Pilot-Scale Demonstration of Ilmenite Processing Technology – Project Update

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Mining & Reclamation Classroom
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The NRRI Approach -
*how do we harness our resources to create the sustainable product pipeline of the future?*

**Broaden Offering** – create portfolio of opportunities

**Create Higher Value** – move up value chain; functionality, smart materials; *KEEP THE VALUE IN MINNESOTA*

**Reduce Waste** – higher yield, *lower cost*; reduced impact; *competitiveness*

**Model Responsible Stewardship** – demonstrate resource stewardship as *differentiators for competitive advantage*

*Translate data into information for sound, long-term decision-making*
Pilot-Scale Demonstration of Ilmenite Processing Technology

**Background**: Decades of Minnesota ilmenite (FeTiO$_3$) research but not commercialized due to high MgO content in concentrate

**Goal**: Produce high-purity iron and titanium products from Minnesota ilmenite. Scout vanadium and magnesium products for future.

**Collaboration**: Process Research Ortech (PRO) in Toronto, Ontario

**Impact**: NE Minnesota jobs; revenues from natural resources; more robust mining economy in Minnesota

**Funding**: IRRRB ($300k), UM ($150k), and UMD ($150k)
The Search for Higher-Value Products

- Iron Concentrate
- Iron Oxide Pellet
- DR Grade Pellet
- Iron Nuggets
- Iron Oxide Powder
- Titanium Dioxide Powder

Crude Iron Ore
Crude Ilmenite Ore

$10's  $100's  $1000's$
Hydrometallurgy Introduction
Ilmenite Demonstration Project

Ilmenite Ore

- High Silica Waste
- Road Patch & Surfacing

Concentrate

- HYDROMETALLURGY
  - High Purity
  - TiO₂
  - Fe₂O₃
  - V
  - Mg

Iron Tails

- HIGH VALUE IRON PRODUCTS
  - Nuggets
  - Pig Iron
Technical Results

- Upgraded ilmenite from ~25% to ~40% TiO$_2$; produced tons of ilmenite concentrate
- Produced 98.5% pure Fe$_2$O$_3$ powder
- Produced 99.3% pure TiO$_2$ powder baseline with 99.8% pure TiO$_2$ optimized value
- Inert solid tailings per Ontario Reg. 558; recycles majority of streams
- Geological models of Longnose deposit
Economic and Marketing Results

High-Level Economic Analysis:
- 60k TiO$_2$ plant CAPEX: estimated $164.2M
- 60k TiO$_2$ plant OPEX: estimated $713/ton production cost and mining 0.5 Mmtpa crude ore
- Potential for 150 jobs

Marketing Analysis for Titanium Dioxide Product:
- Paint/coatings industry, but obtain a supply agreement from producers with manufacturing facilities in the area.
- Plastics industry, but obtain a supply agreement from producers with manufacturing facilities in the area.
- Determine what products can use TiO$_2$ that currently do not (substitute an input). Find a specialty market.
- Determine what products currently use TiO$_2$ at small quantities, but are projected to increase demand above current overall market levels as the demand for the niche product increases.

Source: USGS Titanium
**Project Management Results**

- **Safety:** Zero incidents, near-misses, or injuries
- Expanded scope: iron oxide development, titanium purity optimization study, UMD CED marketing study
- Final report submitted May 25, 2017
- Finished approximately 6% under budget (~$36k)
Path Forward

- Hydrometallurgy capabilities at NRRI
- Opportunity for:
  - Optimization and variability studies
  - Additional characterization and drilling campaigns
  - Recovering additional metals from the process
  - Value-added products from iron oxide and titanium dioxide powders
- Networking with stakeholders
  - DNR, MPCA, local governments, etc.
  - Potential consumers, mine operators, engineering firms, marketing firms, etc.
- Pre-feasibility and complete feasibility studies
Thank you

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