Nanocomposites and nanomaterials

Nanocomposite magnetic mineral sorption materials

O.V. Makarchuk[1], T.A. Dontsova[1]

[1] National Technical University of Ukraine "Kyiv Polytechnic Institute"
Prospect Victory, 37, Kyiv-03056, Ukraine.
E-mail: xtfhn9207@ukr.net, dontsova@ua.fm

Adsorption is considered to be an effective and versatile method for removing pollutants from aqueous solutions. The cheap efficient sorption materials will always be popular as technical decision in development of technologies for wastewater treatment. The saponite clay is one of the ideal candidates for creation cheap sorption materials. However, separation of saponite particles from water after sorption process is a problem. Thus, the modification saponite clays by nanoscale magnetite are proposed. These nanocomposites based on natural saponite clay and magnetite will be easily separated from aqueous solutions after sorption process by magnetic separation. Thus, purpose of this work – creation of nanocomposite magnetic mineral sorbents (MS) with various contents of magnetite and investigation their structural and magnetic properties.

Synthesis was carried by impregnating saponite clay a magnetic fluid on based nanomagnetite (Fe_3O_4). Magnetic fluid was obtained by known method Elmore [1]. Four samples of magnetic mineral sorbent with various contents of Fe_3O_4 were received: 2 % (MS-2), 4 % (MS-4), 7 % (MS-7), 10 % (MS-10). MS samples were investigated by X-ray diffraction analysis on Rigaku Ultima IV. The diffractograms were automatically analyzed by MS software package PDXL with using databases ICDD/PDF-2 and COD. Magnetic characteristics (magnetization and coercive force) were determined by ballistic magnetometer of Steinberg.

The sorption properties of MS towards dyes were defined in the following order MS-10<MS-2<MS-4<MS-7. The crystallites size of magnetite in composites was 2.4 nm 6.2 nm 9.6 nm and 7.4 nm for MS-2, MS-4, MS-7 and MS-10, respectively. So, magnetite particles were obtained nanoscale single-domain.

The specific magnetization the samples for MS-2, MS-4, MS-7 and MS-10 was 2.2 $A \cdot m^2/kg$, 3.0 $A \cdot m^2/kg$, 4.5 $A \cdot m^2/kg$ and 6.5 $A \cdot m^2/kg$, respectively. Thus, the single-domain particles were identical to the magnetization due to the placement of all spin in the same direction. The coercive values correspond to 12 E for samples MS-7 and MS-10, and not found for samples MS-2 and MS-4. It follows that the size of Fe_3O_4 nanoparticles in these samples achieved the critical size at which the magnetic particles are into the super paramagnetic state. Thereby, the optimal content of Fe_3O_4 in magnetic mineral sorbents on based saponite clay in this case there is in the range between 4 and 7%.

1. *Dontsova T. A., Ivanenko I. M., Perecos A. O.* Synthesis of magnetite by homogeneous chemical deposition for preparing of magnetic fluid on its basis //Young Scientist.-2014.**-8(11).-**P. 186-189.