

Utilization of Malaysia EAF slags for effective application in direct aqueous sequestration of carbon dioxide under ambient temperature

ABSTRACT

Iron and steel industries are among the contributors of CO₂ emission in large volume into the atmosphere, causing detrimental effects to the environment and the ecosystem at large scale. These industries also generate solid wastes in the form of electric arc furnace (EAF) slag during operations which result in about 10-15% slag wastes per ton of steel produced. In this study, the EAF slags from an iron and steel-making factory in Klang, Malaysia was utilized for CO₂ sequestration through direct aqueous mineral carbonation. According to the surface area analysis, the fresh EAF slag has a mesoporous structure, its elemental composition shows the presence of 20.91 wt.% of CaO that was used for the sequestration of CO₂ through carbonation. The sequestration capacity was found to be 58.36 g CO₂/kg of slag at ambient temperature in 3 h, with the liquid/solid (L/S) ratio of 5:1 and using <63µm particle size. Moreover, the shrinking core model (SCM) was used to analyze the solid-fluid reaction in a heterogeneous phase and the CO₂ sequestration shows to be controlled by the product layer phase. The EAF slag is demonstrated to have the potential of CO₂ sequestration at ambient temperature.

Keyword: Engineering; Materials science; Chemistry; Environmental science; Carbon dioxide (CO₂); Sequestration; Environment; Electric arc furnace (EAF) slag; Mineral carbonation