Phosphogypsum Facts: Issues Surrounding Phosphate Mine Tailings

Information drawn from the Florida Institute of Phosphate Research (an industry group) and a series of newpaper articles in the Charlotte County (Fla.) Sun-Herald.

- The phosphate industry generates over 30 million tons of phosphogypsum each year.
- More than 900 million tons of phosphogypsum are stacked in more than 20 stacks in Florida.
- Phosphogypsum stacks can be up to 200 ft high and cover 400 acres of land each.
- Phosphogyspsum is acidic, rich in phosphate, and mildly radioactive, which has prevented from being put to beneficial uses.
- Alterenative uses include road-building and as an amendment to landfill wastes, such uses are yet to be approved by regulatory agencies.

The history of phosphate mining and recovery in Florida dates back roughly one hundred years, but only for the past fifty years or so has the industry produced phosphoric acid on a commercial scale by reacting phosphate rock with sulfuric acid. In this process, about five tons of by-product calcium sulfate, called phosphogypsum in the industry, are produced for every ton of phosphoric acid made.

In Florida this material generally has been stockpiled on the ground, adjacent to the chemical plants where the phosphoric acid was produced. To date, some nine hundred million tons of phosphogypsum have been stockpiled in central and north Florida, with the total projected to grow to some one billion tons by the year 2000.

Phosphogypsum Production

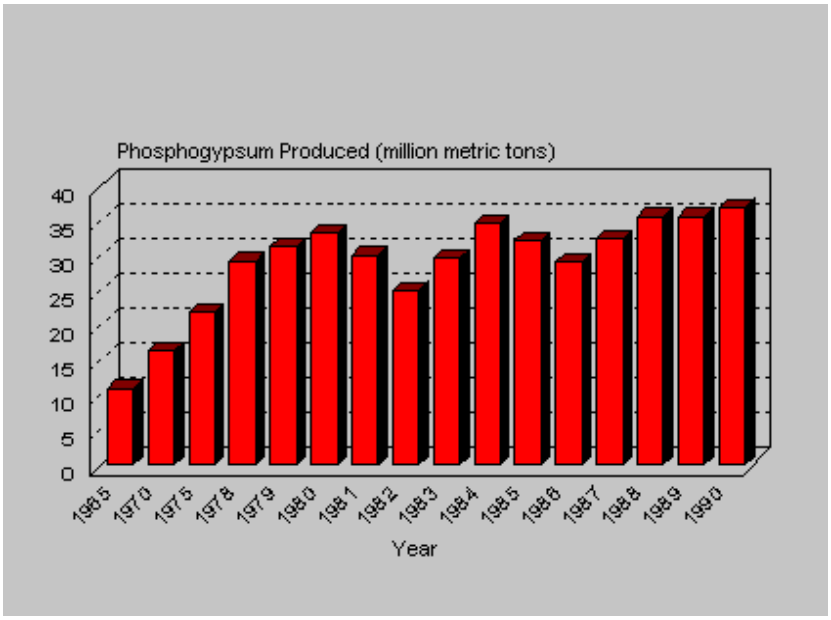
Over the years, Florida has rather consistently produced 70% of the domestic phosphoric acid. In Florida, for each ton of phosphoric acid produced, 4.8 tons of phosphogypsum are produced. This information was calculated using national data on phosphoric acid production by multiplying domestic acid production by 0.70, then by 4.8 to obtain an accurate estimate of phosphogypsum production in Florida.

Although there has been fluctuation from year to year, there has been a general increase of the tonnage of phosphogypsum produced over the period of record. The period of record from 1970 to 1980 showed the most dramatic increase. From 1970 to 1980 there was an increase of 103%. From 1980 to 1990 there was an increase of 11.3%. Although this was a smaller increase, the overall increase of the 1965 to 1990 period of record was 235%.

Tonnage of Phosphogypsum Produced

Year	Phosphogypsum Produced (million metric tons)	Year	Phosphogypsum Produced (million metrictons)
1965	11.06	1983	29.76
1970	16.38	1984	34.72
1975	22.05	1985	32.32
1978	29.36	1986	29.18
1979	31.44	1987	32.56
1980	33.33	1988	35.74
1981	30.23	1989	35.76
1982	25.17	1990	37.10

Source: Gordon Nifong at the Florida Institute of Phosphate Research (FIPR), 1855 West Main Street, Bartow, Florida 33830, (813) 534-7160.



Current Issues in Phosphogypsum Disposal:

Virtually all phosphogypsum is stacked in waste piles because three aspects of phosphogypsum detract from its widespread use:

- It is relatively **acidic**
- It contains a small amount of **fluoride**.
- It is slightly **radioactive**.

The radium content of phosphogypsum is 20 to 30 picoCuries Ra-226 per gram (pCi/g), whereas the radium content of most soils and rocks, and of natural gypsum, is on the order of 1 to 2 pCi/g or less. This radioactivity is generally perceived by the public as the major problem with its use. Radon gas and the daughter products of radon decay become the products of concern following the decay of radium. This low-level radioactivity has precluded most of the obvious ways in which this material could be usefully recycled, such as a filler for concrete or in road construction. Research is being conducted within the industry to find a use for this by-product material A few recent updates from FIPR:

1. Using Phosphogypsum to Build Roads

The United States Environmental Protection Agency (EPA) has indicated that it will accept the terms of a Polk County deed restriction on land where a road would be built using phosphogypsum. FIPR is now waiting for a letter confirming the deed restriction and risk assessment acceptance.

Pursuit of an exemption to build a phosphogypsum road on deed restricted land has been ongoing for the past three years. As part of the exemption request process, FIPR contracted with Ontario-based Senes Consultants Limited to do a study of the risks to those who build, travel on, or live near such a road. Senes presented a final report to the FIPR Board of Directors in April and concluded that any risk such a road poses is well within EPA's acceptable limits.

The study first looked at worst-case scenarios that caused EPA to ban phosphogypsum use due to the trace amount of radium it contains. It then put any scenario that might have a reasonable possibility of exceeding EPA's acceptable risk criterion to a "probabilistic" test that estimated the most likely risk to a person working on, living near, or driving on the road . This test used established data where possible and conservative estimates where there are no data available.

The study used EPA's own computer modeling systems and found that the "incremental lifetime risks from a lifetime exposure, due to the use of phosphogypsum in roads and agriculture, are below EPA's benchmark risk levels."

EPA's benchmark risk level resulted in a ban on phosphogypsum use. The ban is based on an assumption that 100 years from now a road built with phosphogypsum would be abandoned and someone would build a house on the roadbed, stay in the house 18 hours a day for 70 years and perhaps suffer health problems connected to radon exposure.

2. Using Phosphogypsum as Beneficial Addition to Landfills

Phosphogypsum hastens the decomposition of waste without any apparent harm to the environment, according to Phase II of a project to see if phosphogypsum can extend the life of landfills by speeding decomposition of municipal solid waste (MSW).

Phase I of the study found phosphogypsum hastened the decomposition of simulated MSW (grass clippings and wood mulch) by 40 to 50 percent in three months. Phase II is testing the concept on real MSW in a controlled setting. If it works, the next step will be to try it in a full-scale landfill.

Florida is predicted to produce eight to 10 million tons of MSW per year by the year 2010. Maximizing the use of existing landfill sites in Florida is a primary goal for every solid waste authority in the state. A method or the technology to do this is needed. This study could provide a basis for another EPA exemption request to use the Central Florida phosphogypsum, which is currently banned.

Spills Frequent in Phosphate Mining

When phosphate giant IMC-Agrico held a workshop last year to gather input on its plans to mine 43,000 acres in DeSoto, Hardee and Manatee (Florida) counties, a half-dozen Charlotte County retirees showed up. All six had the same question: What happens to the Peace River in the event of a spill?

They included Warren Worthly, who said he retired and moved to Punta Gorda because of the

pristine waters of Charlotte Harbor. "I am concerned about a catastrophic failure, like the ones (on a Central Florida creek) in 1992, 1994 and 1997," he said. "Five hundred million gallons spilled because of a dam break into this poor little river."

Timeline of Some Major Phosphate-Waste Spills

Dec. 1997
Mulberry Phosphate: 54 million gallons of phosphogypsum process water spilled when a dam breaks.

Oct. 1994
Cargill: 20 million gallons of water from a sand tailings pit spills into Peace River near Fort Meade.

Nov. 1994
IMC-Agrico: Nearly 500 million gallons of water from a clay settling pond floods into the Alafia River near Keysville in eastern Hillsborough County.

June 1994
IMC-Agrico: Sinkhole opens in phosphogypsum stake, releasing gympsum pnd water and gypsum into groundwater.

Oct. 1994
IMC-Agrico: 1.8 billion gallons of water from a clay settling pond spills into Payne Creek. Most of it settled before reaching the Peace River.

Oct. 1993
Cargill: Report: Fish killed when acidic water spilled into Archie Creek from the east Tampa plant in Gibsonton.

Late 1990
Gardinier: 250,000 gallons of water from a clay settling pond near Fort Meade leaks into a creek that feeds into the Peace River.

1988
Gardinier: Thousands of fish killed at mouth of Alafia River after acidic spill from Gardinier Riverview plant.

Dec. 1971
U.S. Phosphoric: Clay pond dam breaks near Fort Meade, releasing 2 billion gallons of clay water into the Peace River. Large fish kill reported.

March 1967
Mobil: 1,500 acre-feet of clay water spills near Fort Meade and reaches the Peace River. Fish kill reported.

Worthly referred to past catastrophes, such as the space shuttle Challenger and the Titanic, as proof they happen.

"My question is, why should we believe you?" said Gene Hingery. "This slick presentation looks great on the wall, but the track record is awful."

Lee Thurner, IMC-Agrico's vice president/general manager of minerals operations, is familiar with those concerns. He likened IMC-Agrico's record to that of Exxon, whose reputation for environmental protection around the world was sullied by a single mishap when the Exxon Valdez tanker ruptured in Alaska in 1989.

IMC-Agrico is the world's largest phosphate mining company. It owns more than 300,000 acres in Florida and has mined 16,000 acres since it was formed in 1993 in a merger of IMC Global Inc. and Freeport McMoRan Resource Partners, LLP.

"We are a rather significantly huge industrial operation," Thurner said. "I think we have an enviable record."

The group DeSoto Citizens Against Pollution differs with Thurner on IMC-Agrico's record. "I think they have a terrible history," said Alan Behrens, DCAP president. In the five years the company has been in existence, it has been fined $454,220 for unauthorized discharges. Almost all of that amount was related to two clay settling-area accidents that occurred in 1994, but a small portion was related to two other relatively minor incidents.

IMC-Agrico has experienced the following mishaps:

- June 1994 -- A sinkhole opened under a phosphogypsum stack, releasing acidic fertilizer processing water and gypsum into groundwater at a facility in Central Florida.
- October 1994 -- At the Payne Creek Mine, a clay settling pond dam failed, spilling 1.8 billion gallons of clay-laden water. Most of the clay settled out before the water got to the Peace River. The dam was built before the state strengthened regulations on how earthen mining dams must be constructed.
- November 1994 -- A clay settling-pond dam failed at the Hopewell Mine, spilling nearly 500 million gallons. The water flooded Keysville in eastern Hillsborough County. A plume muddied the Alafia River for two days.
- Other accidental releases include an ore slurry spill into Little Payne Creek in November 1993 and a release of mine water into the South Prong of the Alafia River in December 1995.

There were no environmental impacts from those unauthorized releases, Thurner said. Even the November 1994 clay pond spill had little environmental impact, he claimed.

"There were no fish kills in the river and no apparent environmental effects other than to reclaimed wetlands near the settling pond, which were damaged by rushing water," Thurner said.

IMC-Agrico officials explained earth packed around a spillway pipe that went through the dam washed out when the pipe was used for the first time.

One of the worst spills on record occurred in December 1971, when a clay pond owned by U.S. Phosphoric broke and released 2 billion gallons of clay-laden water into the Peace River in Fort Meade. A major fish kill was reported. As a result, the state's environmental health department issued regulations to strengthen the way dams were constructed.

Likewise, settling-pond design was again improved after IMC-Agrico's 1994 accidents, according to Thurner. The improvements include:

- Concrete embedments and filter drains for spillways designed to eliminate "piping" problems.
- Dam performance instrumentation installed to monitor internal conditions.
- All-weather roadways built at the toe of the dam to facilitate routine inspections.
- Changes to berms for slurry water.

“The success of these measures is seen in the fact that even the El Niño events of the winter of 1998 did not result in any unauthorized discharges,” Thurner said.

Behrens remains skeptical. “The bottom line is, there is no guarantee there won't be other major spills,” he said.

Neutralizing Spills: Strategies Proposed by Florida Institute of Phosphate Research (FIPR)

Mike Lloyd, FIPR Chemical Processing Research Director, is part of the Phosphogypsum Impoundment Technical Advisory Forum (PITAF). This group of regulators, scientists, phosphate industry representatives, and other experts was formed after a fish kill occurred in December 1998 when a dam at the top of a phosphogypsum stack broke and acidic water from a cooling pond spilled into the Alafia River.

The group will recommend procedures and practices to avoid this happening again. "I hope that there is never another spill, but humans make mistakes and it may happen again," Lloyd told FIPR board members. The industry should have mitigation plans on hand, he said, and the DEP (Florida Department of Environmental Protection) should be confident that these plans would minimize the environmental impacts.

FIPR will study how effectively mitigation could reduce these impacts. The Institute's Board of Directors agreed at their April quarterly meeting to launch a research project to look at the environmental impacts of using lime to neutralize the acid in any phosphate processing water that might spill into the environment. Using lime in this way has been successful in the past. Lloyd related the story of an American Cyanamid process pond spill about 30 years ago into the South Prong of the Alafia River. The company reacted immediately and dumped lime into the river to neutralize the acid in the process water. As a result a minimum number of fish died.

The question is, did the lime impact the environment in other ways? "FIPR should be in this up to its neck," said Richard Coleman, the environmental representative to the Institute's Board. "Industry is going to have to do something that is good, but we ought to be involved. We are the phosphate research institute representing this area, this subject, and the public. We need to have some of our scientists right smack in the middle of this because the public is extremely interested."