



Project Summary

Evaluation of Volatile Organic Emissions Data for Nonprocess Solvent Use in 15 Commercial and Industrial Business Categories

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The report gives results of a project to gather and evaluate existing data on nonprocess solvents; i.e., products not directly incorporated into specific industrial processes. This information is to be incorporated into an overall inventory project assessing consumer product use and emissions. An additional objective of this project is to identify pollution prevention approaches and technology demonstration opportunities to enhance regulatory development efforts. The report presents the data and information gathered for nonprocess solvent use in the following industrial/commercial business categories: automotive repair; bakeries; building renovation; chemical manufacturing; electrical equipment maintenance and repair; florists; furniture repair/restoration; heating, ventilation, and air-conditioning services; machine shops; mold release agents; office products; quick print shops; road paving; roofing; and textile manufacturing.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Ozone nonattainment and air toxics issues are among the most difficult environmental problems facing the U.S. Significant contributors to these environmental issues are the volatile organic compound (VOC) emissions that result from the use of a wide range of consumer and commercial products. Consumer products, as defined by the Clean Air Act Amendments of 1990, include paints, coatings, and solvents. For the purposes of this research, this definition has been interpreted as including the use of such products in industrial applications when the products are not directly incorporated into a specific process (nonprocess solvents).

The primary purpose of this project was to gather and evaluate existing data and information on nonprocess solvent use in the following industrial and commercial business categories:

- automotive repair;
- bakeries;
- building renovation;
- chemical manufacturing;
- electrical equipment maintenance;
- florists;
- furniture repair/restoration;

- heating, ventilation, and air conditioning (HVAC) service;
- machine shops;
- mold release agents;
- office products;
- quick print shops;
- road paving;
- roofing; and
- textile manufacturing

For the purposes of this effort, nonprocess solvents are considered to be commercial/consumer products that are used by industry, in commercial operations, and/or by individual consumers. In industrial operations, nonprocess solvents are neither used as part of the production line nor incorporated into a product or chemically modified as part of a manufacturing process.

Cleaning and lubricating solvents as well as solvents used in certain adhesives are generally considered to be nonprocess solvents. An exception to this is in-process parts cleaning, such as vapor degreasing. Although this report focuses on emissions of nonprocess solvents that are VOCs, information also has been gathered concerning the nonprocess use of 1,1,1-trichloroethane (1,1,1-TCA) and methylene chloride (MeCl₂), both of which have negligible photochemical reactivity.

Relationship Between Categories

Data gathered for specific categories apply to many industries. For example, many of the nonprocess solvents used in building renovation, roofing, and HVAC service are the same as those used in the maintenance of large chemical, textile, and bakery facilities. Other common maintenance and repair operations, such as electrical repair and simple metalworking, may also take place in many large and small facilities. Automotive repair work is performed at facilities that maintain truck fleets. In addition, all of the categories use office products and equipment to some extent.

Products and Operations Common to Many Categories

Adhesives. In building renovation, adhesives for wall and floor coverings, joints, and pipe insulation are used. Building renovators and HVAC service workers commonly use cements to connect polyvinyl chloride pipes. In furniture renovation, and occasionally electrical equipment maintenance, plastic laminates are attached to wood using contact cement. Furniture

renovators also use water- and solvent-based adhesives to fasten wood to wood. In roofing, rubber roofs are joined together and attached to buildings using silicon caulk adhesive. Rubber cements, rubber cement thinners, and aerosol adhesives are commonly found in offices. Each of these adhesives may contain a wide variety of solvents.

Equipment Cleaning and Parts Washing. Parts washing machines are commonly used to clean grease, oil, and dirt from machine parts in automotive repair, machine shop, chemical, and textile facilities. Parts washers contain petroleum distillates and possibly trace amounts of chlorinated solvent. A brush, sometimes mounted to the nozzle of the solvent delivery hose, is used to aid cleaning.

Facilities may also clean parts by immersing them in, or wiping them with, solvent. For example, many automotive repair facilities clean carburetors by soaking them in solvent. In road paving, petroleum-distillate-based solvents are used to soak and clean parts removed during periodic maintenance and repair of heavy equipment. Road paving and roofing operations may use petroleum distillates, kerosene, or diesel fuel for cleaning tools.

Periodically, solvents are used to clean spray equipment that is used to apply stains, sealers, and top coats for furniture restoration or mold release agents for molding operations. Solvents are also used to clean overspray from spray booths used in furniture restoration.

Paint Thinners and Strippers. Paint thinners and strippers are widely used in building renovation and furniture restoration. Building renovators may remove varnishes, sealers, and finishes with methylene chloride (MeCl₂)-based strippers. Wood furniture refinishers use MeCl₂-based strippers that often contain other solvents, such as toluene, acetone, xylene, naphtha, methyl ethyl ketone (MEK), and/or one or more alcohols.

Other Products. Aerosol coatings are used for touch-up work in electrical equipment repair, furniture repair, and HVAC maintenance. Acrylic coatings are also found in many office environments. A variety of aerosol lubricants and penetrants are used in automotive repair, HVAC maintenance, and machine shops. Expanding foam sealants are used in building renovation and HVAC repair to prevent water and air leakage from around pipes. A product that is commonly used contains hydrofluoroalkanes, 4,4'-diphenylmethane diisocyanate (MDI), and oligomers of MDI. Aerosol coatings may also be used as sealants.

Additional Results for Each Category

Automotive Repair. These facilities use many prepackaged, solvent-containing products, such as fuel additives and carburetor, choke, brake, and fuel injector cleaners. Many of these products are aerosols. Floors are often cleaned with water.

Bakeries. Bakeries use limited quantities of nonprocess solvents. Federal regulations control the use of solvents in the presence of food. Therefore, solvents are not used for routine bakery cleaning.

Building Renovation. Lacquer thinner is often used to remove excess adhesive when installing laminates. Electrical contacts are cleaned with solvent. A finish, used to brighten and seal ceramic tile and grout, contains glycol ethers. Ceramic tile mastic contains petroleum distillates. Spackling putty, used when installing or patching interior walls, contains a small VOC component. Alternative paints, adhesives, cleaners, and strippers which contain little or no solvents are commercially available. The need for solvent-based cleaners is likely to be reduced as these products improve and gain acceptance.

Chemical Manufacturing. Chemical manufacturing facilities are generally large operations composed of many smaller units. Nonprocess solvents are likely to be used extensively for both internal and external equipment cleaning in batch and continuous operations, for routine equipment maintenance, and for floor cleaning.

Electrical Equipment Maintenance. Aerosol contact cleaners and flux degreasers are commonly used in the maintenance and repair of electrical equipment. These products usually contain mixtures of halogenated solvents, sometimes combined with hydrocarbons and/or alcohols.

Florists. Florists use water-based preservatives containing only sugars, buffering salts, and biocides. Florists tend to avoid using solvent-based cleaners because these products may have an adverse effect on the condition of their plants and flowers.

HVAC Service. Some HVAC technicians clean coils and other parts removed from refrigerators and air conditioners by wiping or spraying them with solvents. Water-based products, which may contain a small percentage of glycol ethers, can also be used to clean coils.

Furniture Repair and Renovation. Water-based finishes are commercially available but not widely used. Alternative cleaners are also being introduced. One product, derived from orange peel extracts, can be used for cleaning hands, lacquer overspray, and preliminary cleaning. It is

not effective at stripping all finishes. Stained upholstery is sometimes spot cleaned. Products used for spotting upholstery may contain propylene glycol or a petroleum distillate-type solvent. Water-based products containing 5 to 7% solvent are also available for general cleaning of upholstery.

Machine Shops. Parts may be cleaned with 1,1,1-TCA and/or perchloroethylene (perc) for inspection, grinding, or prior to shipping. These solvents are applied using a vapor degreaser, by hand wiping, or by dipping. Solvents can be found in the cutting fluids and coolants used in machine shops. Straight oils, soluble oils, and semisynthetic cutting fluids contain petroleum oils. Synthetic cutting fluids do not contain petroleum oils.

Mold Release Agents. External mold release agents used in plastic molding operations traditionally contain solvent-based carriers. These carriers are usually the chlorofluorocarbons R-11 or R-12, but other halogenated solvents, such as MeCl_2 , may also be used. External release agents with water-based carriers are commercially available but they are usually more expensive than solvent-based products and require a longer processing time since they evaporate more slowly. Other alternative technologies are: release agents with petroleum-based carriers; semi-permanent release agents, which can be used several times before needing to be reapplied; internal release agents, which are contained in the plastic itself; and atomized release agents, which do not require the use of a carrier.

Office Products. Inks in pens, markers, stamp pads, and typewriter ribbons are

either solvent- or water-based. Permanent inks are usually alcohol-based, but other solvents, such as MEK, may also be used. Most water-based inks contain glycols, ether alcohols, and/or trihydric alcohols. Many correction fluids and thinners contain 1,1,1-TCA. One manufacturer has discontinued producing its thinner and reformulated its correction fluid to eliminate 1,1,1-TCA. The new correction fluid contains 40% VOCs. Solvents may be used to clean keyboards and other surfaces. Whiteboard cleaners may contain alcohols and ether alcohols.

Quick Print Shops. Most quick printers operate dry-process photocopiers but some work with wet-process copiers. Solvents are used in the operation and routine maintenance of both types of photocopiers. Even though the dry-process machines use dry toner, small amounts of emitted organic vapors have been detected. Wet-process copiers use liquid toner and dispersant, both of which contain naphtha, and primarily emit a mixture of branched alkanes. Quick printers may operate offset presses that use non-heatset paste inks which commonly contain petroleum hydrocarbons and/or vegetable oils. These presses use fountain solutions that usually contain isopropanol as well as other solvents.

Road Paving. Roads generally are constructed of either portland cement concrete (concrete) or bituminous asphalt concrete (asphalt). Concrete is an inorganic mixture of cement, aggregate, and water. Asphalt is a mixture of asphalt cement and aggregate. Asphalt cement, a derivative of the bottom cut in the distillation of crude oil, contains a maximum of 0.5%

VOCs. Cutback asphalt is based on a mixture of asphalt cement and kerosene or naphtha. When formulating cutback asphalt, approximately 20 to 45%, by weight, of kerosene or naphtha is added to asphalt cement. Aggregate is added so that the final product contains 5 to 5.5% of the solvent and asphalt cement. The solvent evaporates as the asphalt cures. Currently, cutback asphalt represents less than 4% of all asphalt prepared.

Roofing. Roof coverings are made of various materials including rubber, tar and gravel, plastic, metal, and foam. Tar and gravel roofs are installed by heating petroleum-derived asphalt to form a material that is similar to the asphalt cement used in road paving. Petroleum-derived asphalt is pumped onto the roof and spread out evenly with mops that are discarded after being used. This asphalt contains virtually no VOCs when it is properly distilled. After the asphalt cools, sand and/or gravel is spread over the surface. Cutback asphalt may be used in detail work, such as flashing. When rubber roofs are repaired, the area around the patch must be cleaned to ensure proper adherence. Cleaners used for this may contain heptane, isopropanol, and toluene.

Textile Manufacturing. Stained goods are usually spot cleaned with products that contain 1,1,1-TCA, trichloroethylene, or perc. Petroleum-distillate-based cleaning products may be used for spotting but these products dry much more slowly than the more widely used spot cleaners. Some facilities may wash stained fabric with soap to reduce the amount of spot cleaning required.

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*The complete report, entitled "Evaluation of Volatile Organic Emissions Data for
Nonprocess Solvent Use in 15 Commercial and Industrial Business Categories,"
(Order No. PB94-152212/AS; Cost: \$19.50; subject to change) will be available
only from:*

*National Technical Information Service
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