DEVELOPMENT OF NANOHYBRID MATERIAL FOR ANTIBIOTICS REMOVAL AND DEGRADATION

A.Toropov*, A.Aitbekova, M-R.Babaa, S.Mikhalovsky

School of Engineering, Nazarbayev University, Astana, Kazakhstan; *andrey.toropov@nu.edu.kz

INTRODUCTION.

This project is about a technique to accelerate the degradation of antibiotics (for example Doxycycline) using a severe confined environment and a physical agent. The confining medium is carbon nanotubes (CNTs) because of their low internal diameter (of the order of 1 to 10 nanometers), high physicochemical stability, high mechanical strength, and presence of strong intermolecular forces at their inner surface that contribute to the degradation effect. This new technique will find a niche in pharmaceutical industries where many processes are not sufficiently clean to eliminate a significant amount of antibiotic residues from waste streams.

The aim of this work is developing of a new technique with high industrial relevance to remove antibiotics by means of carbon nanotubes using a three-step procedure: encapsulation, degradation, and removal.

MATERIALS AND METHODS.

The raw CNTs were purified by refluxing in 3 M nitric acid for 24 hours under ultrasonication. Then, CNTs were opened and shortened by dispersing in a mixture of concentrated sulfuric acid and nitric acid (3:1 by volume) for 24 h under ultrasonication. Synthesis of hybrid material CNTs/Fe_3O_4 was carried out in a solvothermal system by reduction of $FeCl_3$ with ethylene glycol in the presence of acid-treated CNTs. These methodological approaches were chosen taking into account recent publications [1-6].

Characterization of magnetic CNTs was carried out by transmission electron microscopy and scanning electronic microscopy.

RESULTS AND DISCUSSION.

The results obtained allowed us to conduct preliminary work for the implementation of the main objectives of this study. Primarily, opening of carbon nanotubes was successfully completed. Then we carried out their magnetisation using the solvothermal method. As a result, a sample that has notable ferromagnetic properties (reacts to a magnetic field) was obtained. It is also noted that the specific surface area increases (from 164 to 271 m^2/g) along with weight loss (up to 60%) of the sample after acid treatment of nanotubes for opening.

CONCLUSIONS.

The samples of nanohybrid materials with magnetic properties obtained will be used for formation of antibiotic@magnetic CNTs cluster for studies of sorption removal and degradation of antibiotics. Research in this direction will be continued.

ACKNOWLEDGMENTS.

We thank NU for bridge funding of this grant.

REFERENCES.

1. Chen S, *et al.* (2007). J. Am. Chem. Soc., 129 (9): 2416-2417.
2. Kummerer K. (2009). Chemosphere, 75: 417-434.
3. Qu S, *et al.* (2008). Journal of Hazardous Materials, 160: 643–647.
4. Skulason S, *et al.* (2003). Journal of Pharmaceutical and Biomedical Analysis, 33(4): 667-672.
5. Sunaric S, *et al.* (2009). Journal of Analytical Chemistry, 64: 231-237.
6. Wang H, *et al.* (2013). Water Research, 47: 4198-4205.