Evaluation of bentonite deposits from Greece for industrial applications

Eleni Koutsopoulou[1], George E. Christidis[1] and Ioannis Marantos[2]

[1]Technical University of Crete, Department of Mineral Resources Engineering, 73100 Chania, Greece
(ekoutsop@upatras.gr)
[2]Institute of Geological and Mineral Exploration (IGME), Spyrou Loui 1, 13677 Acharnes, Athens, Greece

Clay minerals find numerous industrial and environmental applications due to their outstanding physical and chemical properties. These applications include environmental protection, remediation, engineering, construction, agriculture, pharmaceutical and various process industries (CHRISTIDIS, 2011). Bentonites, which are important industrial clays rich in smectite, have attracted intense research interest because after processing they allow the development of high added value materials with novel applications in a variety of uses.

Recently, bentonite deposits from the islands of Chios and Samos, eastern Aegean and from areas of Thrace (Skaloma, Sappes), NE Greece have been assessed for their mineralogical and geochemical characteristics and for their potential use in traditional industrial applications. Bentonites from Chios Island consist of smectite, SiO_2-polymorphs (opal-CT or opal-C), dolomite and minor quartz, plagioclase and calcite. Samos bentonites consist of smectite, SiO_2-polymorphs (opal-CT and/or opal-C), quartz and K-feldspar. In Thrace, the bentonites of Skaloma area are characterized by the presence of smectite, SiO_2-polymorphs (opal-CT and opal-C), calcite and traces of zeolites, quartz and illite. In the area of Sappes the bentonites consist of smectite, quartz, calcite, plagioclase, illite and kaolinite. These low-moderate grade bentonites were classified according to the layer charge of the smectites present, following the characterization scheme of CHRISTIDIS et al. (2006). The smectites in Chios and Samos bentonites are medium-high charge montmorillonites whereas their Thracian counterparts contain low charge montmorillonites (Skaloma) and Fe-rich beidellites (Sappes) (KOUTSOPOULOU et al., 2016).

The CEC of the bentonites varies between 70 and 90 cmol/kg, and is considerably lower in the bentonites from Sappes (40-50 cmol/kg). The bentonites have a moderate swelling index and only in some samples from Chios and Skaloma may be considered as acceptable (above 30 ml gel/2 g clay). The beidellites from Sappes display very low swelling indices in accordance with the smectite content and the crystal chemical characteristics of the smectites. The colour data show that the bentonites from Chios and Samos Islands and Skaloma area (Thrace), have superior colour compared to the Sappes bentonites. Although the presence of silica phases (eg. opal-CT) in the former areas may affect colour to some degree, the presence of Fe-rich beidellite and illite in Sappes and the low smectite content could be the main reason for the poorer colour quality. The specific surface area of the samples ranges between 9 to 38 m^2/g in most samples and can be further increased after acid activation. Indeed, preliminary tests showed that the studied bentonites are suitable for crude oil clarification after acid activation and treatment of the bentonites with different amines has produced a series of organophilic end products, which have been employed in the formulation of clay polymer nanocomposites. The results of the present study show that these moderate-low grade bentonites could be used in high added-value applications after processing.

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