



Suitability of the methylene blue test for determination of cation exchange capacity of clay minerals related to ammonium acetate method

Maja Milošević (1), Mihovil Logar (1), Biljana Dojčinović (2), and Suzana Erić (1)

(1) University of Belgrade, Faculty of Mining and Geology, Belgrade, Serbia, (2) University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia

Cation exchange capacity (CEC) represents one of the most important parameters of clay minerals which reflects their ability to exchange cations with liquid phases in near contact. Measurement of CEC is used for characterizing sample plasticity, adsorbing and swelling properties which later define their usage in industrial purposes. Several methods have been developed over the years for determination of layer charge, charge density, charge distribution, etc. and have been published in numerous papers (Czimerova et al., 2006; Yukselen and Kaya, 2008). The main goal of present study is comparison of suitability of more recent method - methylene blue test in regard to older method - ammonium acetate for determination of CEC.

For this study, we selected one montmorillonite clay (Bogovina, Serbia) and two mainly kaolinite clays (Mil-ićinica, Serbia). Chemicals used for CEC determinations were solution of methylene blue (MB)($14 \cdot 10^{-6}$ M/ml) and ammonium acetate (AA) solution (1M).

The obtained results are showing generally lower values in case of MB method. The main difference is due to molecular aggregation of MB on the clay surface. AA method is highly sensitive to the presence of CaO. Release of Ca ion from the sample into the solution can limit the saturation of exchange sites by the ammonium ion. This is clearly visible in case of montmorillonite clay. Fe²⁺ and Mg ions are difficult to move by the ammonium ion because of their ion radius, but in case of MB molecule there is no such restriction in removing them from the exchange sites. MB solution, even in a low concentration ($2 \cdot 10^{-6}$ M/ml), is showing preferable results in moving the ions from their positions which is already visible after adding a small quantity of solution (25cm³). Both MB-titration and MB-spot test yield similar results and are much simpler methods than AA and they also give other information such as specific surface area (external and internal) whereas AA method only provides information about cations in exchangeable positions.

Both methods, methylene blue test and ammonium acetate method, have advantages and disadvantages and differ in their requirements for the sample preparations but in general method selection is depending on the specific application of the given sample.

References:

- Yukselen, Y. and Kaya, A., Engineering Geology 102 (2008) 38-45
- Czimerova, A., Bujdak, J. and Dohrmann, R., Applied Clay Science 34 (2006) 2-13