CHAPTER 5

CONCLUSION

The general conclusion to be drawn from the experimental results is as the following :

1. The specimens with satisfactory strength and volume stability can be fabricated mainly by using lime or lime-containing waste with FGD gypsum and fly ash. The superior composition of the composite materials results because of the suitable lime/fly ash ratio (0.29).
2. Increase in the curing temperature of the specimens increases the pozzolanic reaction and enhances the rate of strength gain. However, the pozzolanic reaction is hindered above 50°C since the hydration and other reactions of the paste are stopped or decreased.
3. The hydration product, C-S-H(I), which formed through the pozzolanic reaction of amorphous silica of the fly ash with lime as well as ettringite formed by the reaction of alumina in the fly ash with lime and gypsum are responsible for the soundness and strength of the hardened specimens.
4. The early strength of FGD gypsum-fly ash-lime specimens, activated by physically accelerating method, increases with increasing content of β-HH. However, it is found from the experiment that the amount of β-HH in the composition with satisfactory strength and volume stability under water should not be higher than 40 wt%.
5. The chemical activation shows much more significant acceleration effect than the thermal activation. Based on the physical and mechanical properties of composite material, the optimum content of Na_2CO_3 and $CaCl_2$ in the composition should be taken as 3 wt% and 4 wt%, respectively.
6. The addition of 3 wt% Na_2CO_3 significantly increased the early strength, but slightly the later strength. The addition of 4 wt% $CaCl_2$ increases the early strength less than Na_2CO_3, but tends to raise the later strength.

7. The addition of Na_2CO_3 raises the alkalinity of the solution, hence accelerates initial pozzolanic reaction and results in the formation of ettringite, which give the high early strength. While the presence of $CaCl_2$ decreases the alkalinity of the solution because it favours the formation of Friedel's salt ($3CaO.Al_2O_3.CaCl_2.10H_2O$). The strong increasing of Friedel's salt and gradual pozzolanic reaction tend to raise later strength than the Na_2CO_3-activated pastes.
8. Some part of lime in the composition gypsum composite materials can be replaced with lime mud or sludge waste. It is found from the experiment that the highest content of lime replacement materials used in the composition with satisfactory strength and other properties is 50 wt% for lime mud and 30 wt% for sludge waste.
9. The use of sludge waste in the composition shows higher volume stability and better performance under water than that of lime mud. This advantage of sludge waste is resulted from the included chrysotile fibers.