CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This research studied the primary smelting reactor by using the METSIM model as simulation tool for process control. Emphasis is placed on the determination of an appropriate configuration of the PSR which is represented by FRL furnace or El Teniente converter in the program. In order to prepare a suitable model model, the model was validated with plant data. After the model was verified, an analysis of process parameters was performed together with investigating further the effect of copper concentrates and its chemical compositions. The following conclusions can be drawn from the investigations.

6.1.1 Process variables

The manipulated variables such as the copper concentrate feed rate, oxygen flow rate, blowing air flow rate, flux feed rate and revert feed rate have been investigated to find the impact on the process performance as indicated by controlled variables and the yield of PSR.

The copper concentrate feed rate has significant influence on all the controlled parameters including yield because it is the main raw material. The more it is added, the higher is the output. It is however less significant effect in composition of product because the rate of reaction is still the same.

The effect of oxygen flow rate and blowing air flow rate are varied. The result shows that the heating of unreacted gas causes a decrease in furnace temperature. If oxygen is not enough to oxidize with minerals, the white metal grade is decreasing.

Flux feed rate is the main variable to control slag quality because it is the raw material to generate fayalite slag. The model calculates the slag composition in order to find optimum flux feed rate and critical feed rate sufficient enough to generate fayalite slag.

The last variable that is investigated in this study is revert feed rate. It can be seen that it affects all controlled parameters because revert components consist of both slag and matte materials and also require heat to melt. It has direct bearing on the temperature of the PSR. The yield is also improved by recycling revert because of the presence of white metal in the revert.

6.1.2 Copper concentrate properties

Copper concentrates mainly contain copper sulfide minerals. These minerals are analyzed for copper, iron and sulfur in order to study the effect of variation of these in the copper concentrate.

The copper content has a significant influenced on the copper in white metal, slag and yield improvement. In addition, the higher copper content lowers the temperature of the furnace because it generates less heat from the oxidation of the iron sulfide.

Iron content in copper concentrate has less impact on the controlled variables such as the decomposition of minerals to iron sulfide. It affects heat generation and fayalite slag and magnetite production.

The sulfur content has major influence the generation of heat. The copper concentrate which has higher percentage of sulfur assuming copper and iron content is the same, consumed large amounts of oxygen and generate heat which can produce very high temperature in reactor.

6.2 Recommendations

The model did not estimate oxygen usage in PSR. It assumes that the extent of reaction is fixed and oxygen can be reacted only as defined from extent of reaction. For this reason, the use of the model is limited to estimating the oxygen utilization. Even though the standard parameters which were discussed in Table 4-6 were not changed during the operation, it is found that oxygen utilization or oxygen efficiency change with blowing air and oxygen flow rate variation. Because of this, it could be different in actual operation and may not be the same as model calculation. In order to solve this problem, the model should be developed by the following recommendations;

a) Addition of oxygen efficiency calculation in the model as a function of blowing air flow rate or oxygen flow rate where the equation can be observed from plant data or other studies.

b) Estimates the extent of reaction as a function of temperature which can be derived from the study of phase equilibrium, or calculated from thermodynamic model which is built in another program.

The estimation of heat loss in the model was performed by constant heat flow but actually heat loss should calculate as a function of furnace temperature and velocity of gas. It is recommend to calculate the heat loss by inputting an equation instead of fixed value so that the results from the heat balance will be more accurate.