Zeolites and Heat Storage

In colder months, house heating is one of the most expensive costs. It can be reduced by storing of waste heat produced in factories and thermal power plants and can be used to heat up buildings. Thermal heat can be stored in many ways, the most promising is storing by sorption process (surface binding). A new and very promising concept of thermal heat storage consists of systems that utilize reversible physical-chemical sorption phenomena (mostly water adsorption on solid sorbents) to store energy. Under the influence of a heat supply, water is desorbed from the material and is then stored separately (an endothermic phenomenon referred to as the charging or activation of material). When water and sorbent are put into contact, there is a heat release (an exothermic phenomenon referred to as a material's discharge or deactivation). Many materials can be used as adsorbents, the most efficient are zeolites. Zeolites are crystalline microporous materials, built of SiO_4 and AlO_4 tetrahedra. Negative charge of the framework, created by AlO_4 tetrahedra, is neutralized with alkaline and alkaline earth cations, which can be exchanged.

The purpose of this research was to prepare a zeolite NaX, by using low-cost reagents, which has high water adsorption capacity. The zeolite NaX crystallized from the hydrogel after different crystallization times. Mg^{2+} and Ca^{2+} exchanged samples of the zeolite NaX were prepared as well as the composites by a deposition of $CaCl_2$ and $MgCl_2$ solutions on the zeolite NaX. The sample prepared with deposition with $CaCl_2$ solution shows the highest water adsorption capacity among all samples (0.318 g of water per 1 g of dry zeolite). The chemical composition has a great influence on the water adsorption capacity and the specific storage capacity, which can be changed by tuning of the chemical composition of the zeolite NaX. MgNaX-60 has the highest water adsorption capacity and zeolite NaX has the lowest. Zeolites MgNaX possess the highest specific storage capacity (158 kJ/kg) for low temperature (20 - 88 °C) heat storage (e.g. solar energy).

The MgNaX-30 sample has the highest specific storage capacity of 158 kJ/kg in the temperature range from 20 to 88 °C. Preparation of zeolites is low-cost and simple synthesis. These results are promising for further research, which would allow to store thermal energy

Keywords: adsorbent, zeolite NaX, water adsorption, heat storage.