CHAPTER 1

INTRODUCTION

Hydrated salts are ionic compounds that trap water molecule within their crystal structure as they crystallize. The water molecules are called the water of hydration. When the salt hydrate gets heated it is converted to its anhydrous form or to a salt hydrate with fewer moles of water. There is a lot of significance in much undiscovered area of salt hydrates. The study of salt hydrates helps us to discover new areas and new options in scientific research.

Phase change of salt hydrate is a challenging area is the. Currently the society and countries are moving toward more energy efficient and energy saving methodologies. The study of salt hydrates helps us to contribute towards these efforts. A dominant part of the European and Western parts use electricity from nonrenewable resource for domestic heating and hot tap water generation. A promising heat storage method and use the stored whenever required can be provided by developing salt hydrate as heat storage concept based on thermochemical reactions. Thereby dependence on nonrenewable sources can be reduced. [1-3]

The study preformed also helps us to analyses salt prediction sequence and thereby helps in designing chemical engineering process to extract valuable salts from salt lake brine economically and efficiently. The aqueous phase and salt phase of various salts were studied. [2-10]

The salt hydrates have few industrially attractive properties such as: (1) high latent heat of phase change per unit volume, (2) relatively high thermal conductivity (almost double that of paraffin waxes), (3) small volume change on dehydration and hydration, (4) compatibility with many thermoplastics, and (5) non-toxicity. Many salt hydrates are sufficiently inexpensive for use in thermal storage. Many researchers have studied the compounded eutectic hydrate salt to achieve more suitable phase change temperature and better cold storage performance.

Furthermore, It has been widely used in solar energy storage, industrial waste heat utilization, building heating and air conditioning, thermal management of mobile devices, and so on. The traditional ice storage and water storage cannot reach the temperature of low-temperature cold storage. The temperature requirement of low cold storage is between −20 and −30°C, and the high-temperature cold storage is between 0 and 4°C. However, the ice storage and water storage systems can only reach 0°C, which cannot meet the requirements of the low-temperature application. Adding inorganic salts in the water can ensure that the amount of phase change latent heat almost unchanged and reduce the phase change temperature of the storage material at the same time. Compound salts can not only further reduce the melting point of solidification but also optimize and modify the overall physical properties of certain materials. However, notable disadvantages of salt hydrates limit their application in thermal insulation composites. The major difficulty of using salt hydrates as PCMs is their incongruent or semi-congruent melting.[20-30]

Contrary to the congruent dehydration (melting) behavior of hydrated salts, which occurs if the anhydrous salt is entirely soluble in its water of hydration at the melting temperature, in incongruent and semi-congruent melting the amount of water separated from the hydrated salt is not sufficient to dissolve the salt crystals. Therefore, the resulting mixture becomes supersaturated, and the salt crystals segregate from the water phase. As a result of this phase segregation, recombination of salt with water of crystallization becomes unachievable during freezing. This irreversible dehydration causes the loss of thermal effectiveness of the hydrated salt on thermal cycling. Other disadvantages of hydrated salts are difficulty in crystal nucleation and experiencing supercooling, and corrosiveness[31-55]

Apart from aforementioned problem, the storage capacity depends on the volume-specific enthalpy of melting. At temperatures below 423 K, the most significant values are found for salt hydrates. Therefore, the technical literature is rich in proposals of heat storage applications for salt hydrates. However, for practical performance besides the heat storage capacity, appropriate melting–

crystallization temperatures within a few degrees are crucial for intended applications. Also, reversible phase changes over many heating–cooling cycles have to be ensured, which is easier with congruent melting than with incongruent melting hydrates. Also, most of the salt hydrates are incongruently melting, which requires technical measures to reach hydration equilibrium. Knowledge of the solid–liquid equilibria represents the most important presumption for systematic evaluations of the suitability of salt mixtures. Unfortunately, there are only a few detailed experimental investigations of such phase diagrams. Due to the tendency of salt hydrates for supercooling, experimental determinations of liquidus curves are time-consuming. Therefore, it has been decided to develop a suitable thermodynamical model for phase analysis of salt hydrate well as validating the result with experimental data for solid-liquid phase diagram determinations.

1.2 Objectives of the Study

The main objectives include:

1. Study of Charging and Discharging cycles
2. Study of Capacity of batteries
3. Study of thermal management in batteries