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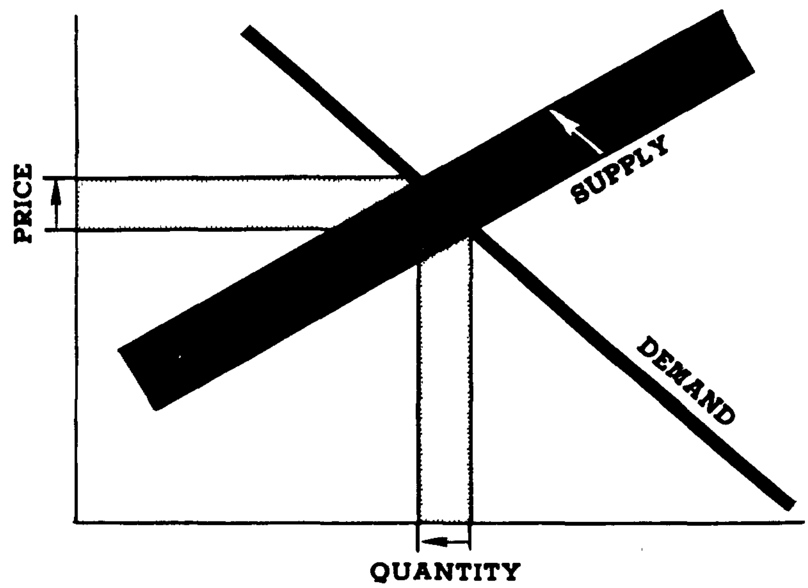
ECONOMIC ANALYSIS OF INTERIM FINAL EFFLUENT GUIDELINES FOR THE CARBON BLACK INDUSTRY -- GROUP II



U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Water Planning and Standards
Washington, D.C. 20460

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ECONOMIC ANALYSIS OF INTERIM FINAL EFFLUENT GUIDELINES FOR THE CARBON BLACK INDUSTRY – GROUP II

Contract No. 68-01-1541
Task Order No. 39

OFFICE OF WATER PLANNING AND STANDARDS
ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

April 1976

Arthur D Little, Inc.

PREFACE

The attached document is a contractor's study prepared for the Office of Water Planning and Standards of the Environmental Protection Agency (EPA). The purpose of the study is to analyze the economic impact which could result from the application of alternative effluent limitation guidelines and standards of performance to be established under sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended.

The study supplements the technical study (EPA Development Document) supporting the issuance of proposed regulations under sections 304(b) and 306. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports proposal of certain effluent limitation guidelines and standards of performance based upon an analysis of the feasibility of these guidelines and standards in accordance with the requirements of sections 304(b) and 306 of the Act. Presented in the Development Document are the investment and operating costs associated with various alternative control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effect of alternative approaches in terms of product price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Water Planning and Standards of the EPA. This report was submitted in fulfillment of Contract No. 68-01-1541, Task Order No. 39 by Arthur D. Little, Inc. Work was completed as of April 1976.

This report is being released and circulated at approximately the same time as publication in the Federal Register of a notice of interim final rulemaking under sections 304(b) and 306 of the Act for the subject point source category. The study is not an official EPA publication. It will be considered along with the information contained in the Development Document and any comments received by EPA on either document before or during proposed rulemaking proceedings necessary to establish final regulations. Prior to final promulgation of regulations, the accompanying study shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the contractor who studied the subject industry. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industry.

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report is one of a series of reports being prepared by Arthur D. Little, Inc. (ADL) for the Environmental Protection Agency (EPA) under Contract No. 68-01-1541, Task No. 39. The overall objective of this task is the determination of the economic impact that EPA interim final effluent limitations will have on eight point-source categories. The EPA plans to name the following industries as point-source categories:

- Pharmaceuticals (SIC 2831, 2833, and 2834);
- Gum and Wood Chemicals (SIC 2861);
- Pesticides and Agricultural Chemicals (SIC 2879 and those establishments engaged in manufacturing agricultural pest-control chemicals covered under SIC 281 and 286);
- Adhesives (SIC 2891);
- Explosives (SIC 2892);
- Carbon Black (SIC 2895);
- Photographic Processing (SIC 7221, 7333, 7395, 7819); and
- Hospitals (SIC 8062, 8063, and 8069).

This report on the carbon black industry is based upon the recommended wastewater treatment technology and treatment cost estimates presented in the "Draft Development Document for Interim Final Effluent Limitation Guidelines and Proposed New Source Performance Standards for the Carbon Black Point Source Category," March 1976 (superseding the original February 1975 version).

For the purpose of analyzing the wastewater characteristics and necessary wastewater treatment technology, and for developing cost estimates for the implementation of such technology, the Development Document has divided the carbon black industry into four separate subcategories, based on the type of manufacturing process employed. The subcategories are as follows:

Subcategory A – Carbon Black Manufacture by the Furnace Process;
Subcategory B – Carbon Black Manufacture by the Thermal Process;
Subcategory C – Carbon Black Manufacture by the Channel Process; and
Subcategory D – Carbon Black Manufacture by the Lamp Black Process.

1.2 PURPOSE AND SCOPE

The purpose of this report is to assess the economic impact on the U.S. carbon black industry (SIC 2895) from the cost of meeting interim final EPA effluent limitation guidelines applicable to the direct discharge of wastewater effluents from point sources.

Compliance with the effluent limitation guidelines may require the carbon black industry to install complete end-of-pipe wastewater treatment facilities, upgrade existing facilities, and/or modify its manufacturing process operations. The proposed effluent limitations guidelines are divided into three compliance levels:

- Level I – by 1977, for existing industry installations, the "Best Practicable Control Technology Currently Available" (BPCTCA) as promulgated, is to be applied;

- Level II – by 1983, for existing industry installations, the "Best Available Technology Economically Achievable" (BATEA), as promulgated, is to be applied; and

- Level III – for manufacturing installations constructed after the promulgation of applicable guidelines, the "New Source Performance Standards" (NSPS), are to be applied.

This report presents the results of the prescreening process and technical and economic analyses applied to the carbon black industry to determine the economic impact of the effluent limitations.

1.3 ECONOMIC ANALYSIS METHODOLOGY

1.3.1 Prescreening

A prescreening methodology was developed to aid in selecting those industry subcategories that probably would not be significantly impacted by the interim final effluent guidelines.

ADL initiated the project by studying the Development Document and compiling industry information. To provide a preliminary assessment of the economic impact of water pollution control on the industry (both in general and as defined by the interim final effluent guidelines), we considered a number of technical and economic factors. We next summarized these factors in short statements which we presented, in tabular form, to the various members of the ADL team who were knowledgeable on the industry and its pollution control problems. In considering the various factors and their effect on economic impact, we used only information readily retrievable. We invoked this limitation to prevent an excessive use of available resources in conducting the prescreen exercise. The completed information tables and the accompanying ADL expert comments are contained in the body of this report.

To determine which industry subcategories we would recommend for elimination from further economic impact study, we finally evaluated the information of the ADL experts against four criteria. If an industry subcategory met any one (or a combination) of these criteria, we considered its elimination. The criteria were:

1. The industry subcategory was generating no wastewater;

2. The ratio of BPCTCA* plus BATEA** treatment cost to selling price was less than 2% and/or the ratio of BPCTCA plus BATEA to profits was about 15% or less;

3. Practically all of the plants in the subcategory were currently discharging into municipal sewage systems and would continue to do so with little or no pretreatment costs incurred; and

4. The treatment facilities recommended in the Development Document had already been installed in practically all of the plants of the subcategory.

1.3.2 Economic Analysis

In assessing the economic impact of the interim final effluent guidelines on the carbon black industry, we considered the following economic and technical factors:

- The end-uses of carbon black and the nature of the relationship between the suppliers and major users of carbon black;
- The degree to which carbon black is a non-substitutable ingredient in its major end-product – rubber tires;
- The stability of the markets for carbon black and the sensitivity of end-product (rubber tire) price to carbon black price;
- The growth in demand for carbon black as related to the demand for automobile rubber tires;
- The reserve capacity of the carbon black industry;
- Trends in carbon black manufacturing technology; and
- Technological factors affecting the industry's ability to achieve zero discharge.

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*Best Practicable Control Technology Currently Available
**Best Available Technology Economically Achievable

1.4 CHARACTERIZATION OF THE U.S. CARBON BLACK INDUSTRY

The carbon black industry in the United States can be characterized by the following statements:

- Carbon black is currently manufactured by eight U.S. firms in a reported total of 36 active manufacturing facilities.

- Total carbon black production in 1973 was 1,587,600 metric tons, which represents about 83% of an estimated annual production capacity of 1,892,000 metric tons. More than three-fourths of the carbon black production capacity is located in Louisiana and Texas.

- The value of U.S. carbon black production in 1973 was approximately $284 million, representing an average 1973 price of $179/metric ton ($0.0812/lb). Since the cost of raw materials, viz., petroleum and natural gas, represents a very large component of the total manufacturing cost, recent increases in both gas and oil prices have resulted in increased carbon black prices. Carbon black prices in the fourth quarter of 1975 were characteristically $243/metric ton ($0.11/lb), a 35% increase over the 1973 level.

- Typically, more than 93% of total carbon black consumption is in rubber applications, and the rubber tire industry is by far the principal consumer. (Upwards of 90% of all carbon black produced is destined for tire manufacturing.) Printing ink represents the second largest use of carbon black.

- The United States is an exporter of carbon black (typically 5% of total production). Recently installed overseas production capacity has resulted in a trend toward shrinking U.S. exports, however.

- More than 91% of all carbon black currently produced is manufactured by the furnace process (Subcategory A). Most of the remainder are manufactured by the thermal process (Subcategory B). The amount of carbon black manufactured by the channel and lamp black processes (Subcategories C and D) is essentially insignificant (less than 0.1% of total production).

- Manufacturing plants employing the furnace process (Subcategory A) do not produce any inherent process wastewater streams, although about one-third of the plants do discharge small wastewater streams consisting of plant washdown water and stormwater runoff.

- The thermal process (Subcategory B) produces a small wastewater stream consisting of recirculating cooling water purge that is carbon black-contaminated.

- Plants employing the channel and lamp black processes do not discharge process wastewater streams.

1.5 TREATMENT TECHNOLOGY AND ASSOCIATED COSTS

According to the Development Document, Subcategory C – carbon black manufacture by the channel process – and Subcategory D – carbon black manufacture by the lamp black process – do not discharge wastewater and therefore will not incur wastewater treatment costs.

Subcategory A – carbon black manufacture by the furnace process – and Subcategory B – carbon black manufacture by the thermal process – do include plants that discharge wastewater. Therefore, these subcategories will incur wastewater treatment costs. For achieving the BPCTCA, BATEA, and BADCT* effluent limitations, all of which stipulate zero discharge of wastewater, the Development Document recommends sedimentation, followed by filtration, prior to recycling the treated wastewater back into the process as quench water.

The wastewater treatment costs presented in the Development Document were based on a "model plant" approach, i.e., the wastewater treatment cost estimation was developed for a representative plant in the industry. The treatment costs for the model plant are presented in Table 1.5A.

TABLE 1.5A

WASTEWATER TREATMENT COSTS FOR SUBCATEGORIES A AND B

	(ENR 1944 – 1974 Costs)	
	Subcategory A – Furnace Process	**Subcategory B – Thermal Process**
Model Plant Production Rate	214 metric ton/day	68 metric ton/day
Model Plant Wastewater Flow Rate	28,800 gpd	13,000 gpd
Capital Investment for Wastewater Treatment Facility	$279,900	$181,800
Total Annual Cost	$56,700/yr	$40,900/yr
Unit Treatment Cost	$0.75/metric ton	$1.71/metric ton

*Best Available Demonstrated Control Technology.

The methodology of the cost estimates presented in the Development Document appears reasonable; however, we believe that there are a number of strictly technical areas which make the model plant upon which the Development Document cost estimates were based unrepresentative of some plants within the carbon black industry. Some of the areas of major differences between the model and actual plants, as found in the carbon black industry survey, are:

- Net rainfall/evaporation balances;
- Ability to implement storm water segregation;
- Ground water infiltration;
- Present use of wet scrubbers at some plants;
- Effect of water quality on the product; and
- Plant wash practices.

We concluded that the differences between the model and actual plants in these technical areas probably would not preclude *most* of the plants in the carbon black industry from achieving zero discharge, although it is quite possible that certain plants in certain situations might find such a practice technically and economically unfeasible. In such specific cases, particularly where extensive in-plant equipment and piping modifications will be required, the costs presented in the Development Document might be far exceeded.

1.6 ECONOMIC IMPACT ON THE U.S. CARBON BLACK INDUSTRY

Based on our prescreen analysis, we concluded that if the wastewater treatment cost estimates presented in the Development Document are incurred by the carbon black industry as a direct result of implementation of the interim final effluent guidelines, there would be no significant economic impact on the carbon black industry. Thus, we eliminated the carbon black industry from further intensive economic impact analysis for the reasons described in Section 1.3.1. The results of our analysis are given below:

1.6.1 Subcategory A – Furnace Black

Of the 29 plants in this subcategory, only 10 plants (representing approximately 35% of the total furnace black production) discharge wastewater; therefore, it is unlikely that the other 19 will incur wastewater treatment costs. Of these 10 plants, the estimated total investment is $1,870,000, and the total annual treatment cost is $380,000. The unit treatment cost is only 0.34% of selling price. This percentage of treatment cost to selling price is so low that it is not possible to quantify its potential effect on production, employment, new investment, or plant closures.

1.6.2 Subcategory B – Thermal Black

Of the four plants in this subcategory, only two plants appear to have point-source wastewater discharge. The total estimated investment to achieve zero discharge is $510,000, and the total annual treatment cost is $120,000. The unit treatment cost is only 0.78% of the selling price. Again, this percentage is so low that it is not possible to quantify its potential effect on production, employment, new investment, or plant closures.

The total industry-wide treatment cost is $500,000, or 0.17% of the value of carbon black production for 1973.

The cost of wastewater treatment for the carbon black industry is summarized in Table 1.6A.

TABLE 1.6A

COST OF WASTEWATER TREATMENT FOR THE CARBON BLACK INDUSTRY

Subcategories	Estimated Number of Plants	Estimated Production (metric ton/yr)	Treatment Cost as a Percent of 1974 Selling Price	Total Industry-Wide Annual Cost (millions of dollars)	Total Industry-Wide Investment (millions of dollars)
			BPCTCA+BATEA	BPCTCA+BATEA	BPCTCA+BATEA
A. Furnace Black					
1. Total plants	29	1,452,650	–	–	–
2. Plants discharging wastewater	10	500,900	0.34	0.38	1.87
B. Thermal Black					
1. Total plants	4	134,950	–	–	–
2. Plants discharging wastewater	2	67,475	0.78	0.12	0.51

Notes:

1. All treatment costs adjusted to the 1974 level (ENR Construction Cost Index – 1994).
2. Selling price for both furnace black and thermal black taken as $0.10/lb.
3. Treatment costs derived from EPA Development Document cost model.
4. Same wastewater generation rates used for both furnace and thermal black. (This procedure results in the furnace black costs being an absolutely worst-case estimate.)

Source: Arthur D. Little, Inc., estimates and EPA Development Document.

2.0 INDUSTRY CHARACTERIZATION

2.1 THE PRODUCT AND ITS MANUFACTURING PROCESSES

Carbon black is a black, fluffy, finely divided powder consisting of 90% to 99% elemental carbon. Carbon black is uniquely different from other bulk carbons, such as charcoals and cokes, both in terms of properties and applications. Although there are many different grades of carbon black, it is generally treated as a single product.

In essence, carbon black is manufactured by producing carbon from either liquid or gaseous hydrocarbon materials. Depending upon the process, the production is achieved either by thermal degradation or incomplete combustion. In the United States, there are currently four different manufacturing processes employed. Each process is briefly described below.

2.1.1 The Furnace Black Process

In terms of total installed capacity, the furnace black process is by far the most predominant in the U.S. carbon black industry. In the furnace black process, carbon black is produced by the partial combustion of natural gas or petroleum distillates. In the gas furnace process, natural gas is partially combusted in refractory-lined furnaces. The carbon particles are removed from the gas stream by means of bag filters. Yields (in terms of the percent of carbon in the feedstock actually converted to carbon black) for plants employing the gas furnace range from 10% to 30%.

In the oil furnace variation, low-sulfur oil, similar to residual oil, is generally atomized into a natural gas-fired combustion zone. The carbon black particles are collected by bag filters in the same manner as the gas furnace variation. Yields for the oil furnaces range from 35% to 65%. Higher yields, coupled with an increasing shortage of natural gas, have been responsible for a trend toward oil furnace installations.

2.1.2 The Thermal Black Process

The thermal black process is based on the cracking of hydrocarbons rather than on partial combustion, as in the case of furnace black. Thermal black furnaces are operated in alternating heating and production cycles. During the heating cycle, the furnace is heated by burning hydrogen gas previously liberated from a production or cracking cycle. When heated to the proper temperature, the feedstock (generally natural gas) is introduced into the furnace, and the production cycle begins. Carbon is collected from quenched effluent gases also by means of bag filters. Yields generally range from 40% to 50%. Although the thermal process is the second most predominant production process, the increasing price of natural gas does not favor its growth.

2.1.3 The Channel Black Process

The channel black process is an almost obsolete process in which carbon black is made by partially burning natural gas in special chambers where the flames are made to impinge upon cooled surfaces. Carbon black deposited on the surfaces is continuously removed by mechanical scrapers. The yields are very low, varying from 1% to 5%. Low yields, coupled with the rising price of natural gas, have virtually eliminated this process. In fact, there is only one channel black plant currently in operation.

2.1.4 The Lampblack Process

The lampblack process is the oldest method of manufacturing carbon black (its origin dates back to ancient times). Lampblack, as carbon black manufactured by this process is called, is manufactured by burning selected oils in a restricted supply of air. In terms of its contribution to total industry-wide production, lampblack manufacture is relatively insignificant. Since there are certain special applications for lampblack, it is still manufactured in the United States at two different plants.

2.2 MANUFACTURERS, PRODUCTION, AND MARKETS

Carbon black is currently manufactured by eight U.S. firms in a reported total of 36 active manufacturing facilities. A listing of the eight manufacturers, along with their estimated production capacities, is presented in Table 2.2A. As of 1974, the carbon black industry had a production capacity of approximately 1,892,000 metric tons per year. The total production capacity is distributed according to manufacturing process as follows:

	Metric Tons/Yr
Furnace black	1,731,000
Thermal black	159,300
Channel black	1,800
Total	1,892,100

In terms of available production capacity, the Cabot Corporation is the largest supplier. The four largest producers – Cabot, Cities Service, Ashland Chemical, and Phillips Petroleum – account for well over 70% of the available production capacity.

Over three-fourths of the carbon black production capacity is located in Louisiana and Texas. The concentration of carbon black plants in the Gulf Coast area was originally the result of a need to be near natural gas feedstock suppliers.

For its rather large size, the carbon black industry is not very labor-intensive. During 1971 approximately 3200 people were employed by the entire industry.

TABLE 2.2A

PRODUCTION CAPACITY OF CARBON BLACK MANUFACTURERS
(as of 1974)

Producer	Capacity (metric tons/yr)
1. Cabot	
• Furnace black	414,600
• Thermal black	45,400
• Channel black	1,800
2. Cities Service	
• Furnace black	360,200
• Thermal black	25,000
3. Ashland Chemical	
• Furnace	294,800
4. Phillips Petroleum	
• Furnace black	214,600
5. J. M. Huber	
• Furnace black	170,100
• Thermal black	20,900
6. Continental Carbon	
• Furnace black	181,400
7. Sid Richardson Carbon Co.	
• Furnace black	95,300
8. Commercial Solvents Corp.	
• Thermal black	68,000
Total industry capacity	1,892,100

Source: "Chemical Profiles," Schnell Publishing Company, July 1, 1974

A 10-year history of total carbon black production is presented in Table 2.2B. During the 1963-1973 period, total carbon black production increased from 934,000 metric tons per year to 1,588,000 metric tons per year, an increase of 70%. The carbon black industry typically operates reasonably close to its production capacity. During 1973, the total production was 1,588,000 metric tons, or 83% of estimated total capacity.

TABLE 2.2B

TOTAL ANNUAL PRODUCTION OF CARBON BLACK

Year	Total Production (1000 metric ton)
1973	1,588
1972	1,452
1971	1,369
1970	1,330
1969	1,344
1968	1,276
1967	1,127
1966	1,167
1965	1,068
1964	1,008
1963	934

Source: "Minerals Yearbook," 1963-1973

Until major oil and gas price increases began during the latter part of 1973, the price of carbon black was very stable. During the 1963-1973 period, the average price of carbon black rose only 14%. The average price of carbon black in 1973 was $179 per metric ton ($0.0812/lb), thus resulting in a total 1973 carbon black production level valued at $284,000,000. Average yearly carbon black prices are presented in Table 2.2C.

TABLE 2.2C

AVERAGE YEARLY PRICES OF CARBON BLACK

	Average Price	
Year	($/metric ton)	($/lb)
1973	179	0.0812
1972	171	0.0776
1971	169.5	0.0769
1970	167	0.0758
1969	160	0.0726
1968	161.4	0.0732
1967	158	0.0717
1966	158	0.0717
1965	155.6	0.0706
1964	154.5	0.0701
1963	157	0.0713

Source: "Minerals Yearbook," 1963-1973

The cost of the hydrocarbon feedstocks is a major component of the overall manufacturing cost. During 1973, the carbon black industry consumed 49,682 million cubic feet of natural gas and 623,236 thousand gallons of liquid hydrocarbons, having an estimated total value of approximately $68,000,000, or 24% of the total value of the final product.[1] Increases in feedstock prices have greatly increased the price of carbon black in recent years. In 1975 fourth-quarter carbon black prices were characteristically $243 per metric ton ($0.11/lb), a 35% increase over the 1973 average price of $179 per metric ton. Thus, within the two-year period from 1973 through 1975 the price of carbon black has undergone an increase which was almost three times greater than the increase over the period from 1963 to 1973.

In terms of markets, the carbon black industry has a very clearly defined group of major end-users. The major end users of carbon black are found in the manufacture of rubber, printing ink, paint, paper, and plastics.

By far, the most important consumer of carbon black is the rubber industry. Typically, more than 93% of all carbon black manufactured is destined for the rubber industry, the vast majority of it being used for tire manufacture. We estimate that upwards of 90% of all carbon black produced is used in tire manufacture. Carbon black serves as a reinforcing agent, increasing both abrasion resistance and dimensional stability. In this capacity, it is currently an indispensable ingredient. Typically, a passenger car tire contains 6-7 lb. of carbon black, and there are no substitutes for carbon black in tire manufacturing. To illustrate the degree to which carbon black production is closely tied to rubber production, a parallel plot of carbon black production and total synthetic rubber production is shown in Figure 2.2.

Since tire production is obviously dependent on automobile sales, a large component of carbon black production can be expected to follow automobile sales. Of course, this effect is damped out by the more constant market for replacement tires. There are a number of automotive trends which suggest a decreased rate of growth within the carbon black industry. Consumer trends toward smaller cars with smaller tires, as well as the increased production of longer wearing radial tires, coupled with reduction in driving mileage, will all have a negative effect on the volume of carbon black production.

The second largest volume of carbon black is consumed in the manufacture of printing ink. This market is expected to remain rather stable. Manufacturing applications for carbon black in plastics are expected to increase.

The United States is an exporter of carbon black. In 1973, approximately 5% of the total U.S. production was exported. Historically, the percent of carbon black exported has been declining steadily as more and more foreign manufacturing capacity comes on-stream. Recent dislocations in worldwide hydrocarbon feedstock supplies have resulted in somewhat increased exports. Foreign countries may possibly elect to import carbon black rather than use their available feedstocks.

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1. "Minerals Yearbook," 1973, p. 247.

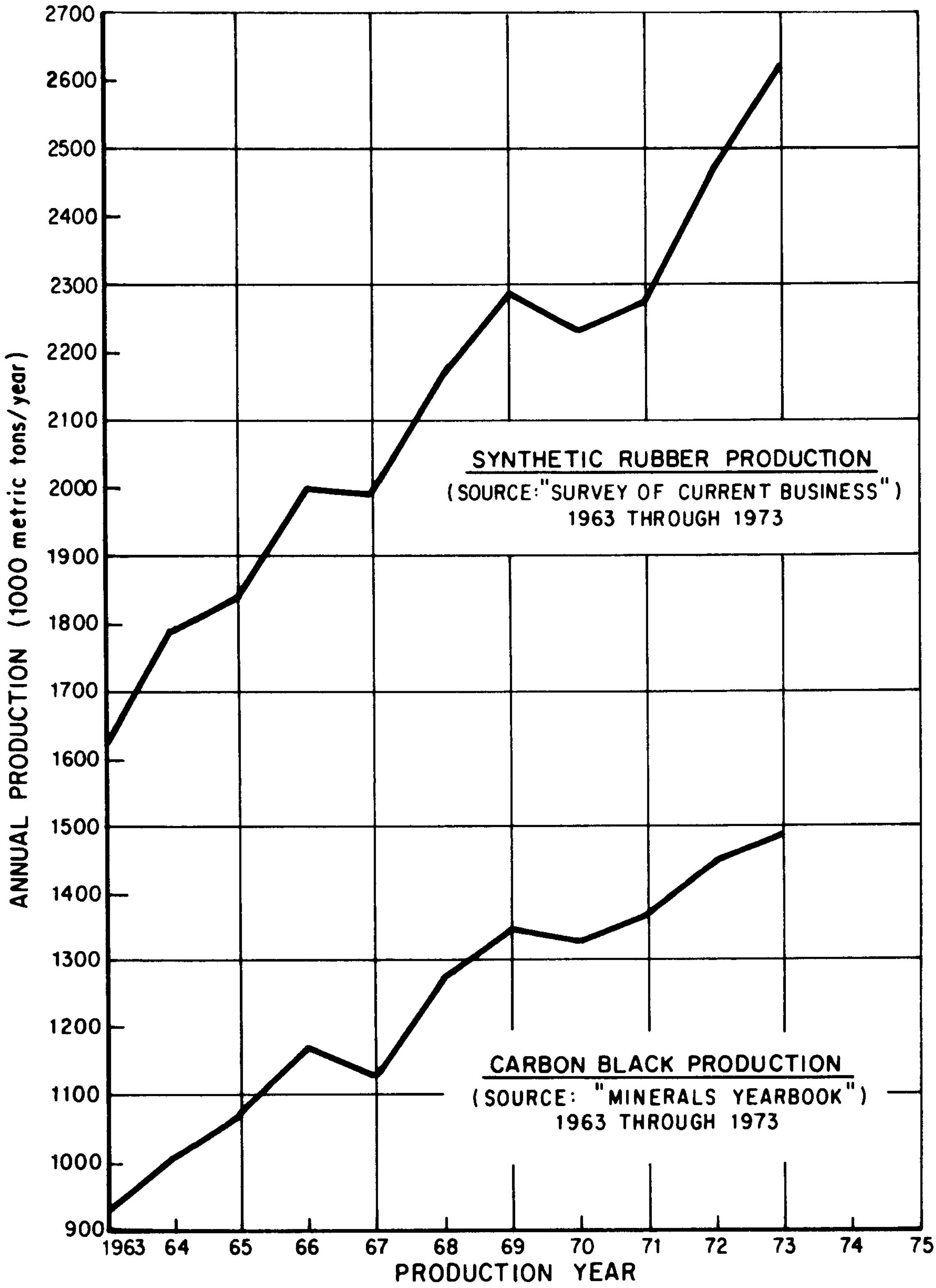

FIGURE 2.2 COMPARISON OF CARBON BLACK AND SYNTHETIC RUBBER PRODUCTION.

3.0 WATER POLLUTION CONTROL PROBLEMS, TECHNOLOGY, AND COSTS

According to the Development Document, neither the channel black process nor the lampblack process produces a contaminated process wastewater stream.

The thermal black process produces an inherent process wastewater stream. It consists of a recirculating cooling water purge contaminated with carbon black. In the thermal black process, furnace gas is quenched with water to reduce its temperature before it is passed through bag filters where the product carbon is removed. The hydrogen-containing exit gas thus contains an appreciable amount of humidity, which must be removed before recycling the hydrogen back into the process as a fuel. The humidity in the gas stream is removed by cooling the gas stream with water sprays, thus lowering the gas temperature below the boiling point of water and thereby condensing out most of the humidity. The spent spray water undergoes a temperature rise caused by the liberated heat of condensation and must, therefore, be cooled prior to reuse. Typically, the spray water is part of a cooling water circuit in which fresh makeup water is added to replenish inevitable losses within the system. As with most cooling circuits, it is necessary to purge or "blow down" a certain fraction of the total circulation to prevent the buildup of undesirable contaminants. In the thermal black process, this blowdown stream is contaminated with small amounts of carbon black lost from the process.

According to the Development Document, certain thermal black plants eliminate this blowdown stream by using it to quench the hot gases leaving the furnaces. Otherwise, the purge stream forms a point-source discharge.

Carbon black manufacturing plants employing the furnace black process do not produce an inherent process wastewater stream. Certain furnace black plants, however, do have small plant washdown streams and stormwater runoff streams. The local rainfall/evaporation relationship plays a large role in determining whether there is, or is not, a point-source discharge from the plant. According to the Development Document, 19 out of a total of 29 furnace black plants do not have point-source discharges. Some plants have no discharge preliminary because of favorable climate conditions, while others are able to use excess water as quench water.

Based on the Development Document, at least two (possibly three) out of a total of four thermal black plants presently do not discharge.

For both Subcategory A – Furnace Black – and Subcategory B – Thermal Black – the Development Document recommends that the BPCTCA and BATEA treatment levels be incorporated under a single "no discharge" requirement. The Development Document further recommends that no discharge be achieved by subjecting process wastewater to sedimentation and filtration (if necessary) and then recycling that water back into the process as quench water.

The wastewater treatment cost model presented in the Development Document considers a "typical" 214 metric ton per day furnace black plant and a "typical" 68 metric ton per day thermal black plant, which generate 28,800 and 13,000 gpd of wastewater, respectively.

The cost model is based on two wastewater treatment steps: Step 1 consists of sedimentation and Step 2 consists of filtration. It is anticipated that certain plants will require only Step 1, while other plants will require both Step 1 and Step 2. In any case, the cost model provides for the treated effluent to be totally recycled back to the process. The Development Document cost models for the furnace black subcategory and the thermal black subcategory are presented in Tables 3.0A and 3.0B.

TABLE 3.0A

SUBCATEGORY A – FURNACE BLACK MANUFACTURE
WASTEWATER TREATMENT COSTS FOR BPCTCA, BADCT,
AND BATEA EFFLUENT LIMITATIONS
(ENR 1994 – 1974 costs)

		Raw Waste Load	Technology Level	
			Step No. 1	Step No. 2
Average Production	– 214 metric ton/day			
Production Days	– 350			
Wastewater Flow	– kl/day	109		
	(gpd)	28,800		
	kl/metric ton product	0.5		
	(gal/1000 lb)	61		
Total Capital Costs			$210,400	$ 69,500
Annual Costs				
Capital recovery plus return at 10% at 10 years			34,300	11,200
Operating plus maintenance			5,600	5,600
Energy plus power			NIL	NIL
Total Annual Cost			39,900	16,800
Unit Cost $/1000 kg product			0.53	0.22
($/1000 lb product)			0.24	0.10

Notes:

1. Since a zero-discharge requirement is specified for each of the treatment levels, BPCTCA, BADCT, and BATEA treatment costs will be identical.
2. It is anticipated that the Step 1 technology level will be required by all plants; certain plants may require Step No. 2 in addition to Step No. 1

Source: EPA Development Document.

TABLE 3.0B

**SUBCATEGORY B – THERMAL BLACK MANUFACTURE
WASTEWATER TREATMENT COSTS FOR BPCTCA, BADCT,
AND BATEA EFFLUENT LIMITATIONS
(ENR 1994 – 1974 costs)**

		Raw Waste Load	Technology Level Step No. 1	Technology Level Step No. 2
Average Production	– 68 metric ton/day			
Production Days	– 350			
Wastewater Flow	– kl/day	49		
	(gpd)	13,000		
	kl/metric ton product	0.7		
	(gal/1000 lb)	86		
Total Capital Costs			$138,700	$ 43,100
Annual Costs				
Capital recovery plus return at 10% at 10 years			22,600	7,100
Operating plus maintenance			5,600	5,600
Energy plus power			NIL	NIL
Total Annual Cost			28,200	12,700
Unit Cost $/1000 kg product			1.18	0.53
($/1000 lb product)			0.54	0.24

Notes:

1. Since a zero-discharge requirement is specified for each of the treatment levels, BPCTCA, BADCT, and BATEA treatment costs will be identical.
2. It is anticipated that the Step 1 technology level will be required by all plants; certain plants may require Step No. 2 in addition to Step No. 1.

Source: EPA Development Document.

From supplementary data made available by the Development Document contractor, it appears that these costs can reasonably be applied across the industry for the purpose of providing an industry-wide estimate of treatment costs – fully recognizing the fact that specific plants may incur costs which are higher or lower than the cost model. Table 3.0C presents the total industry-wide costs that would result if the treatment costs presented in the Development Document cost model were fully incurred. Under this premise, the total industry-wide capital investment would be $2,380,000 and the total industry-wide annual cost would be $491,000. The estimated total annual cost is approximately 0.17% of the total 1973 production value of $284,000,000.

It should be noted that in terms of industry-wide estimates, this is a "worst case" assessment. It assumes that all plants currently have no treatment in place and will incur the

TABLE 3.0C

COST OF WASTEWATER TREATMENT FOR THE CARBON BLACK INDUSTRY

Subcategories	Estimated Number of Plants	Estimated Production (metric ton/yr)	Treatment Cost as a Percent of 1974 Selling Price	Total Industry-Wide Annual Cost (in millions of dollars)	Total Industry-Wide Investment (in millions of dollars)
			BPCTCA+BATEA	BPCTCA+BATEA	BPCTCA+BATEA
A. Furnace Black					
1. Total plants	29	1,452,650	–	–	–
2. Plants discharging wastewater	10	500,900	0.34	0.38	0.87
B. Thermal Black					
1. Total plants	4	134,950	–	–	–
2. Plants discharging wastewater	2	67,475	0.78	0.12	0.51

Notes:

1. All treatment costs adjusted to the 1974 level (ENR Construction Cost Index – 1994).
2. Selling price for both furnace black and thermal black taken as $0.10/lb.
3. Treatment costs derived from EPA Development Document cost model.
4. Same wastewater generation rates used for both furnace and thermal black. (This procedure results in the furnace black costs being an absolutely worst-case estimate.)

Sources: Arthur D. Little, Inc., estimates and EPA Development Document.

total cost presented in the cost model. Also, many plants actually have much lower flow rates than that used in the cost model.

We wish to note that while the cost model presented in the Development Document appears to be reasonable (when compared against normally encountered wastewater treatment costs), we foresee a potential problem area in connection with the "no discharge" requirement included in the BPCTCA and BATEA guidelines. While total recycle is feasible for many plants, it is conceivable that the treatment measures required by certain plants could possibly result in costs far above those presented in the Development Document cost model. For example, extensive revisions to plant layout, plant equipment, and storm sewer piping may be required for some plants in heavy rainfall areas. We believe that it would be prudent to further review the technological and economic feasibility of the no discharge requirement for those plants requiring extensive revisions.

Our contacts with industry representatives have indicated that the following factors could affect the achievement of zero discharge:

- inability to segregate storm water,
- location in a net rainfall region,
- lagoons affected by ground water infiltration,
- poor quality intake water,
- the use of wet scrubbers to control air pollution,
- detergent being used for washing bag filters and general cleaning.

4.0 ECONOMIC IMPACT ANALYSIS OF EFFLUENT GUIDELINES

4.1 PRESCREENING METHODOLOGY

The objective of the prescreen was to provide sufficient information to permit choosing which industry subcategories could be eliminated from further study. Of course, eliminating some of the subcategories would permit a more cost-effective utilization of the available resources for studying the economic impact of the proposed effluent guidelines.

For any prescreen process to be effective, it must:

- Exclude only those subcategories for which there is strong evidence readily available that the economic impact would be insignificant; and

- Not consume a large amount of the available resources.

Initiating the study, ADL developed information which characterized the industry, its markets, its pollution control practices, and any consideration that EPA should know about respective industry subcategories. To obtain the kind of information that was necessary, we developed an outline of the information needed in tabular form.

The ADL experts prepared their comments utilizing only personal knowledge or information that was immediately available. In many instances, there were areas in the information table on which no comment was possible, either because the requisite information was not immediately available, or because the answer was too complex for answering at the prescreen level.

The information contained in the comments and on the information table not only provided the basis for our recommendations concerning the categories we felt the EPA should consider eliminating, but also generalized the condition of the industry with respect to the proposed regulations.

In developing our recommendations, we wanted to have a high degree of certainty that any category we recommended for elimination could not, on further study, be shown to be seriously impacted. Thus, we developed four criteria, any one of which, if met by an industry subcategory, would be enough to give a tentative classification as a subcategory for elimination. These criteria were:

(1) The industry subcategory is generating no wastewater.

(2) The ratio of BPCTCA plus BATEA unit costs to selling price is less than 2%, and/or the ratio of BPCTCA plus BATEA costs to profits is about 15% or less.

(3) Most of the plants in the subcategory are currently discharging into municipal sewage systems and may continue to do so with little or no pretreatment cost incurred.

(4) Most of the recommended treatment facilities have already been installed in most of the plants in the subcategory.

Criterion (1) obviously represents the strongest reason for eliminating an industry from further study. If the industry does not discharge wastewater, water pollution regulations will have nc impact upon the industry.

Criterion (2) is based on discussions with ADL economic experts. We decided that, if this criterion were met, the proposed standards would likely not result in a significant economic impact. Often, our experts had no profit margin information available. In those instances, when the ratio of treatment cost to selling price was less than 2%, we still recommended that EPA consider removing the subcategory from further study. However, this recommendation is not so strong as the recommendations made using profit information.

In considering treatment cost/selling price and treatment cost/profit margin ratios, it is important to realize that the treatment costs presented in the Development Document are for a total treatment system and represent the costs incurred by a plant having no wastewater treatment already in place. Most facilities within the carbon black industry have some form of wastewater treatment already installed.

Criterion (3) also represents a very strong reason for eliminating a subcategory from further study. If the wastewater treatment practice within a subcategory consists mainly of discharging to municipal sewage systems, the cost of that treatment is already being incurred via sewer charges. If the subcategory can continue this practice, be consistent with the pretreatment standards set forth in the Development Document, and yet incur little or no pretreatment cost, then the incremental economic impact to that subcategory will be nil. Since the Development Document does not provide pretreatment costs, criterion (3) was used to eliminate a category only when it was very clear that pretreatment would be either unnecessary or minimal.

Criterion (4) represents a reason for eliminating an industry from further study on the basis that, should the industry meet criterion (4), it would not have to expend as much money as the Development Document indicates to meet the proposed standards.

4.2 RESULTS OF THE PRESCREEN ANALYSIS

We recommend no further study of the economic impact of the guidelines on the lamp black and channel black producers, because they produce no effluents and therefore meet the requirements of prescreening criterion (1).

We recommend no further study of furnace black and thermal black because unit treatment costs as a percent of selling price are below 2%, thereby meeting the requirements of prescreening criterion (2).

Based on a representative selling price of $220 per metric ton, the unit treatment cost as a percent of selling price is only 0.34% for furnace black and 0.78% for thermal black (see Table 3.0C).

4.3 ECONOMIC AND TECHNOLOGICAL FACTORS

The precise impact of the guidelines, although judged to be insignificant on the bases of the prescreening criteria, will depend on the complex interaction of a number of technological and economic factors facing the industry (see Table 4.3). These include the following:

- The end-uses of carbon black and the nature of the relationship between the suppliers and major users of carbon black;
- The degree to which carbon black is a non-substitutable ingredient in its major end-product – rubber tires; the stability of the markets for carbon black and the sensitivity of end-product (rubber tire) price to carbon black price;
- The growth in demand for carbon black as related to the demand for rubber tires for automobiles;
- The reserve capacity of the industry;
- Trends in carbon black manufacturing technology; and
- Technological factors affecting the industry's ability to achieve zero discharge.

Although we did not subject these subcategories to further analysis, because their unit treatment costs were so low in relation to the pre-screening criteria, certain conclusions can be drawn from the economic factors cited above which indicate that the guidelines will have little impact on the industry. The non-substitutability of carbon black in its major application – rubber tires – and the small value of carbon black compared to the final value of the product ($0.60 worth of carbon black in a tire selling for $50.00) suggest that the demand for carbon black is highly price inelastic. Thus, the demand for carbon black would not be significantly affected by price increases of the magnitude discussed in this report, and there would be no significant impact on the output and employment in the industry.

TABLE 4.3

INFORMATION TABLE – CARBON BLACK INDUSTRY

Industry Data	Subcategories: A. Furnace Black	Subcategories: B. Thermal Black
1. Annual Production (metric tons)	1,452,650	134,950
2. Production Value ($ millions)	319.6	29.7
3. Representative Range of Unit Selling Price* ($/metric ton)	220	220
4. Estimated Profit Margin (% of selling price)	Not Available	Not Available
5. BPCTCA (1977) Treatment Cost** ($/metric ton)	0.75	1.71
6. BATEA (1983) Treatment Cost** ($/metric ton)	0.75	1.71
Technical and Economic Factors Pertinent to Economic Impact Analysis		
Technical Factors		
7. Possibility of drastically reducing or totally eliminating wastewater flow rate	High	High
8. Possibility of substantially reducing cost of end-of-pipe treatment via in-plant changes and/or process modifications	High	High
9. Fraction of plants with substantial wastewater treatment facilities in place.	Moderate	Moderate
10. Fraction of plants presently discharging into municipal wastewater treatment facilities.	None	None
11. Frequency or likelihood of plants sharing waste treatment facilities with other manufacturing operations.	Low	Low
12. Degree to which proposed treatment departs from currently employed treatment.	Varies	Varies
13. Seriousness of other pending environmental control problems (including OSHA).	Moderate	Moderate
Economic Factors		
14. BPCTCA plus BATEA unit treatment cost as percentage of unit selling price.	0.34	0.78
15. BPCTCA plus BATEA unit treatment cost as percentage of unit profit margin.	Not Available	Not Available
16. Would the demand for the industry's product be significantly affected by a 10% increase in price?	Not Greatly	Not Greatly

*Selling price is based on approximate 1974 level ($0.10/lb).

**BPCTCA and BATEA treatment costs have been adjusted from 1972 to the 1974 level using the Engineering News Record Construction Cost Index (1972 = 1780, 1974 = 1994).

5.0 ECONOMIC IMPACT ON THE U.S. CARBON BLACK INDUSTRY

Based on our prescreen analysis, we concluded that, if the wastewater treatment cost estimates presented in the Development Document are incurred by the carbon black industry as a direct result of implementation of the interim final effluent guidelines, there would be no significant economic impact on the carbon black industry. Thus, the carbon black industry was eliminated from further intensive economic impact analyses. The results of our analysis are given below:

Subcategory A – Furnace Black – Of the 29 plants in this subcategory, only 10 plants (representing approximately 35% of the total furnace black production) have wastewater discharges, and will therefore be likely to incur wastewater treatment costs. Of these 10 plants, the estimated total investment is $1,870,000, and the total annual treatment cost is $380,000; thus the unit treatment cost is only 0.34% of the selling price. This percentage of treatment cost to selling price is so low that it is not possible to quantify its potential effect on production, employment, new investment, or plant closures.

Subcategory B – Thermal Black – Of a total of four plants, no more than two plants appear to have point-source wastewater discharges. The total estimated investment to achieve zero discharge is $510,000, and the total annual treatment cost is $120,000. Thus, the unit treatment cost is only 0.78% of the selling price. Again, this percentage is so low that it is not possible to quantify its potential effect on production, employment, new investment, or plant closures.

Wastewater treatment costs for subcategories A and B are $500,000, or 0.17% of the value of the 1973 carbon black production. We believe that this percentage is so small that there will be no significant rise in carbon black prices and no significant change in carbon black demand.

There is, however, at least one plant that must both segregate its stormwater and replace its wet scrubbers to meet the zero-discharge requirement. This plant will surely incur water pollution control costs significantly above those presented by the Development Document cost model. The economic impact on this specific plant could be significant.