



Phosphogypsum

Seeking a safe strategic solution,
for all markets

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IFA 2005

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Professor Julian Hilton

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Alexandria: the ambiguity of benefit

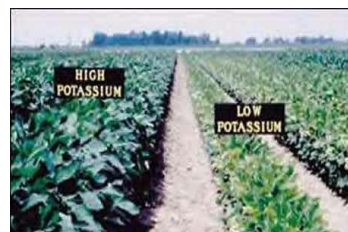
Pharos: a lighthouse & a library:
A light for the body and a light for
the mind

Which was destroyed by itself,
by fire

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Food: The Ambiguity of Benefit

- 150 years ago starvation and disease were the primary risks to 90% of the world's population
- Life expectancy was c. 42 years
- For 85% of us, fertilizers and improved public health have doubled life expectancy
- But we are facing major challenges to our capacity to continue to feed ourselves
- And also facing an obesity epidemic which will, for the first time in human history, cause a succeeding generation to live a shorter life than the previous one



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How do we maintain the
benefits of success?

The Phosphogypsum challenge

- a) Inherent
- b) Indicative case

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Stacking or dumping PG

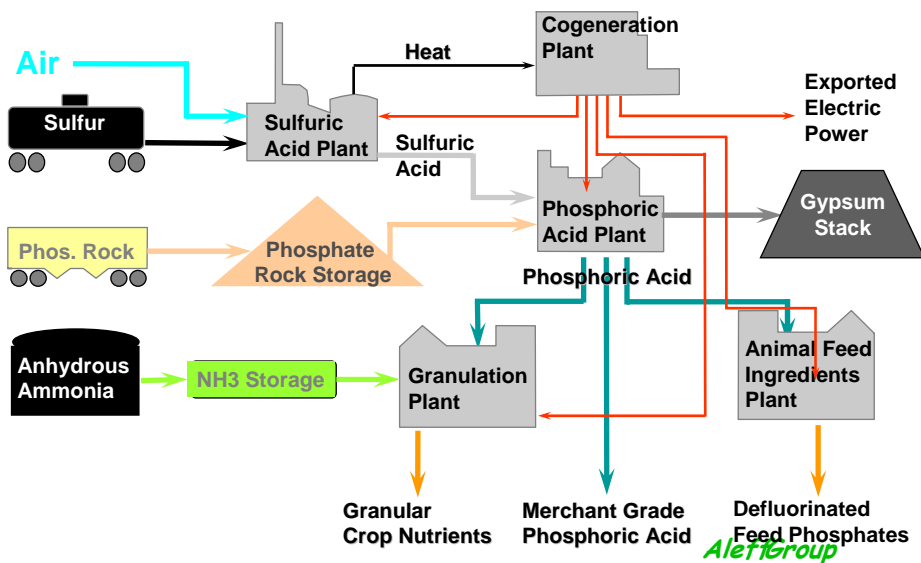
**A nineteenth century solution
to a twenty-first century
problem?**

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At the chemical processing plant phosphate rock is reacted with sulfuric acid and converted into the phosphoric acid used to make fertilizer. Phosphogypsum, a byproduct of the chemical processing, is stored in stacks. It is pumped to ponds at the top of the stacks to settle. Pond systems include collection areas at the foot of a stack for cooling the water coming out of the plant. All water is recycled for use in the plant.



Processing Plant Flowsheet



Problem Characterisation

- Inadequate knowledge
 - Inventory of activity
 - Key metrics
 - Reference standards
- In-process and endpoint challenges
 - Cost
 - Occupational health and safety
 - Commercial viability
 - Environmental stewardship
 - Public health

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Biosecurity?

- Biosecurity and risk management
 - “All hazards” context
 - Management/ mitigation
 - Communication
 - Tort
 - Business model – victim of “thought inertia”
 - Regulatory “overspill” effect
- A global challenge: a global solution?

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In Process

- Worker Safety
- Exposure Monitoring
- Public Health
 - Mining areas
 - Mined areas
 - Product exposure
- NORM
- Mining
- Beneficiation
- Processing
- To Market “Pathways”



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“End Point”/ Critical Control Points

- In Product
 - Customer or consumer exposure/ risk
 - Risk to value chain
- In PG
- In Process Water
- In Food Production/ Consumption Continuum
- In Environment
 - Soil
 - Air
 - Water



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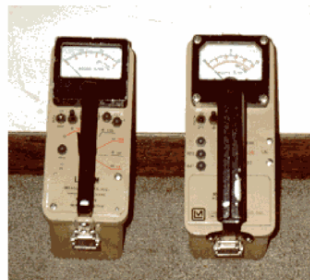
Current Examples

- Chinese producer:
 - 1.1M tonnes pa produced
 - 800K tonnes used
 - = 300K tonnes surplus – dumped in river
 - Government now using powers to close plants that break environmental standards
- Bulgarian producer:
 - New permit add a 1.8Ha footprint to gyp stack
 - Would like to exploit market potential in E Europe/ candidate countries for EU
- Florida:
 - Congressman would like to get rid of stacks...
 - 7.7 Bn tonnes in stacks, rising c 300K tonnes pa

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The Context

- Trend towards regulatory enforcement, worldwide
- Need for “whole life cycle” stewardship
- Thought and practice leadership – through IFA?
- Common standards



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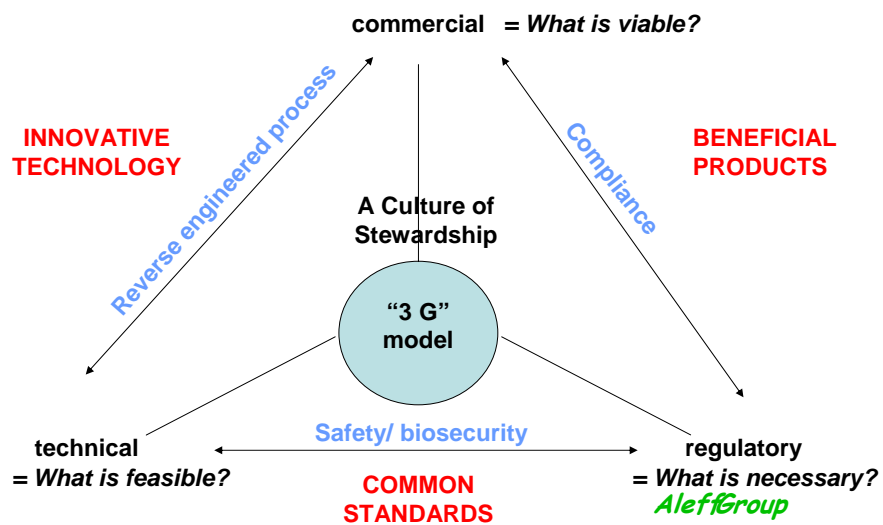
Risk Management

- Good science and good technology must be at the heart of good regulation and good governance
- Industry should take a lead: cp ICH in the pharma sector
- IAEA Working Party on radiation safety issues in Phosphate sector
- GMO bans; Cadmium rule: EU
- Public perception/ risk aversion
- Misuse of the "Precautionary Principle"
- EPA Rule blights PG use in US since 1992 and threatens "spill over" effect into other markets



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The Model



The Methodology

- **Empirical** – what we have done and know to date
- **Grounded Hypothesis** – what is our desired end point, and can we get there?
- **Blue Ribbon** – what are the best available practices and technologies?

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The Goals

- Find a long-term, “strategic” solution
 - Safe, efficacious
 - Technically imaginative
 - Reinvents business model
- Rework the approach to regulatory affairs, based on experience from pharma
- Reduce or eliminate strategic risks to business
- Engage the active participation of IFA and its members

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Is a stack necessary?

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Uses for PG

- Crop production
- Soil amendment
 - Routine
 - Emergency = eg Tsunami, hurricane, flooding
- Landfill
- Road bed/ construction
- Shoreline Restoration
- Housing Construction
- Etc.

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The EPA effect

Is the Rule the Solution or the Problem,
Cause or Symptom?



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The Problem – Example: Florida

- Since the mid-eighties, the annual production rate of phosphogypsum has been in the range of 40 to 47 million metric tons per year. The total amount generated in the United States from 1910 to 1981 was about 7.7 billion metric tons.
- In Central Florida, one of the major phosphoric acid producing areas, the industry generates about 32 million tons of phosphogypsum each year. They have a current stockpile in stacks of nearly 1 billion metric tons.

US EPA Website, July 2004

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Self-inflicted Wounds

- 1989 Rule Promulgated
- 1992 EPA Confirmed the Rule
- Industry accepts Rule without substantive objection
 - Except for a few skirmishes in Louisiana
- 1999 Rule modified accepting errors in science, but still highly restrictive
- No scientific basis for the rule
- No one has been able to replicate the data or the modeling
- Stacking has become a de facto standard

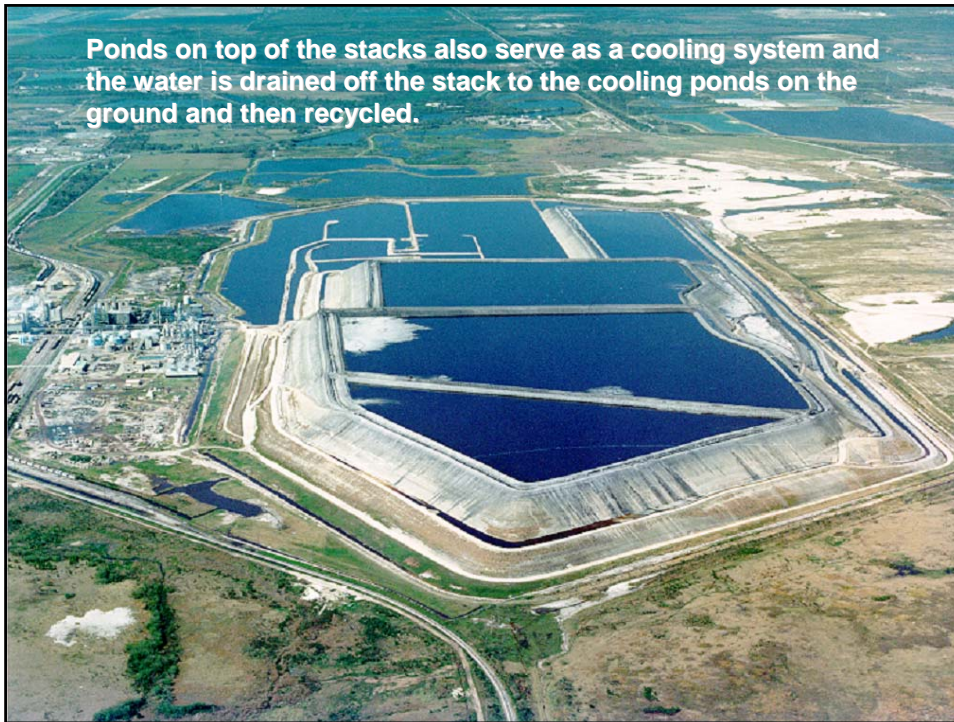
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The Rule

The EPA Rule

- **Sec. 61.204 Distribution and use of phosphogypsum for agricultural purposes.** [64 FR 5574 February 3] Phosphogypsum may be lawfully removed from a stack and distributed in commerce for use in agriculture if each of the following requirements is satisfied:
 - The owner or operator of the stack from which the phosphogypsum is removed shall determine annually the average radium-226 concentration at the location in the stack from which the phosphogypsum will be removed, as provided by Sec. 61.207.
 - The average radium-226 concentration at the location in the stack from which the phosphogypsum will be removed, as determined pursuant to Sec. 61.207, shall not exceed 10 picocuries per gram (pCi/g).
 - All phosphogypsum distributed in commerce for use pursuant to this section by the owner or operator of a phosphogypsum stack shall be accompanied by a certification document which conforms to the requirements of Sec. 61.208(a).
 - Each distributor, retailer, or reseller who distributes phosphogypsum for use pursuant to this section shall prepare certification documents which conform to the requirements of Sec. 61.208(b).
 - Use of phosphogypsum for indoor research and development in a laboratory must comply with Sec. 61.205.

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Some Consequences

- Cost: \$5 /t of P_2O_5 impact on tight margins
 - 20 Stacks in FL – elsewhere?
 - Lifetime cost of maintaining stacks/ End of Life liability
 - The process water “economy”, its Impact Now and Later
 - Accidents and Incidents
 - Holes in stacks at IMC and CF
 - Spills and Discharges of process (pond) water
 - Bankruptcy Leaving the State With the Problems.
 - Public perception
 - Loss of Land Use
- At the Tipping Point?

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Piney Point....at Bursting Point



The Solution Is now the Problem



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Regulatory Blight

The risk is High that if the EPA Rule is not reworked it will not only persist in the US, but will be used as a reference standard in much of the Rest of the World

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Reframing the Problem

- Why let PG go to waste?
- How can we realign the incentives?
- What are the necessary conditions for success?
 - Technical/ Public Health
 - Environmental
 - Regulatory
 - Commercial
 - Contemporary data

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Four Conclusions

1. The issue is global
2. The solution must be transparent and involve all stakeholders
3. Time to rework the EPA rule, based on contemporary safety and utility data to avoid “overspill” into other markets.
4. The rule is more symptom than cause, symptom of a business model in need of revision. Industry should lead.
5. The phosphate industry at this pivotal point in its history will do well to transform from a 2G (commodity) to a 3G (added value) business and PG management is the place to start.

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Project Overview

- Safety, efficacy and long-term viability of PG products/ uses
- Five years:
 - 1-2: focus on safety; define desired end points; collect reference data set; establish basis for uses
 - 3-5: focus on efficacy; test uses, focused on agronomic and related applications
- Eight Work Packages
- Wide opportunities for stakeholder participation
- Transparent publication policy
- Blue Ribbon management group
- Reviewers
 - IFA, IAEA, EPA, FDEP, FIPR, AAEWII, Academia...

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