Physico-Chemical nanomaterials science

Prospects for the use of polysaccharide nanocomposites for cleaning and disinfection of drinking water

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Quality drinking water is the most important factor in human health. Therefore, in recent years much attention has been paid to the problem of by-products of water disinfection. The use of traditional disinfectants, such as chloragents and ozone, leads to the formation of toxic chlorine-containing compounds, nitrosamines, bromates, etc. In this regard, it is relevant to search for alternative disinfectants, the use of which allows you to get high-quality drinking water. A group of such materials includes nanocomposites based on natural polysaccharides – chitosan (Chs), alginate (Alg) and carrageenan (Crg).

Chitosan nanoparticles were prepared using a typical gelation reaction between the positively charged amino groups of chitosan and the negatively charged counter-ions of sodium tripolyphosphate (TPP). The nanochitosan emulsion had an average size of 180 nm, the zeta potential was +30 mV. The positive charge of the chitosan nanoparticles suggested that the emulsion was stabilized by the hydrogen bonding between the amino and hydroxyl groups of the chitosan and the hydroxyl group and oxygen atom of water. Chitosan-Ald/Crg-TPP nanocomposites were prepared by polyelectrolyte complexation and ionic gelation, the latter compound acting as cross-linker. Using Chs-Alg/Crg nanoparticles as control, the effect of the cross-linker in the particles properties was studied. A decrease in size (from 500 nm to 150 nm) and in zeta potential (from +75 mV to +40 mV) and in stability (from one week to up to 6 months) were observed.

These nanocomposites were evaluated against Gram-positive bacteria (*S. aureus*), Gram-negative bacteria (*E. coli*) and fungi (*C. albicans* and *As. niger*). Antimicrobial screening tests polysaccharide nanocomposites have better results compared to the precursor. The cleaning effect is achieved due to electrostatic attraction of nanoparticles to the surface of pathogens and self-assembly of particles into agglomerates with violation of the integrity of cell membranes. In addition, it has been shown that nanocomposites can effectively purify water from suspended particles, dyes and heavy metal ions. To purify drinking water, simply mix the nanoparticles in contaminated water and then filter out the liquid.

The test results for tap water found that a disinfectant and bactericidal action of polysaccharide nanocomposites and their hygienic safety during prolonged use provides a real possibility of their applications in water treatment.