Chapter 8. Conclusions and recommendations

This study has shown that the flotation of galena from the Rosh Pinah ore body can be affected by various factors such as the dosage of flotation reagents, the concentration of dissolved heavy metals (mainly copper), copper-cyanide complexes, the grinding environment, the quality of process water and the mineralogical occurrence of the ore. The flotation selectivity between galena and sphalerite in the lead rougher concentrate was studied and the following conclusions were made:

- Xanthate collectors such as SNPX and PNBX were found to be unselective for the flotation of the Rosh Pinah composite sample. It was observed that the recovery of sphalerite increased with both the recovery of galena and the concentrate mass pull. Reagent such Aerophine 3418A, which is a dialkyl dithiophosphinate collector developed by Cytec, has been found to be more selective during the flotation of galena from Cu-Pb-Zn sulphide ore, especially when the ore body contains silver. Thus, it is recommended that Aerophine 3418A be tested alone and in conjunction with xanthate on the Rosh Pinah ore body;

- The recovery of sphalerite was higher when the composite was milled in a dry environment as compared to wet milling. The recovery of galena decreased after milling in a dry environment, while wet milling improved its recovery. In addition, more positive pulp potentials were measured when the composite had been ground in a dry environment;

- The recovery of sphalerite increased after activation with Cu(II) ions while that of galena decreased when the composite was dry ground in a mild steel mill with mild steel grinding media. However, the recovery of galena was not affected after wet milling in a stainless steel mill. The recovery of Cu(II)-activated sphalerite was independent of the milling environment (wet or dry) and grinding media;

- The activation of sphalerite by cuprous cyanide complexes, which are present in the recycled water, was clearly shown in this study. Both batch flotation tests and XPS analysis have confirmed that sphalerite was activated by copper(I) from the cuprous cyanide complexes. The recovery of copper(I)-activated sphalerite increased further when the composite was dry milled as compared to wet milling. To the best of our knowledge, this is the first example of sphalerite activation by cuprous cyanide species from the process water. Although the activation mechanism is still unclear, it is believed that cuprous cyanide adsorb onto the sphalerite surface followed by the ion exchange reaction between the cyanide and xanthate ions. Another possibility is the decomposition/oxidation of cuprous cyanide followed by adsorption of cuprous/cupric oxide or hydroxide onto the surface of sphalerite. The presence of cuprous/cupric oxide or hydroxide will promote the activation of sphalerite as described during the activation of sphalerite by Cu(II) ions. It is recommended that more surface analysis be conducted to clarify this. Techniques such as XPS and secondary ion mass spectrometry (SIMS) can be used to examine the nature of the activating species when cuprous cyanide is used. Based on the results reported in this study, dry milling of the composite would not be recommended despite the arid location of the Rosh Pinah concentrator. In addition, more water survey is required to understand the seasonal effect of process (recycled) water on the metallurgical performance of the plant;

- Batch flotation tests have shown that the use of cyanide alone is not efficient for the depression of sphalerite due to the mineralogical texture of the Rosh Pinah ore. A large quantity of galena locked and/or attached to sphalerite was observed in the lead concentrate. Their prevalence increased with increasing particle size. The use of both cyanide and zinc sulphate improved the depression of sphalerite much better than cyanide alone. In addition, selectivity can be improved by regrinding the rougher concentrate prior to the cleaning stage due to poor liberation between galena and sphalerite. A flowsheet has been proposed to improve selectivity between galena and sphalerite in the lead flotation circuit.