of these facilities, a plant inspection and a developed detailed 1983 VOC emissions inventory. The facility inspections were carried out during April - June, 1984. Each of these plant visits had the following purposes:

- To enable the DNR to better understand those processes that result in the VOC emissions;
- To explain the purpose and background for this rule development; and
- To solicit operations information and detailed VOC emission estimates regarding each of the processes in question. Confidentiality privileges under Wisconsin Statute and Wisconsin Administrative Code were offered by the DNR.

Based upon data supplied by the facilities and their coatings/solvents vendors, the Department was able to develop a detailed 1983 VOC emissions inventory for each facility. Each inventory was finalized and considered complete. Appropriate facility personnel approved, in writing, the DNR inventorying method and calculations. The reported VOC emissions from calendar year 1984 operations are now used in this RACT analysis.

2.2 Revised Potential VOC RACT IV Facilities List

In December, 1983 the Department promulgated the RACT III rule that limited VOC emissions from major petroleum-based drycleaning operations in southeastern Wisconsin. "Major" operations were defined as any facility process (or group of processes if similar but more than one) emitting 100 tons or more VOCs per calendar year. The Department decided to propose that the diminimus VOC emission value, below which a source would be exempt from further RACT IV consideration, would also be 100 actual tons per calendar year. This diminimus value would conform to the U.S. EPA guidance on RACT III rule promulgation (46FR7136, see Section 1.3 herein).

Based upon the inventorying effort, geographical restriction, and the 100 ton-per-year actual VOC emissions minimum for potential RACT IV sources, the list of facilities that may be subject to an RACT emission limitations was culled to seven (four leather coater's, a resin manufacturer, a coatings manufacturer, and an aerosol can filling operation). The primary step in this rule development process is a RACT assessment and feasibility analysis for each of the process types listed above.

During October - mid-December, 1985, the Department solicited public comment on all draft VOC RACT IV rules. This included a public hearing on November 15, 1985 in Milwaukee.

Based upon the comments received, the Department decided to separate the VOC RACT IV rules package. The revised rules for synthetic resin manufacturing, coatings manufacturing and aerosol can filling-operations were eventually adopted by the Natural Resources Board, at its February, 1986 meeting. These three rules are scheduled to become effective as part of the Wisconsin Administrative Code on September 1, 1986.

Further Department work on the remaining draft VOC RACT IV rule (leather coating) was delayed until after the other RACT IV rules were adopted by the Natural Resources Board. The comments received on both proposed rule and its supporting materials were considerably more substantial than for the other rules. This technical support document focuses solely upon background and basis for the proposed leather coating VOC RACT rule.

2.3 RACT IV Criteria and Data Sources

The U.S. EPA has defined RACT as follows:

"The lowest emission limitation that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. RACT for a particular source is determined on a case-by-case basis, considering the technological and economic circumstances of the individual source." (Federal Register, September 17, 1979, Page 53762). This definition was a primary criteria in the entire RACT IV rule development process.

In working towards understanding the leather coating process as a VOC source, the Department has used the following sources of information:

- Existing CTG's and Wisconsin VOC RACT rules - noting where similarities may exist between CTG and the non-CTG processes;
- Facility information and recommendations, primarily during the fall, 1985 public comment period;
- Information from other states which have leather coating VOC RACT rules; and
- The Department's understanding of this process in assessing what might constitute RACT for it.

Chapter Three contains the Department's understanding of the leather coating process, its role as a VOC emission source and how these emissions could be reduced through reasonably available control technology (RACT).

Chapter Three

Leather Coating VOC RACT Assessment

3.1 Leather Coating in Southeast Wisconsin

Leather coating is a principle process in the animal hide tanning industry, which stabilizes and transforms animal hides into a diverse variety of leather types. This industry is quite significant in southeastern Wisconsin.

Leather coating is a large source of VOC emissions. There were four leather coating facilities in the region which each emitted at least 100 tons of VOC's during 1984. These four facilities reported to the DNR Air Emissions Inventory a total of 1054 tons of VOC emissions for calendar year 1984, and are listed as follows:

- 1) Amity Leather Products Company
West Bend
DNR Facility Identification Number (FID#) 267009710
- 2) Flagg Tanning Corporation
Milwaukee
FID #241030020
- 3) Gebhardt - Vogel Tanning Company
Milwaukee
FID #241038490
- 4) Pfister and Vogel Tanning Company
Milwaukee
FID #241023750

3.2 Process Description

3.2.1 The Tanning Process

The raw hides that arrive at the leather coating facility (also called tannery) must be readied before coatings can be applied to them. The hides are trimmed, washed, and then removed of all remaining hair, fat, muscle and other unwanted animal tissue by applying enzymes. A bating (enzymes and salts) solution is applied to the hides to reduce swelling, lower pH, and reopen the hide structure to allow removal of the degraded proteins. After bating, hides are thoroughly washed to remove any substances that have been loosed or dissolved.

The next major phase in hide processing is the actual tanning. Hides or skins are tanned to give them the mechanical properties of leather, such as abrasion resistance and flexibility, and to prevent them from decaying. The main tanning agents used commercially are chromium sulfate solutions.

Next, the hides are fed through a machine with two large rollers to wring excess moisture from the material. Because hides are usually too thick for most uses, the finer grade grain leather is often separated from the flesh side leather (called the split) after the initial tanning operation using a machine resembling a horizontal bandsaw.

Following the initial tanning process, which is primarily for preservation of the fibers, operations are carried out to impart the desired look, feel, and working qualities specified by the customer. Hides are placed in drums and first treated with retan formulations, followed by dye formulations, and then by fat liquoring chemicals.

Finishing requires a series of operations which give leather its final surface qualities. For this, chrome tanned hides are subjected to several finishing processes, as follows:

- Setting out (smoothing and stretching),
- Drying,
- Water conditioning and buffing,
- Plating (smoothing and embossing), and
- Finishing

3.2.2 Leather Finishing Methods

The finishing materials are applied to leather by flow, rolling, or spray equipment. Various coating materials, both water-based and solvent-based, are used to provide abrasion and stain resistance, and to enhance color and gloss. This stage of the tanning process results in emissions of volatile organic compounds (VOCs) to the atmosphere.

A hide's first coating is often applied via the "flow" method. The flow method is commonly used to soften and waterproof leather principally for the shoe industry. Some of the VOC's in the coating may be permanently bound in the leather. This is called impregnation. The conveyORIZED hides are fed under a conduit for the flow coating. This conduit has a line of holes at its bottom. The coating flows through these holes in a slow, steady stream or "curtain". The transfer efficiency of flow coating is close to 100%. Sometimes this "impregnation" coat is applied by roll coating, a method which will be discussed later.

Next, the hides are hand fed onto a conveyor belt that goes through a varied combination of air atomized (Figure 2) and/or roll coating machine (Figure 3) applications. The predominant type of leather coating machine uses a rotary nozzle spray method, with either six or eight spraying heads. For spray applications, the coating material is fed into the spraying system by vacuum hose from a 55 gallon drum. Only one coating material is sprayed at each application.

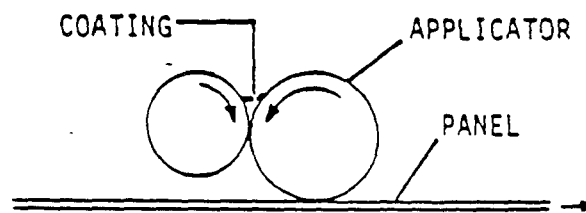
The spraying arms are mounted on a central shaft and have the coating fed to the spray guns via lines mounted on the arms. The arm rotates and sprays the coating on the hide as it passes underneath it.

The front portion of the spray coater contains an optical or electrical scanner that sizes up the continually-varying widths and gaps between hides. This information is used by a microprocessor to control the release of coating through the spray nozzles so as to reduce the amount of overspray. There is a water wash holding tank at the bottom of the open spray booth to catch any coating material that run off or miss the hide. After the coating has been applied, the hide is allowed to dry, either by passing through a dryer or by hang-drying before the next coat is applied.

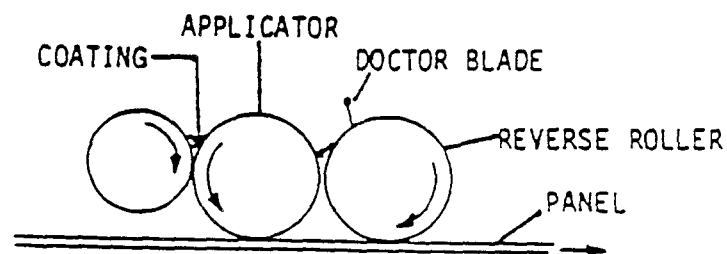


Figure 2

Single Spray Nozzle Operations
Schematic Picture



A. DIRECT ROLL COATER



B. REVERSE ROLL COATER

Figure 3

A. Direct Roll Coater
B. Reverse Roll Coater
Schematic Diagrams

Another type of spray coating is the oscillating arm. This system uses the same conveying and drying system as the rotary sprayer. It differs in that instead of having several guns mounted on a carousel, one gun is mounted on an arm that swings back and forth. As with spray coater's, microprocessors can be here used to reduce overspray.

The stationary sprayer is a line of spray nozzles that remain stationary as the hides move underneath them. Again, microprocessors can be used to reduce overspray from this equipment.

The sprinkler sprayer (or seasoner) is used to sprinkle a coating onto the hides at low pressure as they pass underneath. Microprocessors are not commonly used here as the coating is collected in a trough and reused.

The use of the roll coater in leather coating is relatively new technology that is based upon a combination of both pure roll coating and the rotogravure process. The coating material is applied to the leather, in the opposite direction of the substrate movement by revolving hard steel rolls (Figure 3). The depth of the coating is determined by the gap between the rolls (A and B in Figure 3). This process borrows from the rotogravure technique in that the coated roll is "pitted" with thousands of tiny recessed dots. The coating material is usually fed from a small container such as a 5 gallon can, via vacuum hose into a reservoir at the base of the lower roller. The coating is picked up by the recessed dots, held in by the liquid's surface tension, and then transferred to the hide upon impact. The pitted roller aids in the uniform coating application to the leather.

The coating transfer efficiency of a roll coater can approach 100% as a tray beneath the rollers catches any unused coating and channels back into the feeder can. According to Pfister and Vogel (1986), roll coating requires only 20% of the material used in an equivalent air-atomized spray application. After each coating, the hide is subject to either air or oven drying.

Technical problems such as lack of penetration, uneven applications, and bunching of hides (particularly thinner ones) have limited the use of roll coating equipment. However, with experience and improvement, this economical technology has been gaining in use in the leather coating industry.

Each hide is subjected to several different coatings. The three general types of applications are called base, intermediate, and finishing coats. The base coat is usually applied to the hide as a stain, penetrator and flow aid. The primary purpose of intermediate coats is to promote and improve the adhesion properties of the hide allowing for improved application of the finish or top coats. The intermediate coats may also fine tune the hide's texture, color or print since penetration and flow ability is also important here. The top coats give the leather its desired gloss and resiliency. It is essential that these coatings be applied in a series of thin layers rather than in one or two spreads so that the drying and flexibility properties of the leather can be maintained. The question of how many, and what types of materials that are sprayed onto any particular piece of leather depends upon the type of initial raw hide used and desired finished product.

In the case of air-atomized spray systems, the various base, intermediate and final coating applications have a variety of names. These different applications are sometimes referred to as follows:

- "spray stain" (base)
- "spray middle" (middle)
- "spray effect" (1st top coat), and
- "spray lacquer" (2nd top coat)

Each of these different coating types pertains to the type of material that is being used (i.e., "stain", "middle", "lacquer", or "effect"). Many leathers are not subject to each of these finishes. Some leathers receive more than one coat of certain finishes. As stated earlier, each coating system can be highly individualistic.

In the final stage, the completed material is measured, graded and shipped to the appropriate leather goods manufacturing facility for final production fabrication.

3.2.3 Coating Formulations

The Department surveyed the tanneries of southeastern Wisconsin during 1984 and found that each tannery maintains an extensive variety of coatings in its stock. The multitude of different hides, desired colors, textures, conditions and finishes necessitate a large, varied coating inventory. The data collected during the Department survey indicate that any particular coating falls into one of three categories as follows:

- Strict lacquers. These resin-based coatings contain approximately 70-95% organic solvents (VOCs) by weight. The remaining material are resins and pigments (i.e., the "solids"). The lacquers contain three components; the coloring ingredient (pigments), additives, and solvent. Pigments are finely divided organic or inorganic material that imparts color. No known heavy metals or toxics are commonly used in lacquer formulations. The additives, usually organic resins and polymers serve as a binder (stabilizer) between pigment and the leather substrate and give the coating the desired characteristics, such as gloss and skuff resistance. The solvent is the medium in which the additives are dissolved and dispersed to transfer the pigment to the leather substrate.
- Lacquer emulsions. These coatings are similar to strict lacquers. However a surfactant (e.g., sodium lauryl sulfate) is applied to the material so that it can be water-miscible. The user then dilutes the material with water in appropriate amounts. These coatings vary from 20-30% water by weight and 5-15% solids by weight. The remaining 55-75% of these emulsions are comprised of solvents. The lacquer emulsions, which are water-miscible, are diluted with about 25% water by the leather coater before application.
- Water-based coatings. These coatings contain less than 10% organic solvents. This type of coating has gained in use over the past few years as the technology has developed and use of these materials has improved. Their popularity is due to their increased solids-carrying capability. With water-based coatings, less "vehicle" is necessary to spread the solids onto the hides.

Representative formulations for these various coatings along with their typical costs are presented in Table 2. As Table 2 indicates, the solvent-based coatings are generally slightly less expensive than their water-based counterparts.

Lacquers have the following advantages over water-based coatings:

- They have much less surface tension, thus allowing a more uniform spread and better penetration when applied. Water, with its higher surface tension is a poor thinner that is more likely to "bead" on the product. Poor penetration into the leather and reduced drying capacity are also of concern with water-based coatings in some cases.
- There is less sticking to the plating machine during the embossing or "plating" when the leather's texture is being modified;
- They give higher quality gloss to the finished leather; and
- They impact enhanced water resiliency and scruff-resistance.

Most of the advantages that solvent-based coatings have over their water-based counterparts are at the top coat application stage where gloss and resiliency must be well-established.

However, the water-based coatings have the advantage of being able to hold more solids in the primary vehicle (water). Water-based coatings can carry upwards of 50% more solids by weight. This can be important in the base and intermediate coating stages where much less water-based coatings need be applied than comparable lacquers. Since gloss, resiliency and other surface characteristics are of less concern at these earlier coating applications water-based materials can and are used here.

3.3 VOC Emission Rates

After the flow coating (if applied), the subsequent coatings are usually applied to the leather by either a rotary nozzle sprayer or by a roll coater, with the former being the predominant method in southeastern Wisconsin. The rotary nozzle sprayer has been described in Section 3.2.2.

The leather coating process involves a wide variety of hides, and type, number and thickness of coatings. As such, the Department decided to estimate VOC emission rates based upon the amount of coating material, per each coating, that would be applied to any one series of hides. The VOC emission rate unit is kilograms per 100 square meters (kg VOC/100m²) of leather for each application. Each VOC emission factor would highlight the above-listed variations.

In calculating VOC emissions from any uncontrolled surface coating operation, it is generally assumed that all VOCs contained in the coating evaporate and are eventually emitted into the ambient atmosphere. This assumption could be modified in light of conclusive evidence to the contrary.

Table 2

Representative Leather Coating Formulations and Cost ^(a)

Percent Content by Weight

Ingredient	Water-based	Lacquer Emulsions ^(b)	Strict Lacquer
VOCs	10	60	85
Solids	30	15	15
Water	60	25	0
Cost range			
(\$/lb) ^(a)	0.70-2.70	0.80-1.20	0.75-2.10
(\$/kg) ^(a)	1.54-5.95	1.76-2.65	1.65-4.63
Representative			
Cost (\$/lb) ^(a)	2.20	0.90	0.90
(\$/kg) ^(a)	4.85	1.98	1.98

^(a) Derived from estimates supplied by the Henkel Corporation, Oak Creek, 1985. Year 1985 dollars.

^(b) Assuming that the basic lacquer emulsion is diluted 3 parts emulsion to 1 part water.

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The large Milwaukee area tanneries supplied VOC emission rate data to the Department during late 1985 - early, 1986. This information shows that there is a wide variation in the coating application among the leather finishers in southeastern Wisconsin. One coater uses very little water-based materials and no roll coating. Another facility needs to apply several extra coats to much of its leather to enhance the leather's scruff-resistance and waterproof qualities for use in footwear manufacturing. Different coatings are sometimes applied separately. On other occasions, various coatings are mixed together and then applied. One tannery uses the roll coating technology primarily with low solvent coatings; another employs similar equipment mostly with lacquers. In general, there are numerous permutations and combinations of different coating materials and methods of application in use in southern Wisconsin. The result is that there is a wide range in the VOC emission rates. Table 3 presents some ranges for various coating systems (i.e., coating type and application method) based on the information supplied by the leather finishers to the Department during the past seven months. The numbers contained in Table 3 highlight the wide variation in VOC emission rates from leather coating operations.

3.4 Potential Leather Coating VOC RACT Measures and Cost

3.4.1 Low Organic Solvent/High Solids Coatings

VOC emissions from lacquers (over 80% VOCs) or lacquer emulsion-based coatings (over 50% VOCs) can be reduced by more than 50 percent by employing coatings which have low levels of organic solvents (less than 20% VOCs). The actual VOC reduction achievable depends on the organic solvent contents of the original coating and the proposed alternative(s). Substituting low organic solvent or high solids coatings is the accepted method to lower VOC emissions from all industrial surface coating operators.

Using a coating which has a low organic solvent content may preclude the need for any further controls. In some cases, the coating equipment and procedures may need not be altered when a plant converts to low solvent coatings. This would keep the capital investment in coatings substitution or reformulation to a minimum.

Because water-based and high solids coatings are a proven technology that can feasibly reduce VOC emissions, the Department is proposing that this type of coating constitutes a reasonably available control technique for reducing VOC emissions from leather coating operations.

The Department is aware that product specification requirements can often necessitate the continued use of high solvent coatings. Each type of leather has its own requirements that must be met. Each individual coating system must be evaluated on a case-by-case basis as to whether low solvent/high solids finishes can be adequately substituted.

3.4.2 Roll Coating

Roll coating, as stated in section 3.2.2, has become increasingly popular in certain sectors of the leather finishing industry due to its higher transfer efficiency (estimated to be close to 100%). Pfister and Vogel Tanning Company (1986) stated that roll coating applications require only about 20% of the finishing material used in a comparable air-atomized spray application.

Table 3
VOC Emission Rates
Various Coating Systems
Southeastern Wisconsin - 1985^a

Application Method	Coating Type	VOC Emission Rate (kg/100 m ²)
Flow	Oil Impregnation	2.39-9.76
Air Atomized Spray	Stain	7.81-14.16
Air Atomized Spray	Middle	0.33-6.41
Air Atomized Spray	Emulsion	3.42 ^b
Air Atomized Spray	Effect (1st top coat)	1.95-12.7
Air Atomized Spray	Lacquer (final top coat, sealer)	2.44-16.11
Roll	Oil Impregnation	2.93 ^b
Roll	Stain	1.12-2.93

^aBased upon information received from Amity Leather Products Co., Gebhardt-Vogel Tanning Company, and Pfister & Vogel Tanning Company during November 1985 - April 1986.

^bOnly one value presented from the above listed leather finishers.

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According to a midwest distributor of leather coating equipment, a typical roll coater costs between \$26,000 and \$35,000 (year 1984 dollars, including installation and setup costs).

Assuming that roll coater's use one-fifth the finish of spray systems, it is likely that a roll coating machine could pay for itself within ten years of operation through reduced coating usage. After its payback period, the equipment would give the company a net savings in reduced coating costs. This benefit could occur even if depreciation and tax write-off deductions are not included. A net zero cost of the equipment over 10 years would imply that the ten year, gross annualized cost per ton of VOCs reduced would also be zero. This compares quite favorably with the cost of reducing VOCs for other surface coating categories (Table 4).

The high efficiency, relative simplicity, proven experience, and anticipated capital return of this equipment makes it a pragmatic technique for reducing the amount of VOCs into the atmosphere. As such, the Department is proposing that roll coating constitute a VOC reasonably available control technique (RACT) for leather coating operations. Roll coating would be a Department approved method to meet compliance with any promulgated leather coating VOC emission limitation control requirement.

In recommending roll coating as one VOC RACT for leather finishing, the Department is aware that this method cannot be substituted for the air-atomized spray method in all cases. Product specifications often require the use of spraying. Because of the roll coater's considerable savings in coating, it is to the leather finishers economic advantage to continually investigate every possible use of this technology in its operations.

3.4.3 Microprocessor Controls on Air-Atomized Spray Equipment

The rotary arm sprayer has the potential for much overspray and underspray on the hides passing below it. This unevenness in the finishing application also results in much unnecessary solvent (and VOC's) being emitted into the atmosphere. As such, the Department is proposing that microprocessor controls (e.g., "electric eyes") on all air-atomized spray equipment be a required VOC RACT for the leather coater's. According to the Pfister and Vogel Tanning Company (1986), rotary air atomized spray equipment without microprocessor controls results in a typical transfer efficiency of 27%. However, Pfister and Vogel stated that the use of a microprocessor increases the efficiency to 45%. This results in a reduced coatings consumption by 40%.

This equipment is relatively inexpensive to install and can pay for itself in reduced coating costs in several months. Indeed, most air atomized spray systems used in the southeastern Wisconsin leather coating industry are already fitted with these microprocessor controls.

Table 4

Analyzed Estimated Cost (Year 1985 Dollars)
Per Ton of VOC Reduction
Industrial Surface Coating Categories
In Wisconsin that are Subject to RACT^(a)

<u>RACT I</u> <u>Industrial Surface Coating Category</u>	<u>Analyzed Cost</u> <u>per ton VOC Reduction^(b)</u> <u>(\$ per ton/yr)</u>
Cans	34
Fabrics	420
Automobiles	5400
Metal Furniture	500
Large Appliances	1700

^(a) From Exhibit 1-2, Economic Impact of Implementing RACT Guidelines in the State of Wisconsin, Volume 1, Executive Summary, Drafter Final Report Booz, Allen and Hamilton, Inc., October 6, 1978.

^(b) Adjusted from Booz-Allen's year 1978 dollar estimate to 1985 dollars by assuming 40% inflation in cost between these years.

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3.4.4 Add-On Controls

Add-on VOC controls are post-process techniques that allow for the venting and either destruction or removal of VOC's after the coatings have been applied to the hides. Incinerator and carbon adsorbers would be examples of add-on controls.

Add-on controls as a potential leather coating VOC RACT must be evaluated in terms of annualized cost portion of VOCs reduced. These calculations for a representative thermal incinerator (no heat recovery) are based on equations developed by WAPORA (1981) and contained in Table 5.

The gross ten-year annualized cost of an incinerator, as calculated in Table 5, is \$144,230. Assuming an overall control efficiency of 85%, a source that approximates the parameters listed in Table 5 and emits 100 tons VOCs per year would pay $\$144,230 / (0.85 * 100 \text{ tons}) = \$1,697/\text{ton VOC reduced}$. A two hundred ton/year VOC source with similar operating specifications would pay $\$1697/2 = \$848/\text{to VOC reduced}$. However, it can be assumed that the larger the source, the more operation and maintenance costs. The cost/VOC reduction factor is not a constant multiple of one baseline value. Nevertheless, the cost of reducing leather coating VOC emissions is comparable when compared with similar estimates for other surface coating operations (Table 4). The Department, based upon the information available to it, and the subsequent calculations (Table 5), is recommending that thermal incineration be considered on a case-by-case as VOC RACT.

At this time, the Department is also preliminarily recommending that compliance with any promulgated leather coating VOC emission limitation rule be achievable through the appropriate application of low-solvent coatings, microprocessor controls on spray systems, and roll coating technology alone. The status of this recommendation may change in light of new data.

Carbon adsorption is not being recommended as VOC RACT for leather coating. This type of system, which is approximately three times as expensive as a thermal incinerator of comparable size (WAPORA, 1981) is only feasible when much of the captured solvent can be recycled. The multitude of different leather coating vented to a carbon adsorber make such recovery system economically unfeasible since additional expensive distillation would be required for any solvent recovery.

3.5 Proposed Leather Coating RACT VOC Emission Limitation Rule

3.5.1 Proposed VOC Emission Limits

As section 3.2 and 3.3 describe, the leather coating VOC emissions are derived from a large number of permutations in the coating formulation and application types. This wide variety of coating systems make it difficult to succinctly define a VOC emission limitation or limitation that would reflect an adequate implementation of RACT (section 3.4). The absence of a U.S. EPA control technique guideline (CTG) for this category compounds the problems involved in setting VOC RACT limits for leather coating.

Table 5
Estimated Annualized Cost
Thermal Incinerator (No Heat Recovery)
Leather Coating Facility

Assumptions

- Representative air velocity in the vicinity of the coating equipment:
150 ft./min
- Flow rate in vicinity of coating equipment:
 $150 \text{ ft./min} * 8 \text{ ft. (wide)} * \text{ft. (high)} = 1200 \text{ ft.}^3/\text{min}$
- Operating Temperature: 1300°F = Temp.
- VOC Conc. in gas stream: 50 ppm
- Hours per year operation = 40 hrs/day * 260 days/yr = 2600 hrs/yr. actual running time is 1300 hrs/yr. (0.5 * operating time)
- Overall Control Efficiency: 85%
- Heat recover = $\frac{1}{6}$
- Base year (1981) fuel cost: \$2.13/MMBTU^(a) (#2 fuel oil)
- Base year (1981) electrical cost: \$0.055/kwh^(a),
- Inflation factor, year 1985 dollars to year 1981 dollars: 1.4,
- Interest on equipment purchase loan: 18%,
- Full loan payment annually uniform in 10 years,
- Deduction for depreciation, taxes and interest not included, and
- Installation Cost: 2.8 * unit cost (not including interest)^(a)

Calculations

- 1) Unit cost: $\$ = 2.7 * \text{flow rate} + 22,000$
 $= 2.7 * 12000 + 22,000$
 $= 54,400 \text{ (year 1981 dollars)}$
- 2) Including factors for inflation and installation:
 $(1.4) * (2.8) * \$54,400 = \$213,200$

Table 5 (Continued)

- 3) Total interest on the equipment and installation loan, assuming complete uniform payment over ten years:

$$[(1.18^{10} - 1) / 0.18] * \$213,000 = \$451,000$$

- 4) Annualized cost of equipment, installation and interest over a 10 year period:

$$(\$213,000 + \$451,000) / 10 = \$66,400/\text{year}$$

- 5) Annual Electrical Costs = (HP) * (0.75) * (Hr/yr operation) * (elec. costs) * Inflation^(*)

Where HP = Horsepower for fan

$$\begin{aligned} &= [SCFM^{1.0363} * (459 + \text{temp})^{1.85}] / 94.2 * 10^6 \\ &= [12000^{1.0363} * (459 + 1300)^{1.85}] / 94.2 * 10^6 \\ &= 180.7 \text{ horsepower} \end{aligned}$$

$$\begin{aligned} \text{Electrical Costs} &= (180.7) * (0.75) * 2600 * \$0.055/\text{kwh} * 1.4 \\ &= \$27,130/\text{yr.} \end{aligned}$$

- 6) Annual Fuel Costs = (BTU/hr) * (fuel unit cost * 10⁻⁶) * hr/yr * Inflation factor^(*)

$$\begin{aligned} \text{where BTU/hr} &= SCFM * [1.28 * (1400 - \text{Temp}) * (1 - \text{HR}) \\ &\quad - (0.29 * \text{ppm} * \text{RT})] \end{aligned}$$

$$\begin{aligned} &= 12000 * [1.28 * (1400 - 1300) * (1) - (0.29 * 150 * 0.5)] \\ &= (12000) (128 - 7.23) = 1.449 * 10^{10} \text{ BTU/hr.} \end{aligned}$$

$$\text{Annual Fuel Cost} = (1.449) * (\$7.13) * 2600/\text{yr.} * 1.4 = \$37600/\text{yr}$$

7. Annual Water Cost = SCFM * (hr/yr) * \$0.30/10³ gal. * Inflation^(*)

$$= 12000 * 2600 * 0.3 * 10^{-3} * 1.4$$

$$= \$13100/\text{yr.}$$

$$\begin{aligned} \text{Total Annualized Costs:} & \text{Annualized equipment purchase (\#4) + Electrical} \\ & (\#5) + \text{Fuel} + \text{Water (\#7)} \\ & = \$144,230/\text{yr.} \end{aligned}$$

^(*) From Assessment of Organic Emissions in the Flexible Packaging Industry (EPA-600/2-81-009), WAPORA, Inc., Chevy Chase, MD. January, 1981.

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The original draft rule had only one limit representing a composite of various leather coating materials (water-borne, emulsions and lacquers) and application types (spray and roll). Based upon comments received on this first draft of the rule, the Department has striven to improve the rule by establishing VOC limits that more accurately reflect the wide variety of coating types.

The revised rule would establish VOC emission limits for each of the basic functional coating types (impregnation, stain, base or middle, effect and finish coats) that are significant emitters of VOC's. It is recognized that each of these function types (save for impregnation) has a somewhat identifiable range of VOC emission rates for air-atomized spray systems. Based on data received by the Department, qualitative assessments of potential VOC emission reductions have been projected for each function type. These assessments are based upon research and testing with the available technology that is proposed as RACT. These projections are based upon the assumption that customer specifications and state-of-the-art technology will remain essentially the same for the immediate future.

U.S. EPA CTG's recommended VOC emission limits based, in part, upon evidence that some facilities had already met these limits by applying the category-specific RACT. The Department has developed its leather coating VOC RACT limits in a similar manner. Namely, the Department studied the total range of VOC emission rates for each function type as submitted by the leather coating facilities. Based upon these ranges (minimum and maximum values are listed in Table 3), the Department has determined that the 16% in each spray coating range (frequency distribution) would represent an adequate degree of RACT. In other words, the proposed VOC limits would be established at a level that is currently being achieved about 16% of the time at the 3 largest leather coater's in the Milwaukee area.

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This standard translates into the proposed VOC RACT emission limitations for the following categories (with accompanying proposed Department definitions):

- Impregnation coat (penetration into the hide for tightening or setting up the fibers. Also used for increased hide flexibility without cracking):

2.9 kilograms VOCs per 100 square meters (2.9 kg VOCs/100m²) of finished product, regardless of the number of impregnation coats applied (6.0 pounds VOC per 1000 square feet - 6.0 lbs VOCs/1000 ft²).

- Stain coat (color development, or color deepening of the hide's base): 9.3 kg VOCs/100m² (19 lbs VOC/1000 ft²) of finished product regardless of the number of stain coats applied.
- Base color coat (gives the leather its predominant color. It follows any impregnation and/or stain coats, or precedes any effect or final finish coats): 1.0 kg VOCs/100m² (2.0 lbs VOCs/1000 ft²) of finished product, regardless of the number of base color coats applied.

2.9 kg m²
should be 2.9 kg m²
and 1.0 kg m²
should be 1.0 kg m²

- Effect coat (tones the base color and reduces the leather's surface coefficient of friction): 2.0 kg VOCs/100m² (4.0 lbs VOCs/1000 ft²) of finished product, regardless of the number of effect coats applied, and
- Final finish coat (to help improve the leather's gloss, water-resistance and scruff-resistance qualities): 3.4 kg VOCs/1000 ft²) of finished product, regardless of the number of final finish coats applied.

The Department is aware that each finished leather product is subject to one, and only one application of the above-listed coating types. Some leathers receive several applications of one coat, others experience none at all of certain coats, while still other leathers receive coats that are not even contained in any of the above-listed coating categories. The Department has defined these categories and subsequent VOC emission limits based upon a fair statistical representation of the major VOC - emitting spray lines. Some other coating function types (e.g., seasoning) result in negligible amounts of VOC emissions. By controlling the amount of VOCs emitted from the five - previously listed coating function types, the Department fully addresses the VOC emissions concern in southeast Wisconsin's leather coating industry.

3.5.2 Proposed Rule Flexibility in Meeting the VOC Emission Limits

The purpose of this proposed rule is to help reduce the total amount of ozone - precursor (VOCs) emitted into southeastern Wisconsin's atmosphere. The separate limits listed in Section 3.5.1 reflect what might be reasonably expected for each coating function type in achieving this goal. However, the Department is aware that achieving each limit for each product may be difficult. Furthermore, the leather coater's may more readily comply with other certain application limits at certain times. Subsequently, the proposed rule contains a subsection on internal offsets (NR 422.17(03)) of VOC emission rates to meet the facility's monthly-weighted allowable emission limit. Some of the facility's specific leather coating production runs would be allowed to exceed the RACT limit for any given month if the VOC emissions in excess of that allowable for that month would be "offset" by VOC emissions from other lines that are below their respective RACT limits for the same month. Furthermore, the proposed leather coating VOC emission limitations are expressed in units of kilograms VOC per 100 square meters (kg/100m²) of finished leather product regardless of the number of specific coats applied. These emission rate units allow for maximum flexibility in determining which RACT method(s) may be employed to achieve the limit. Any combination of low solvent coating technology roll coating, computer - controlled spray systems, incineration or any other department - approved RACT method may achieve this primary requirement of the rule. Subsection NR 422.04(1), Wis. Adm. Code ("Methods of Compliance") lists the VOC control options that would be available to any leather coating facility subject to the rule.

3.5.3 Recordkeeping and Reporting Requirements

Each affected facility will obviously have to closely monitor its coatings usage, VOC emission totals, production totals, and methods of compliance employed for all coating lines subject to the rule. This monitoring must necessarily be done on a monthly basis to meet the internal offset provisions. In the short run, monthly production schedules will need to be evaluated, possibly revised and closely followed to ensure that the facility's overall monthly-weighted emission rate is not exceeded. Records of these activities must be maintained and reported to the Department in accordance with proposed Chapter NR 439 ("Compliance Demonstration"), which will be proposed for adoption approximately concurrently with this rule, but as part of different Natural Resources Board order number. (2)

3.5.4 Proposed Compliance Schedule and Variance Provisions

The Department's commitment to develop, promulgate and implement all VOC RACT rules include the provision of certified final compliance for each affected facility not later than December 31, 1987. This date is the same as the ozone attainment deadline for the southeastern Wisconsin ozone nonattainment area. Each stationary sources subject to any RACT must achieve compliance with the appropriate rule before this date in order for the region to take certified credit for the subsequent VOC reductions. These VOC reductions are required under the 1982 Ozone State Implementation Plan for southeastern Wisconsin.

If this proposed rule is promulgated, it will be done so at a late date, relative to the December 31, 1987 deadline. On the other hand, much (if not most) of the technology necessary to achieve compliance is already in place for the affected leather coating facilities. It would be a matter of improving and enlarging the role of these VOC emission control technologies to meet the rule requirements. As such, the Department believes that this rule can be coupled with in the required timeline (i.e., before December 31, 1987) by meeting the following compliance schedule, as measured from the effective date of the rule:

- Submit final plans for achieving compliance within 4 months,
- Award contracts for equipment modifications or issue orders for the purchase of component parts to accomplish equipment modifications within 5 months,
- Commence construction or installation of equipment modifications within 7 months, and
- Achieve final compliance not later than December 31, 1987.

This schedule is somewhat tighter than that required in previous VOC RACT rules. However, any affected facility that believes it can not meet this schedule, or any other provision(s) in the rule, may apply for a variance under section NR 439.05.

3.5.5 Estimated Impact of the Proposed Rule

1980 is the base year for estimating the impact of any RACT rule as part of the 1982 ozone plan. Since that time, the southeastern Wisconsin leather coater's have substantially increased the efficiency of their operations. Computer-controlled spray equipment, roll coating and low solvent coatings either came into initial use or were greatly expanded in use during the first half of the 1980's at these tanneries. The surge in foreign competition will further mandate continued improvements in their operations.

And most of these improvements have and will continue to result in less coating be applied to the leather. Less coating means fewer VOCs emitted. A prime example is by simply employing computer controls on spray lines, the amount of coating used has been reduced by 40% since 1980 (Pfister and Vogel (1980)). Furthermore, the leather coater's are always seeking ways to expand their use of water-based coatings, which are less costly than solvent-based coatings on per unit area basis. By setting the VOC emission rates near the low end of the air atomized spray ranges listed on Table 3, the Department has established goals that are achievable by the affected facilities in the required timeline (i.e., before December 31, 1987).

The projected impact of this rule on the region's leather coating VOC emissions can not be made at this time. Currently, there is not enough information available to the Department to make this estimate. Such calculations will be conducted when the affected facilities begin supplying monthly records as part of its rule compliance requirements.

The leather coating industry is relatively complicated in understanding its impact on VOC emissions. Developing VOC RACT and proposed rule for this industry has not been easy either. Subsequently, the rule's impact will also take awhile to understand.

Both the energy and environmental impacts (primarily industrial wastewater) from leather coating operations are approximately proportional to the amount of coating used. Since roll coating is more efficient than spray coating, there would be a net reduction in energy consumption and process wastewater when the former equipment is employed.

When substituting water-based coatings, there may be a slight increase in energy consumption due to some additional oven-drying.

There would be an increase in natural gas consumption if thermal incineration is utilized as a method to comply with any emission limitation. The impact on the environment from increased natural gas usage would be negligible.

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References

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Pfister and Vogel Tanning Company, April 29, 1986A: VOC Reduction Study Report. Submitted to the Wisconsin Department of Natural Resources, Bureau of Air Management.

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Wayne, W. S.; Wehrle, P. F.; and Carroll, R. E., 1967: "Oxidant Air Pollution and Athletic Performance," Journal of the American Medical Association, 199:901.

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U.S. EPA, January 22, 1981: Federal Register, Vol. 46, pp. 7186.

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U.S. EPA, 1980: Environmental Impact Guidelines for New Source Leather Tanning and Finishing Industries (EPA-130/6-80-002), pp. 143.

WAPORA, Inc. 1981; Assessment of Organic Emissions In the Flexible Packaging Industry. EPA-600/2-81-009. 85 pp.

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State of Massachusetts

PUBLIC HEARING DRAFT

(22) Leather Surface Coating

- (a) Applicability. 310 CMR 7.18(22) applies in its entirety to any person who owns, leases, operates or controls leather surface coating line(s) which in total have the potential to emit, before the application of air pollution control equipment, equal to or greater than 50 tons per year of volatile organic compounds.
- (b) Reasonably Available Control Technology Requirements. On or after July 1, 1993, unless exempted by 310 CMR 7.18(22)(c) or granted a non-renewable extension by the Department under 310 CMR 7.18(22)(d), no person subject to 310 CMR 7.18(22)(a) shall cause, suffer, allow or permit emissions from any leather surface coating line in excess of 27.4 lbs VOC/gallon of solids applied.
- (c) Exemptions. The requirements of 310 CMR 7.18(22)(b) do not apply to:
1. a. any person subject to 310 CMR 7.18(22)(a) who is able to demonstrate to the Department that, since January 1, 1990, the leather surface coating line(s) have not, in total, emitted, before the application of air pollution control equipment, greater than or equal to 50 tons per year of volatile organic compounds; and
b. provided the person obtains a permit restriction from the Department under 310 CMR 7.02(12) which restricts the potential emissions to below 50 tons per year; and
c. provided the person complies with other sections of 310 CMR 7.18(22).
 2. any person subject to 310 CMR 7.18(22)(a) who, according to the Department, has complied with 310 CMR 7.18(17) prior to January 1, 1993.
- (d) Extensions.
1. Any person subject to 310 CMR 7.18(22)(b) may apply in writing to the Department for a non-renewable extension of the implementation deadline. The person must apply to the Department for the non-renewable extension at the same time the person submits the emission control plan required by 310 CMR 7.18(20).
 2. The Department will consider a non-renewable extension of the deadline in 310 CMR 7.18(22)(b) until no later than July 1, 1994, provided the emission control plan submitted for approval 7.18(20), meets the following criteria in addition to those of 310 CMR 7.18(20):

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- a. the emission control plan must meet all requirements of M.G.L.c. 21I; and,
 - b. the emission control plan must be approved by a Toxics Use Reduction Planner certified under M.G.L.c. 21I, or an employee of the facility must be certified as a Toxics Use Reduction Planner; and,
 - c. implementation of the plan must meet the emission limitations of 310 CMR 7.18(22)(b) or achieve a 85% emissions reduction, whichever is greater, without using add-on air pollution control equipment, as calculated on a mass of VOC emitted per gallons of solids or unit of production; and,
 - d. the emission control plan must also contain contingency measures to meet the RACT emission limitation in 310 CMR 7.18(22)(b); such measures must automatically take effect if the emissions reductions achieved by meeting the requirements of M.G.L.c. 21I do not satisfy 310 CMR 7.18(22)(b).
- (e) Plan Submittal Requirements. Any person who owns, leases, operates or controls a leather surface coating line(s) subject to 310 CMR 7.18(22)(a) must submit an emissions control plan, and have the plan approved by the Department under 310 CMR 7.18(20).
- (f) Continuous Compliance. Any person who owns, leases, operates or controls a leather surface coating line(s) subject to 310 CMR 7.18(22)(a) shall maintain continuous compliance at all times with their approved emissions control plan. Compliance averaging times will be met in accordance with the requirements of 310 CMR 7.18(2)(a). Demonstrations of compliance may include considerations of transfer efficiency provided that the baseline transfer efficiency is equal to or greater than 65%, and the transfer efficiency test method is detailed in the emission control plan (310 CMR 7.18(20)) approved by the Department.
- (g) Recordkeeping Requirements. Any person who owns, leases, operates or controls a leather surface coating line(s) subject to 310 CMR 7.18(22)(a) shall prepare and maintain daily records sufficient to demonstrate compliance consistent with the applicable averaging time as stated in 310 CMR 7.18(2)(a). Records kept to demonstrate compliance shall be kept on site for five years and shall be made available to representatives of the Department and EPA in accordance with the requirements of an approved emission control plan (310 CMR 7.18(20) or upon request. Such records shall include, but are not limited to:

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transfer efficiency test method is detailed in the emission control plan approved by the Department.

(h) Recordkeeping Requirements. Any person who owns, leases, operates or controls a coating line(s) subject to 310 CMR 7.18(21)(a) shall prepare and maintain daily records sufficient to demonstrate compliance consistent with the applicable averaging time as stated in 310 CMR 7.18(2)(a). Records kept to demonstrate compliance shall be kept on site for five years and shall be made available to representatives of the Department and EPA in accordance with the requirements of an approved emission control plan (310 CMR 7.18(20)) or upon request. Such records shall include, but are not limited to:

1. identity, quantity, formulation and density of coating(s) used;
2. identity, quantity, formulation and density of any diluent(s) and clean-up solvent(s) used;
3. solids content of any coating(s) used;
4. actual operational and emissions characteristics of the coating line and any appurtenant emissions capture and control equipment;
5. quantity of product processed;
6. any other requirements specified by the Department in any approval(s) issued under 310 CMR 7.18(20) or any order(s) issued to the person.

(i) Testing Requirements. Any person who owns, leases, operates or controls a coating line(s) subject to 310 CMR 7.18(21)(a) shall, upon request of the Department, perform or have performed tests to demonstrate compliance with 310 CMR 7.18(21). Testing shall be conducted in accordance with EPA Method 24 and/or Method 25 as described in CFR Title 40 Part 60, or by other methods approved by the Department and EPA.

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1. identity, quantity, formulation and density of coating(s) used;
 2. identity, quantity, formulation and density of any diluent(s) and clean-up solvent(s) used;
 3. solids content of any coating(s) used;
 4. actual operational and emissions characteristics of the coating line and any appurtenant emissions capture and control equipment;
 5. quantity of product processed;
 6. any other requirements specified by the Department in any approval(s) issued under 310 CMR 7.18(20) or any order(s) issued to the person.
- (h) Testing Requirements. Any person who owns, leases, operates or controls a leather surface coating line(s) subject to 310 CMR 7.18(22)(a) shall, upon request of the Department, perform or have performed tests to demonstrate compliance with 310 CMR 7.18(22). Testing shall be conducted in accordance with EPA Method 24 and/or Method 25 as described in CFR Title 40 Part 60, or by other methods approved by the Department and EPA.

State of Illinois

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POLLUTION CONTROL BOARD

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Section 218.920 Applicability

- a) ~~The requirements of this Subpart shall apply to a source's miscellaneous fabricated product manufacturing process emission units which are not included within any of the categories specified in Subparts B, E, F, H, Q, R, S, T, V, X, Y, Z or BB if the source is subject to this Subpart. A source is subject to this Subpart if it contains process emission units, not regulated by Subparts B, E, F (excluding Section 218.204(1) of this Part), H (excluding Section 218.405 of this Part), Q, R, S, T (excluding Section 218.486 of this Part), V, X, Y, Z or BB of this Part; which as a group both:~~
- ~~1) Have maximum theoretical emissions of 91 Mg (100 tons) or more per calendar year of VOM if no air pollution control equipment were used, and~~
 - ~~2) Are not limited to less than 91 Mg (100 tons) of VOM emissions per calendar year in the absence of air pollution control equipment, through production or capacity limitations contained in a federally enforceable permit or a SIP revision.~~
- a) Maximum theoretical emission:
- 1) A source is subject to this Subpart if it contains process emission units, not regulated by Subparts B, E, F (excluding Section 218.204(1), H (excluding Section 218.405), Q, R, S, T, (excluding Section 218.486) V, X, Y, Z or BB of this Part; which as a group both:
 - A) Have maximum theoretical emissions of 90.7 Mg (100 tons) or more per calendar year of VOM if no air pollution control equipment were used, and

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- B) Are not limited to less than 90.7 Mg (100 tons) of VOM emissions per calendar year in the absence of air pollution control equipment, through production or capacity limitations contained in a federally enforceable permit or a SIP revision.
- 2) If a source is subject to this Subpart as provided above, the requirements of this Subpart shall apply to a source's miscellaneous fabricated product manufacturing process emission units which are not included within any of the categories specified in Subparts B, E, F, H, O, R, S, T, V, X, Y, Z, AA, BB, OO, RR, or TT.
- b) Potential to emit:
- 1) A source is subject to this Subpart if it has the potential to emit 22.7 Mg (25 tons) or more of VOM per year, in aggregate, from emission units that are:
- A) Not regulated within Subparts B, E, F, H, O, R, S, T (excluding Section 218.486), V, X, Y, Z, or BB of this Part, or
- B) Not included within one of the following categories: synthetic organic chemical manufacturing industry (SOCMI) distillation, SOCMI reactors, wood furniture, plastic parts coating (business machines), plastic parts coating (other), offset lithography, industrial wastewater, autobody refinishing, SOCMI batch processing, volatile organic liquid storage tanks and clean-up solvents operations.
- 2) If a source is subject to this Subpart as provided above, the requirements of this Subpart shall apply to a source's miscellaneous fabricated product manufacturing process emission units, which are not included within:
- A) Subparts B, E, F, H, O, R, S, T, V, X, Y, Z, AA, BB, CC, DD, OO, RR or TT of this Part, or
- B) One of the following categories: synthetic organic chemical manufacturing industry (SOCMI) distillation, SOCMI reactors, wood furniture, plastic parts coating (business machines), plastic parts coating (other), offset lithography,

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industrial wastewater, autobody refinishing, SOCM batch processing, volatile organic liquid storage tanks and clean-up solvents operations.

- bc) If a source ceases to fulfill the criteria of subsections (a) and (b) above, the requirements of this Subpart shall continue to apply to a miscellaneous fabricated products manufacturing process emission unit which was ever subject to the control requirements of Section 218.926 of this Part.
- ed) No limits under this Subpart shall apply to emission units with emissions of VOM to the atmosphere less than or equal to 0.91 Mg (1.0 ton) per calendar year if the total emissions from such emission units not complying with Section 218.926 does not exceed 4.5 Mg (5.0 tons) per calendar year of this Part.
- de) For the purposes of this Subpart, an emission unit shall be considered regulated by a Subpart if it is subject to the limits of that Subpart. An emission unit is ~~not~~ considered not regulated by a Subpart if it is not subject to the limits of that Subpart, e.g., the emission unit is covered by an exemption in the Subpart or the applicability criteria of the Subpart are not met.
- ef) For the purposes of this Subpart, ~~uncontrolled VOM emissions in the absence of air pollution control equipment~~ are the emissions of VOM which would result if no air pollution control equipment were used.

(Source: Amended at ___ Ill. Reg. ___, effective _____)

Section 218.926 Control Requirements

Every owner or operator of a miscellaneous fabricated product manufacturing process emission unit subject to this Subpart shall comply with the requirements of subsection (a), (b) or (c) of this Section:

- a) Emission capture and control techniques which achieve an overall reduction in uncontrolled VOM emissions of at least 81 percent from each emission unit, or

(Board Note: For the purpose of this provision, an emission unit is any part or activity at a source of a type that by itself is subject to control requirements in other Subparts of this Part or 40 CFR 60, incorporated by

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reference in Section 218.112, e.g., a coating line, a printing line, a process unit, a wastewater system, or other equipment, or is otherwise any part or activity at a source.)

b) For coating lines:

1) ~~The~~ The daily-weighted average VOM content shall not exceed 0.42 kg VOM/l (3.5 lbs VOM/gal) of coating as applied (minus water and any compounds which are specifically exempted from the definition of VOM) during any day. Owners and operators complying with this ~~Section~~ limitation are not required to comply with Section 218.301 of this Part, or

2) For leather coating lines at a source where the criteria of Section 218.920(a) are not met:

A) The VOM contained in stain coatings, other than stain coatings applied to specialty leather, as applied at the source in any consecutive 12 month period shall not exceed 10 tons; and

B) The total VOM content of all coatings, including stains, as applied to a category of specialty leather, shall not exceed 38 lbs per 1000 square feet of such specialty leather produced, determined on a monthly basis, or

c) An alternative control plan which has been approved by the Agency and approved by the USEPA as a SIP revision.

(Source: Amended at ___ Ill. Reg. ___, effective _____)

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Monterey Bay Unified Air Pollution Control District

PART 1 GENERAL

1.1 Purpose

The purpose of this rule is to reduce the emissions of volatile organic compounds (VOCs) into the atmosphere during the use, application, or drying of VOC-containing leather treatment materials and solvents used in leather processing facilities, operations, and processes.

1.2 Applicability

The provisions of this rule shall apply to all facilities, operations, and processes where leather is treated with volatile organic compounds or with materials that contain VOCs. As of the date of adoption of this rule, Salz Leathers of Santa Cruz is the sole affected source

1.3 Exemptions

There are no exemptions to the rule.

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1.4 Effective Dates

1.4.1 The requirements of this rule shall be effective on the date of adoption.

1.4.2 Effective dates for emission reduction measures are given in sections 3.1 and 3.2 of this rule.

1.5 References

1.5.1 The requirements of this rule implement provisions of the District Air Quality Management Plan of 1991.

1.5.2 The requirements of Sections 3.1 and 3.2 of this rule are derived from Section 40918 (b) of the California Health and Safety Code and Section 182 (b)(2) of the federal Clean Air Act which require the use of the best available retrofit control technology and reasonably available control technology for the attainment of state and federal ambient air quality standards for ozone.

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PART 2 DEFINITIONS

2.1 Combined efficiency

The capture efficiency multiplied by the control efficiency of capture and control equipment, expressed as overall weight percent, to be used for compliance with section 3.1 of this rule.

2.2 Exempt organic compounds

Group III compounds as defined below.

2.3 Group I compounds

any organic compound which has been identified as a toxic air contaminant including, but not limited to, methylene chloride.

2.4 Group II compounds

any stratospheric ozone depleting compound including, but not limited to: 1,1,1-trichloroethane, trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), chlorodifluoromethane (HCFC-22), 1,1,1-trichloro-2,2,2-trifluoroethane (CFC-113), 1-chloro-1,1-difluoro-2-chloro-2,2-difluoroethane (CFC-114), chloropentafluoroethane (CFC-115), 2,2-dichloro-1,1,1-trifluoroethane (HCFC-123), 1,1-dichloro-1-fluoroethane (HCFC-141b), 1-chloro-1,1-difluoroethane (HCFC-142b), 2-chloro-1,1,1,2-tetrafluoroethane (HCFC-124).

2.5 Group III compounds

any of the following: trifluoromethane (HFC-23), 1,1,1,2-tetrafluoroethane (HFC-134a), pentafluoroethane (HFC-125), 1,1,2,2-tetrafluoroethane (HFC-134), 1,1,1-trifluoroethane (HFC-143a), 1,1-difluoroethane (HFC-152a), and the following classes of perfluorocarbons: (a) cyclic, branched, or linear, completely fluorinated alkanes; (b) cyclic, branched, or linear, completely fluorinated ethers with no unsaturations; (c) cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations; and (d) sulfur-containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.

2.6 High-volume low-pressure spray

to spray a coating by means of a spray gun that operates between 0.1 and 10.0 psig air pressure.

2.7 Leather treatment

any liquid material applied onto or impregnated into leather to beautify, protect, or give a finished appearance or quality to the leather, including, but not limited to; lacquers, oils, resins, stains, and top coats.

2.8 Leather treatment process

any portion of an operation where leather treatment materials are applied and/or cured, including material application and the heating, drying or storage of treated leather.

2.9 Ozone depleting compounds

Group II compounds, as defined above.

2.10 Volatile organic compound (VOC)

any compound containing at least one atom of carbon, except: methane, carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, ammonium carbonate, and Group I, Group II, and Group III compounds. When measured or calculated, the VOC concentration of leather treatment materials shall be expressed as the weight of VOCs per volume of treatment material. The volume of treatment material shall not include water or exempt solvents as defined. The oil portion of oil treatment mixtures shall be considered nonvolatile for the purpose of this definition.

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REGULATION IV
PROHIBITIONS

Monterey Bay Unified Air
Pollution Control District
24580 Silver Cloud Court
Monterey, CA 93940

PART 3 REQUIREMENTS

3.1 Sources permitted to emit more than 250 tons per year

By no later than November 1, 1994, any leather processing operation with permitted VOC emissions of five or more tons per day or 250 or more tons per year shall control emissions by the use of control technology which achieves a combined efficiency of 85 percent.

3.2 Sources permitted to emit less than 250 tons per year

By no later than November 1, 1993, any leather processing operation with permitted VOC emissions of less than five tons per day or less than 250 tons per year shall comply with the following requirements:

- 3.2.1 Leather treatment materials shall be reformulated so that the VOC content of each material does not exceed the following limits in pounds per gallon of material as applied:

Material	11/1/93	1/1/95	1/1/96
Stain	7.5		
Oil	7.5		
Resin	1.3		
Top coat	4.0		

- 3.2.2 By no later than November 1, 1993, the following methods shall be utilized to minimize VOC emissions: roll coating for oil application and photoelectric spray controlled spray guns for the application of other VOC-containing treatments.

- 3.2.3 On or after November 1, 1995, a person or facility may not apply leather treatment materials to leather unless the material is applied with properly operating equipment, according to proper operating procedures, and by the use of one of the following methods: roll coating, flow coating, dip coating, or photoelectric spray controlled high-volume low-pressure spray.

3.3 Restricted reformulations

A leather treatment material shall not be reformulated with Group I compounds (toxic air contaminants) or Group II

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compounds (stratospheric ozone depleting compounds) for the purpose of compliance with this rule.

3.4 Restricted clean-up solvents

Group I or Group II compounds shall not be used as clean-up solvents for leather treatment processes or equipment.

3.5 Storage in closed containers

All materials which contain VOCs, including treatments, solvents, and clean-up wastes, shall be kept in containers that are closed except when filling or emptying.

3.6 Incidental emissions

All materials which contain VOCs, including media into which VOCs have been absorbed or adsorbed by emissions control devices and all forms of VOCs to be recovered, recycled or disposed, shall be handled, stored and transported so that emissions of VOCs to the atmosphere, soil, groundwater, or any other environmental media are minimized.

PART 4 ADMINISTRATIVE REQUIREMENTS

4.1 Daily Material Usage Record

A Record of daily VOC usage shall be created and maintained for each day that leather is processed.

4.1.1 The Record shall be in a format which is approved by the District.

4.1.2 The Record shall be signed at the end of each shift or at the end of each day by the responsible operator or facility manager.

4.1.3 The Record shall be kept on a 24 hour daily basis and made available upon request for inspection by the District for two years from the date of each entry.

4.1.4 The Record shall provide the following data for each day:

4.1.4.1 the amount of VOCs mixed, dispensed, and emitted from each designated stock or brand name mixture,

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REGULATION IV
PROHIBITIONS

Monterey Bay Unified Air
Pollution Control District
24580 Silver Cloud Court
Monterey, CA 93940

4.1.4.2 the amount of VOCs used and emitted as clean-up or testing materials, and

4.1.4.3 a summation of the amount of VOCs emitted from all operations in the facility.

4.2 Quarterly summary

A summary of daily emission amounts, tabulated monthly, shall be submitted quarterly.

4.3 Book of formulas

A book of designated leather treatment material formulas shall be maintained at the facility and provided to the District upon request. The book shall contain such treatment designations and technical data sheets for stock and brand name chemicals and mixtures used to formulate each designated treatment so that the estimates of daily emissions may be verified.

PART 5 TEST METHODS

5.1 The VOC content of treatments and solvents shall be determined using Method 24 of the U.S. Environmental Protection Agency (40 CFR 60, Appendix A).

5.2 The quantity of exempt organic compounds in treatment formulas and solvents shall be determined using California Air Resources Board Test Method 432.

5.3 The control efficiency of air pollution control equipment shall be determined using EPA Methods 2, 2A, 2C, or 2D for measuring flow rates and EPA Methods 25, 25A, or 25B for measuring the total gaseous organic concentrations at the inlet and outlet of the control device.

5.4 The capture efficiency of control equipment shall be determined according to the EPA protocol of Title 40, Code of Federal Regulations, Part 52.741.

* * * * *

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APPENDIX D

LEATHER TANNING AND FINISHING FACILITIES

D.1 Introduction to Appendix D

This appendix lists all of the facilities known to be tanning or finishing leather. Various sources were used to compile this list. These sources included emissions data bases, State and local agency inventories, industry directories, conversations with professionals in the leather industry, and published reports. Due to constant changes within the industry, there may be some inadvertent omissions or inclusions of plants in the list.

APPENDIX D - LEATHER TANNING AND FINISHING FACILITIES

CALIFORNIA

Salz Leathers, Inc.
1040 River Street, Box 1840
Santa Cruz, CA 95061
(408) 423-4470

COLORADO

Western Tanning Inc.
1454 Highway 50
Delta, CO 81416
(303) 874-7631

FLORIDA

Acme Sponge & Chamois Co, Inc.
855 E. Pine Street, Box 338
Tarpon Springs, FL
(813) 937-3222

IOWA

Oshkosh Tanning Co., Inc.
Industrial Park Road
Boone, IA 50036
(515) 432-8500

ILLINOIS

Gutmann Leather Co.
1511 W. Webster Ave.,
Chicago, IL 60614
(312) 348-5300

Horween Leather Company
2015 Elston Avenue
Chicago, IL 60614
(312) 772-2026

Huch Leather Company
1525 West Homer Street
Chicago, IL

MASSACHUSETTS

Carr Leather Company
500 Boston Street
P.O. Box 270
Lynn, MA 01903
(617) 599-2511

Barnet Corp.
58 Pulask Rd.
Peabody, MA 01960

Bond Leather Co., Inc.
Summit Industrial Park
Bldg. 38, Summit Street
Peabody, MA 01960
(508) 531-3227

Rex Finishing, Inc.
R 119 Foster St.
Peabody, MA 01960
(508) 531-2076

Richard Leather Co., Inc.
9 Webb Street, Box 868
Salem, MA 01971
(508) 745-5440

Salem Suede, Inc.
72 Flint Street
Salem, MA 01970

MAINE

Irving Tanning Co.
Main Street
Hartland, ME 04943
(207) 938-4491

Camden Tanning Corp.
116 Washington St.
P.O. Box C
Camden, ME 04843
(207) 236-3394

Prime Tanning Co., Inc.
Sullivan Street
P.O. Box 713
Berwick, ME 03901
(207) 698-1100

Wilton Tanning Company
Route 2 & 4
Wilton, ME

MARYLAND

W.D. Byron & Sons, Inc.
312 N. Conocoheague St.
Williamsport MD 21795
(301) 233-7500

MICHIGAN

Eagle Ottawa Leather Company
200 N. Beechtree Street
Grand Haven, MI 49417
(616) 842-4000

Whitehall Leather Company
900 South lake Street
Whitehall, MI 49461
(616) 893-1315

MINNESOTA

S.B. Foot Tanning Co.
Bench Street
Red Wing, MN 55066
(612) 388-4731

MISSOURI

Blueside Companies
205 Florence Rd.
St. Joseph, MO 64502
(816) 279-7468

Hermann Oak Leather Co.
4050 North First Street
St. Louis, MO 63147
(314) 421-1173

NORTH CAROLINA

Lackawanna Leather Company
P.O. Box 939
Conover, NC 28613
(704) 322-2015

NEBRASKA

Lackawanna Leather Company
2420 Z Street
Omaha, NE 68107
(402) 734-2360

NEW JERSEY

Schwarz Leather Co.
400 Gotham Pkwy
Carlstadt, NJ 07072

UDO Finishing Company
49 Vesey Street
Newark, NJ 07105

Seton Company
849 Broadway
Newark, NJ 07104
(201) 485-4800

American Leather Manufacturing Co.
219 Elizabeth Ave.
Rahway, NJ 07065
(201) 382-1700

NEW YORK

Colonial Tanning Corp.
8-10 Wilson Street
Box 1068
Gloversville, NY 12078
(518) 725-7190

Fashion Tanning Co., Inc.
6 Van Rd., P.O. Box 1220
Gloversville, NY 12078
(518) 733-7961

Leather Agent, Inc. Tannery
177 W. Fulton Street
Gloversville, NY 12078
(518) 735-3777

Androme Leather Corp.
21 Foster Street
Gloversville, NY 12078

Fromglo Plant
91 Second Street
Gloversville, NY 12078

Independent Leather Mfg. Corp.
315-329 S. Main Street
Gloversville, NY 12078
(518) 725-9416

JBF Industries Inc.
41 W. 11th Ave
Gloversville, NY 12078
(518) 725-7414

Pan American Tanning Corp.
318 W. Fulton Street
Gloversville, NY 12078
(518) 773-7565

Twin City Leather Co., Inc.
3-15 River Street
Gloversville, NY 12078
(518) 725-8113

Wood & Hide Leather Co., Inc.
68 Wood St., P.O. Box 786
Gloversville, NY 12078
(518) 725-7105

Classic Leather Sales Corp.
126 West Fulton St.
Johnstown, NY 12095
(518) 762-9294

Karg Brothers, Inc.
6-20 East Fulton St.
Johnstown, NY 12095
(518) 762-3148

Adirondac Leather Inc.
Fisher Avenue
Johnstown, NY 12095

Allied Split Corp.
422 N. Perry Street
Johnstown, NY 12095

Arrow Leather Finishing Co.
21-23 West St.
Johnstown, NY 12095

Gordon Finishing Co., Inc.
19 West State St.
Johnstown, NY 12095

Pearl Leather Finishers Inc.
Industrial Park
Johnstown, NY 12095

Simco Leather Corp.
99 Pleasant Ave.
Johnstown, NY 12095
(518) 762-7100

Carville National Leather Corp.
Knox Avenue, P.O. Box 40
Johnstown, NY 12095
(518) 762-1634

H&J Leather Finishers, Inc.
312 N. Perry Street
Johnstown, NY 12095

K-Lynn Split Inc.
40-52 W. State St.
Johnstown, NY 12095

Peerless Tanning Co., Inc.
24 Briggs Street
Johnstown, NY 12095

Townsend Leather Co.
45-49 Townsend Ave.
Johnstown, NY 12095

OHIO

Conneaut Leather Inc.
West Adams St.
Conneaut, OH 44030-1160
(216) 593-5205

PENNSYLVANIA

Howes Leather Co., Inc.
Cooper Road
Curwensville, PA 16833

Garden State Tanning
Locust & Franklin Streets
Fleetwood, PA 19522

Gunnison Brothers, Inc.
9041 Tanning Road
Girard, PA 16417-0327
(814) 774-5616

Leather Tech, Inc.
964 Postal Rd.
Allentown, PA 18103

Mercersburg Tanning
209 Oregon St.
Mercersburg, PA 17236
(212) 686-7666

Westfield Tanning Company
360 Church Street
Westfield, PA 16950
(814) 367-5951

Seton Company
Horton Road
Saxton, PA 16678
(814) 635-2937

TENNESSEE

Volunteer Leather Company
Kefauver Drive
Milan, TN 38358
(615) 367-8417

Lannom Tannery
Box 550
Tullahoma, TN 37388
(615) 455-2288

Tennessee Tanning Co.
915 N. Atlantic St., Box 967
Tullahoma, TN 37388
(615) 455-3441

Coey Tanning Co., Inc.
441 Bugscuffle Rd.
Wartrace, TN 33713

TEXAS

S.B. Foot Tanning Co.
Schroetner Industrial Park
Cactus, TX 79013
(612) 388-4731

UTAH

Fox Valley Tanning, Inc.
633 West Center Street
North Salt Lake, UT 84054
(801) 298-3894

WISCONSIN

Berlin Tanning & Mfg, Co
235-T S. Wisconsin St.
Berlin, WI 54923
(414) 361-1818

Cudahy Tanning Company
5043 S. Packard Ave
Cudahy, WI 53110
(414) 483-8100

Blackhawk Leather Ltd.
1000 West Bruce St.
Milwaukee, WI 53204
(414) 671-2690

Gebhardt-Vogel Tanning Co.
2615 W. Greves Street
Milwaukee, WI 53233
(414) 383-4818

Pfister & Vogel Tanning Co.
1513 N. Water St.
Milwaukee, WI 53201
(414) 273-7160

Paul Flagg
1031 Maryland Avenue
Sheboygan, WI 53082

Thiele Tanning Co.
123 N. 27th Street
Milwaukee, WI 53208
(414) 933-1526

Amity Leather Products Co.
742 Indiana Ave
West Bend, WI 53095
(414) 338-6601

WEST VIRGINIA

Howes Leather Co., Inc.
Rt. 250
Frank, WV 24920
(304) 456-4898

APPENDIX E

SELECTED CONTACTS

E.1 Introduction to Appendix E

This appendix includes a list of selected contacts made during the development of the report. This list is provided to assist State and local agency personnel in identifying key professionals who may be of assistance in developing rules for leather tanning and finishing facilities.

APPENDIX E. SELECTED CONTACTS

Environmental Protection Agency

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