BACTERICIDAL PHILLIPSITES FOR WATER TREATMENT

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Zeolitic adsorbents and ion exchangers are promising for environmental protection, especially in the remediation of hazardous heavy metal-polluted soils or in the purification of industrial wastewater, in such cases it is necessary to provide the sorption material with bactericidal properties in order to prevent the growth of microorganisms on its surface.

Silver-, copper-, and zinc-containing micro-mesoporous materials have been prepared on the basis of phillipsite from Shukhuti, Western Georgia, using ion-exchange reactions between zeolite and a salt of a transition metal in the solid phase followed by washing. Synthesized adsorbent-ion-exchangers are characterized by chemical analysis and sorption data, XRD patterns, FTIR spectra, SEM images; they remain the crystal structure and general properties of phillipsite, and contain up to 230 mg/g of silver, 66 mg/g of copper, and 86 mg/g of zinc. The introduction of hydrated Ag^{+}, Cu^{+2}, and Zn^{+2} ions into the channels and pores of the zeolite is facilitated by the developed system of mesopores (specific volume up to 0.17 cm^3/g) in the used natural phillipsite. Ion-exchange synthesis leads to an increase in the dispersion of the material and insignificant loss of microporosity.

The release of silver ions from 0.1 g of zeolite into the aqueous medium (100 mL of salina) occurs fairly easily and after 6 hours their amount exceeds the minimal inhibitory concentration (MIC) for Ag^{+} ions toward *Escherichia coli*. On the contrary, the amount of Cu^{+2}, and Zn^{+2} ions released after 24 hours corresponds to ~0.5MIC. Nevertheless, all three samples of metal-containing phillipsits show rather high bactericidal and bacteriostatic (Kirby-Bauer test) activity toward *E. coli,* and the antibacterial activity could be ascribed not only to released ions but also to modified zeolite itself, as recently noted.[1-2]

The resulting materials have sorption and bactericidal properties, sufficient for their use in the purification and disinfection of water. The compliance of proposed “dry” procedure with high environmental standards is confirmed by its low Sheldon’s factor E in comparison with the similar green chemistry metrics of conventional methods of the ion exchange in solutions.

References
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