CHAPTER VIII

SUMMARY

Evolution of gas from DRI materials as a result of their final reduction was studied by heating crushed DRI samples in a sealed capsule isothermally or in a steel bomb with varying temperature. Changes of the chemical composition and the thermophysical properties of DRI materials when their temperature rises were determined from the gas evolution results and the differential thermal analysis of DRI and were utilized in modification of the computer model originally described in reference 58. The modified model can determine the rate of transfer of heat into the inert spheres as well as the DRI pellets of all types and specifications.

Experimental studies on transfer of heat into the immersed metallic particles were made by heating cold nickel spheres, sintered iron spheres and prereduced iron pellets in hot liquid slags of different compositions and temperatures. The growth of the shell of solid slag on inert particles and the rate of evolution of gas from DRI pellets were experimentally determined by withdrawing the heated particles from slag, cracking the solid skull and measuring the thickness of the shell by calipers. Effects of evolution of gas on thickness of the frozen shell of slag were investigated by blowing nitrogen from gas ports bored in the nickel spheres into the slag and measuring the thickness of the slag shell.

The computer model was tested against empirical information on the thickness of the slag shell, the rate of heating of immersed particles

and the evolution of gas from DRI pellets. Physical transfer models were suggested to describe the results obtained from comparisons of the experimental and mathematical results. The dominant transfer mechanisms were determined from the best fits of the experimental and computational data.

The information available on the thermodynamics of reduction reactions was successfully utilized to explain the results of the evolution experiments. Effects of the test conditions and the sample specifications on these results were verified.

The simulation model was exploited to determine the rate of heating and melting of D-R pellets of different sources when immersed in hot slags of various conditions. Effects of the conditions of the bath of slag and the specification of pellets were determined. The optimum melting conditions were summarized.