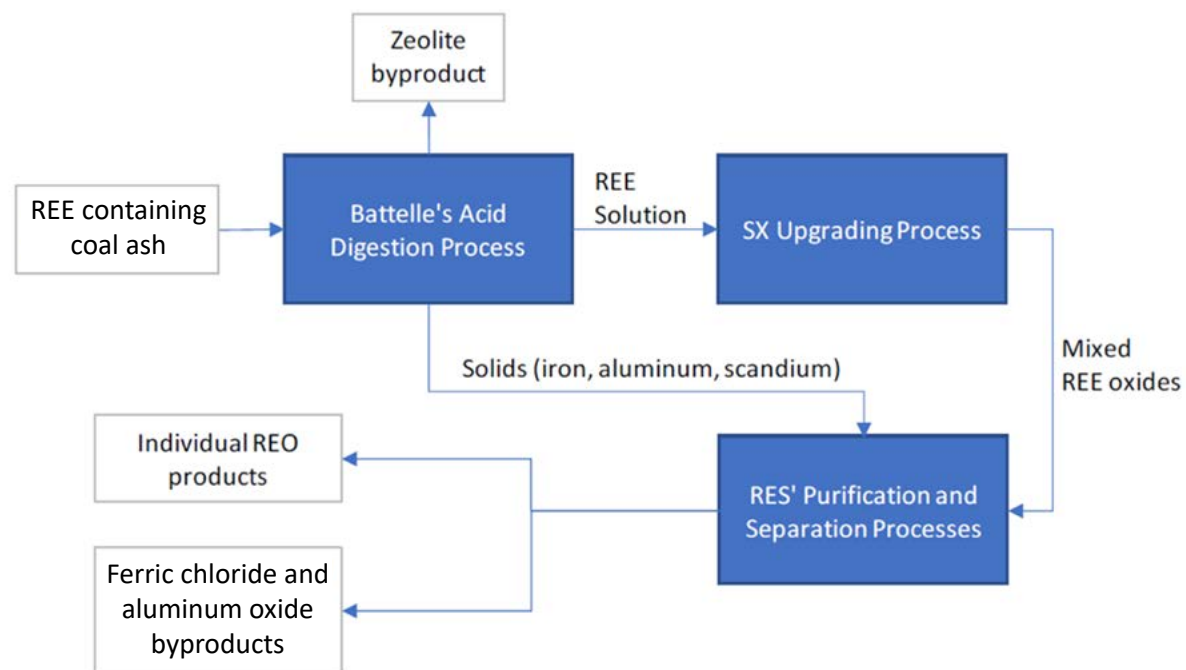


HIGH PURITY RARE EARTH ELEMENTS (REE) RECOVERED FROM COAL ASH VIA A NOVEL ELECTROWINNING PROCESS

Generating and purifying environmentally benign and economically sustainable REE products from domestic coal ash resources

REE RECOVERY PROCESS DEVELOPED

Battelle Memorial Institute (BMI) and **Rare Earth Salts (RES)** worked together to develop and validate BMI's acid digestion process and RES's novel electrowinning separation and purification process, as well as overcome contaminant challenges.



ACID DIGESTION PROCESS IMPROVES REE DIGESTION



Acid digestion makes metals easier to separate by dissolving a coal ash sample into solution by adding acids and heating it until the metals break away from the other undesired materials. BMI successfully scaled up their acid digestion process to increase the concentration of mixed REE materials in solution and provided enough material for the RES facility.

Scaled-Up Acid Digestion Process

ZINC REMOVAL IMPROVES SOLVENT EXTRACTION (SX)



After acid digestion, aluminum and zinc remained in solution with the REEs. Aluminum was easily removed, but zinc presented a challenge. To overcome it, BMI used a new extractant composition selective for zinc over the REEs to be implemented prior to the traditional SX process as a pretreatment to remove zinc. BMI successfully scaled up their SX process 100x to 10 kg per batch.

REO Material for Purification

Electrowinning Produces High-Purity Rare Earth Oxides (REO)

During the electrowinning process, metal ions present in a solution are separated using a direct current. A concentrated, mixed REE solution was fed to RES's electrowinning process to obtain the final coal-based, high purity REO products.

TECHNOLOGY PRODUCES REO PRODUCT WITH A PURITY OF ~90%

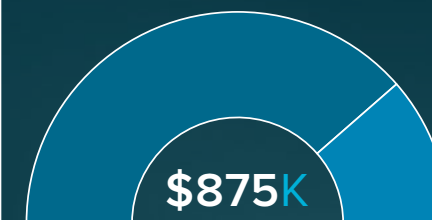
With the zinc interference minimized, RES's electrowinning process recovered a concentrated REO product. A lanthanum oxide product with a purity of approximately 90% was generated. A purity of 90% renders the material suitable for further processing into a pure metal form for subsequent incorporation into commodity or national defense products.



~90% Pure REO Product

AWARD NUMBER
DE-FE0031529

PROJECT BUDGET



- DOE\$674,940
- PERFORMER.....\$200,000

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CORE COMPETENCIES



MATERIALS ENGINEERING
and MANUFACTURING



PROGRAM EXECUTION
and INTEGRATION

PARTNERS



RARE EARTH SALTS

BATTELLE