# On the Applications of the Natural Clinoptilolite from Serbian deposits

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**ABSTRACT**

Adsorptive, catalytic, and antimicrobial performance of Serbian clinoptilolite-rich tuffs (ZT) are discussed. ZT transformed into Fe-containing ZT (Fe-ZT) removes anions such as nitrate, phosphate, salicylate, and ciprofloxacin from water media. Fe-ZT adsorbs Se(IV) and Se(VI) oxyanions, and the Se-containing products can be used for the cultivation of *Pleurotus ostreatus* mushrooms. The funguses convert inorganic Se from Fe-ZT to more valuable organically bound form. Both ZT and Fe-ZT as soil supplements retain nitrogen and potassium in sandy silty loam and silty clay soils.

Kinetics, thermodynamics, and adsorption studies of several metal cations by ZT show its good adsorption ability recommending it for wastewater treatment. Calorimetric studies of adsorption of atenolol, acetylsalicylic acid, and salicylic acid onto M-ZT (M – $Cu^{2+}$, $Mn^{2+}$, $Ni^{2+}$, or $Zn^{2+}$) indicated that the adsorption capacity depends on the nature of both M and pharmaceuticals which electron-donor groups greatly influence on adsorption mechanism.

ZT is an excellent carrier for ultrafine (2-5 nm) nano oxide particles whose catalytic activity was proven in biomass pyrolysis to phenols. The ZT converted into $SO_4$-$SnO_2$-ZT is catalytically active in acid-catalyzed esterification of levulinic acid to levulinate. Small amounts of the Fe species in ZT are responsible for photodegradation of organic dyes under visible light irradiation. The combined action of $SnO_2$ and the zeolite host is responsible for the photocatalytic activity of $SnO_2$-ZT in the degradation of methylene blue.

M-ZT is excellent carrier of useful bacteria whereas bactericidal activity of Ag-ZT recommends it for disinfection of water and remediation of soils contaminated with human pathogens.

*Keywords:* natural zeolite, adsorption, catalysis, antimicrobial activity, nano-oxides, biomass.