Modified clay minerals for water cleaning and recycling

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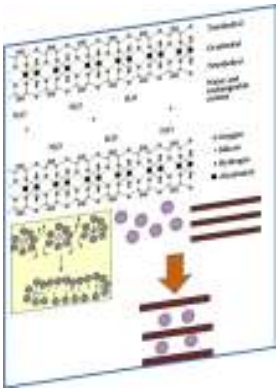
A new technology for purification of organic-contaminated water employs a complex between micelles, or vesicles, of an organic cation and a clay mineral, such as montmorillonite (MMT). Micelles of octadecyltrimethylammonium (ODTMA), and benzyldimethylhexadecylammonium (BDMHDA) bromide were mostly used [1, 2]. Vesicles used were composed of didodecyldimethylammonium (DDAB) [3]. Both types of complexes have a very large surface area, large hydrophobic domains, and typically are designed to have a large excess of positive charge. They can be effective in the removal from water of anionic and neutral pollutants such as herbicides (anionic and hydrophobic ones), anionic detergents, antibiotics and other anionic drugs, and components of DOM (dissolved organic matter) such as fulvic and humic acids. DOM is not a pollutant per se, but treatment of water, e.g., by chlorination, results in production of trihalomethanes, which are carcinogenic. Noteworthy, DOM also promotes the migration of herbicides to ground water. The nature of the head group of the organic cation was shown to be critical [1].

In our work, we compared the behaviour of two micellar organoclays realized by using natural MMT and ODTMA and bovine serum albumin (BSA) as surfactants. The herbicides atrazine, and tribenuron-methyl, together with its main degradation product 2-methoxy-4-methylamino-6-methyl-1,3,5-triazine, and the non-steroidal anti-inflammatory (NSAID) drug diclofenac potassium were used as sorption models.

The micelle-clay complexes were prepared as suggested by Polubesova et al. [1, 2]. Column filters (about 20 cm) made of a mixture of quartz sand and micelle-clay complexes at 50:1 w/w ratio removed 80% to 98% of the herbicides and up to 99.9% of 2-methoxy-4-methylamino-6-methyl-1,3,5-triazine and diclofenac from initial solutions. Efficiency of removal with micelle-clay filtering was significantly enhanced comparing to results obtained by using activated carbon. A quartz-clay layer placed into the bottom of the filter was able to capture almost all the released surfactants from micelle-clay complexes avoiding their leaking out the filter. The adsorption of contaminants studied was more efficient on ODTMA-MMT and BSA-MMT than natural MMT, since the surfaces of the modified micelle clay are more hydrophobic than the natural MMT. The effectiveness of atrazine and tribenuron-methyl adsorption coupled with the complete removal of the tribenuron-methyl derivative and diclofenac potassium gives account of the usefulness of organoclay systems for the elimination of this kind of pollutant from water in cleaning processes.



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