

Bacterial bioleaching of low grade nickel limonite and saprolite ores by mixotrophic bacteria

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Abstract. Utilization of indigenous bacteria should be considered to establish a successful biohydrometallurgical process. In this study, mixotrophic iron-oxidizing bacterial consortia consisting of *Comamonas testosteroni*, *Alicyclobacillus ferrooxydans* and *Pantoea septic* which were isolated from Indonesian mineral ores were examined to determine their abilities to recover nickel from limonite and saprolite ores in the bioleaching experiments using stirred tank reactors. The nickel bioleaching experiments inoculated with the bacterial consortia were carried out using coarse limonite ores and weathered saprolite ores with pulp density of 10% w/v. Abiotic controls were also carried out replacing the inocula by the sterile medium. The bioleaching processes were monitored by measuring Ni and Fe contents and pH of the leaching solution as well as the total bacterial enzymatic activity measured as FDA hydrolytic activity. The effect of leaching on the mineralogy of laterite ores was investigated by the scanning electron microscope equipped with energy-dispersive spectroscopy (SEM-EDS) and X-ray powder diffraction (XRD). After 28 days of incubation, the FDA hydrolytic activity was observed in both bioleaching experiments containing limonite (17.2 µg fluorescein/mL) and saprolite ores (16.9 µg fluorescein/mL). The leached Ni and Fe in the bioleaching experiments containing limonite ores (30% Ni and 5.6% Fe) was greater than that in abiotic controls (1% Ni and 0.1% Fe) with the pH range of 2.5 to 3.5. However, the bacterial consortia were less capable of bioleaching of Ni (2.5%) with the similar leached Fe (6%) from the saprolite ores. In abiotic controls, the medium pH remained relatively constant (pH 6). It was concluded that these bacterial isolated as the consortium were capable of nickel bioleaching (precious metal) more effectively than iron (gangue metal), thus being applicable to the commercial processing of the difficult-to-process low-grade nickel laterite ores in Indonesia.

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