Recovery of Critical Materials from E-Waste

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- Grant #: IGEM25-007
- Reporting Period:
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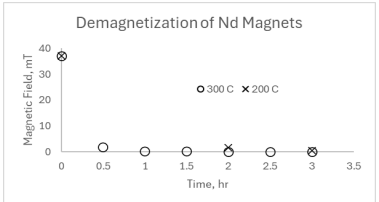
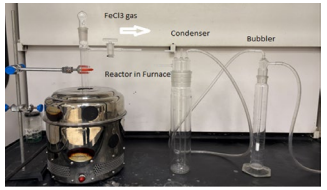
Summary of progress towards proposed milestones

Milestone 1: **Pretreatment of Magnetic Material**	•Short narrative of progress: Two steps sequential treatment of magnetic material to convert the magnet into a particulate form suitable for chemical reaction processing optimized •**Demagnetization** •Time and temperature conditions for complete demagnetization determined experimentally. •**Particle size reduction:** •A grinding cycle was established to achieve a particle size of less than 38 microns using a planetary ball mill (Model PQ-N2). 
Milestone 2: **Development of Experimental Setup for Solid-State Chlorination**	•Short narrative of progress: Experimental setup shown in the figure; • The system is configured to evacuate $FeCl_3$ formed during the reaction and condense it in a condenser. This step potentially permit more efficient separation of neodymium (Nd) from iron (Fe). Glass reactor and other pieces fabricated 
Milestone 3: **Solid State Chlorination Experimentation**	•Short narrative of progress: Setup completed as described above. •The setup is designed to operate with ~100 mg of magnetic material. Preliminary experiments have indicated successful conversion of metals into chlorides. In addition, experiments are proposed to be conducted using thermogravimetric analysis/differential scanning calorimetry (TGA/DSC) which required <10 mg of metal. •Troubleshooting of the TGA/DSC instrument (NETZSCH STA-409) in progress.
Milestone 4/5: **Chloride Reduction and Electrowinning Experimentation**	•Short narrative of progress; To be initiated
Milestone 6: **Technoeconomic Analysis and Life Cycle Assessment**	•Short narrative of progress: To be initiated

Summary of expenditures and budget performance

- ***Key Insights***
- Spending is ON TRACK with proposal progress, but slightly under anticipated expenditures
- Major expenditures included
  - Personnel: PI summer salary, graduate student stipend
  - Supplies: Reactor fabrication; reagent, gases, and laboratory supplies;
  - Graduate student tuition

Challenges/Changes

- Two graduate students budgeted for, successful hiring of one student: experimental effort supplemented through hire of undergraduate students

	Budgeted	Spent	+/-
Personnel (Salary + Fringe) PI, co-PI, two Graduate Students,	87,752	38,247	49,505
Operating Expenses (Materials/Supplies, Publication)	26,832	3,759	23,073
Graduate Tuition and Health Insurance	25,416	5,583	19,833
Total	140,000 (100%)	47,589 (34%)	92,411 (66%)
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Projection of work in next reporting period

- Experimental Studies
    - Analysis and characterization of the material
    - Solid-state chlorination using TGA/DSC and the large-scale reactor setup
    - Investigation of chloride reduction for the separation of Fe from rare earths
    - Electrowinning of Nd/rare earth metals
- Process Development and Analysis
    - Conceptual development and finalization of the process flow sheet
    - Preliminary technoeconomic analysis (TEA)
    - Preliminary life cycle assessment (LCA)
- Publications and Conference Presentations