Sloping Sand Bed for Mineral Sand Plant Effluent Clarification

By Jim Gusek, P.E.
Sovereign Consulting Inc.
Lakewood, Colorado

James Renner and David Settles
Southern Ionics Minerals, LLC
Patterson, Georgia
OUTLINE

- Other Applications
- The Site
- The Problem
- The Options
- Sub-Aerial Tailings Deposition Model
- Bench Testing
- Full Scale Design
- Other Applications (Revisited)
Other Applications

(If Space Is Available)

- Drying AMD sludge (in drier portions of underground mines)
- Drying AMD sludge on surface of fine coal refuse impoundments
- Fine coal refuse
- Replacing settling ponds
- Replacing clarifiers and filter presses
- Managing any sludge that is slow-settling with minimum flocculation
At its Mission Mine in Southeast Georgia, Southern Ionics Minerals (SIM) extracts high-quality Zircon sand that has unique properties of strength and endurance, enabling SIM’s U.S. customers to produce high end products that are important to our country’s security and economy. Titanium-bearing minerals are also recovered.

See: www.southernionicsminerals.com
The Problem

- The raw mineral ore sand contains a naturally-occurring, low-density organic **humate** fraction that is liberated in the milling process at the Offerman Plant.

- Due to its low-density characteristic, the humate is difficult to de-water even with chemical flocculation and plant process modifications to minimize its liberation.

- A low-cost but efficient de-watering process was needed to remove humate particles (400 ppm TSS) that resisted settling.
The Problem

Suspended humates (post-coagulant & flocculent) quickly blind a traditional sand filter

Full scale design flow rate:

190 to 950 m$^3$ per day or 35 to 175 gpm
The Options

- Slow sand bed filtration,
- Settling ponds,
- Nanofiltration
- Reverse osmosis, and
- Commercial sand filters

All were considered and rejected due to excessive costs and maintenance concerns associated with repeated back-flushing and/or membrane fouling.
Chance favors the prepared mind...

- L. Pasteur
Sub-Aerial Tailings Deposition Model

**Stage 1:** Waste slurry is deposited in a thin lift.

**Stage 2:** After settling.

**Stage 3:** After drainage (100% saturation).

**Stage 4:** After drying (partial saturation).
Thin Film Settling
Sub-Aerial Tailings Deposition Model

- Header Pipeline
- Slurry Offtake (typ)
- Deposition Zones
- Tailing Basin
- Decant Pond
- Starter Deposition Embankment
- ZONE C
- ZONE B
- ZONE A
- Slope
- Return Pipeline
- Tailing Pipeline
- Mill
Rubber-tired equipment can drive on sub-aerial deposited tailings within a week or two of cessation of placement.
Bench Testing – May 2016
Bench Testing #1 – May 2016
Bench Testing #1  - May 2016
Bench Testing #2 - May 2016
Bench Testing #2 - May 2016
Full Scale Design

Full scale design flow rate:

190 to 950 m³ per day or 35 to 175 gpm
Full Scale Design

Single center drain for 2 separate sand beds

Section Running East-West, Single Center Drain

Section Running North - South

Rice Rock Sand - 3' 

Three pipes in 12 inches of Medium Gravel 

1 - 30' 2 - 

Optional Fine gravel, 6'
Full Scale Design

1% Slope

300 ft / 91.5 meters
Full Scale As-Built

Spare – Not Used
Construction – Winter 2017
DRIED HUMATE
Other Applications - Revisited

(If Space Is Available)

- Drying AMD sludge (in drier portions of underground mines)
- Drying AMD sludge on surface of fine coal refuse impoundments
- Fine coal refuse itself
- Replacing settling ponds
- Replacing clarifiers and filter presses
- Managing any sludge that is slow-settling with minimum flocculation
Thank You

Nihil simul inventum est et perfectum

- Latin Proverb

jgusek@sovcon.com

Sovereign Consulting Inc.

Southern Ionics Minerals
Nothing is invented and perfected at the same time.

- Latin Proverb

jgusek@sovcon.com