The Mercer Underclay in Pennsylvania is being researched as a source of critical minerals such as Alumina (Aluminum Smelter Feedstock), Lithium (for Lithium-Ion Batteries), and Rare Earths (for Rare Earth Magnets). Materia USA is developing production facilities in Pennsylvania for recovery of salable critical mineral commodities from the mercer underclay. Mineral processing includes separating individual minerals by gravity separation, magnetic separation, electrostatic separation, and flotation.

Previous work has been done on the mercer underclay magnetic separation produced a concentrate enriched in Goethite and Tourmaline (Lithium Mineral) and an Anatase, (TiO2)-enriched product.

**INTRODUCTION**

The goal is to research the results of the mineral processing for plant design by getting equipment in production mode, this includes:

a. Grinding samples for mineral processing tests
b. Evaluating grinding behavior of mercer clay lithotypes
c. Integration with valid XRF results for real analyses while running mineral processing tests (i.e. Understanding the XRF)

Objective Questions

XRF test: Which particles are magnetic?
XRF reproducibility: How do the spread between minimum % and maximum % of the averages of multiple analysis vary with particle size? Do we need to do additional sample preparation on mill products (or products of other mineral processing tests)?

**RESEARCH OBJECTIVES**

The goal is to research the results of the mineral processing for plant design by getting equipment in production mode, this includes:

a. Grinding samples for mineral processing tests
b. Evaluating grinding behavior of mercer clay lithotypes
c. Integration with valid XRF results for real analyses while running mineral processing tests (i.e. Understanding the XRF)

**Equipment & Methods**

1. Nodule Clay- 1 Hour, 21 kg Media Charge (1.4 cm Balls), 4 kg Feed Charge
2. Semi-flint Clay- 20 Minutes, 21 kg Media Charge (1.4 cm Balls), 4 kg Feed Charge
3. Feed and Products for Both Tests Screened at 5, 12, 40, 100 and 200 Mesh
4. Multiple XRF tests on each size fraction was done to test reproducibility of the XRF
5. New Normative Analysis Technique was developed to estimate mineral composition

**RESULTS**

Normative Analysis: In order to estimate mineral composition, a technique was developed involving converting some oxides into the mercer clay that corresponds to each oxide. For example: Fe₂O₃ analysis was used to calculate Goethite and TiO₂ to calculate Anatase composition

**ACKNOWLEDGEMENTS**

I would like to thank the Penn State Energy and Mineral Engineering Department for providing me with this valuable opportunity to gain research skills and experience.

I would also like to thank Pete Rozelle for his guidance and support throughout the research process.