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Mechanism of the metal-salt coating phenomenon in concrete waste tips used in the alkalizing treatment of acid mine drainage and its inhibition by rice husk

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Acid mine drainage (AMD) contains high concentrations of heavy metals, requiring long-term treatment to avoid their release into the environment causing ecosystem reduction and health problems. Unfortunately, the high economic burden of these treatments is a global issue. For this reason, low-cost AMD treatment using natural chemical and biological reactions, which is called "passive treatment (PT)", has attracted researchers' focus in recent years. One of the PT technologies is adopting crushed concrete waste material (CMW) as an alkaline agent to remove metals [1]. However, due to the composition of AMD, the alkalizing effect of CMW is not sustained over the long term as a metal coating forms on its surface during this process. It has been observed that mixing rice husks (RH) with CMW inhibits the formation of this coating, but its mechanism behind it is still unclear. In this study, we thus demonstrated the coating phenomenon of CMW and the effect of combining it with RH through lab-scale experiments. We also constructed a water quality prediction model to consider the introduction of this technology in various AMD compositions.

Scanning electron microscopy coupled with energy dispersive X-ray spectroscopy (SEM-EDX) was used to observe the spatial distribution of metals on the surface of CMW, RH, and the precipitates obtained from the AMD treatment reactor. The lab-scale experiment investigated metal precipitation behavior, and the results were reproduced by a chemical model using the geochemist's workbench (GWB).

The SEM-EDX analyses revealed that Zn and Cu precipitated on the surface of CMW as silicate minerals, suggesting that the supply of Si from CMW is a prospective reason for metal coating formation. The same elemental distribution was also observed on the surface of RH and precipitates, which were obtained from the CMW-RH reactor. The lab-scale experiment showed that the release of Si was stimulated under CMW-RH system compared to the CMW alone, and the dissolved Zn and Cu were almost removed. The metal concentrations were reproduced by GWB simulation; the details of the phenomena will also be discussed in the presentation.

Reference

[1] Takaya et al., *J. MMIJ*., 2022.