The preparation of organo-bentonite by a new gemini and its monomer surfactants and the application in MO removal: A comparative study

Chunjie Wang a, Xiaohui Jiang a, Limei Zhou a, Guangqiang Xia a, Zhengjun Chen a, Ming Duan b, Xiaomin Jiang c

Chemical Synthesis and Pollution Control Key Laboratory of Sichuan Province, China West Normal University, Nanchong 637009, Sichuan, PR China
State Key Laboratory of Oil and Gas Reservoir Geology and Exploitation, Southwest Petroleum University, Chengdu 610500, Sichuan, PR China
Southwest Electric Power Design Institute, Chengdu 610021, Sichuan, PR China

HIGHLIGHTS

► N₆ is more effective than N₄ in expanding basal space and in removing MO.
► N₄ mainly stays in interlayer, however N₆ on the clay surface due to its big head.
► MO removal by N₆-Bt/N₄-Bt is pH dependent.
► The complex of MO–N₆-Bt/MO–N₄-Bt forms during MO removal.

ABSTRACT

Gemini surfactant, 1,1-(butane-1,4-diyl)-bis(3-(tetradecyloxycarbonyl)pyridinium) dibromide (designated as N₆), and the corresponding monomer, 1-ethyl-3-(tetradecyloxycarbonyl)pyridinium bromide (N₄), were prepared and utilized to modify sodium bentonite (Na-Bt). The surfactant modified bentonites (N₆-Bt for the gemini modified bentonite and N₄-Bt for the monomer modified one) were then used for methyl orange (MO) removal from the wastewater. The results indicated that the gemini surfactant N₆ was more effective than the monomer N₄ at expanding the interlayer space of Na-Bt and in removing MO from wastewater. The maximum basal spacing of N₆-Bt (4.02 nm) was almost twice as that of N₄-Bt (2.63 nm). MO removal efficiency was 9.68% for 4.0N₄-Bt and 99.88% for 4.0N₆-Bt at a dosage of 0.06 g, respectively. N₄ easily intercalated into the interlayer of Na-Bt, however more N₆ mainly stayed on the solid surface owing to its bigger head. The adsorption of both N₄ and N₆ on Na-Bt obeyed the pseudo-second-order kinetic model and Langmuir isotherms. The solid-state UV–vis spectrometry evidenced the formed complex of N₆/N₄ with MO on Na-Bt, and the stronger interaction of N₆-Bt with MO.

1. Introduction

Dyes are used widely as coloring agents in textile, cosmetic, leather, printing, food, plastic and so on. Due to their resistance to degradation, they remain in wastewater. Dyes and their metabolic products might be carcinogenic and mutagenic [1,2]. Several conventional methods, for instance, coagulation and flocculation, membrane filtration, biological treatments, adsorption and advanced oxidation processes, are available for the treatment of dye wastewater, in which the adsorption is the most effective and convenient one [3–7]. Clay minerals are potential absorbents.