# On the adsorption of tetracycline by nanocrystalline calcined zink-aluminum hydrotalcites

Halyna Starukh, Olena Oranska

*Chuiko Institute of Surface Chemistry, National Academy of Sciences of Ukraine, 17 General Naumov Str., Kyiv 03680, Ukraine*

*starukh_galina@ukr.net*

As cost-competitive sorbents, hydrotalcites (HTs) and their derivatives have been found capable of sorption a variety of aqueous inorganic and organic compounds [1]. After calcination at an appropriate temperature, HT with $CO_3^{2-}$ as the interlayer anion can transform into mixed solid solution, that is, a homogeneous phase consisting of mixed oxides, and the adsorption capacity of calcined HTs (cHTs) can be markedly enhanced over that of the original HT. The enhanced adsorption capacity is generally attributed to a "memory effect" by which the layered structure is reconstructed in association with the mixed solid solution and the aqueous anions can be concomitantly adsorbed into the interlayers of the restored HTs.

ZnAl cHTs were synthesized directly by citrate method by combustion of mixture of metal nitrates and citric acid. Traditional coprecipitation method was used to obtain ZnAl HTs. The crystal structure, morphology and textural properties of HTs were examined before using these composites for study of tetracycline (TC) adsorption from aqueous solutions. Calcined ZnAl HTs showed higher adsorption capacities for aqueous TC compared to HTs (Table 1). In aqueous suspension, during TC adsorption, the structure of calcined HT was partially restored, and a significant content of Zn/Al oxide solid remained. Tetracycline adsorption to cHT was dependent on both reconstruction of layer structures (by the memory effect of HT) and adsorption by $Al_2O_3$ surfaces. The adsorption of TC on the surface of ZnAl cHT and ZnAl HT was established to occur on the centers of one specific type.

***Table 1***. Langmuir, Freundlich and Dubinin–Radushkevich isotherm constants for the adsorption of tetracycline by hydrotalcites

| Sample | Langmuir isotherm | | | Freundlich isotherm | | | Dubinin–Radushkevich isotherm | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $A_\infty$, mg/g | $K_L$, l/mmol | $R^2$ | $K_F$, (mmol/g)·(l/mmol) | 1/n | $R^2$ | $K_{D\text{-}R}$, $mol^2/kJ^2$ | $A_\infty$, mg/g | $R^2$ | E, kJ/mol |
| ZnAl cHT | 134,7 | 86,0 | 0,91 | 1,50 | 0,55 | 0,85 | 0,564 | 213,5 | 0,86 | 7,14 |
| ZnAl HT | 81,8 | 30,5 | 0,79 | 0,45 | 0,51 | 0,83 | 0,012 | 87,6 | 0,83 | 6,51 |

The present work demonstrates that calcined hydrotalcites may be promising adsorbents for effective removal of TC from water resource.

## References

1) Bergaya F., Lagaly G. *Handbook of Clay Science;* Hardbound, 2013