A Pollution-Prevention and Economically-Viable Technology for Separation of Rare Earth Elements from Powder River Basin (PRB) Coal Ashes

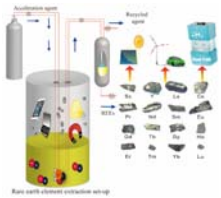
PI: Maohong Fan – *University of Wyoming*

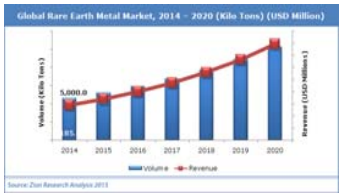
Co-PIs: Hanjing Tian – *West Virginia University;* Eric Williams and Gabrielle Gaustad – *Rochester Institute of Technology;* Hertanto Adidharma

Maciej Radosz - *University of Wyoming*

NETL Project Contact: Mr. Vito N. Cedro

Background for Proposal

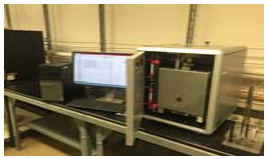




Catalysts (petroleum refining...)
Electronics (display phosphors...)
Magnets, Glass; ceramics; metal alloys...

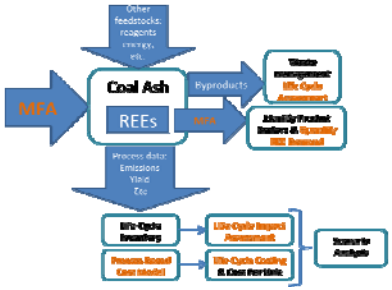
Mass: ~185,000 tons in 2014 ◂ ~300,000 tons in 2020
Revenue: ~ USD 5.0 billion in 2014 ◂
~ USD 9.0 billion in 2020

Equipment and Facilities



Feasibility Study

- UW+WVU:
- Discussion of information developed in sampling and characterization plan
- RIT:
- Waste management characterization and benchmarking
- Comparison of REEs from coal ash with current REE production and coal ash disposal.



Risk Management Plan

- Proposed systematic random coal ash sampling method is problematic
  - Try alterative probability sampling methods such as cluster random sampling
- Competition of RREs with other valuable elements (Cu, Pb, Mn, Ni, etc.)
  - Control pH
  - Control leaching fluid
- Long time needed for separating the small RREs-containing solid
  - Use an environmentally friendly assisting agent

Technical Approaches

2 wt-% Rare Earth Production

- REEs and other valuable materials leaching from coal ashes
- Separating REEs+other-valuable materials loaded solid from leaching mixture
- De-watering solid for obtaining at least 2 wt-% REEs containing solid

Factorial Study

- Characteristics of coal ashes
- Physical
  - +BET characteristic
  - +Theromo-analysis
- Chemical
  - + Concentration of REEs
  - + Concentration of other elements

Milestones

Associated milestone	Milestone title	Evaluation Index	Quantitative or qualitative goals
Milestone 1	Updated project management plan (UPMP)	2/31/2016	M1-The UPMP is completed and submitted according to NETL's requirements.
Milestone 2	Updated sampling and characterization plan (USCP)	3/31/2016	M2- USCP is completed and submitted according to NETL's requirements.
M3	Sampling and characterization of coal ash	8/30/2016	M3.1-Discover at least 10 million tons of coal ash that have at least 300 ppm REEs. M3.2- Complete sampling and characterization of identified PRB coal mines that have at least 300 ppm REEs. M3.3 Sampling and characterize report is finished and submitted.
M4	Feasibility study	9/30/2016	M4.1-Environmental, technical and economic feasibility of recovering REEs from the proposed feedstocks by geographic location are determined. M4.2 - 50% less energy consumption of the new REEs recovery technology compared to state-of-art process is achievable based on feasibility study. M4.3--Feasibility report will be submitted to NET...
M5	2 wt% REE material production	4/30/2017	M5. Is consisting at least 2.0 weight % total REE content on an elemental basis and measured on a dry basis is produced.
M6	Life cycle analysis	4/30/2017	M6- Life cycle analysis is completed.
M7	Preparation for phase I report and phase II application	4/30/2017	M8 Phase I design package and summary report, and Phase II application package are finished for NETL.