

POTENTIAL USE OF CLINOPTILOLITE–SMECTITE CLAYSTONES FROM THE OUTER FLYSCH CARPATHIANS (POLAND) FOR REMEDIATION

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The aim of this work was the comparison of physico-chemical properties of a clinoptilolite–smectite claystone with a zeolite fraction separated from this rock, and the evaluation of their potential use for remediation. The claystone outcrops are found near Rzeszów (SE Poland) as the Trójca Red Shale Member of the Variegated Shales Formation (Upper Paleocene–Lower Eocene) within the Skole Unit of the Outer Flysch Carpathians (RAJCHEL, 1990). The rock consists of 60–80% smectites, 15–30% clinoptilolite, and 15–30% quartz, feldspars, illite/glaucanite and kaolinite (FRANUS & DUDEK, 1999). Zeolite concentrate (90–95% purity) was separated by sedimentation as a fraction > 25 µm.

Cation exchange capacity (CEC, NH_4OAc static method), specific surface area (A_s , BET method), sorption of heavy metals from aqueous solutions (Cr(III), Cu(II), Pb(II), Zn(II)) and sorption of gases (SO_2 , CO_2 , NH_3) were compared for the raw claystone and clinoptilolite separate (KŁAPYTA et al., 1999; BAJDA et al., 2000).

The CEC of the shale (380 meq/kg) is lower than that of the zeolite (660 meq/kg), whereas the specific surface area of the shale is higher (46 m²/g) compared to 20 m²/g for zeolite).

The amount of heavy metals removed from solutions by the shale is higher than that removed by the zeolite and equals to 562 mM/kg for Cr, 221 mM/kg for Cu, 190 mM/kg for Pb, and 256 mM/kg for Zn, the zeolite removes 260 mM/kg Cr, 172 mM/kg Cu, 136 mM/kg Pb and 142 mM/kg Zn. Desorption from the shale is higher for Cu and Pb while desorption from the zeolite is higher for Cr and Zn.

The zeolite fraction shows a very high adsorption capacity for CO_2 and SO_2 gases, 1060 and 1270 mM/kg, respectively. The shale adsorption equals to 250 mM/kg for CO_2 and 640 mM/kg for SO_2 . However, adsorption of gaseous ammonia (NH_3) is higher for the shale (2740 mM/kg) than for the zeolite (1870 mM/kg).

From the above data it can be seen that both the shale and the zeolite separate show physico-chemical properties making them suitable for their use for remediation or in various branches of industry and agriculture. Their characteristics, however, are significantly different. Therefore, separation of zeolite concentrate is recommended for certain applications.

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