Zeolite - its specific properties and their utilization in geoutourism

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Abstract
Properties of nature zeolites determinates their utilization in many sectors. Even it could seems specific mix nature zeolites with geotourism, it have intense utilization in that area. Slovak zeolites have approprite properties for utilization, what was the reason for association slovak zeolites and their utilization in geotourism.

Key words: zeolite, utilization, geotuorism, properties

INTRODUCTION

Economic deposits of natural zeolite (Fig. 1) occur in the East-Slovakia basin, where originated by alteration of rhyolite and rhyodacite volcanoclastic rocks of the Lower Badenian (Nižný Hrabovec deposit) (Baláž & Kúšik, 2010). The second area of zeolite occurrences is the region of the Central-Slovakia neovolcanites, where zeolites originated by the alteration of rhyolite tuffs of the Upper Sarmatian - Pannonian (Bartošova Lehôtka deposit) (Grecula et al., 1997).

Main useable properties of clinoptilolite are as follows:

- Reversible hydratation and dehydratation
- High ability of the gas sorption
- High level of termoability
- Resistance against aggressive substances
- High ion capacity exchange and selectivity (Kozáč et al., 1981; Grecula et al., 1997).

All properties can be used in several areas in geotourism, e. g. during the process of tourist trail optimization (Janočková et al., 2012; Štrba & Kurtová, 2013).

PROPERTIES OF NATURE ZEOLITES

One important property of zeolite is the ability to exchange cation. This is the trading of one charged ion for another on the crystal. One measure of this property is the cation exchange capacity (CEC). Zeolites have high CEC's, arising during the formation of the zeolite from the substitution of an aluminum ion for a silicon ion in a portion of the silicate framework (tetrahedral units that make up the zeolite crystal. Zeolites properties come from structure of the zeolite, which is described in the next section.

STRUCTURE OF NATURE ZEOLITE

Natural zeolites have a rigid, 3D crystalline structure (similar to a honeycomb) with a network of interconnected tunnels and cages. Water moves freely in and out of these pores but the zeolite framework remains rigid. Another special aspect of this structure is that the pore and channel sizes are nearly uniform, allowing the crystal to act as a molecular sieve. The porous zeolite is host to water molecules and ions of nitrogen, potassium and calcium, as well as a variety

of other positively charged ions, but only those of appropriate molecular size to fit the structure of the natural zeolite (Reed et al., 1993).

The structure (Fig. 2) of clinoptilolite consists of three-dimensional grid, see the figure number one. It consists of silicate tetrahedrons $(SiO_4)_4$ - mutually interconnected through oxygen atoms, while the proportion of silicon atom is replaced by aluminum atoms $(AlO_4)_5$ -This creates a characteristic spatial structure with a significant incidence of cavities interconnected by channels, which are stored in metal kation, or water molecules. The total volume of these cavities is 24 to 32%.

SPECIFIC SURFACE OF NATURAL ZEOLITES

The specific surface belongs to the basic physical parameters allow characterization of the material, and has a direct relationship to the amount of adsorbed amount on the surface of the material.

Fig. 1 Natural zeolite, clinoptilolite from the deposit Nižný Hrabovec (Zeolite Klinoptilolite, 2013)

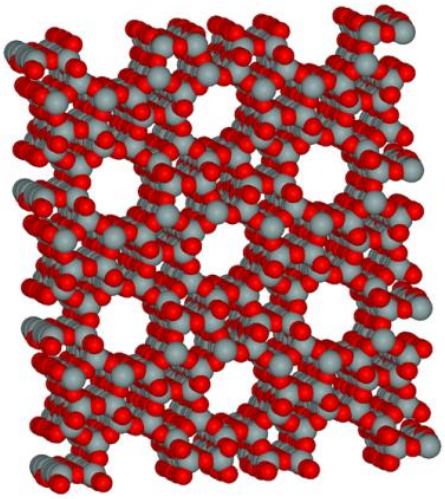

Fig. 2 The crystal structure of zeolite, x ray crystallography, location of atoms (Zeolite, 2013).

Used adsorption method allows determination of the total surface of the material - the outer and inner surface, which is usually several times larger than the outer surface (Kužvart et al., 1998; Foldesová & Hudec, 2007).

RELEVANT PROPERTIES OF NATURAL ZEOLITE

Tetrahedrons (SiAl) O4 create a porous structure cause ion exchange capacity. The effective channel diameters: mostly from 0.2 to 0.7 nm result to adsorption. The total volume of empty space in the structure of natural zeolites: 28-58% of the mineral render catalytic action. Exposure zeolite structure to alkali metal hydroxide is extracted mainly silicon. Dependence of modifying hydroxide solution concentration could occur to partial change of surface but also inside pore structure of zeolite. Silicon passes in the form of dissolved silicon acid to solution in the clinoptilolite is increasing proportion of aluminum and as the result of silicon extraction is creating new meso-pore structure. At the same time is processing ion exchange of cations in clinoptilolite (Foldesová & Hudec, 2007; Muchová & Pavolová, 2011). By exposing zeolite structure to acids and hydroxide solutions

could be changed properties of nature zeolite, in the way we need it. These are the best properties of zeolites.

UTILIZATION OF NATURE ZEOLITE IN GEOTOURISM

By using of properties of nature zeolites can be used nature zeolites in many areas with their application in geotourism (e. g. Janočková et al., 2012; Pavolová et al., 2012). Examples are as follows:

Zeolites are used as feed additives and rehabilitation of livestock environment by breeding animals and their utilization in geotourism. Zeolite as substrates is by growing plants beautified and improving surrounding. Building and construction also uses zeolites because of good water adsorption. Special zeolites products can be used by reconstruction of old or destroyed geotourism objects (Rybár et al., 2011; Rybár et al., 2012). Also has to be mentioned significant application of zeolite in environmental, mostly by water purification or water treatment.

CONCLUSION

Even it is very unusual to connect such different themes, we can see close connection between properties of nature zeolites and their direct utilization in praxis and in geotourism. It can be not review subjects isolated. Connections which are most unexpected can bring the best solutions.

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