PROJECT INVESTIGATORS:
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Sustainable bioleaching of platinum-group metals from spent automotive catalytic converters

"The E3B funding enabled us to make new connections with academia, with the goal of establishing a long-term academic–industrial collaboration, developing technologies for metal extraction that connect magnetic separation and bioleaching," Bunting Europe

PROJECT AIMS: The demand for platinum-group metals is growing due to the need for next-generation batteries in electric vehicles. Spent automotive catalytic converters (SACCs) are a valuable source of platinum-group metals, but environmentally friendly recycling needs to be developed. The project aimed to develop a fully microbiology-based approach for platinum-group metal recovery from spent SACCs. Magnetic separation was tested for metal fraction enrichment and sequential bioleaching was used, involving:

- base-metal solubilisation by acidophilic chemolithotrophs in a closed-loop leaching system
- subsequent platinum-group metal recovery from SACC residues using an organic acid-producing fungus

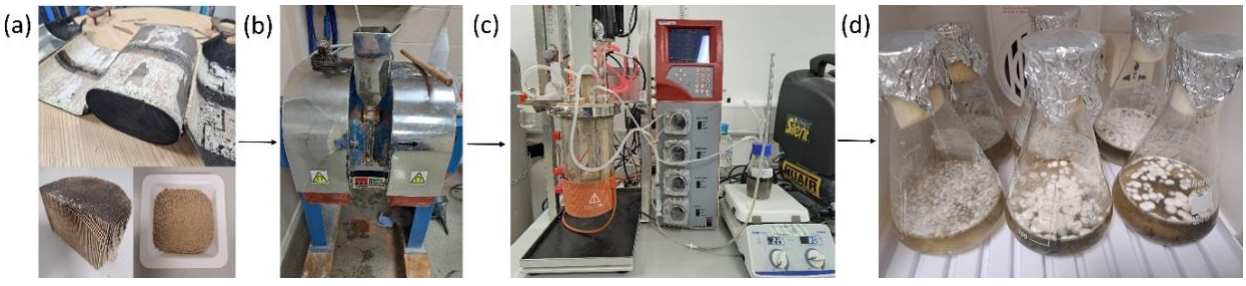
OUTCOMES & NEXT STEPS:

- The method will be tested for its potential to recycle spent printed circuit boards
- A project on fungal bioleaching of spodumene, a mineral containing lithium, is being developed in collaboration with the industrial partner and new collaborators at McGill University (Canada) and the University of St. Cyril and Methodius (Slovakia)
- Project findings were presented at two conferences; Biomining '23 (Falmouth, UK) and the Geological Association of Canada/Mineralogical Association of Canada joint annual meeting (Sudbury, Canada)
- A publication is being prepared

RESULTS: Overall, we successfully applied sequential bioleaching using acidophilic chemolithotrophs and an organic acid-generating fungus to extract aluminium and platinum-group metals, respectively, from SACCs. The main findings are:

- Two SACCs contained ~25% Al, 0.8% Fe, and 0.7% Pd or 0.2% Pt
- Wet magnetic separation did not remove the Fe fraction from crushed or milled SACCs
- Transition metals were solubilised using sequential indirect and direct bioleaching using moderately thermophilic sulfur-oxidizers (*Sulfobacillus* and *Acidithiobacillus* spp.), achieving >99% Al extraction
- Of note, indirect leaching achieved greater Al solubilisation rates (7-9 mg/day) than direct bioleaching (5.3 mg/day)
- Al was recovered from leachates at pH 6
- Direct bioleaching using the organic acid-generating fungus *Penicillium ochrochloron* recovered up to 17% Pt from a SACC residue
- Fully microbiology-based sequential SACC processing was performed in the laboratory; however, a contaminating cyanogen (*Pseudomonas* sp.) that solubilised platinum-group metals was detected during transition metal leaching. This finding emphasises the need to sterilise source materials in bioleaching processes that are sensitive to microbial contamination

Change in technology readiness level: 1 to 2



Sequential bioleaching of spent automotive catalytic converters (SACC): (a) SACC preparation, (b) magnetic separation, (c) indirect closed-loop leaching of base metals using biogenic H_2SO_4 generated by bacteria, (d) direct bioleaching of platinum-group metals using a biogenic organic acid generated by a fungus.