Mosaic’s Beneficiation Process Overview
DeSoto County Workshop – May 31, 2022
## Presentation Outline

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Why What We Do Matters

John Yasalonis - Senior Manager, Digital Deployment
Our Mission
We help the world grow the food it needs.

Our Work
We are the world's leading integrated producer and marketer of concentrated phosphate and potash.
How We Do, What We Do, Matters

Our Principles:

WE ARE RESPONSIBLE, INNOVATIVE, COLLABORATIVE, AND DRIVEN.

- We are accountable for the safety and wellbeing of our colleagues and our company.
- We act with integrity and conviction.
- We are careful stewards of natural resources.
- We collaborate across departments and geographies to accelerate our performance.
- We foster innovation and ideas that make us better.
- We strive to achieve excellence knowing we can always improve.
North America Business

Our Footprint in North America; Feeding Customers Around the World

- North America Business:
  - Approximately 34% of Estimated Annual Potash Production
  - 74% of Estimated Annual Production of Concentrated Phosphate Crop Nutrients
- Phosphate is Mined in Central Florida and Peru
- Potash is Mined in Saskatchewan and New Mexico.
- Mosaic produces high-quality fertilizers and animal feed, then market and deliver our finished products—about half to customers in North America, and half to customers around the world, including those in all key agricultural regions.
Mining is the First Step in the Phosphate Crop Nutrition Production Process

1. **Mining & Mineral Operations**
   - Phosphate Matrix Composed of Phosphate Rock, Clay, and Sand is Extracted from the Ground.
   - Clay and Sand are Removed Through a Beneficiation Process.
   - The Refined Phosphate Rock is Transported by Rail for Further Processing.

2. **Crop Nutrition Production**
   - Our Fertilizer Production Facilities in Florida and Louisiana Process Nutrients in the Phosphate Rock into a Water-Soluble Form Suitable for Plant Uptake.

3. **Domestic and International Distribution**
   - Finished Fertilizer Products are Distributed both Domestically and Internationally by Ship, Barge, Rail, and Truck to Retailers who Sell and Deliver Directly to Farmers.
Mine Process; Simple Process Made Up of Several Simple Steps

**Mining “Field” Operations**

**Dragline Operations**
Draglines access in-ground phosphate rock bearing ore commonly referred to as “matrix”

**Ore Pumping**
Ore is transported via pumping to Beneficiation Plant

**Beneficiation “Plant” Operations**

**Washer, Clay Removal, Pebble Production**
Incoming ore is “washed” with water through screens to remove clays and capture large phosphate rock “pebble”

**Sizing, Flotation, Concentrate Production**
Remaining ore, not removed or captured in the “Washer” is separated via flotation to remove sand and capture fine phosphate rock “concentrate”

**Storage and Shipping**
Captured phosphate rock (“pebble” and “concentrate”) are shipped via rail to crop nutrition production facilities
What is Beneficiation?

Travis McClenithan - Senior Manager, Operations
What is Beneficiation? A Technical Word for Processes Used to Separate Phosphate Rock from Sand and Clay

Beneficiation [verb] [1]:

In the mining industry or extractive metallurgy, beneficiation is any process that improves (benefits) the economic value of the ore by removing the gangue minerals, which results in a higher-grade product (ore concentrate) and a waste stream (tailings).

There are many different types of beneficiation, with each step furthering the concentration of the original ore.

Typical Florida Phosphate Mining: “Ore” is Comprised of Phosphate Rock, Sand, and Florida Phosphatic Clays

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<th>“Phosphate Rock”</th>
<th>Sand</th>
<th>Clay</th>
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<td>Fluoroapatite or Francolite</td>
<td>Quartz (beach sand)</td>
<td>Many different clay minerals, palygorskite, montmorillonite, others</td>
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Florida History of Almost 150 Years Providing Phosphate Rock for Crop Nutrition Products

- Phosphate Deposits in Central FL Discovered in 1881 Along the Banks of the Peace River near Ft. Meade.
- River Pebble Mining Ceased in 1908.
- Land Pebble Mining Still Active.
- Flotation Processing Began in 1927 and Continues Today.

~1930’s marked the start of improved phosphate “beneficiation” processes with the addition of “flotation” technology.
We utilize the physical and chemical differences between the clay, sand, and phosphate minerals in our beneficiation processes!

For example, clays particles are very small while some phosphate rock is very large. For these minerals we can use physical separation processes such as screening.

Other phosphate rock is about the size of beach sand – for this size material we use differences in surface chemistry to make separation.

CLAY MINERALS

Many different clay minerals, palygorskite, montmorillonite, others

0.01 mm 0.1 mm

SAND

Quartz: SiO₂

0.1 mm

1.0 mm

PHOSPHATE ROCK MINERALS

Fluoroapatite or Francolite: Ca₁₀(Cl₂ or F₂)(PO₄)₆

0.1 mm

“Concentrate” Product
Phosphate rock
0.1 mm – 1.0 mm

20 mm (~3/4”)

“Pebble” Product
Phosphate rock
1.0 mm – 20 mm

*** Phosphate minerals are incredibly varied, with Ca often replaced with Na, Mg, Mn, Pb, etc. and PO₄ replaced with AsO₄, SiO₄, CO₃ etc.
Beneficiation Basic Process – Step by Step Separation of Non-Phosphate Minerals, Capture of Phosphate Rock

Process 1

WASHER: Screening & Clay Removal
- Mechanical Separation
- Screens/Shaking
- Rinsing
- Scrubbing

1. Removal of CLAY
2. Capture of >1.0 mm phosphate rock “Pebble”

Process 2

SIZING & FLOTATION
- Gravity sizing
- Separation by air flotation after conditioning

1. Removal of SAND
2. Capture of <1.0 mm phosphate rock

Shipping
Beneficiations Steps

Chelsea Kucharsky - Senior Manager, Operations
All About Beneficiation
Beneficiation Steps: Washer and Clay Removal

**Washer: Screening, Clay Removal, and Capture of “Pebble” Phosphate Rock**

Stationary and vibrating screens are used to separate clay minerals (very small <0.01 mm) and phosphate rock (>1.00 mm)

- Oversize clay balls/sticks between ~3 – 20 cm (~1 - 8 inches) are removed by rotating screens called “Trommels”
- Clay is removed through rinsing of matrix on screens and scrubbing of matrix in log washers, as well as through cyclones
- All material > 1.0 mm (primarily phosphate rock) is removed to a product pile as “pebble” product. This product is typically ~60 BPL or ~27% P2O5 in grade.
- All material between 0.1 – 1.0 mm (primarily small sized sand and phosphate rock) is moved forward in the process to the Sizing and Flotation steps
Beneficiation Steps: Sizing and Flotation

Sizing/Flotation: Gravity sizing of material 0.1 – 1.0 mm in size, followed by flotation separation of sand from phosphate rock.

Three Steps – Sizing, Phosphate Flotation, and Then Sand Flotation

- **Sizing**
  - Gravity processes such as cyclones (“cyclones” are used in bagless vacuum cleaners you use at home), and hydraulic sizers (these are large tanks that use upwards water velocity to “classify” or “size” particles based on their size and density.
  - A step that helps the flotation step to be more efficient

- **Flotation**
  - Incoming sand/phosphate slurry is conditioned to preferentially create a hydrophobic surface on the phosphate rock. This causes the phosphate rock to act as if it has a polished wax surface, similar to when you wax your car!
  - Millions of air bubbles are introduced and the hydro-“hydro-phobic” phosphate particles latch on to the air bubble and ride it to the surface
  - Collected material is then scrubbed to strip the wax-like coating and sent to a second flotation step where sand is floated. This helps improve overall grade of material.
  - Removed sand is immediately pumped back to the mine-field to start the Reclamation process
Phosphate rock is typically stored on-site, then blended/loaded and shipped via rail to crop nutrition production facilities

- Primary shipping method is rail – all current mine facilities utilize this method except for our Wingate mine which is limited to truck shipping per their operating permit.

- Phosphate rock grade (quality) management is important to assist our crop nutrition production facilities in making quality fertilizer products

- Mosaic Florida mines ship ~12+ million tons of phosphate rock locally in the Tampa Bay region on an annual basis
Technology Transformation

Chelsea Kucharsky - Senior Manager, Operations
Technology Transformation

- Adapting and evolving our business through technology is critical to staying ahead
- We’re using technology to help us work safer, stay connected and make real-time, data-driven decisions

**Integrated Operations Centers**
Real time visibility and optimized decision making

**Modeling & Analytics**
Better outcomes through augmented decision support tools

**Automation & Process Controls**
Stable processes and lower fixed costs

**Process Digitization**
Improved employee and customer experiences
Technology Transformation: Integrated Operations Center – Florida Mining

Operational Transformation Powered by Innovation and Technology

Integrated Operations Center (IOC):
To drive and leverage the use of innovative technology across our Florida mining operations.

Data driven decisions

Work safer

Efficiency

Create greatest possible value for our employees and stakeholders
Technology Transformation – Centralized Beneficiation Control Rooms

Travis McClenihan
Sr. Mgr. Operations, South Fort Meade