STUDY OF ABSORPTION PROPERTIES OF CHEMICALLY MODIFIED HALLOYSITE SAMPLES WITH X-RAY FLUORESCENCE AND X-RAY POWDER DIFFRACTION METHODS

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Halloysite is a clay mineral, chemically similar to kaolin, typically formed by hydrothermal alteration of aluminosilicate minerals [1]. On the microscopic scale halloysite usually occurs as nanotubes, which average diameter is a few dozen of nanometers and lengths is in the range of few micrometers. Sometimes, depending on deposit, these nanotubes split open and unroll to form laths or spatula shapes [2]. Halloysite nanotubes are much cheaper and easier available then carbon nanotubes, have high mechanical and chemical strength and as a result they are very well suited for nanotechnology. Additionally, because of biocompatibility of the halloysite they are frequently used in environmental protection and industry for example as sorptive material in biofilters or coagulant for water and sewage treatment plants. Surprisingly, despite of common exploiting, the chemistry of the halloysite nanotubes, inner and outer surfaces of their nanoscale volumes are not yet well studied [2]. Recently growing applications of the halloysite stimulate many research studies on properties, possible chemical modifications of their structure [3, 4] and technological applications [5, 6].

The aim of the measurements presented here was study of the absorption properties in the halloysite nanotubes. The analysed halloysite samples come from strip mine "Dunino" in the vicinity of Legnica (Poland). The measurements were performed in the Institute of Physics of Jan Kochanowski University (UJK) in Kielce (Poland) in collaboration with Institute of Chemistry UJK.

The samples were analysed with three different complementary X-ray spectrometry techniques: X-ray powder diffraction (XRPD) [7], classical X-ray fluorescence (XRF) [8] and its modification total reflection X-ray fluorescence (TXRF) [9]. The XRPD technique was used for determination of concentration of halloysite mineral and chemical composition of the raw and chemically modified samples. With classical, wavelength dispersive x-ray fluorescence (WDXRF) method, changes of the elemental composition in the sample as a results of treatment with different concentration of sulphuric acid were measured. With total reflection X-ray fluorescence technique (TXRF) concentrations of the trace elements absorbed by halloysite nanotubes in filtration process were determined. As a result it has been shown that application of the complementary X-ray spectrometry techniques allows on observation of changes of the sample composition caused by chemical modifications of the halloysite samples and studies of their absorption properties.

In this work the experimental setups, sample preparation procedures and obtained results will be presented and discussed in details.

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