**Lab-Scale Tank and Heap Bioleaching of Light Shred Fractions by *Acidithiobacillus Ferrooxidans.***

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**Highlights**

* Bioleaching efficiencies up to 80% within 20 days.
* Heap bioleaching shows high potential for Cu and Zn.
* Leaching efficiencies are highly dependent from loading rates.

**1. Introduction**

Companies in the field of automotive and residual waste usually crush materials in big shredders in order to increase the surface area for further processing. During the shredding process, the so called light shred fraction, containing mainly plastics and other synthetic polymers, is discharged and deposited. However, these fractions still contain reasonable amounts of metals such as Fe, Cu, Ni and Zn, making them an interesting substrate for bioleaching. Within the last six decades, the use of microbes for metal recovery, known as bioleaching, raised the interest of scientists and industry, mainly due to their higher efficiency as well as the milder and environmental friendly process conditions1. The extremely acidophilic, metal-sulphide-dissolving bacterium *Acidithiobacillus ferrooxidans* is one of the most prominent and well-studied bioleaching organism which leaches metals either indirect *via* the production of sulfuric acid or direct by enzymatic oxidation2.

**2. Methods**

In order to develop a bioleaching process for the metal recovery from shredded fractions, two different approaches including a heap and a continuous-stirred-tank reactor were tested. In stirred tank reactor experiments, a 25 L glass reactor was inoculated with a culture of *A. ferrooxidans* and stirred continuously at 150 rpm. At regular intervals, the concentration of the shredded fraction was increased (up to 100 g\*L-1) and parameters such as pH and redox potential were measured. In a second approach a heap bioleaching system for metal recovery was investigated. The system consisted of a 20 L glass reactor with a sieve plate at the bottom, a pump for circulation of the leachate and a sprinkling system at the top. The leachate was inoculated with *A. ferrooxidans* and pumped in a circular way to rinse the substrate from the top of the heap. In both experiments the temperature was kept constant at 30°C and the pH was regulated automatically via dosage of 1 M sulfuric acid. For calculation of the leaching efficiency, the metal concentrations in solid substrate and leachate were measured *via* Inductively Coupled Plasma-Mass Spectrometry (ICP-MS).

**3. Results and discussion**

Metal recovery from shredded light fractions in the continuous stirred tank bioleaching system showed promising results after 20 days with leaching efficiencies of up to 80% for Cu, Ni and Zn, respectively (Fig.1-A). In the heap reactor, bioleaching with *A. ferrooxidans* resulted in leaching efficiencies of 15–35% after 33 days. By comparing the metal recovery of chemical leaching and bioleaching in the heap reactor, it is clearly visible that Cu and Zn were only leached in the presence of microorganism indicating the high potential of biological leaching (Fig. 1–B).

**A**

**B**

**Figure 1.** Bioleaching efficiencies of Fe, Cu, Ni and Zn in stirred tank (A) and heap reactor (B). Green bars indicate the biological leaching by *A. ferrooxidans.*

**4. Conclusions**

Two different bioleaching processes were tested according their ability for metal recovery of Fe, Cu, Ni and Zn from light shred fractions. The stirred tank reactor was operated with loading rates from 10-100 g\*L-1 showing high leaching efficiencies for all metals. The operation of the heap bioleaching reactor was more difficult but showed high potential in the biological leaching of Cu and Zn. This makes both processes interesting for further investigations and applications in industry and especially metal recovery.

**References**

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