Phosphogypsum – Waste or Resource?

Presenter: Neil Beckingham
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Economic Impacts: The Fertilizer Institute (TFI) members provide nutrients that nourish the nation’s crops; generate more than $155 billion in economic activity annually.

Job Impacts: The fertilizer industry directly supports 51,000 retail jobs, 15,000 wholesale facility and 23,000 manufacturing jobs.

Phosphate Specific Impacts: Phosphate fertilizer sales in the U.S. 2016 valued at $4 billion; exports valued at more than $1.5 billion.
Why is Phosphate Fertilizer Important?

- Phosphate enters the food cycle with plants and moves through the food chain
- We get it from the food we eat
- Replaces vital nutrients lost at each harvest
- Enables >50% of the world’s food supply
- Dramatically increases crop yields, allowing more crops on less land
- Reduces food costs
- Nutrition
What is Phosphogypsum (PG)

- Phosphogypsum (PG), commonly known as gypsum or calcium sulfate, is a by-product of phosphate fertilizer manufacturing.
- Approximately 5 tons of PG are produced per ton of phosphoric acid produced in a typical facility.
- PG is a high volume, low toxicity by-product of phosphate fertilizer manufacturing.
What is a Gypstack?

Typical Phosphogypsum System

- \( \text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{SO}_4 + 6\text{H}_2\text{O} \rightarrow 3\text{CaSO}_4.2\text{H}_2\text{O} + 2\text{H}_3\text{PO}_4 \)

5.2 tons of Phosphogypsum produced per ton of P2O5

Chemical Plant

Cooling Pond

Gypsum Stack

HDPE Liner

Mosaic
Manufacturing 101

Air

Sulfur

Phos. Rock

Anhydrous Ammonia

NH3 Storage

Sulfuric Acid Plant

Phosphate Rock Storage

Phosphoric Acid Plant

Phosphoric Acid

Cogeneration Plant

Power to our mines and the grid

Gypsum Stack

Granulation Plant

Granular Crop Nutrients

Merchant Grade Phosphoric Acid

Animal Feed Ingredients Plant

Defluorinated Feed Phosphates

Mosaic
Gypstack Life Cycle

- Stack systems are permitted and their liners rigorously inspected
- Stack systems are closed (reclaimed) once they meet their maximum design height and capacity
Background – EPA Rule

Original PG Rule (1989):

- Storing PG in stacks and mines only option
- Very conservative radiological exposure assumptions were utilized.
Amended PG Rule (1992):

• Revised to reflect legal challenges

• Provided a limited waiver for reuse, *i.e.*, approved limited agricultural use (RA 226 <10 pCi/g)

• Created unwieldy petition process
What Has Changed – PG Stacks

- The size, costs, and complexity of maintaining PG stacks have all increased since 1989
- At least 1.7 billion tons of PG stored in the U.S. and worldwide
- Reuse and recycling in many countries today
- Desire for regulatory reform creating U.S. reuse opportunity
Scientific understanding of risks from low level radiation has evolved considerably in last 30 years.

The International Atomic Energy Agency (“IAEA”) (members include the U.S.; has the duty to “establish or adopt … standards of safety for protection of health”) concluded:

- PG with 1 Bq/g (27 pCi/g) or less can be reused without any meaningful restriction, and PG with higher concentrations can still be reused safely under certain conditions.
Potential Uses

• Landfill Cover
• Road Construction
• Cement and Concrete
• Coastal Zone Barriers
• Mine Reclamation
• Agriculture
• Rare Earth Extraction
Discussion & Questions