CHAPTER 1

INTRODUCTION

1.1 Motivation

Due to more stringent environmental protection and the conservation of valuable resources, it is very important for Thailand to appropriately manage its industrial waste. Flue-gas desulfurization (FGD) gypsum ($CaSO_4.2H_2O$) is one of the solid wastes obtained from the desulfurization of combustion gases from power plants of which the increasing amount is creating a long term environmental problem to the inhabitants nearby. Under a proper quality control this gypsum is proved in our laboratory to be more consistent in quality and surpasses the performance of natural gypsum, it can be used by the cement industries without purification.

In the production of gypsum plaster which depends on the conditions of calcination, calcium sulfate hemihydrate ($CaSO_4.1/2H_2O$, HH) can be produced in two forms, α and β-HH. Under industrial conditions, α-HH is usually produced by treatment of natural or synthetic gypsums in an autoclave to temperature above $100^{\circ}C$ and is found to consist of comparatively large ideomorphic crystals that needed comparatively low quantity of water for their workability. This form also give higher strength than β-HH, prepared by dry calcination under atmospheric pressure that consists of small rounded crystallites of porous nature, hence needs higher quantity of water for workability.

Due to the high strength of α-HH, it may be used as a starting material for production of building material in combination with β-HH if the production cost is favorable. However, the disposal of gypsum products has some problems owing to its ability to absorb water from ambient condition that causes fairly high porosity, leading to low mechanical strength. This important disadvantage of gypsum products can be improved by the combination of gypsum with amorphous silica (SiO_2), alumina (Al_2O_3) and hydrated lime ($Ca(OH)_2$) to produce the insoluble phases of calcium silicate hydrate ($2CaO.2SiO_2.3H_2O$, CSH) and tricalcium sulfoaluminate hydrate , Ettringite, ($3CaO.Al_2O_3.3CaSO_4.31H_2O$, $CA\bar{S}H$).

The advantages of CSH and $CA\bar{S}H$ over the conventional gypsum plaster are water resistance and superior mechanical strength. These composite products can be used as building components and probably may be appropriate for the exterior application.

1.2 Objective

Since gypsum industries are the potential consumers of FGD gypsum, the objective of this research is to convert FGD gypsum to α-HH and composite materials consisted of insoluble phases from pozzolanic reaction. α-HH plaster is intended to be used for interior building components, and composite materials are aimed for interior and possible exterior building components, i.e. gypsum block.

1.3 Scope

The scope of this work covers the study of FGD gypsum on their chemical and physical properties relevant to the process of gypsum plaster. The synthesis of α-HH from the FGD gypsum is done by calcining under vapor pressure in an autoclave on a laboratory scale, and the preparations of composite materials are proceeded by mixing with other raw materials, shaping, and curing at scheduled age. The specimens of α-HH and the composites are characterized for chemical, physical, and mechanical properties. The stability and durability of the composite materials are also carried through.