ABSTRACT

The investigation of Nickel Boron (NiB) alloy production was undertaken in a D.C. arc furnace in an attempt to yield an alloy containing a minimum of 15% boron (B). The aluminothermic, magnesiothermic and the dual reduction with aluminium and magnesium (alumino-magnesiothermic) reduction of boron oxide (B_2O_3) production methods were investigated. The impact of varying the reductant mass was investigated. The alloys produced by the aluminothermic, magnesiothermic and alumino-magnesiothermic production methods were analyzed in comparison to NiB master alloy B specification. The maximum B content of the aluminothermic reduction process was found to be 7.59 %. This result was obtained from the reaction which reached a maximum process temperature of 1666°C. The input B_2O_3 in the feed was at 15% excess over stoichiometry. The aluminothermic runs were solely fluxed with lime (CaO). In the magnesiothermic experiments, excess input B_2O_3 was used as flux. The maximum B content obtained for this production method was found to be 11.82%, where 15% excess reductant magnesium was used. Moreover the maximum recorded operating temperature reached was 1779°C. The alumina-magnesiothermic production method yielded a maximum of 10.88% B content in the alloy; at a peak operating temperature of 1796°C and 15% excess input B_2O_3. The process was fluxed with silica (SiO_2).

It was also found that excess B_2O_3 increased the B yield.

The alloys produced by the aluminothermic and alumino-magnesiothermic processes were contaminated with aluminium and silicon, respectively.

Further research is required to determine the thermodynamic interaction of the species in the liquid systems investigated.