BOOK REVIEW

Water Purification by Micelle-Clay Nano-Particles

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This book is an authoritative international reference for researchers and engineers involved in water tertiary treatment. The authors present material for those concerned with water treatment techniques, for such areas as drinking water, swimming pool water, industrial process water, municipal and industrial waste water. The book takes account of the scientific and analytical aspects of the process of water purification by filtration using modified nano-particles of natural materials as clay minerals, and incorporates major technological advances of the last twenty years, including the results obtained with the project "Diffusion of nanotechnology based devices for water treatment and recycling" - NANOWAT (ENPI CBC MED I-B/2.1/049, Grant No. 7/1997), 2012-2015.

The first chapter guides the reader to know the book content and the motivations that have pushed the authors to tackle a complex work of collection and explanation of what the literature offers about this specific theme.

The introductory chapter deals with a brief lesson on cationic/anionic adsorption phenomena that are also the basis of colloid and clay minerals' (or phyllosilicates) chemistry in soil science (especially in soil chemistry).

Preparation, structures and physical-chemical characteristics of micelle-clay complexes are described in chapter 2. This is a very important chapter to understand the properties of the micelle clay complexes and how the filtration process can arise by using these nano-particles. The authors are very clear about the importance of all the experimental investigations carried out to define the right concentrations and the best ratios between the clay mineral and the organic micelles in order to obtain the best adsorption efficiency of the anionic and hydrophobic pollutants. The results are enriched with analytical measurements obtained by means of complex instrumental techniques (Freeze-fracture electron microscopy, X-ray diffraction, Fluorescence) necessary to validate the experimental achievements of the cited researchers. My personal interest was particularly attracted by the section, "Preparation of granulated micelle-clay complexes," together with the section "Possible optimization of the design of the granulated micelle-clay complex" (Chapter 6), which is a dramatic issues when this filtration technology should be transferred from the laboratory to pilot scale. The granulation process is the key for the accomplishment of a commercial plan of this filtration technology.

Chapter 3 provides an analysis of the effect of various parameters on adsorption in dispersion systems (polyphasic) and useful theoretical and practical information on the adsorption kinetics, offering a rigorous model to calculate and foresee the effectiveness of the process. The authors confirm my personal conviction that the processes taking place in heterogeneous phases can be solved only by elaborating second order kinetics (Langmuir) or higher order kinetics. I agree with them that all approximations of a lower order than the second often reported in the literature can lead to incorrect estimates and conclusions. By a practical point of view and for process applications, the final sections about the effects of volume filtered, flow rate and flow velocity, filter length, pollutant concentration on the effectiveness of contaminants' removal offer a valid guide for users.

I enjoyed particularly in the reading of Chapter 4, which contains a large number of applications of the technology reported in published papers. This chapter is a comprehensive review of experimental results of water purification from herbicides (and other pesticides), dissolved organic matter, pharmaceuticals, and

microorganisms including bacteria, viruses and the parasite *Cryptosporidium parvum*. It is a very important chapter, with a wealth of details and suggestions (normally not found in the reviews). It often includes modeling and estimates of capacity of several applications of the filtration processes using the composite nano-clay materials. Some tentative for filter regeneration when used for the removal of microorganisms' load are successfully reported as well as information about the release of the surfactants in the effluent water (after filtration) when the technology is used for obtaining drinkable or irrigation water, which issues are of fundamental importance for the release of sanitary authorizations. Noteworthy, the technology is also proven and modeled for the removal of inorganic anionic pollutants such as perchlorate and ferricyanide.

The book not only deals with the use of micelles-clay based on tetralchylammonium salts in the filtration of wastewater but also gives remarkable information in Chapter 5 on the use of liposome/vesicle-clay and polymer-clay composites, which can be useful for the purification of drinking water avoiding the presence of toxic residues of the ammonium salts.

The last chapter gives an overview of the use of micelle-clay in combination with other technologies such as activated carbon, biological degradation and photo degradation The last chapter gives an overview of the use of micelles-clay in combination with other technologies, giving an account of the possible adoption of different decontamination methods according to the destination of the purified water, and demonstrating the vivacity of the research in the sector whose evolution is not certainly completed but can still offer interesting ideas for the design of pilot plants of considerable effectiveness in the tertiary treatment of wastewater.

This chapter, together with many of the articles reviewed in the previous chapters, offers considerable insights for the preparation of joint projects that can reinforce international cooperation on a very important problem such as the purification and reuse of water whose scarcity is of global interest.

I like to underline that the authors close each chapter with a <conclusions and remarks> section that allows the reader to have a summary view of the research objectives dealt with in the chapter and of the possible further explorations.

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