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The effect of humic acid and chitosan on coagulation of iron(III) hydroxide by NaCl

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Boundary zones play an important role in ocean ecosystems, as zones of considerable biogeochemical activity [1]. The river-sea transition zone is of particular importance due to the increased anthropogenic impact on river ecosystems. Transformation of the forms of riverine matter (dissolved, colloidal and suspended) in this zone significantly affects the state of marine ecosystems. The colloidal component of river runoff practically has not been studied, in contrast to the dissolved and suspended forms.

This work is part of our research on the transport of riverine matter (clays, carbonates) to the sea and is aimed at studying the influence of electrolytes and dissolved organic matter (DOM) on the stability of colloidal iron [2].

The variety of factors affecting the processes in the river-sea zone required the study of the transfer process in laboratory conditions. Iron(III) hydroxide sol - ($Fe(OH)_3$) (particle size 10-30 nm) in NaCl solutions was chosen as a model system. Humic acid (HA) separated from coal (leonardite) (Powerhumus, Humintech Ltd.) was chosen as a model of transformed DOM of river water. Biopolymer chitosan (Ch), 83 kDa, 82% deacetylation degree, chloride form (Bioprogress Co) was a model of fresh DOM (flocculant) released in situ in the river-sea area. The sol was prepared by $FeCl_3$ hydrolysis under boiling. The size of $Fe(OH)_3$ particles was determined with a Zetatrac analyzer (Microtrac Inc., USA).

The aggregative stability of the sol was shown to remain constant until the salt concentration of 18‰, after which the particle size increased sharply from 10 to 500 nm. The presence of HA does not significantly affect the behavior of the sol. The addition of a Ch solution (50 mg/l) to the sol leads to a loss of its stability at 3‰ NaCl, while the lower concentrations of Ch (10 mg/l) do not affect the behavior of the sol. That is consistent with our previous studies in which the introduction of freshwater bacteria in the sol caused an increase in its particle size at 5‰ NaCl, which can be explained by the flocculation of the sol by active substances, released during the viral lysis of bacteria [2].

The sol behavior changes significantly if a Ch solution was added to $Fe(OH)_3$ pre-modified with HA, the sol stability in this case was maintained up to 18‰ NaCl. HA is likely to create a protective layer on the iron hydrosol particles, which reduces the flocculation activity of Ch. It was determined that about 50% of the total iron carried by rivers is deposited in the river-sea mixing zone. According to our data, HA can facilitate the transport of colloidal iron to the outer part of the mixing zone even in the presence of flocculants (fresh DOM), capable of depositing it in the inner part of the mixing zone.

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