Economic Impact Analysis For the Proposed Carbon Black Manufacturing NESHAP

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EPA-452/D-00-003
May 2000

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1. OVERVIEW

The EPA is proposing national emission standards for hazardous air pollutants (NESHAP) that will affect major sources of hazardous air pollutant (HAP) emissions in covered under the carbon black manufacturing source category. Carbon black manufacturing is classified under Standard Industrial Classification (SIC) code 2895 and North American Industrial Classification System (NAICS) code 325182.

This analysis provides a brief economic profile of the carbon black manufacturing industry, an overview of the HAP emissions and proposed NESHAP, and a screening analysis of the impact the proposed NESHAP will have on firms in the carbon black manufacturing source category.

2. INDUSTRY PROFILE

What is carbon black?

Carbon black is a black, powder or granular substance made by burning hydrocarbons in a limited supply of air. This produces a black smoke containing extremely small carbon black particles which can be separated from the combustion gases to form a fluffy powder of intense blackness.[1,2,3] Carbon black is used mostly as a reinforcing agent for rubber. The largest use of carbon black is in the manufacture of automotive tires. It is also used to color printing ink, painting, paper, and plastics. [1 through 6]

How is carbon black made?

There are five processes currently used to make carbon black:

- # Furnace black process - aromatic oils (based on crude oil) are burned in a reactor, producing carbon black and tailgas. After cooling, the carbon black is separated from the tailgas, densified, and processed into pellets of varying grades/sizes. This process is the most widely used in the U.S, comprising over 95% of all domestic carbon black production.
- # Thermal black process - natural gas is burned in a reactor to produce carbon black and tailgas, and is then processed in a fashion similar to the furnace black process.
- # Acetylene black process - similar to the thermal black process, except that acetylene is the raw material used, and the carbon black is not processed into pellets.
- # Lampblack process - one of the oldest carbon black processes. An aromatic oil (based on coal tar) is heated in a flat cast-iron pan to produce carbon black.[1,2,3]

The bone black process has been excluded from the carbon black manufacturing source category, since they have no combustion-related processes, and do not appear to be significant sources of HAP emissions.

What are the end uses for carbon black?

Rubber products - especially rubber tires - is the primary end use for carbon black. Table 1 below lists the primary uses of carbon black, along with estimated 1994 carbon black consumption.[1 through 6].

Table 1 - U.S. Carbon Black Uses and Estimated 1997 Consumption

Carbon black uses	Estimated consumption (Million lbs/yr)	Percent of total estimated consumption
Tires	2,450	70
Automotive (other than tires - belts, hoses, etc.)	370	11
Industrial Rubber Products (molded and extruded goods)	340	10
Non-Rubber Uses (e.g., paint, plastics, paper, ink, and ceramics)	350	10
Total	3,510	100*

* - percentages do not add up to 100 due to rounding.

Reference: Chemical Economics Handbook, SRI International

The particle size, structure, and surface area of carbon black plays a significant role in the material properties of rubber, plastics, and other products, For this reason, carbon black is made in various grades to meet the varying material needs and specifications of manufacturers. In general, carbon black grades with smaller particle size have better reinforcing and abrasion resistance qualities than those with larger particle size.

What companies/facilities make carbon black?

From the mid-1970s through the mid-1980s, the use of carbon black declined due to such factors as smaller cars with smaller tires, the use of longer lasting radials, and lower highway speeds, which increased tire life. Since 1986, these factors have leveled off and carbon black use has been experiencing slow but steady growth.

The EPA has identified 22 domestic carbon black production facilities, owned and operated by eight companies. Fourteen of these facilities are located in Louisiana and Texas. Table 2 lists the companies involved in carbon black production, the general location of each of their facilities, the primary production process used at each facility uses, and the 1997 estimated production capacity for each facility. The top six companies accounted for approximately 99 percent of total domestic production capacity.[5,6]

Table 2 - Carbon Black Facilities and Estimated Production Capacity		
Company/facility location	1998 estimated capacity (millions lbs/yr)	Carbon black process
Cabot Corp. - 995 million lbs., 24 percent of total capacity, 4800 employees		
Franklin, LA	355	Furnace
Ville Platte, LA	355	Furnace
Pampa, TX	65	Furnace
Waverly, WV	220	Furnace
Sid Richardson - 750 million lbs., 19 percent of total capacity, 500 employees		
Addis, LA	255	Furnace
Big Springs, TX	205	Furnace
Borger, TX	290	Furnace
Columbian Chemicals[a] - 795 million lbs., 19 percent of total capacity, 13,924 employees (parent corp.)		
El Dorado, AR	130	Furnace
Ulysses, KS	115	Furnace
Centerville, LA	350	Furnace
Moundsville, WV	200	Furnace
Engineered Carbons Corp.[b] - 570 million lbs., 14 percent of total capacity, 1,190 employees		
Baytown, TX	180	Furnace
Borger, TX	210/45	Furnace/Thermal
Orange, TX	135	Furnace
Continental Carbon[c] - 560 million lbs., 13 percent of total capacity, 2000 employees (parent corp.)		
Phenix City, AL	100	Furnace
Ponca City, OK	280	Furnace
Sunray, TX	180	Furnace
Degussa Corporation - 495 million lbs., 12 percent of total capacity, 25,000 employees		
Louisa, LA	220	Furnace
Belpre, OH	145	Furnace
Aransas Pass, TX	130	Furnace
Chevron Chemical		
Baytown, TX	20	Acetylene decomposition
General Carbon Company		
Los Angeles, CA	1	Lampblack
Hoover Color Corporation		
Hiwassee, VA	1	Charring of animal bones
Source category total	4,195	

Sources: Chemical Economics Handbook, SRI International

[a]Owned by Phelps-Dodge Corporation
[b]Owned by Ameripol-Synpol
[c]Owned by China Synthetic Rubber Corporation

What are the production costs for carbon black manufacturing?[7]

The U.S. Census Bureau's 1997 Economic Census breaks down the annual production costs for 22 carbon black facilities in NAICS code 325182 (carbon black manufacturing) by capital expenditures, labor costs, and total material costs. These costs are summarized in table 3 below. The cost of production totals approximately $625 million, which is 63 percent of the value of shipments for 1997.

While the Economic Census provides a subtotal of electricity costs as part of total material costs, it does not provide cost subtotals for fuel, contract work, or resales. These subtotals are listed in the table below under "other production costs".

Table 3 - 1997 Annual Production Costs

Costs of Production	Amount ($1,000)	Percent of Total Production Cost	Percent of Value of Shipments
Capital Expenditures	89,107	14.3	9.0
Material Costs	368,595	59.0	37.2
Labor Costs	90,694	14.5	9.2
Electricity Costs	30,775	4.9	3.1
Other costs	45,932	7.3	4.6
TOTAL	625,083	100	63.1

Source: 1997 Economic Census (Reference 7).

What are the prices for carbon black?[6]

Prices vary for carbon black, depending on the grade of carbon black desired. Table 4 reflects the trend in carbon black prices over the past decade. Since the grades of carbon black used in industry are numerous and varied, three of the grades used most commonly in rubber production were selected for presentation in table 4. These three grades represent an upper, middle, and lower bound in terms of price, based on the information readily available.

Table 4 - Carbon Black Price Trends, 1985 - 1997			
Year	Prices, cents per pound (bulk carload)		
	general purpose carbon black (N660 grade, larger particle diameter)	high abrasion (N330 grade)	super abrasion carbon black (N110, smaller particle diameter)
1985	31.25	33.00	38.50
1986	31.25	33.00	38.50
1987	24.75	27.00	32.50
1988	25.75	28.00	33.50
1989	20.75	28.00	30.00
1990	21.50	25.00	30.00
1991	20.50	23.00	29.00
1992	21.50	24.50	30.00
1993	28.25	32.50	41.25
1994	30.25	34.50	43.75
1995	32.75	37.50	46.75
1996	32.75	37.50	46.75
1997	32.75	37.50	46.75

Source: SRI International (Reference 6).

As shown, carbon black prices have rebounded from a sharp decline in the late 1980's, holding steady in the years 1995-1997. Prices for the most commonly used rubber grades ranged in 1997 from $0.47 per pound for super abrasion carbon black (N110, smaller particle diameter) to $0.33 per pound for general purpose carbon black (N660 grade, larger particle diameter). If ordered in bag or box lots, the price per pound was generally 3 or 4 cents per pound higher. 1997 prices for specialty blacks (used mostly for pigments, paints, inks, etc.) range from $0.50 to over $5.00 per pound.

How much carbon black is imported to/exported from the United States?[7]

According to the U.S. Census Bureau, approximately 255 million pounds of carbon black was imported into the United States in 1997, down from a high of 335 million pounds the previous year. In the decade preceding 1997, the trend has been toward steady increases in carbon black imports, mostly from Canada, Columbia, and Mexico. The value of these imports ranges from $0.18 per pound (Columbia) to $1.68 per pound (Japan).

In 1997, the United States exported 337 million pounds of carbon black to other countries. Over the past several years, exports have fluctuated widely, but have generally increased from a low of 71 million pounds in 1985. More than half of U.S. carbon black exports (178 million pounds) went to Canada. The overall average unit value of exported carbon black was $0.48 per pound, ranging from an average of $0.27 per pound (Luxembourg) to an average of $1.13 per pound (United Kingdom).

Are there consumer substitutes for carbon black?[6, 8]

For rubber production, the most notable substitute for carbon black is precipitated silica. In recent years, tire manufacturers have replaced up to 25% of the carbon black with silica to create what is commonly called a "green" tire. The tires are so named because they reduced the rolling resistance of tires significantly, improving traction, wear, and fuel efficiency. However, the material cost of adding silica is nearly twice the cost of carbon black, and the cost of processing and compounding the materials are higher. While the green tire has had some marketing success in Europe, the Asia-Pacific region, and Latin America, that success has not been equaled in the United States.

What is the anticipated growth for the carbon black manufacturing industry over the next few years?

Estimates for projected growth in the industry range from 1.5% to 3% per year over the next several years. This growth is expected to track gains in rubber demand, particularly in the tire industry.[6, 9] Industry news suggests limited expansion of production capacity was planned for the years 1997-1998[9]. The EPA has found no information on upcoming facility expansions or new facility construction. Based on 1997 U.S. production amounts (3,650 million lbs) and reported capacity (approximately 4,000 million lbs), it appears reasonable that the projected growth over the next could be absorbed by existing facilities without need for expansion or new facilities.[6, 10]

3. HAP EMISSIONS AND PROPOSED CONTROLS

What HAP are emitted from carbon black plants?[11 through 14]

HAP emitted from the furnace black process primarily take the form of reduced sulfur compounds (e.g., carbon disulfide and carbonyl sulfide). There are three primary HAP emitted from the carbon black process (1) carbon disulfide, (2) carbonyl sulfide, and (3) hydrogen cyanide.

What health effects do these HAP present to the public?[11 through 14]

Health effects identified include: chronic (long term exposure non-cancer effects), acute (short term exposure non cancer effects), reproductive and development effects, and cancer effects. The degree of adverse effects to health can range from mild to severe, depending upon:

- the ambient concentrations observed in the area (e.g., as influenced by emission rates, meteorological conditions, and terrain),
- the frequency of and duration of exposures
- characteristics of exposed individuals (e.g., genetics, age, pre-existing health conditions, and lifestyle) which vary significantly with the population, and
- pollutant specific characteristics (e.g., toxicity, half-life in the environment, bioaccumulation, and persistence).

What is the source of HAP emissions in carbon black manufacturing facilities?[12 through 19]

From the data available, the EPA has concluded that process vents account for the vast majority of HAP emissions from carbon black facilities. While some HAP may be emitted from other emission points (e.g., storage vessels, equipment leaks, and wastewater) they generally would not exceed more than one percent of a facility's total HAP emissions.

Process vent emissions are primarily tailgases from the reactors. The gases are sent to a baghouse were the carbon black is removed from the tailgases. After separation of the carbon black product, most of the tailgases are then emitted to the atmosphere or sent to a combustion control device. Some of the gases may be sent to a carbon monoxide (CO) boiler as fuel to supply heat for product dryers.

What level of control does the proposed rule specify for affected facilities?

The levels of control proposed for process vents at affected carbon black manufacturing facilities are shown in Table 5 below.

Table 5 - Proposed Level of Control for Carbon Black Facilities		
If a facility is considered an. . .	And its process vents. . .	The facility must vent emissions through a closed vent system to. . .
Existing facility	# handle an emission stream with a HAP concentration equal to or greater than 260 parts per million volume (ppmv), and # are associated with the main unit filter	# a flare, or # any combination of control devices that reduces emissions of HAPs by either: ▸ 98 percent by weight or ▸ to a concentration of 20 parts per million by volume (ppmv), whichever is less stringent.
New facility	handle an emission stream with a HAP concentration equal to or greater than 260 parts per million volume (ppmv)	▸ a flare, or ▸ any combination of control devices that reduces emissions of HAPs by either: ▸ 98 percent by weight or ▸ to a concentration of 20 parts per million by volume (ppmv), whichever is less stringent.

In addition, there are leak detection and repair requirements (LDAR) for regulated equipment at both existing and new facilities. LDAR programs must be implemented for regulated equipment after the reactor if the equipment:

- # contains or contacts HAP in amounts equal to or greater than 500 ppmv, and
- # operates equal to or greater than 300 hours per year (hr/yr).

4. COSTS AND IMPACTS

What costs will this proposed regulation impose on the carbon black source category?

Based on the criteria established in the proposed NESHAP, EPA believes that seven carbon black facilities will need to add control equipment in order to comply with the regulation. Five facilities are expected to install incinerators, and two facilities are expected to install flares. These facilities are all privately owned. The EPA estimates the total annual cost for these seven facilities combined to be approximately $10.5 million per year. This total includes capital recovery, labor, maintenance, energy, and administrative costs. Table 6 below provides a breakdown of the estimated annual costs for the seven facilities, in fourth quarter 1997 dollars.

Table 6 - Annual Costs for Carbon Black Manufacturing NESHAP

Cost item	Amount ($000)
Operating labor	52
Supervisory labor	8
Maintenance labor	54
Maintenance materials	54
Natural gas	557
Electricity	60
Overhead	92
Taxes, insurance, and administration	2,195
Capital recovery	7,474
Total annual costs	$10,546

In addition, EPA estimates the proposed rule would subject facilities within the source category to additional monitoring, inspection, recordkeeping and reporting (MIRR) costs. The facilities would be affected as follows:

- Five facilities are expected to install incinerators to meet the proposed NESHAP. These facilities would conduct all MIRR activities, including testing and related tasks.
- Two facilities are expected to install flares to meet the proposed NESHAP. Since flares cannot be tested, both facilities would conduct all MIRR activities except testing and related activities.
- The EPA expects that an additional 13 facilities will basically conduct only MIRR activities, except testing and related tasks. These facilities would not install any control equipment to meet the proposed NESHAP.
- Two other facilities will need to do nothing more beyond reading the rule.

The MIRR costs for the first three years after promulgation of the NESHAP are summarized in table 7 below.

Table 7 - Monitoring, Inspection, Recordkeeping and Reporting Costs			
Level of MIRR Effort	**No. of Facilities**	**Total Cost per Facility**	**Cost per Facility, annualized over the first three years**
Reading the rule	2	$500	$200
MIRR except testing and related tasks	15	$49,700	$18,900
All MIRR	5	$52,900	$20,200

What is the anticipated impact of control costs on the industry?

To assess the impact of the impact the proposed NESHAP would have on the industry, EPA performed a "sales test" as a initial impacts screening analysis for affected firms in the industry. Under this analysis, EPA looked at the annualized cost of compliance with the rule as a percentage of annual sales. Using this approach, if a firm has a cost-to-sales ratio of 1% or less, it is presumed that the regulation has no significant economic impact.

This analysis also presumes that firms cannot pass on the cost of complying with the proposed NESHAP to their consumers. Since it is likely that these firms could pass on some portion of the compliance cost to their customers, the cost-to-sales ratios presented here overstate the economic impacts incurred by the affected firms.

The results of this screening analysis are shown in table 8 below.

Table 8 - Screening Analysis for Firms Affected by the Proposed Rule				
Firm (Parent) Company	No. of Facilities Affected by Rule	Annualized cost of control, including MIRR ($000)	Parent Company Total Sales for 1997 ($000)	Cost-to-sales ratio (%)
Continental Carbon (China Synthetic Rubber Corp.)	3	$2,688	$218,200[a]	1.21
Columbian Chemical (Phelps-Dodge Corp.)	4	$6,112	$3,914,300[a]	0.15
Degussa-AG	3	$1,942	$8,524,000[b]	0.02
Cabot Corporation	4	$76	$1,629,989[a]	>0.01
Engineered Carbon (Ameripol Synpol Corp.)	3	$57	$475,000[c]	0.01
Sid Richardson	3	$57	Not available	Not available

Sources: [a]From company annual reports (References 20, 21, 22).
[b]TableBase, 1999 (Reference 23).
[c]D&B-Duns Financial Records Plus, 1999 (Reference 24)

As shown in the preceeding table, only one firm (Continental Carbon) has a cost-to-sales ratio that exceeds 1%. The EPA therefore concludes that one company may experience significant impact to some undetermined degree as a result of the carbon black NESHAP.

Financial information on one additional firm (Sid Richardson Company) could not be found. However, this firm would incur only minimal MIRR costs as a result of the regulation. The EPA believes it reasonable to assume that the cost-to-sales ratio for this firm would be less than 1%, based on comparison to firms with similar production.

The price elasticity of demand for output for SIC 289 (the 3-digit parent for the carbon black industry - SIC 2895) is -0.8. In general this implies that a 1% increase in output price leads to a 0.8% decrease in output demand. Since this represents a case of somewhat inelastic demand (i.e., a price elasticity of demand less than one), carbon black produccers would have some capability to pass some of their operating costs - including pollution control costs - onto their consumers. This may mitigate the impact of the proposed NESHAP to affected firms, including Sid Richardson Company.

Are any small businesses significantly impacted by this NESHAP?

The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires Federal regulatory agencies to determine whether a proposed or final regulation will have a significant impact on a substantial number of small entities. For SIC 2895, a small entity is defined by the Small Business Administration as a firm with 500 or fewer employees (a small entity cut-off for NAICS 325182 will not be available before October 1, 2000). This cut-off is made based on parent company employment. At this time, only one parent company included in the carbon black source category has been identified as having 500 or fewer employees (Sid Richardson Company). As discussed above, this company is expected to incur only minimal MIRR costs as a result of the proposed NESHAP.
Therefore, the EPA does not believe that the proposed carbon black NESHAP will have a significant impact on a substantial number of small entities.

Are any government entities significantly affected by this NESHAP?

No government agencies manufacture carbon black. They therefore would not be subject to this rulemaking.

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