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Reuse of extractive waste from an abandoned mine site: case study of Campello Monti, Italy

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The progress and prosperity have been based on finite mineral resources and fossil fuels. Sustainable development goals of the United Nations and the implementation of the Paris Agreement, resulted in the vast utilization of a wide range of minerals for green technologies such as low-carbon applications. The global demand for raw materials has increased during the last decades (Kinnunen and Kaksonen, 2019).

In addition to clear economic and societal benefits, mining has also created environmental challenges via significant amounts of mining and quarrying waste termed as extractive waste. However, these wastes can be transformed into valuable secondary metal sources combining metals recovery and environmental management.

The current study, focuses on reuse and recovery targeted on extractive waste from abandoned mines in Campello Monti. It is a small settlement of Valstrona village in the northern sector of Piemonte, (NW Italy). Geologically, the site is present in the ultramafic layers of mafic complex of Ivrea Verbano Zone and consists of anorthosites, gabbros, gabbro-norite, lherzolites, peridotites, pyroxenites, titanolivin. The area was exploited for nickel production from Fe-Ni-Cu-Co magmatic sulphide deposits from 1865 until 1940s. Currently, the area has waste rock and operating residues dumps.

As, the extractive waste from Campello Monti has not been moved from 1940s and recovery trials have also not been performed. Our study dealt with: (1) reusing fine fraction (<2 mm) of waste rock as soil additive, and (2) recovering raw materials from coarse fraction (>2 mm) of waste rock and operating residues, by means of dressing methods like wet shaking table and magnetic fraction.

The seed germination and plant growth experiments performed using Blok et al. (2008) showed no major detrimental impact on *Lepidium sativum* plants. Although the plant growth decreased to 31% after adding 45% of waste rock to sand and blonde peat mixture. However, by adding

fertilizers this can be mitigated to certain extent.

The coarse fraction of waste rock crushed to <0.5 mm showed recovery of Co, Cu and Ni as 53%, 42% and 66% using shaking table. Whilst, for the same size and dressing method operating residues depicted recovery of Co, Cu and Ni in the range of 55-76%. Whilst, the recovery of these elements varied from 35-41% for operating residues and waste rocks using magnetic separation. The micro-XRF mineral mapping of the concentrates obtained from both dressing methods demonstrated presence of pyroxene, pyrrhotite, olivine, magnetite, pentlandite and chalcopyrite.

The present investigation highlights the methodologies used for obtaining raw materials from extractive waste. Thus moving from the linear economy patterns of mineral extraction to circular closed loops.

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