7. Conclusions

The following can be concluded:

- Measured activity coefficients of vanadium oxide in $CaO\text{-}Al_2O_3$ slags confirm that vanadium is present as V^{3+} under conditions present in industrial operations.

- The Al_2O_3 content of the slag has a strong effect on the vanadium activity coefficient.

- Industrial slag samples indicate that the $MgO\text{-}Al_2O_3$ phase is the major repository of oxidic vanadium in solidified slag.

- The strong dependence of the vanadium oxide content of the solidified slag sample on the Al_2O_3 content is associated with V_2O_3 substituting Al_2O_3 in the $MgO\text{-}Al_2O_3$ spinel-type phase.

- Analyses of industrial slags indicate that slags with higher Al_2O_3 contents clearly have lower vanadium oxide contents.

- Slag samples taken for industrial X.R.F. analyses contain metal droplets and the oxidic constituent is not representative of the average bulk composition.

- Industrial X.R.F. analyses taken over 3 months show that high-alumina slags are beneficial for vanadium recovery. Furthermore, the aluminium content of the ferrovanadium is not strongly dependent on the alumina content of the slag.

- The amount of droplets entrained for the slag samples analysed is not strongly dependent on the tap temperature.

- Vanadium losses as entrained metal droplets could not be fully quantified due to the strong segregation behaviour and crowding close to the slag metal interface. The positional effect of droplet entrainmnet introduces too much uncertainty. A 3-D mapping of the slag sample must be established in order to fully quantify the positional effect on droplet entrainment.

- The predicted relationships show a strong effect of slag basicity on the soluable vanadium loss.

- Although the effect of retained MgO on the vanadium activity coefficient is not known, MgO is detrimental to the soluble vanadium loss due to the lowering of the alumina activity.

- The lower predicted vanadium content compared to industrial slag samples is a result of the aluminium activity in ferrovanadium which could not be fully quantified.

- Lower MgO contents, higher aluminium contents in ferrovanadium and lower tap temperatures will yield lower vanadium oxide losses.

8. Recommendations for future work

- New sampling methods must be derived to quantify the amount of droplets entrained in the slag to quantify the effect of slag basicity on metal droplet entrainment. Special care has to be taken to ensure that the determined amount of entrained droplets is representative of the bulk slag sample. One such way is to sample from both the y and x direction to establish a three-dimensional mapping of the bulk slag sample. Only then will the positional effect on droplet entrainment be fully quantified. A number of slag samples should be subjected to this new form of sampling to establish the effect of slag composition on metal droplet entrainment.

- Because of the many uncertainties regarding the aluminium activity in liquid ferrovanadium, experiments should be performed for oxygen activities in the same order as previously used in experiments.

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