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Nicholas: The Potential for the Export of Polish Sulfur to the Florida Market

# THE POTENTIAL FOR THE EXPORT OF POLISH SULFUR TO THE FLORIDA MARKET

*James C. Nicholas\**

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## I. BACKGROUND

Poland is the second largest exporter of sulfur in the world.<sup>1</sup> Florida is one of the largest importers of sulfur.<sup>2</sup> Therefore, this paper will analyze of the economic feasibility of importing Polish sulfur into the Florida market.

Florida annually imports between 3 and 4 million (metric) tons of elemental sulfur,<sup>3</sup> virtually all of which are used in the production of phosphatic fertilizers. The primary source of this sulfur is the western Gulf of Mexico.

Sulfur production in both the Gulf of Mexico and Poland is through the Frasch method<sup>4</sup> which involves the pumping of super-heated water into sulfur formations in order to melt the sulfur. The liquefied sulfur is then pumped to the surface and transported into holding tanks. Specially designed ships transport the Gulf of Mexico sulfur in its liquid form to the port of Tampa, Florida. Upon arrival in Tampa, it is placed in heated holding tanks and held for shipment to the fertilizer plants by truck. Throughout this process, reheating maintains the Frasch-processed sulfur in its molten state.

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1. 167 THE BRITISH SULPHUR CORP. LTD., SULPHUR 17 (1983). See also MINERAL POLICY SECTOR, CANADIAN DEPT. OF ENERGY, MINES, AND RESOURCES, SULPHUR: ECONOMIC MARKETING AND TRANSPORTATION REVIEW AND FORECAST TO THE YEAR 2000 2F; FERTILIZER ECONOMIC STUDIES LTD., FURTECON, 1982 14-24 (1982).

2. FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION, THE SOCIAL, ECONOMIC AND ENVIRONMENTAL CONSEQUENCES OF HANDLING EITHER LIQUID OR SOLID SULPHUR IN FLORIDA 3-1 (1984) [hereinafter LIQUID OR SOLID].

3. *Id.* at 4-2.

4. U.S. DEPT. OF THE INTERIOR, BUREAU OF MINES, MINERAL FACTS AND PROBLEMS, Bull. No. 667, 1065 (1976) [hereinafter MINERAL FACTS AND PROBLEMS].

Alternative sources of sulfur for Florida are the western United States and Canada. These sources supply an estimated 1.3 million tons annually.<sup>5</sup> Every year approximately 200,000 tons of Canadian sulfur enters the Florida market; the remainder comes from the western United States.<sup>6</sup> Unlike the Gulf of Mexico sulfur, these alternative sources produce recovered sulfur.

Tampa, Florida, has been the port of entry for molten sulfur since the early 1960's.<sup>7</sup> Prior to that time, Florida had imported slate sulfur, i.e., sulfur which has been allowed to cool and solidify. Slate sulfur, however, caused numerous environmental problems because of the dust it emitted. Thus sulfur importers, local governments, and the State of Florida, mutually agreed to discontinue slate sulfur importation and replace it with molten (liquid) sulfur importation. Being a liquid, molten sulphur does not produce dust, thus reducing the pollution problems of slate sulfur.

Unfortunately, molten sulfur can be shipped only over a limited distance because sulfur hardens when it cools below 246 degrees Fahrenheit. Thus, the greater the transportation distance, the greater is the cooling. In addition, molten sulfur must be reheated so as to maintain its liquid state if the travel time is great. As a result, because of their proximity to Florida only Gulf of Mexico sources were feasible for the Florida market.

The development of "sour" natural gas, i.e., natural gas with high sulfur content, has resulted in increasing quantities of recovered sulfur.<sup>8</sup> Recovered sulfur is removed from natural gas in a liquid form. The traditional processing of this sulfur was by forming it into large blocks of slate. However, because of the pollution caused by slate sulfur, shipment in this form was complicated and increasingly prohibited. This problem led to the innovation of forming sulfur in a solid state, thus reducing the environmental effects resulting from sulfur dust. These sulfur forms are known as "prills".<sup>9</sup>

Prilled sulfur emits very little dust. Also, because of its solid state, prilled sulphur is less expensive to ship and store than molten sulfur. Beginning in 1978, the suppliers of Canadian prilled sulphur sought to enter the Florida market. However, the Gulf of Mexico Frasch

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5. CANADIAN TRANSPORT COMMISSION (1984) (unpublished data); Greenmarkets July 11, 1983, at 5; Greenmarkets Nov. 29, 1982, at 1 & 7.

6. *Id.*

7. See LIQUID OR SOLID, *supra* note 2, at 6-3.

8. See MINERAL FACTS AND PROBLEMS, *supra* note 4, at 1078.

9. M. Raymont & J. Hyne, Remarks at Am. Inst. Clevy.

Processing suppliers opposed the Canadians entrance because of the Gulf of Mexico suppliers' substantial investment in liquid technology which they had originally made to avoid the environmental problems caused by slate sulfur.

In 1985 the State of Florida adopted regulations which would allow several types of prilled sulfur to be transported into and stored in Florida.<sup>10</sup> This decision by the State of Florida has created an opportunity for all world sulfur suppliers to compete in the Florida sulfur market. Poland, being a major producer and exporter of prilled sulfur, may wish to consider exporting to the Florida market.

Poland is a major world producer and exporter of sulfur capable of providing over 5 million tons per year. Poland's annual production of sulfur is approximately equal to the amount of sulfur imported into Florida. Additionally, Poland has total sulfur reserves of 80 million tons, or 1.5 percent of total world reserves.<sup>11</sup> While Poland has a relatively small proportion of total world sulfur reserves, it produces approximately 10 percent of the total world supply of sulfur.<sup>12</sup>

However, Poland has not been maintaining its relative position in the world market. In 1970 Poland produced 4.8 million tons or 10.1 percent of world production. In 1980 Polish production rose to 5.4 million tons, but its share of world production had fell slightly to 9.9 percent. By 1990 Polish production is estimated to reach 6.2 million tons but this will constitute only 8.5 percent of world production. Poland's declining world share is a result of competition with the large quantities of recovered sulfur coming out of the Middle East and Canada. Middle Eastern sulfur production had been increasing at an annual rate of 8 percent.<sup>13</sup> However, the current oil "glut" has restrained this rate of increase in the recent past. The tendency for some years has been for sulfur production to exceed sulfur demand. The excess production results from the recovery of sulfur as a by-product of "sour" natural gas production. However, the vast quantities of recovered sulfur in Canada are now declining. Consequently, new opportunities for trade in sulfur will occur.

Great distances and prohibitions on sulfur slate has excluded Polish sulfur from the Florida market in the past.<sup>14</sup> Now however, these

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10. FLA. ADMIN. CODE §§ 17-2.215, 2.600, 2.960.

11. CANADIAN DEPT. OF ENERGY, MINES, AND RESOURCES, SULPHUR, MINERAL BULLETIN, MR 150 (1976). MINERAL FACTS AND PROBLEMS 1063 (1976).

12. FERTILIZER ECONOMICS STUDIES LTD., FURTECON, 1982 14-24 (1982).

13. 167 THE BRITISH SULPHUR CORP. LTD., SULPHUR 17 (1983).

14. See FERTECON, *supra* note 12; CANADIAN DEPT. OF ENERGY, MINES, AND RESOURCES, ECONOMIC, MARKETING AND TRANSPORTATION REVIEW AND FORECAST TO THE YEAR 2000, 12.

prohibitions have been abandoned. Thus, there currently exists a potential for the sale of Polish sulfur in the Florida market.

As Table 1 illustrates, the world is a net consumer of sulfur (i.e., use of sulfur demand exceeds sulfur production), thus indicating that prices should be higher in the future because current consumption exceeds current supply. However, the large quantities of sulfur in inventory, especially in Canada (15 million tons), indicates that sulfur price increases may still be far off in the future. Additionally, the world regions do not tend to balance themselves. For example, eastern and western Europe are almost equal in their surpluses and deficits. Poland constitutes the vast majority of eastern European production and virtually all of eastern European exports. Thus, while these regions appear to balance, it is Polish production which in fact creates this balance. Saudi exports do not balance the imports of Africa, Asia and Oceania. Canada is the major exporter which balances the world market. Canadian exports go primarily to the United States (15%), to South Africa (12%), to Brazil (9%), and to Australia (9%). By contrast, Polish exports go primarily to western Europe (46%), to eastern

TABLE 1  
WORLD SULPHUR SUPPLY/DEMAND 1985  
THOUSAND OF METRIC TONS

REGION	PRODUCTION	USE	SURPLUS (DEFICIT)
WEST EUROPE	8,891	11,403	(2,521)
EAST EUROPE*	12,816	14,806	1,990
POLAND	5,034	1,207	3,827
AFRICA	1,120	5,031	(3,893)
ASIA	10,060	9,940	120
OCEANIA	210	1,223	(1,013)
CANADA	7,337	2,184	5,153
UNITED STATES	13,733	13,820	(87)
C/S AMERICA	3,616	3,864	(248)

\* EXCLUDING POLAND

SOURCE: FERTECON, 1982, Fertilizer Economic Studies Ltd., P. 14-24

Europe (39%), to Africa (9%), to India (4%), and to Brazil (1%). The only area of global competition is in Brazil where Canadian sales far exceeds Polish sales.

Canada is clearly the dominant influence in the world sulfur market and has tended to be the world price-setter. This tendency may decrease in the future as Canadian inventories decrease. In 1980, the Canadian inventory stood at 20 million tons. As Table 2 illustrates, Canadian inventory has consistently declined, and projections are that this decline will continue into the foreseeable future. However, the decline in Canadian inventory will probably not occur as evenly as the projections show. Rather, the decline will occur over time in response to long-term world market conditions. Thus, the trend indicates that current consumers of Canadian sulfur will be forced to look elsewhere for their supplies of sulfur. Moreover, as Canadian supplies lessen, prices will also rise.

## II. THE FLORIDA MARKET FOR SULPHUR

Florida contains some 2.6 billion tons of reserves of phosphate rock.<sup>15</sup> Annual production of phosphate rock in Florida has averaged between 40 and 50 million tons per year. This production represents approximately 80 percent to 90 percent of total United States production and approximately 33 percent of total world production.

Production of fertilizers from phosphate rock almost exclusively uses the sulfur imported into Florida. The size of the Florida reserves tends to indicate that the demand for sulfur by Florida phosphate producers is long term. However, the Florida phosphate industry has been facing both economic and regulatory problems. The economic problems are related in part to the troubled domestic agricultural industry and to vigorous foreign competition. Also the declining value of the U.S. dollar abroad has compounded these problems.

The regulatory problems are related to the environmental consequences of the strip mining technology employed in phosphate mining. State authorities imposed the environmental regulations at a time of economic distress for the industry.<sup>16</sup> The result has been a sharp drop in phosphate production. Table 3 shows recent United States and Florida phosphate rock production along with the prices of phosphate rock and diammonium phosphate (DAP).

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15. U.S. BUREAU OF MINES, MARKETABLE PHOSPHATE ROCK (1983).

16. FLA. ADMIN. CODE 27-2.006.

**TABLE 2**  
**CANADIAN PRODUCTION, SALES AND INVENTORY**  
**OF SULPHUR**  
**1979 - 2000**  
**MILLION TONS**

	PRODUCTION	SALES	INVENTORY
1979	7.0	6.6	20.1
1980	7.0	8.3	18.8
1981	7.5	8.8	17.5
1982	7.6	8.6	16.5
1983	7.6	7.7	16.4
1984	7.7	7.9	16.2
1985	7.9	8.1	16.0
1986	7.9	8.3	15.6
1987	8.0	8.4	15.2
1988	8.1	8.7	14.6
1989	8.2	8.9	13.9
1990	8.4	9.2	13.1
1991	8.5	9.4	12.2
1992	8.7	9.6	11.3
1993	8.9	9.9	10.3
1994	9.1	10.2	9.2
1995	9.3	10.6	7.9
1996	9.7	10.8	6.8
1997	9.8	11.0	5.6
1998	10.2	11.4	4.4
1999	10.7	11.8	3.3
2000	11.0	12.0	2.3

SOURCE: Canadian Department of Energy, Mines and Resources

Florida is the primary supplier of phosphate fertilizers for the United States. Over the years the United States and Florida have seen their market shares of world trade slip. In 1975 the U.S. portion

TABLE 3  
 PHOSPHATE ROCK PRODUCTION, PRICE OF ROCK  
 AND PRICE OF DAP  
 UNITED STATES AND FLORIDA

	U.S. OUTPUT	FLA OUTPUT	ROCK PRICE	DAP PRICE
1980	54,400	47,200	\$35.71	
1981	52,925	45,960	\$39.78	\$168-172
1982	37,306	31,515	\$40.70	\$178-179
1983	40,000	37,500	\$35.00	\$169-175

SOURCE: U.S. Department of the Interior, Bureau of Mines "Market-able Phosphate Rock - June 1983"

of world phosphate trade was 35 percent while in 1982 it had fell to 26 percent.

Morocco has been one of the major new entrants into world phosphate trade.<sup>17</sup> However, competition alone cannot explain the problems of the Florida phosphate industry. The high value of the U.S. dollar has greatly eroded the export position of the industry. Table 4 shows a weighted index of the value of the U.S. dollar against all major currencies. A value of 100 would indicate parity. Thus, the decline in U.S. phosphate production is consistent with the timing of the sharp rises in the value of the dollar.

These factors have caused the Florida phosphate industry to look to cost control as a means to maintain profitability while it attempts to maintain its market share. For example, the industry closed costly mines.<sup>18</sup> Additionally, fertilizer producers sought to reduce their cost of materials, specifically sulfur. This situation resulted in a coincidence of interests between Canadian sulfur exporters and the Florida phosphate industry. Florida phosphate producers sought other sources of sulfur hopefully more competitive than the existing suppliers. The increased competition meant seeking Canadian prilled sulfur. Previously, the Canadian sulfur entering Florida was all liquid sulfur, transported to Florida by rail. Bringing Canadian liquid sulfur to Florida by rail is probably not an effective method of acquiring sulfur in large quantities. Canadian sulfur prills were sought to provide the quantities

17. GREENMARKETS, vol. 7, 7 (1983); ECONOMIS REPORT OF THE PRESIDENT 373 (1986).

18. GREENMARKETS, vol. 7, 10 (1983).

**TABLE 4**  
**INDEX OF THE VALUE OF THE U.S. DOLLAR**  
**AGAINST OTHER CURRENCIES**  
**1975 - 1985**

	INDEX	# CHANGE
1975	98.5	
1976	105.6	7.2%
1977	103.3	-2.2%
1978	92.4	-10.6%
1979	88.1	-4.7%
1980	87.4	-0.8%
1981	102.9	17.7%
1982	116.6	13.3%
1983	125.3	7.5%
1984	138.3	10.4%
1985	143.2	3.5%

SOURCE: Economic Report of the President  
 U.S. Government Printing Office, 1986, p. 373.

of sulfur needed. Whether Canadian prilled sulfur would be less expensive remains a matter of great debate. Terminal facilities would need to be constructed, and these costs, in addition to shipping and other related expenses, could eliminate the price advantage. However, the Florida phosphate industry appears to believe that the existence of an alternative supply would be advantageous, regardless of the cost of such alternatives.

### III. THE PRICE OF SULFUR IN FLORIDA

As Table 5 illustrates, the price of sulfur, like the price of any natural resource, is subject to sharp fluctuations. Note also that the prices listed are for long-term contract delivery. Spot prices tend to be \$10 to \$15 per ton less. Additionally, large quantities tend to sell at discounts from the stated price.

The sharp increase in sulfur price occurred at the same time as the rise in the value of the U.S. dollar. These two factors combined to create a difficult situation for the Florida phosphate industry. As a result, the industry sought alternative sources of sulfur.

TABLE 5  
 PRICES OF SULPHUR, FOB TAMPA  
 PER TON  
 1970 TO 1985

	PRICE	# CHANGE
1970	\$26	
1971	\$24	-7.7%
1972	\$24	0.0%
1973	\$24	0.0%
1974	\$28	16.7%
1975	\$58	107.1%
1976	\$64	10.3%
1977	\$64	0.0%
1978	\$68	6.3%
1979	\$72	5.9%
1980	\$106	47.2%
1981	\$134	26.4%
1982	\$146	9.0%
1983	\$116	-20.5%
1984	\$124	6.9%
1985	\$149	20.2%

SOURCE: Greenmarkets, McGraw-Hill, Volumes 1-9, (1978-1985).  
 U.S. Dept. of the Interior, Bureau of Mines, "Mineral Facts  
 and Problems" Bulletin No. 667 (1976)

Table 6 contains estimates of the cost of providing Polish sulfur to the Florida market. The author made these costs estimates and did not incorporate terminal costs at Gdansk, or any other costs not clearly shown.

The contract price of \$149 yields a netback value of \$123.37. A spot sale would yield a netback of \$108 to \$113 per ton. This estimated netback value is below the current price at Gdansk. Thus, importation of Polish sulfur would appear to be economically infeasible. However, there exist several factors which could change this situation.

TABLE 6  
ESTIMATED COSTS AND NETBACK VALUE  
PER TON

COST ITEM	COST PER TON
TRANSPORTATION	\$8.00
SHRINKAGE	\$3.73
TERMINAL, DESTINATION	\$6.00
REMELT/FILTRATION	\$8.00
PRICE FOB TAMPA	\$149.00
NETBACK AT GDANSK	\$123.37

SOURCE: Greenmarkets, Vol. 7, September 26, 1983, p. 6

The first factor relates to the location of mining activity in Florida. Most current phosphate mining is in the central Florida area, near Tampa.<sup>19</sup> The above calculations are based upon the entry of Polish sulfur at the port of Tampa. However, new phosphate mines are being opened in north central Florida which is closer to the port of Jacksonville than to Tampa. If Jacksonville were the port of entry, shipping costs between Gdansk and Jacksonville would be less. Moreover, it is possible that the market price is higher at Jacksonville than at Tampa because there are less shipping costs to the point of use from Jacksonville than from Tampa. If the Jacksonville price were \$155 and the transport costs were \$8, the Gdansk netback would be \$131. However, this value is still marginal at best.

A second factor to be considered is the back-haul potential.<sup>20</sup> Florida is a major producer and exporter of agricultural products, especially citrus.<sup>21</sup> The economic feasibility of agricultural products, like most natural resources, highly depends upon shipping costs because of the low value-to-bulk ratio. Backhaul possibilities tend to reduce shipping costs and enhance economic feasibility of trade in such commodities.

19. UNIVERSITY OF FLORIDA, BUREAU OF ECONOMIC AND BUSINESS RESEARCH, FLORIDA STATISTICAL ABSTRACT 282 (1986).

20. Irwin, THE ECONOMICS OF TRANSPORTATION. ("Back haul" is the opportunity to obtain favorable shipping rates on vessels returning without a predetermined cargo after delivery of the primary cargo.)

21. UNIVERSITY OF FLORIDA, BUREAU OF ECONOMIC AND BUSINESS RESEARCH, FLORIDA STATISTICAL ABSTRACT 257 (1986).

Thus, if Polish sulfur were considered jointly with bilateral trade in a Florida export, such as citrus, the economic feasibility of both may be enhanced.

Currently there exist no sulfur terminal facilities at the port of Jacksonville. Importing sulfur through the port of Jacksonville will require that such facilities be constructed. The cost of construction may well effect the economic feasibility of the enterprise. Again, bilateral trade may open alternatives. Florida is looking for additional markets for its exports; this interest could lead to joint venture opportunities with the Polish government.

There appears to be some mutual interests between Poland and Florida for sulfur trade. However, such trade possibilities presently appear to be economically infeasible. Potential bilateral trade and joint ventures may possibly alter this infeasibility. Clearly it would be to the advantage of both Poland and Florida if such potentials were realized. Therefore, further consideration of bilateral trade and joint venture opportunities between the two governments should be discussed.

