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Phosphoric Acid and Phosphatic Fertilizers: A Profile

Draft Profile

Prepared for

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Emission Standards Division

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SECTION 1
INTRODUCTION

Phosphoric acid (SIC 28741), made from phosphate rock and sulfuric acid, is the primary material input in almost all of the phosphatic fertilizer used in agriculture. Producers of phosphoric acid use two distinct manufacturing processes to produce two very different basic grades of product acid. Phosphoric acid is produced via the wet process by 18 companies owning 21 establishments . This process produces a "merchant-grade" acid. Phosphoric acid is produced via the thermal process by four companies owning eleven establishments which produce a more highly concentrated and purified acid. The chemical is used as an intermediate product in the manufacture of such final products as phosphate fertilizer or animal feed, concentrated and/or purified high grade phosphoric acid, or used in other industrial processes unrelated to the phosphate industry (Barron, 1993a). The demand for phosphoric acid is therefore a derived demand and the rate of growth in demand for phosphoric acid is largely dependent on the rate of growth in the sectors that use it as an input. Production of phosphoric acid increased from 9.6 million short tons in 1986 to 12.4 million tons in 1991, a 29 percent increase in five years. (U.S. Department of Commerce,1992d)

The fertilizer industry produces nitrogenous, phosphatic, and potassic (potasssium) fertilizers which supply nutrients essential to plant growth. Nitrogen-based fertilizers account for 53 percent of total fertilizer consumption in the United States; phosphorus-based fertilizers, 26 percent; and potassium-based fertilizers, 21 percent (U.S. Department of Commerce,1992d). The U.S. phosphatic fertilizer industry is competitive in world markets due to its high process technology and the availability of raw materials - phosphate rock and sulfur. The U.S. fertilizer industry continues to consolidate into fewer and larger companies in response to stagnant demand and increasing production costs (U.S. Department of Commerce,1992d).

The current-dollar value of phosphatic fertilizer product shipments in 1991 was estimated at $4.2 billion, reflecting a real growth rate of 0.5 percent from 1990. Exports increased while imports continued to be insignificant. The United States leads the world, not only in production and consumption of phosphatic fertilizers, but also in exports. The Soviets follow the United States in consumption; Morocco is second in production (U.S. Department of Commerce,1992d).

1.1 REGULATED ENTITIES AND POLICY ALTERNATIVES

Potential regulated industries will include those with facilities that manufacture phosphoric acid via the wet process, superphosphoric acid and granular phosphate fertilizer. The primary hazardous air pollutants (HAP) associated with wet process phosphoric acid manufacturing and granular phosphate fertilizer production are hydrogen flouride (HF) and various metals associated with the phosphate rock (e.g. arsenic (AS), cadmium (Cd), chromium (Cr), manganese (Mn), and Nickel (Ni). Table 1-1 lists the pollutants expected to be emitted from each of the five subcategories and potential subcategories.

TABLE 1-1. SUMMARY OF HAPs POTENTIALLY EMITTED FROM PHOSPHATE INDUSTRY SUBCATEGORIES

Subcategories	HAP(s)
Calcining Phosphate Rock	Metals (As, Cd, Cr, Mn, Ni)
Reactor Vessels	
Flash Coolers	
Filtration System	
Evaporators	
Storage Tanks	
Wet Process Phosphoric Acid Manufacturing	HF
Superphosphoric Acid Manufacturing	HF
Evaporators	
Filtration System	
Storage Tanks	
Granular Phosphate Fertilizer	HF
Reactor Vessels	Metals (As, Cd, Cr, Mn, Ni)
Granulators	
Dryers	
Coolers	
Material Handling and Storage	
Phosphogypsum Cooling/Evaporation Ponds	HF
Potential Subcategories:	
Purified Phosphoric Acid Production (Wet Process)	Organic Solvents
Liquid Ammoniated Phosphate Fertilizer	HF
Phosphate Rock Drying	Metals (As, Cd, Cr, Mn, Ni)
Phosphate Rock and Granular Phosphate Fertilizer Production Product Handling	Metals (As, Cd, Cr, Mn, Ni)

Source: Radian Memorandum April 28, 1993.

SECTION 2
SUPPLY

2.1 PRODUCTION PROCESS

2.1.1 Phosphoric Acid Manufacturing

Figure 2-1 describes the phosphoric acid manufacturing and phosphate fertilizer production process.

Phosphoric acid can be manufactured by one of two processes: a wet process or a thermal process. Each of these processes produces very different grades of phosphoric acid. Acid produced via the wet process is typically referred to as merchant-grade phosphoric acid. During the wet process, phosphate rock is reacted with sulfuric acid to produce an acid product containing 40 to 54 percent phosphoric acid (P_2O_5) and a calcium sulfate byproduct, gypsum. In some cases, calcination may be required to remove organic material from phosphate rock mined in some parts of the United States depending on the ultimate product use. Merchant-grade phosphoric acid may be used in phosphate fertilizer or animal feed production, be concentrated and/or purified to higher grade phosphoric acid (i.e. superphosphoric acid), or may be used in a variety of industrial processes unrelated to the phosphate industry.

The emission sources and estimated annual emissions for the wet process phosphoric acid manufacturing process is displayed in Table 2-1.

During the thermal process, phosphorus is burned in a combustion chamber and then reacted with water to produce phosphoric acid that contains 75 to 85 percent P_2O_5. Because phosphoric acid produced via the thermal process is highly concentrated and contains fewer impurities, it is generally used in foods or in more specialized industrial applications. Due to apparent low HAP emissions during the production process, thermal process phophoric acid will most likely not be regulated.

2.1.2 Phosphate Fertilizer Production

The principal granulated phosphate fertilizers produced in the United States are

- granulated triple superphosphate (GTSP),
- normal superphosphate (NSP),
- monoammonium phosphate (MAP), and
- diammonium phosphate (DAP).

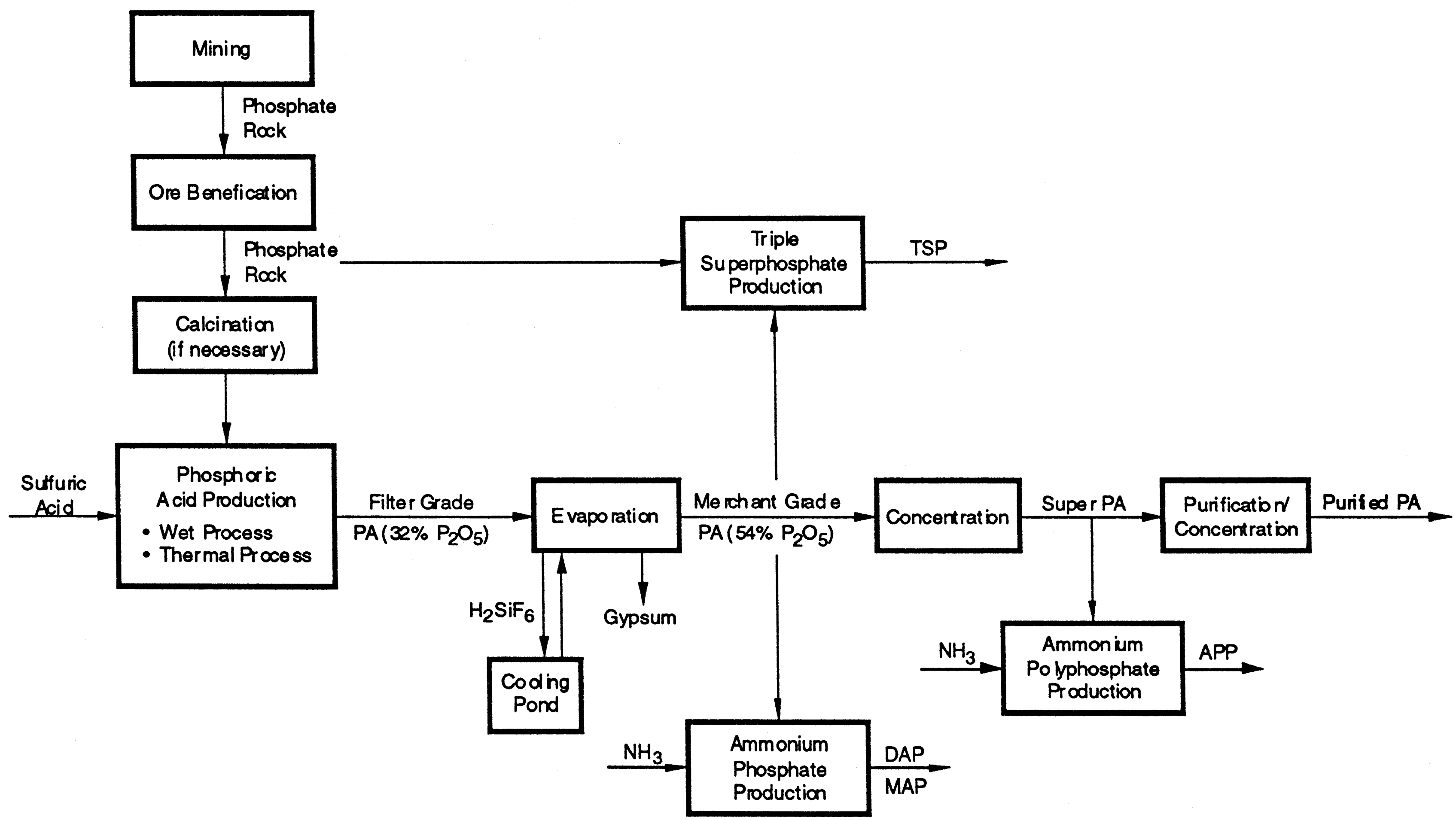

Figure 2-1. Phosphoric Acid Manufacturing and Phosphate Fertilizer Production Processes

TABLE 2-1. WET PROCESS PHOSPHORIC ACID FLOURIDE EMISSIONS FOR A TYPICAL 1,000 TON/DAY SOURCE

Emissions Sources	Estimated Annual Emissions (tons F/year)[1]
Merchant Grade Phosphoric Acid Process Sources	3
Cooling Pond Emissions Associated With Merchant Acid Production	3 - 650[2]
Super Phosphoric Acid Process Sources	0.5[3]
Cooling Pond Emissions Associated With Super Acid Production	0.2 - 42[2]

1. Based on NSPS limits.
2. Pond minimum emissions estimates based on 0.1 acres per daily ton of P_2O_5 and 10 lb. F/acre-day. Ninety percent of pond emissions are apportioned to merchant acid production and 6 percent of pond emissions are apportioned to super acid production.
3. Assumption that 25 percent of merchant phosphoric acid is used to produce super acid.

Source: Phosphoric Acid Manufacturing NESHAP Briefing Package. July 14, 1993.

GTSP is produced when merchant-grade phosphoric acid is reacted with phosphate rock to produce a slurry which is then granulated, dried and screened to produce uniform fertilizer particles with 40 to 48 percent P_2O_5. Normal superphosphate, which has a P_2O_5 content of only 15 to 20 percent, is produced by reacting phosphate rock with weak sulfuric acid. Monoammonium and diammonium phosphates are produced similarly: merchant-grade phosphoric acid is reacted with ammonia to form an ammoniated slurry. The slurry is then granulated, dried, and screened to produce the MAP fertilizer product. In DAP production, additional ammonia is sparged to the bottom of the granulator to produce a more highly ammoniated product. The emission sources and estimated annual emissions for phosphate fertilizer production are displayed in Table 2-2.

2.1.3 Production History and Trends

The 1984 phosphoric acid production record was surpassed in 1988 when 11.6 million tons of P2O5 were produced - 11 million as wet-process acid and 0.6 million as thermal acid. Another high was set in 1991, with 12.3 million tons produced (11.8 million as wet-process acid and 0.5 million as thermal acid). Capacity utilization was 98 percent in 1991 (TVA, 1992b). Phosphorus and phosphoric acid production in the United States is displayed in Table 2-3.

TABLE 2-2. SOLID FERTILIZER FLOURIDE EMISSIONS FOR A TYPICAL 1,000 TON P_2O_5/DAY SOURCE

Emissions Sources	Estimated Annual Emissions[1] (tons F/year)
DAP/MAP Process Sources	10.4
DAP/MAP Cooling Pond Portion	0.024 - 4.8[2]
GTSP Process Sources	34
GTSP Storage	14.4
GTSP Cooling Pond Portion	0.68 - 130[2]

1. Based on NSPS limits.
2. Pond minimum emissions estimates based on 0.1 acres per daily ton of P_2O_5 phosphoric acid production and 0.2 lb F.acre-day. Pond maximum emissions estimates baased on 0.4 acres per daily ton of P_2O_5 phosphoric acid production and 10 lb F/acre-day. 4.6 percent of pond emissions apportioned to GTSP production and 0.16 percent apportioned to DAP/MAP production.

Source: Phosphate Fertilizer Production, NESHAP Briefing Package. July 14, 1993.

Since its introduction in the 1960's, diammonium phosphate (DAP) has grown in importance due to its use in blended fertilizers. Diammonium phosphate production increased from under a million tons in 1965 to over 6.6 million in 1991. Alternatively, triple superphosphate (TSP) production has declined since the mid-1970's. Monoammonium phosphate (MAP) production exceeded TSP production in 1987 and the trend is expected to continue due to its higher analysis and versatility in manufacturing dry blends, granular mixtures, and fluid materials (TVA, 1992b). Production of phosphate fertilizer materials in the United States is displayed in Table 2-4.

2.1.4 Substitutability

Since there are primarily only two material inputs to the production of phosphoric acid, phosphoric rock and sulfuric acid, there is virtually no possible substitution of material inputs for this process. Similarly, phosphoric acid is the major raw material of almost all of the phosphatic fertilizer used in agriculture. Every plant requires some phosphorus to survive. The other primary plant nutrients, nitrogen and potassium, are complementary nutrients in fertilizer but can not substitute for the benefits that phosphorus provides. The various n-p-k mixtures of fertilizers can not really be changed without fundamentally changing the nature of the product a determined by its end uses (which will be discussed in Section 3.4).

TABLE 2-3. PHOSPHORUS AND PHOSPHORIC ACID PRODUCTION—UNITED STATES

Calendar Year	Phosphoric Acid (Wet Process)			Phosphoric Acid (Thermal Process)	Superphosphoric Acid (Wet Process)	Elemental Phosphorus
	Capacity	Production	Rate (%)			
1965	...	2896	...	1009	...	1273
1966	...	3596	...	1000	...	1296
1967	5542	3993	72	1073	...	1345
1968	5530	4152	75	1116	...	1405
1969	5903	4328	73	1107	...	1427
1970	5991	4642	77	1041	...	1367
1971	5926	5016	85	955	312	1249
1972	5990	5775	96	937	547	1239
1973	6518	5919	91	1008	596	1204
1974	6773	6186	91	1027	527	1201
1975	8611	6921	80	757	557	1030
1976	9044	7226	80	723	557	1001
1977	9496	8039	85	707	699	986
1978	9651	8892	92	745	737	1011
1979	9779	9554	98	764	1056	1053
1980	10404	10151	98	697	910	989
1981	10741	9281	86	677	1304	976
1982	10759	7644	71	609	1275	828
1983	10295	9109	88	658	1261	838
1984	11319	10715	95	679	1364	885
1985	11855	10007	84	600	1605	823
1986	11517	8982	78	596	1550	833
1987	11102	10071	91	614	1548	788
1988	11314	10956	97	625	2249	786
1989	12087	10903	90	610	2300	836
1990	12262	11548	94	626	2168	815
1991	12110	11832	98	510	2046	716

Source: USDC, "Inorganic Fertilizer Materials and Related Products," Series M28B, monthly and annual reports, 1981-1991, and "Inorganic Chemicals," Series M28A, annual reports, 1978-1980; and TVA World Fertilizer Market Information Services.

TABLE 2-4. PRODUCTION OF PHOSPHATE FERTILIZER MATERIALS—UNITED STATES

Calendar Year	Superphosphate		Multiple-Nutrient Materials				
	Normal	Triple	DAP	MAP	Other*	Total	Total
1965	1113	1466	...	...	...	1252	3830
1966	1138	1696	...	...	...	1615	4450
1967	1184	1481	...	...	...	2030	4695
1968	938	1419	...	...	...	1839	4196
1969	807	1354	...	...	...	2132	4292
1970	670	1474	...	...	...	2452	4596
1971	626	1503	...	...	...	2863	4992
1972	677	1659	...	...	...	3147	5482
1973	619	1693	...	...	...	3226	5538
1974	698	1719	2100	...	626	2950	5367
1975	484	1678	2655	...	582	3411	5573
1976	383	1595	2876	...	677	3847	5824
1977	340	1791	3455	...	779	4568	6699
1978	291	1820	3936	...	807	5065	7176
1979	353	1842	4257	...	819	5468	7662
1980	425	1693	4972	...	854	6191	8309
1981	237	1491	4076	529	576	5181	6909
1982	139	1065	3681	484	237	4402	5606
1983	122	1246	4782	710	197	5689	7056
1984	127	1124	5804	844	134	6781	8032
1985	100	1190	5340	911	112	6363	7653
1986	65	972	4222	741	109	5071	6108
1987	64	956	5017	963	105	6085	7105
1988	86	976	5450	1084	82	6615	7677
1989	67	832	6175	1061	102	7338	8237
1990	66	929	6427	1119	90	7636	8631
1991	56	904	6690	1166	70	7926	8885

[1]Includes MAP 1974-1980.

Source: USDC, "Inorganic Fertilizer Materials and Related Products," Series M28B, monthly and annual reports.

2.2 COSTS OF PRODUCTION

Rising production costs are causing fertilizer companies to consolidate into fewer and larger organizations (U.S. Department of Commerce, 1992d). Further information on production costs can be found in the most recent "Phosphate Fertilizer Production Cost Survey" available from the Fertilizer Institute for a charge. A more detailed discussion of production costs will be added later.

SECTION 3
DEMAND

3.1 CHARACTERIZATION OF DEMANDERS

The primary industries that use the commodities produced under SIC code 2874 include feed grains, agriculture, forestry and fishery services and fertilizers (U.S. Department of Commerce, 1982). No specific information on household demand is available at this time. In the world market, China and India are primary purchasers of U.S. phosphatic fertilizer exports and will continue to be growing markets (Department of Commerce, 1992d).

Shipments included in SIC code 2874 by class of customer are displayed in Table 3-1.

TABLE 3-1. MANUFACTURER'S SHIPMENTS BY CLASS OF CUSTOMER: 1987. SIC CODE 2874, PHOSPHATIC FERTILIZERS

Class of Customer	Value (Millions of Dollars)	Percent of Total
Total product shipments	3609.0	100
Shipments to other establishments of same company		
Wholesale establishments	1224.2	34
Retail stores and outlets	107.7	3
Other manufacturing establishments	398.7	11
Other nonmanufacturing establishments	NA	NA
Shipments to all other customers		
Wholesalers	611.5	17
Retailers	472.1	13
Manufacturers	493.0	14
Federal, State and Local governments	1.6	NA
All other	300.2	8

Source: U.S. Department of Commerce. *1987 Census of Manufactures, Distribution of Sales by Class of Customer.* 1992.

3.2 PRODUCT CHARACTERISTICS

Goods and services are valued by the consumer because of the properties or characteristics they possess, with these characteristics taken to be an objective, universal property of the good (Lancaster, 1974). Therefore the demand for a commodity is not simply for the physical good itself but instead for the set of characteristics and properties that are contained in a particular commodity.

One of the characteristics/properties of a particular fertilizer is its phosphorus content. No living thing can exist without phosphorus. It must be present in adequate amounts in living cells before cell division can take place. Phosphorus is always found in abundance in young, fast-growing meristematic tissue (Fertilizer Institute, 1982). The nutrient also has many vital functions in photosynthesis, utilization of both sugar and starches, and in energy transfer process.

One of the most interesting aspects of phosphorus is its mobility within the plant. Under conditions of reduced supply or availability, phosphorus can be translocated from old to young tissue. The quality and early maturity of grain crops has, for many years, been associated with adequate phosphorus nutrition. Young plants absorb phosphorus very rapidly, and adequate phosphorus levels provide rapid, extensive growth of roots (Fertilizer Institute, 1982).

In the temperate climatic zone, soil phosphorus levels become more important because low soil temperatures reduce phosphorus absorption by plants. The presence of other nutrients, and even their form, can affect phosphorus uptake also. For example, ammonium nitrogen in starter fertilizers enhances phosphorus uptake and root development for several crops. Such factors are particularly important for early-season corn planted early in cold soils (Fertilizer Institute, 1982).

3.3 DEMAND FOR PHOSPHORIC ACID AND PHOSPHATIC FERTILIZERS

Consumption of single-nutrient phosphate fertilizers and multiple-nutrient fertilizers is described in Tables 3-2 and 3-3, respectively. Consumption of phosphoric acid as a single-nutrient fertilizer fell six percent in 1992, superphosphates grew 2.5 percent while consumption of other single-nutrient phosphate fertilizers fell 21 percent. A more complete description of the demand for multiple-nutrient fertilizers by grade can be found in Commercial Fertilizers, 1992.

Total fertilizer consumed in the United States for 1991 and 1992 by type of phosphate material is included in Table 3-4. Total phosphatic fertilizer consumed in the United States fell slightly (1.4%) from 6,621,809 short tons in 1991 to 6,533,065 short tons in 1992. Diammonium phosphates led phosphatic fertilizer consumption both in 1991 and 1992 but fell slightly (.5%) in 1992. Additional consumption data and historical trends are presented in Section 5.2.

TABLE 3-2. CONSUMPTION OF SINGLE-NUTRIENT PHOSPHATE FERTILIZERS YEARS ENDED JUNE 30, 1991, AND 1992

Short Tons of Material					
Phosphoric Acid		Superphosphate		Other	
1991	1992	1991	1992	1991	1992
47,576	44,652	510,529	523,461	171,161	133,900

Source: Commercial Fertilizers, 1992.

TABLE 3-3. CONSUMPTION OF MULTIPE-NUTRIENT FERTILIZERS YEARS ENDED JUNE 30, 1991, AND 1992

Short Tons of Material					
N-P-K		N-P		P-K	
1991	1992	1991	1992	1991	1992
9,940,003	10,025,964	6,482,100	6,472,810	556,029	583,673

Source: Commercial Fertilizers, 1992.

3.3.1 Substitution Possibilities in Consumption

Commercial fertilizers can be distinguished by their n-p-k content (nitrogen, phosphorus, potassium). Some fertilizers are single nutrient fertilizers and will contain only one of the three major nutrients. Other fertilizers are multiple-nutrient grade fertilizers and contain some combination of two or more of the n-p-k nutrients. All plants require all three nutrients in varying quantities. However, while some crops may require higher amounts of phosphorus, others may require less phosphorus but more nitrogen, etc.

3.3.1.1 Short run substitution

Assuming that the proposed regulation increases the price of phosphoric acid and consequently, the price of phosphatic fertilizer, consumers have few substitution possibilities in

TABLE 3-4 . TOTAL PHOSPHATIC FERTILIZER CONSUMED: UNITED STATES YEARS ENDED JUNE 30 1991, AND 1992.

Short Tons of Material		
	United States	
Phosphate Material Kind	**1991**	**1992**
Basic Slag	8,419	7,006
Raw and Steamed Bonemeal	1,416	1,949
Phos. Acid and Solutions	82,662	98,649
Diammonium Phosphates	3,447,911	3,432,417
Monoammonium Phosphates	1,035,034	978,782
Liquid Ammonium Phosphates	1,125,138	1,156,213
Normal Superphosphate	16,094	25,131
Triple Superphosphate	494,435	498,330
Other	410,699	334,588
Total	6,621,809	6,533,065

Source: Commercial Fertilizers, 1992.

the short run. Farmers could reduce the total amount of fertilizer they consume, thus reducing their demand for phosphorus, and/or they could change the n-p-k content of the fertilizer they consume so that the phosphorus content is reduced. The extent to which the farmer can reduce consumption of phosphorus is dependent on the type of crop being produced, the current maturity of the crop and the amount of phosphorus that is required for that crop to survive (dependent on soil type, climate, etc.). There is no perfect substitute for the benefits that phosphorus provides. Then the short run response to an increase in price leads the farmer to reduce consumption of phosphorus until the marginal benefit provided by the phosphorus equals the higher price.

3.3.1.2 Long run substitution

In the long run, consumers of phosphate fertilizers may have more substitution possibilities. For example, a farmer may alter the type of crops produced to those that require less phosphorus. Other, more pervasive, long-term adjustments include the adaptation of less-fertilizer intensive agricultural technology--perhaps through advances in technology--or net reductions in fertilizer-consuming activities (agriculture, forestry, etc.).

SECTION 4
INDUSTRY ORGANIZATION

4.1 COMPETITIVE STRATEGIES

To accurately measure the effect that a propsed regulation will have on a product market, including its suppliers and demanders, some knowledge of the current market structure is necessary. Information on the number and size distribution of the suppliers, market share and potential market power are all important aspects in determining the current structure of the product market.

The shares of shipments accounted for by the 4,8,20 and 50 largest companies for SIC code 2874 are reported in Table 4-1. These concentration ratios are often used as a measure of the competitive structure of an industry. When a few firms produce a large portion of industry output, this is often interpreted as an indication that the industry is oligopolistic, rather than purely competitive. This interpretation should be modified to consider the concentration of producers in the individual product markets, rather than in the aggregated multi-product industries. For example, one company may produce a small portion of industry output, but a large portion of the output in one product market. It would be mistaken to conclude a perfectly competitive market structure based on industry-level concentration measures, which are usually reported at the multi-product industry level (e.g. 4-digit SIC), rather than the individual product level. However, the existence of high concentration measures at the industry level (e.g., over 40 percent for the largest four firms (Martin, 1988)) may be a good indication of some oligopolistic market power. In 1987, the Census of Manufactures reported a concentration measure of 48 percent for the four largest firms.

The Herfindahl Index is a truncated index and is calculated by squaring the concentration ratio for each of the top 50 companies or the entire universe (whichever is lower), and summing those squares to a cumulative total. It has the merit of combining information about the market shares of all firms in the market, not just the largest four or the largest eight firms. The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry group or industry is at the top. Census of Manufactures data reports that the Herfindahl Index for the phosphatic fertilizer manufacturers increased from 600 in 1982 to 880 in 1987 suggesting that the market is concentrated at the top by a few suppliers.

Specialization ratios represent the ratio of primary product shipments to total product shipments (primary and secondary, excluding miscellaneous receipts) for the establishments classified in the industry. Coverage ratios represent the ratio of primary products shipped by the

TABLE 4-1. SHARE OF VALUE OF SHIPMENTS ACCOUNTED FOR BY THE 4, 8, 20, AND 50 LARGEST COMPANIES: 1987

		Percent Accounted for By						
Year	Companies (Number)	4 Largest Companies	8 Largest Companies	20 Largest Companies	50 Largest Companies	Herfindahl Index for 50 Largest Companies	Primary Product Specialization Ratio (%)	Coverage Ratio (%)
1987	55	48	74	98	99+	880	92	96
1982	69	37	62	92	99+	600	94	94
1977	45	35	57	92	100	NA	93	91
1972	66	29	47	83	99	NA	89	92

Source: 1987 Census of Manufacturers, Subject Series.

establishments classified in the industry to the total shipments of such products that are shipped by all manufacturing establishments wherever classified.

4.2 PLANT/FACILITY CHARACTERISTICS

4.2.1 Physical Characteristics

The location of phosphoric acid manufacturing facilities and phosphate fertilizer production facilities is concentrated largely in areas where phosphate ore is mined: Florida, North Carolina and the Rocky Mountain states. Ore used in the Gulf Coast facilities (Mississippi, Louisiana, and Texas) is reportedly shipped from Florida (Barron, 1993a). Figure 4-1 displays the relative locations of the 21 wet-process phosphoric acid manufacturers while Figure 4-2 displays the relative locations of the 21 phosphatic fertilizer producers.

Capacity data for wet-process phosphoric acid, superphosphoric acid and granular phosphate fertilizer plants can be found in Appendix A. The average capacity is 550,000 metric tons P2O5/year for a wet-process phosphoric acid manufacturer, 228,000 metric tons superphosphoric acid/year for a superphosphoric manufacturer, 375,000 metric tons DAP/MAP per year and 171,000 metric tons GTSP/year for phosphatic fertilizer manufacturers.

Employment figures for SIC code 2874 indicate a slight decline in the total number employed from 10,800 in 1989 to 10,500 in 1991, (U.S. Department of Commerce, 1992b). Total number of employess and production workers are displayed in Table 4-2. The number of establishments by the number of employees is presented in Table 4-3.

TABLE 4-2 NUMBER EMPLOYED IN SIC CODE 2874

	1989		1990	
SIC Code	Number of Employees	Production Workers	Number of Employees	Production Workers
2874	10,800	7,400	10,500	7,500

Source: U.S. Department of Commerce. 1992d. *1990 Annual Survey of Manufactures.* Washington, DC: U.S. Government Printing Office.

TABLE 4-3. NUMBER OF ESTABLISHMENTS BY NUMBER EMPLOYED: 1987 (SIC CODE 2874)

	Number of Establishments Number Employees					
SIC Code	**1 – 9**	**10 – 19**	**20 – 49**	**50 – 99**	**100 – 499**	**500 – 2500**
2874	19	16	12	11	14	5

Source: Census of Manufactures, Industry Series, 1987.

4.3 FIRM CHARACTERISTICS

A regulatory action to reduce hazardous air emissions during the production of phosphoric acid and phosphatic fertilizers will potentially affect the business entities that own the regulated facilities. Facilities comprise a site of land with plant and equipment that combine inputs (raw materials, energy, and labor) to produce outputs . Companies that own these facilities are legal business entities that have the capacity to conduct business transactions and make business decisions that affect the facility. The terms facility and establishment are synonymous in this profile and refer to the physical location where products are manufactured. Likewise, the terms company and firm are synonymous and refer to the legal business entity that owns one or more facilities.

Currently there are a total of 18 companies owning 25 establishments that manufacture wet-process phosphoric acid and/or granulated phosphatic fertilizers. Phosphoric acid is produced by 19 companies operating 21 establishments; superphosphoric acid is produced by 7 companies operating 8 establishments; and granulated fertilizers (DAP, MAP, and GTSP) are produced by 16 companies operating 21 establishments (Barron, 1993a). Table 4-1 lists the companies and the phosphate product produced.

Census data for SIC code 2874 reported in this profile characterizes the phosphatic fertilizer industry as it was in 1987. At that time, 55 companies owned 77 establishments (U.S. Department of Commerce, 1990). Table 4-4 lists the number of companies and establishments for SIC code 2874 as reported by the Census of Manufactures.

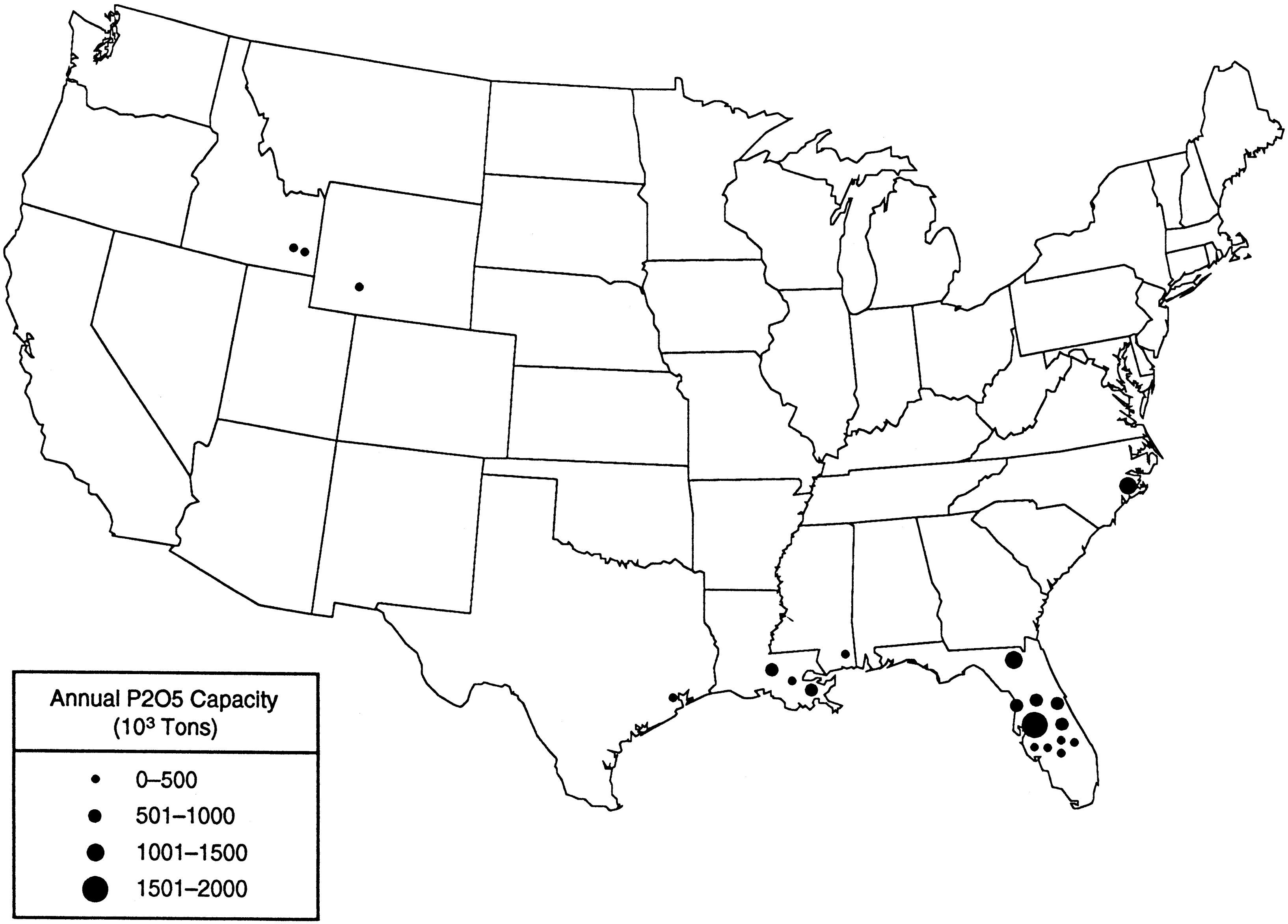

Figure 4-1. Extent of Industry Locations of Wet Process Phosphoric Acid Manufacturing Facilities

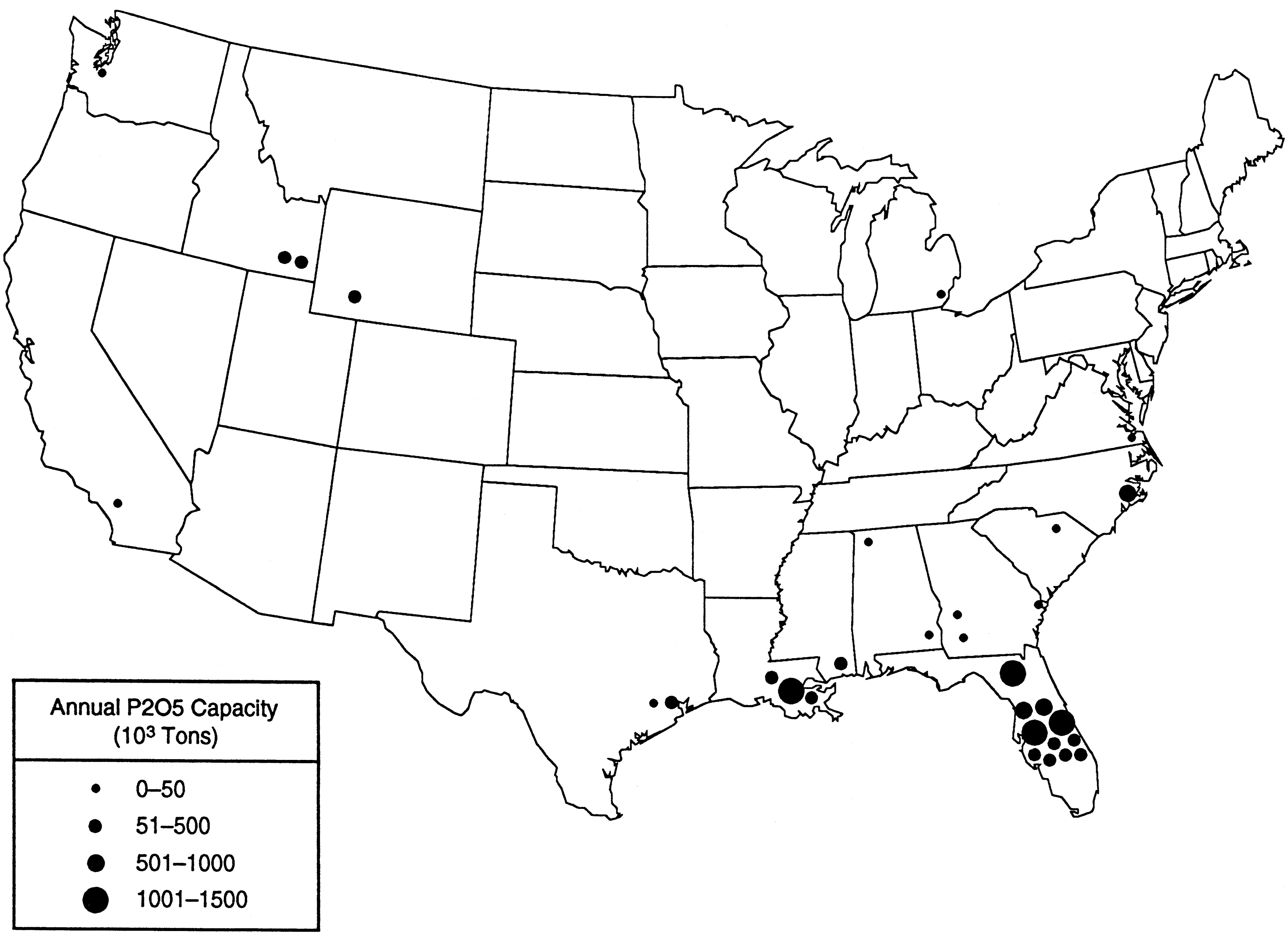

Figure 4-2. Extent of Industry Locations of Solid Fertilizer Production Facilities

TABLE 4-4. HISTORICAL NUMBER OF COMPANIES AND ESTABLISHMENTS SIC CODE 2874

	Companies (No.)	Establishments (No.)
1987 Census	55	77
1986 ASM	NA	NA
1985 ASM	NA	NA
1984 ASM	NA	NA
1983 ASM	NA	NA
1982 Census	69	110
1981 ASM	NA	NA
1980 ASM	NA	NA
1979 ASM	NA	NA
1978 ASM	NA	NA

Source: Census of Manufacturers, Manufacturers Industry Series.

With only 24 companies owning 41 establishments (includes wet and thermal process acid, superphosphoric acid, granular phosphate and normal superphosphate fertilizer production units) currently, the data indicates a trend towards consolidation in the industry to fewer and larger companies since 1982. One clarification of the data needs to be made. Manufacturers reported by the Census data include producers of liquid fertilizers (primarily ammonium polyphosphates). However the current data reported above does not include liquid fertilizer manufacturers. The amount of liquid fertilizer relative to all phosphatic fertilizers was less than five percent in 1987 so this discrepancy is minor.

Currently, a company owns an average of 1.7 establishments as compared to an average of 1.4 establishments in 1987. By operating more than one plant, a firm can spread the fixed costs of administration over a larger output. The result is a multiplant economy of scale that will encourage multiplant operation. There will often be product-specific economies of multiplant operation. By operating more than one plant, a firm can specialize the production of high volume products in single plants.

4.3.1 Legal Ownership of Facilities

Business entities that own composite facilities will generally be one of three types of entities:

- sole proprietorships
- partnerships, or
- corporations.

Each type has its own legal and financial characteristics that may have a bearing on how firms are affected by the regulatory alternatives and on how the firm-level analysis of the regulation might be approached. Table 4-5 shows the legal form of establishments in SIC code 2874 as the industry was represented in 1987.

4.3.1.1 Sole Proprietorship

A sole proprietorship consist of one individual in business for himself who contributes all of the capital, takes all of the risks, makes the decisions, takes the profits, or absorbs the losses. While Behrens (1985) reports that sole proprietorships are the most common form of business, the 1987 Census of Manufactures reports that only 1 of the 77 establishments, or 1.5 percent, are sole proprietorships.

TABLE 4-5. LEGAL FORM OF ORGANIZATION OF ESTABLISHMENTS IN SIC CODES 2874: NUMBER AND PERCENTAGE

Legal Organization	Number of Establishments	Percentage of Establishments
Proprietorships	1	1.5
Partnerships	1	1.5
Corporations	75	97
Other	0	0
Total	77	100

Source: U.S. Department of Commerce. 1991. *1987 Census of Manufactures, Subject Series: Type of Organization.* Washington D.C.: U.S. Government Printing Office. February.

Legally, the individual and the proprietorship are the same entity. From a legal standpoint, personal and business debt are not distinguishable. From an accounting standpoint however, the firm may have its own financial statements that reflect only the assets, liabilities, revenues, costs, and taxes of the firm, aside from those of the individual.

4.3.1.2 Partnerships

The 1987 Census of Manufactures reports that only one of the 77 establishments, or 1.5 percent, are partnerships. A partnership is an association of two or more persons to operate a business. In the absence of a specific agreement, partnerships are general—each partner has an equal voice in management and an equal right to profits, regardless of the amount of capital each contributes. A partnership pays no federal income tax. All tax liabilities are passed through to the individuals and are reflected on individual tax returns. Particularly germane is that each partner is fully liable for all debts and obligations of the partnership (Behrens, 1985). Thus, many of the qualifications and complications present in analyses of proprietorships (e.g., capital availability) are present—in some sense magnified—in analysis of partnerships.

4.3.1.3 Corporations

The 1987 Census of Manufactures reports that 75 of the 77 establishments, or 97 percent, are corporations. Unlike proprietorships and partnerships, a corporation is a legal entity separate and apart from its owners or founders. Financial gains from profits and financial losses are borne by owners in proportion to their investment in the corporation.

4.3.2 Vertical Integration

Vertical integration is a potentially important dimension in firm-level impacts analysis because the regulation could affect a vertically integrated firm on several levels. For example, the regulation may affect companies for whom the manufacture of phosphoric acid is not the company's primary focus but rather is an input into the company's other production processes such as phosphatic fertilizers. A regulation that increases the cost of manufacturing phosphoric acid for vertically integrated firms will also affect the cost of producing the primary products. The majority of the DAP, MAP, and GTSP production units are colocated with wet process phosphoric acid manufacturing units and all of the superphosphoric acid manufacturing units are colocated with phosphoric acid manufacturing units. None of the normal superphosphate production units is located at a site where phosphoric acid or any other granulated phosphate fertilizer is produced. (Barron, 1993a)

4.3.3 Horizontal Integration

Horizontal integration is also a potentially important dimension in firm-level impact analysis for either or both of two reasons. First, a diversified firm may own facilities in unaffected industries. This type of diversification would help mitigate the financial impacts of the regulation. Second, a diversified firm could be indirectly as well as directly affected by the regulation. For example, if a firm is diversified in manufacturing pollution control equipment, the regulation could indirectly and favorably affect it.

The twenty-five companies that currently manufacture phosphoric acid and/or phosphate fertilizers represent a mix of diversified and specialized production units. Such large petrochemical companies as Mobil, Occidental, IMC and Chevron manufacture a wide variety of petrochemical products. Other companies such as MS Phosphates Corp and Farmland are more specialized in the production of phosphoric acid and phosphate fertilizers (Barron, 1993c).

4.3.4 Financial Status

4.3.4.1 Financial Ratios

It is important to characterize the baselines financial condition of the potentially regulated facilities. A widely accepted method of summarizing financial status is the use of financial ratios derived from firm-level financial statements. Profitability is the most comprehensive measure of the firm's performance because it measures the combined effects of liquidity, asset management and debt management. Several ratios are commonly used to measure profitability, including return on assets, return on equity, and return on sales. For all these measures, higher values are unambiguously preferred over lower values. Table 4-6 shows the ratios used in this profile to measure the financial viability of firms in terms of profitability.

TABLE 4-6. KEY MEASURES OF FIRM PROFITABILITY

Measure of Profitability	Formula for Calculation
Return on Sales	$\frac{\text{Net Income}}{\text{Sales}}$
Return on Assets	$\frac{\text{Net Income}}{\text{Total Assets}}$
Return on Equity	$\frac{\text{Net Income}}{\text{Owner's Equity}}$

A firm's profitability may be evaluated using comparative analysis. This comparative analysis would evaluate the profitability of potentially affected firms in baseline versus with regulation by comparing the firm's key measures of profitability with specific industry benchmark ratios reported in Dun and Bradstreet's (D&B's) *Industry Norms and Key Business Ratios*. While these industry benchmark ratios are not reported here, they may be obtained from D&B. Table 4-7 reports the profitability ratios for the phosphate fertilizer industry as reported under SIC code 2874 by Dun and Bradstreet.

TABLE 4-7. FIRM PROFITABLILITY RATIOS FOR SIC CODE 2874, 1992 (23 ESTABLISHMENTS)

	Quartile		
	UQ	**MED**	**LQ**
Return on Sales	6.6	2.2	0.4
Return on Assets	8.5	2.8	(0.5)
Return on Equity	10.4	5.6	(3.9)

Source: Duns Analytical Services. 1993. *Industry Norms and Key Buisness Ratios*. Dun and Bradstreet Business Credit Services. 1992-1993.

4.3.5 Financial Failure

A composite ratio of financial condition, called the Z-score, may also be computed to characterize baseline and with regulation financial condition of potentially affected firms. The Z-score (Altman, 1982) is a multidiscriminant function used to asses bankruptcy potential, and was developed specifically for manufacturing firms. It simultaneously addresses liquidity, asset management, debt management, profitability and market value. This measure of financial failure is not reported here but will be computed at a later date.

SECTION 5
MARKETS

5.1 PRODUCTION

5.1.1 Domestic Production

Table 5-1 lists the value of shipments for SIC code 2874 from 1987 to 1990. Phosphatic fertilizers experienced a 24 percent increase in the value of shiments from 1987 to 1990 and more recently, a 4.1 percent increase in 1990. Phosphoric acid value of shipments increased 10.5 percent from 1987 to 1990 but declined 2.9 percent in 1990.

TABLE 5-1. VALUE OF SHIPMENTS FOR SIC CODE 2874: 1987 TO 1990*

Number	Product	Value of Product Shipments (millions of dollars)			
		1990	1989	1988	1987
2874	Phosphatic Fertilizers	4462.0	4284.5	4149.5	3609.0
28741	Phosphoric Acid	1287.0	1325.5	1270.4	1164.9
28742	Superphosphate and other phosphatic fertilizer materials	2858.1	2629.4	2584.2	2153.8
28744	Mixed fertilizers	269.7	294.2	260.9	256.6
28740	Phosphatic fertilizer n.s.k.	47.3	35.4	34.0	33.7

Source: Annual Survey of Manufacturers, Value of Product Shipments
*Earlier years are available in Census of Manufacturers, Manufacture Industry Series.

The value of shipments for related products from the Current Industrial Report Series are listed in Table 5-2. Diammonium phosphates has traditionally been and continues to be the major shipment of phosphatic fertilizers.

The regulated universe for this profile would include all those products listed above with the exception of thermal process phosphoric acid, other ammonium phosphates, and other phosphatic fertilizer materials. Combined these three products only consisted of three percent of the total product as reported in Table 5-2.

TABLE 5-2. RELATED PRODUCTS FROM CURRENT INDUSTRIAL REPORTS SERIES—VALUE OF SHIPMENTS BY ALL PRODUCERS: 1987 AND 1982

		1987 Product Shipments		1982 Product Shipments	
1987 Product Code	Product	Quantity (1,000s Tons)	Value (Million of Dollars)	Quantity (1,000s Tons)	Value (Million of Dollars)
28741--	Phosphoric Acid	4,314.7	1,151.8	X	1,048.8
28741 81	Thermal	218.4	130.5	192.2	128.2
28741 85	Wet	4,096.3	1,021.3	2,797.7	920.6
28742--	Superphosphoric and other phosphatic fertilizer materials	7,148.2	2,090.6	5,485.1	1,814.0
28742 15	Normal and enriched superphosphates	21.8	6.3	54.4	16.5
28742 41	Concentrated superphosphates	947.6	229.0	1065.1	284.9
28742 51	Monoammonium phosphates	947.1	284.0	481.9	156.8
28742 52	Diammonium phosphates	5,138.7	1,533.7	3,721.6	292.1
28742 55 and 28742 61	Other ammonium phosphates and other phosphatic fertilizer materials	93.2	37.6	162.2	63.8

Source: U.S. Department of Commerce. *1987 Census of Manufactures, Agricultural Chemicals.* 1990. Washington D.C.: U.S. Government Printing Office.

5.1.2 Foreign Trade

During the period 1979 to 1991, U.S. phosphate exports have increased from just under 4 million tons of P_2O_5 to over 6.6 million tons in 1991. The reduction in phosphoric acid exports is due to the decline in super acid exports to the former U.S.S.R. Phosphate exports surpassed domestic consumption for the first time in 1984, and the pattern continued through 1991 (TVA, 1992b). Diammonium phasphates (DAP) is the largest fertilizer chemical in world trade because it contains two primary nutrients, 55 percent phosphorus and about 20 percent nitrogen. The United States leads the world in DAP exports which account for more than 90 percent of total U.S. phosphatic fertilizer exports (U.S. Department of Commerce, 1992d). Phosphate fertilizer exports are displayed in Table 5-3. U.S. exports of phosphoric acid and phosphatic fertilizers increased from 22% of demestic production in 1980 to 28% of domestic production in 1991. For several years, the United States has been exporting about half of its phosphatic fertilizer production (TVA, 1992b).

TABLE 5-3. PHOSPHATE FERTILIZER TRADE—UNITED STATES

	Exports (thousand short tons of P_2O_5)					Imports(thousand short tons)	
	Superphosphate						
Calendar Year	Normal	Triple	Ammonium Phosphates	Phosphoric Acid	Total All Materials	Ammonium Phosphates	Total All Materials
1965	17	233	147	...	427	84	124
1966	18	294	355	...	694	86	135
1967	15	291	584	...	934	102	165
1968	19	533	584	...	1172	119	162
1969	6	361	433	28	890	131	185
1970	8	325	470	19	875	219	283
1971	2	321	624	57	1047	220	291
1972	12	393	835	41	1344	241	347
1973	3	409	1028	74	1581	187	301
1974	6	488	916	159	1648	165	304
1975	6	494	1240	272	2074	144	249
1976	2	589	1307	400	2343	165	233
1977	9	556	1553	447	2602	175	239
1978	7	741	2235	715	3758	154	228
1979	6	732	2260	922	3995	163	266
1980	7	783	2809	847	4512	150	214
1981	5	760	2205	1021	4045	153	225
1982	8	564	2013	1005	3617	116	155
1983	15	606	2350	874	3873	92	126
1984		553	3504	1176	5254	91	128
1985	1	740	3392	1243	5395	84	107
1986	1	625	2346	1316	4296	72	99
1987	1	729	3354	1119	5209	77	128
1988	5	465	3423	1258	5151	62	115
1989	4	262	4669	1249	6184	7	7
1990	6	366	4364	1230	5966	6	6
1991	8	467	5379	758	6612	3	4

Source: USDC, "U.S. Exports," Report FT410, and "U.S. Imports," Report FT135, annual reports; and TVA estimates.

5.1.3 Prices

Since 1980, prices for TSP and DAP have shown substantial fluctuations. With an increase in trade, phosphate prices increased slightly in the late 1980's. However, in 1990 TSP and DAP prices fell 12 and 14 percent respectively before recovering slightly in 1991. In 1991, triple superphosphate was $217 per ton and DAP was $235. Futures contracts for DAP are now offered by the Chicago Board of Trade as a means to manage price risk (TVA, 1992b). Spring season retail phosphate prices in the United States are listed in Table 5-4.

5.2 CONSUMPTION

Domestic phosphate use has declined from a peak of 5.6 million tons of P_2O_5 in 1979 to 4.1 million tons of P_2O_5 in 1991. The increase in U.S. phosphate exports (less than a million tons of P_2O_5 in 1970 to over 6.6 million tons in 1991) has paralleled the increase in consumption in Asia and Oceania. Total world P_2O_5 consumption rose from 14 million metric tons in 1965 to more than 36 million metric tons in 1991. Phosphate use in Western Europe and North America during this same period was virtually unchanged, while consumption in East Europe and the former U.S.S.R. decreased. China and India are primary purchasers of U.S. phosphatic fertilizer exports and will continue to be growing markets (U.S. Department of Commerce, 1992d). Consumption increases achieved in the late 1960's and early 1970's were offset by the steady decline from 1981 to 1987 (TVA, 1993b). Domestic phosphate consumption is displayed in Table 5-5 while world phosphate fertilizer consumption is displayed in Table 5-6.

5.3 SUMMARY AND FUTURE OUTLOOK

Phosphoric acid manufacturers were operating at near capacity, 98 percent, in 1991. A reduction in phosphoric acid exports is due to the decline in super acid exports to the former U.S.S.R. (TVA, 1992b). Domestic phosphate use has declined while U.S. phosphate exports increased during the period 1979-1991. The United States leads the world, not only in production and consumption of phosphatic fertilizers, but also in exports. The Soviets follow the United States in consumption; Morocco is second in production (U.S. Department of Commerce, 1992d). For several years, the United States has been exporting about half of its phosphatic fertilizer production.

The stability experienced in the phosphatic fertilizer industry in 1992 should also characterize long-term prospects for U.S. phosphate fertilizer shipments. The United States should continue to dominate world trade; however, there is likely to be a gradual loss of world market share to Morocco, which is expected to increase production (U.S. Department of Commerce, 1992d).

Within each sector of the industry, many localized geographical markets exist where only neighboring firms compete directly. These submarkets are only loosely tied to a national market, but economic decisions by individual firms are jointly related to national trends. There are relatively few suppliers of phosphoric acid and phophate fertilizers located in distinct geographic areas suggesting localized geographical markets may exist. The existing market structure reflects fundamental market forces that are likely to be an enduring feature of the phosphate fertilizer product market. A future economic impact analysis may use any differences in market structure and pricing practices of phosphoric acid and phosphate fertilizer manufacturers to predict the market responses to a proposed regulation.

TABLE 5-4. RETAIL PHOSPHATE AND POTASH FERTILIZER PRICES*—UNITED STATES

Calendar Year	Triple Superphosphate	Diammonium Phosphate (18-46-0)	Monoammonium Phosphate (11-52-0)	10-34-0	Muriate of Potash (0-0-60)
1965	81	111	...	...	54
1966	81	108	...	...	55
1967	84	113	...	...	54
1968	78	101	...	99	49
1969	74	94	...	88	48
1970	75	94	...	88	51
1971	77	96	...	91	58
1972	78	97	...	91	59
1973	88	109	...	102	62
1974	150	181	...	170	81
1975	214	263	...	236	102
1976	158	189	...	187	96
1977	146	180	...	177	96
1978	151	186	...	181	96
1979	161	199	...	187	107
1980	247	297	...	264	135
1981	248	287	...	278	152
1982	230	267	...	269	155
1983	214	249	...	244	143
1984	229	271	...	254	144
1985	206	244	...	245	128
1986	190	224	242	232	111
1987	194	220	232	219	115
1988	222	251	261	238	157
1989	229	256	268	246	163
1990	201	219	234	226	155
1991	217	235	246	228	156

Source: USDA, "Agricultural Prices," monthly reports.
* Dollars per short ton of material.

TABLE 5-5. PHOSPHATE CONSUMPTION—UNITED STATES

(Thousand Short Tons of P_2O_5)

		Phosphate Products				
		Superphosphate				
Crop Year	Total P_2O_5 Consumption	Normal	Triple	Diammonium Phosphate	Monoammonium Phosphates**	Ammonium Polyphosphates***
1965	3512	95	309	232	...	21
1966	3897	94	413	362	5	30
1967	4305	86	432	417	21	47
1968	4453	79	487	574	38	66
1969	4666	72	585	686	50	81
1970	4574	62	546	698	52	99
1971	4803	55	556	790	61	119
1972	4864	44	577	864	65	147
1973	5085	35	569	1052	64	154
1974	5099	39	538	1049	86	138
1975	4511	36	531	1036	47	128
1976	5228	28	548	1487	81	213
1977	5630	26	559	1658	105	229
1978	5096	21	488	1466	110	212
1979	5606	17	555	1695	149	243
1980	5432	24	525	1611	124	241
1981	5434	22	475	1712	200	276
1982	4814	14	372	1562	233	257
1983	4138	14	325	1314	222	244
1984	4901	17	393	1610	293	334
1985	4658	14	342	1578	308	341
1986	4178	14	320	1483	297	325
1987	4008	10	285	1478	360	334
1988	4129	4	291	1581	392	318
1989	4117	6	265	1537	439	345
1990	4345	3	266	1647	494	357
1991	4151	3	226	1557	502	353

*Additional materials used in the manufacture of mixed fertilizers are not included.
**Total of 11-51-0, 11-52-0, 11-53-0, 11-54-0, 11-55-0, and 13-52-0.
***Total of 10-34-0 and 11-37-0.

Source: TVA, "Commercial Fertilizers," National Fertilizer and Environmental Research Center, annual reports, 1985-1991; and USDA, "Commercial Fertilizers," Statistical Reporting Service, annual reports, 1965-1984.

TABLE 5-6. PHOSPHATE FERTILIZER STATISTICS—WORLD

(Thousand Metric tons of P_2O_5)

	Consumption							
Crop Year	North America	Latin America	Western Europe	East Europe and U.S.S.R.	Africa	Asia and Oceania	Total	Production
1965	3429	435	4330	2612	328	2878	14012	14584
1966	3845	457	4378	2948	357	3143	15127	15974
1967	4260	526	4513	3206	388	3404	16298	17280
1968	4422	633	4783	3479	445	3628	17389	18257
1969	4528	738	4918	3848	475	3813	18319	18748
1970	4418	771	5188	4045	504	3868	18794	19428
1971	4669	916	5486	4410	549	3758	19788	20839
1972	4739	993	5721	4801	611	4255	21121	22426
1973	5017	1242	5843	5040	658	4728	22529	23814
1974	5112	1333	5993	5512	694	5557	24199	25027
1975	4594	1497	5047	6134	747	4899	22919	25840
1976	5244	1573	4918	6872	803	4975	24385	25142
1977	5619	1912	5259	7134	850	5738	26512	27405
1978	5183	2103	5328	7527	874	6426	27442	29347
1979	5715	2170	5757	7888	903	6389	28822	30464
1980	5553	2346	5814	8046	933	7235	29926	32355
1981	5564	2633	5323	7911	1108	7838	30378	33429
1982	5003	2088	4982	8417	1235	8001	29726	30719
1983	4405	2026	5046	8252	1161	8722	29611	31167
1984	5159	1800	5156	9609	1136	9845	32705	35094
1985	4953	2480	5316	9529	1195	10629	34102	36557
1986	4493	2325	5151	10463	1254	9519	33206	34640
1987	4262	2753	5177	11150	1178	10137	34658	37370
1988	4380	2800	5238	11144	1137	11984	36683	39139
1989	4349	2728	5165	11269	1171	13280	37962	41203
1990	4551	2404	4991	10556	1077	13814	37393	39732
1991	4344	2222	4611	9191	1064	14950	36023	38906

p=preliminary.
*Excludes ground rock phosphate for direct application.
**Western Europe includes the former Federal Republic of Germany while Ease Durope + U.S.S.R. includes the former German Democratic Republic and the former U.S.S.R.
Source: FAO, "FAO Fertilizer Yearbook."

Appendix A

APPENDIX A. CAPACITY DATA FOR WET PHOSPHORIC ACID, SUPERPHOSPHORIC ACID, PURIFIED ACID, AND GRANULAR PHOSPHATE FERTILIZER PLANTS (CAPACITY REPORTED AS 10^3 METRIC TONS PRODUCT/YEAR)

Data Review Status	Company	City	State	Phosphoric Acid	Super-Phosphoric Acid	Granulated Fertilizers DAP/MAP		GTSP
	IMC	Mulberry	FL	1700		1215	DAP/MAP	165
	CF	Plant City	FL	830		545	DAP	215
	Cargill	Riverview	FL	720		490	DAP/MAP	225
	Seminole (Cargill)	Bartow	FL	685		870	DAP/MAP	145
	Occidental	Suwanee River	FL	680	590	350	DAP	71
	Farmland	Pierce	FL	600	125	415	DAP/MAP	
	Fort Meade (U.S. Agri)	Fort Meade	FL	480				
	Occidental	Swift Creek	FL	440	145			
	Freeport-McMoran (Agrico)	Bartow	FL	430		75		2500
	Royster	Mulberry	FL	320		290	DAP/MAP	
	Royster	Piney Point	FL	230		210	DAP	
	Conserv	Nichols	FL	200		180	DAP	
	Simplot, J.R.	Pocatello	ID	400	171	210	MAP	70
	Nu-West	Conda	ID	310	120	210	DAP/MAP	
	Freeport-McMoran (Agrico)	Uncle Sam	LA	880				
	Freeport-McMoran (Agrico)	Donaldsonville	LA	470		870	DAP/MAP	
	Arcadian	Geismar	LA	240	150	125	DAP	
	MS Phosphates Corp.	Pascagoula	MS	225		275	DAP	
	Texasgulf	Aurora	NC	1270	490	365	DAP/MAP	230
	Mobil	Pasadena	TX	245		210	DAP	
	Chevron	Rock Springs	WY	210	35	180		
	Purified Acid Partners	Aurora	NC		109d			
	Freeport-McMoran (Agrico)	Taft	LA			315	DAP/MAP	
	Freeport-McMoran (Agrico)	Luling	LA			250		
	Sinochem	Bartow	FL			220	DAP	
	TOTAL			11,565	1,935	7,870		1,371

a = Received
b = Pursuing
3 = Small plants for which permit files were not obtained.
4. Capacity for Purified Acid Partners is for purified phosphoric acid produced from wet process phosphoric acid.