ACID-ACTIVATED SMECTITE AND GLAUCONITE (LUBLIN AREA, POLAND): TEXTURAL PROPERTIES AND ADSORPTION OF β-CAROTENE

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Tertiary clays and sandstones, occurring abundantly in the Lublin area (Poland) contain high amounts of glauconite and smectite (Gazda et al., 2001). The present study was undertaken in order to check the influence of acid activation of clay minerals separated from these rocks on their textural properties and bleaching potential.

Clay minerals, separated by sieving (< 63 μm for smectite-glauconite material) and magnetically (glauconite, from > 63 μm fraction), were activated using 10% HCl or 20% H_2SO_4 at 371°K(±2K), during 1 to 7 hours of reaction, with solid–liquid ratio of 0.067 g/ml. Raw and activated clays were analysed for their mineral and chemical composition (XRD and SEM observation with EDS system). Their physicochemical properties were determined: cation exchange capacity (CEC)—using Mn^{2+} ions desorbed with 1M CH_3COONa solution, as well as specific surface area (BET), specific volume of micropores and specific volume and surface of mesopores—applying argon gas adsorption-desorption in the liquid nitrogen (77°K) temperature (Gregg and Sing, 1982). The content of Mg, Fe and Al elements were analysed in all samples with ICP-AES. The bleaching capacity of tested materials was determined by mixing 1 g of activated material with 40 ml of crude rapeseed oil at the constant temperature of 373°K during 20 minutes. The bleaching potential was estimated based on colour changes of treated oil (mixed with acetone 1:3), measured spectrometrically (Christidis et al., 1997).

The applied acid activation affects the studied clay minerals structures to variable degree. None of applied acids can provoke significant structural alteration of glauconite, only coherent dissolution of whole crystals was observed, incongruent because of silica precipitation. The smectite structure decomposition (observed as 001 XRD reflection degradation) takes place faster than glauconite dissolution. HCl solution applied in the experiments is more aggressive than H_2SO_4 and causes immediate dissolution of smectite, leaving glauconite in fine fraction. 7 hours is needed for smectite dissolution with H_2SO_4.

The textural properties of tested fractions have been significantly improved by activation. The specific surface of the coarse material increases from 78.4 to 324.1 m^2/g after 7 hours of HCl activation and from 85.9 to 236.0 m^2/g for the fine fraction material. The CEC values of glauconite (16.82 meq/100g) and fine fraction (33.17 meq/100g) decrease with acid activation time, due to the dissolution of swelling phases.

The effect of adsorption of β-carotene from rapeseed oil by the tested materials depends on the type of acid applied in the process of their activation. The most advanced bleaching (95%) was found using the sample of fine fraction material after 7 hours reaction with H_2SO_4. Activation by HCl—a more aggressive reagent—results in lower bleaching capacity and confirms the suggestion of "overactivation" (Srasra and Trabelsi-Ayedi, 2000). The produced material can be considered as a high quality bleaching earth.

References

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