CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The contents of this chapter are composed of the conclusions from the composition of the flash furnace accretions and the experimental accretions which were created under laboratory conditions, the differences in structure and composition between laboratory and furnace accretion, and the prediction of the formation mechanism of furnace accretions in the settler of the flash smelting furnace.

7.2 CONCLUSIONS

The common compositions occurring in accretion from the Kalgoorlie Nickel Flash Smelting Furnace, shown in Figure 5.1 to 5.10 of Chapter 5 are summarised as;

The G-burner port accretion was composed of nickel rich olivine which occurred as a major phase, $(Ni,Fe)_2SiO_4$ grains, a lamellar structure of pseudowollastonite ($CaO.SiO_2$) and mullite, a large number of pores, nickel metal, nickel sulphide and nickel oxide occurred as inclusions.

The main structure of H-burner port samples contained $(Ni,Fe)_2SiO_4$ and olivine. The dominant phases of H-burner port samples are $(Ni,Fe)_2SiO_4$, although olivine sometimes was prominent. Some spinels contained wustite which results from the reaction of nickel oxide with the Fe_3O_4 spinel.

The composition of the dust particles contained magnesioferrite, $(Mg,Fe)Fe_2O_4$, olivine, isolated regions of nickel oxide and nickel metal. The comparison of the composition of dust particles and laboratory accretions, which were formed from the furnace dust indicated that nickel metal is oxidized and enters into Fe_3O_4 spinel and olivine during heating at temperatures between 1350 and 1400° C and oxygen potentials between -60 to -40 Kcal.

Wustite, which occurred adjacent to Fe_3O_4 spinel and nickel metal, was found in the 1353-60 and 1353-55 samples and a small amount in 1353-40 sample. At constant oxygen pressure, increasing the temperature about 50° C results in the values of $Ni_{(spinel)}/Ni_{(orthosilicate)}$ increasing by 46 percent , while the magnesium ratio reduced by 4 percent. The increment of nickel content in the spinel phase of the laboratory accretions can be explained by the precipitation of nickel metal from orthosilicate at high temperature and low oxygen pressure as equations (6.4), (6.5) in Chapter 6.

In the furnace accretion formed from the deposition of dust on the wall of the flash furnace, the original phases were Fe_3O_4 spinel and a low iron olivine. The Fe_3O_4 spinel will react with silica and nickel oxide, which formed from the oxidation of nickel metal, and gives a $(Ni,Fe)_2SiO_4$ solid solution. This solid solution will react with the low iron olivine resulting in a higher iron content in olivine. The increased nickel content in olivine is because;

(i) nickel metal was oxidized to form nickel oxide entering into olivine.

(ii) nickel in the $(Ni,Fe)_2O_4$ solid solution reacting with silica.

7.3 RECOMMENDATIONS FOR FUTURE WORK

These experiments did not generate enough data to study the relationship of the reaction between Fe_3O_4 spinel and low iron olivine. The relationship between these phases should be further studied by the effect of temperature, oxygen pressure and heating time on the reaction between the olivine and Fe_3O_4 spinel, orthosilicate and Fe_3O_4 spinel and $(Ni,Fe)_2SiO_4$. In addition, a study of the effect of cooling rate on the structure of flash furnace accretion would give better understanding of the formation of the lamellar phase.