Abstract

High carbon ferrochrome (HCFeCr) alloy is the main source of chromium in steel making processes. During the production of high carbon ferrochrome alloy, in ferrochrome smelters, a substantial amount of slag is produced. These slags are generally disposed of in slag dumps or containment facilities causing environmental and containment problems. The slags have found limited use as aggregate for road surfacing and civil construction. With the renewed interest of exploiting secondary sources of metals, it has been found that most HCFeCr slags sitting in dumps contain a significant amount of alloy (Cr – 10% and Fe – 6 %) which can be recovered profitably if cheap reprocessing technology is applied.

In this study a circuit consisting of a mill and spiral concentrator was evaluated as a possible process route to recover the HCFeCr alloy trapped in the slag matrix. The focus of this present work was to model the mill and the spiral concentrator units using the experimental data generated in the earlier section of the research. Process modeling is crucial as a tool to simulate the plant process and optimize the conditions required for efficient operation. The material specific milling parameters namely the breakage function (B_{ij}) and the selection function (S_{ij}) were determined from the experimental data. The selection function was then used to estimate the parameters of the Austin model using the sum of squared errors. The Austin model parameters were found to be; a= 0.001, α= 4.9, Λ= 6.2 and μ= 3.1 and φi= 0.3, γ=0.6 and β= 5.7 respectively. These functions and parameters were incorporated into a batch milling population balance model to model particle size distribution of the mill product. The mill model predicted product size distribution from the mill at different milling conditions reasonably well. Milling conditions that gave an optimally liberated mill product were identified to be; powder filling of 60%, fraction of critical speed of 80%, ball size of 30mm and ball filling of 20%.

In modeling the spiral, two models were preferred, one by Lynch and Rao (1968) which considers that separation of particles in a spiral happens only because of the density difference of the particles and the other developed by Rao (2004) which takes into account both particle size and density. The two models reasonably predicted the experimental grade (17.21% Cr in concentrate) and recovery/yield of 41% obtained from a single stage rougher spiral test. The Rao (2004) model was however, superior in its prediction.