

Treatment of drilling wastewater from a sulfonated mud system

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Abstract: Treatment of drilling wastewater from a sulfonated drilling mud system in the Shengli Oilfield, East China, was studied. The wastewater was deeply treated by a chemical coagulation–centrifugal separation–ozone catalytic oxidation combined process. The factors (i.e. pH value, chemical dosage, reaction time, etc.) influencing the treatment effect were investigated, and pH = 7 was determined as optimal for the coagulation; polymeric aluminum chloride (PAC) was selected as the optimal coagulant with a dosage of 18 g/L; cationic polyacrylamide (CPAM) with molecular weight of 8 million was selected as the optimal coagulant aid with an optimum dosage of 8 mg/L; and the optimal condition of catalytic ozonation was found to be a pH of 12 and an oxidation time of 40 min. The results showed that the combined treatment process was effective. The oil content and suspended solids content of the effluent reached the first class discharge standard according to China's standard GB 8978-1996 (Integrated Wastewater Discharge Standard) and the chemical oxygen demand (COD) decreased to 195 mg/L from 2.34×10^4 mg/L after coagulation process and ozone oxidation at pH = 12 for 40 min.

Key words: Drilling wastewater, sulfonated mud system, coagulation and flocculation, centrifugal separation, ozone catalytic oxidation

1 Introduction

Drilling wastewater is highly diluted and complicated mixture of drilling mud containing various components of drilling fluid. From the viewpoint of the molecular structure of the organic treatment agents in the drilling fluid, these agents all contain carboxyl, phenolic hydroxyl, quinone, methyl formic acid and other functional groups, and there are various chromophoric groups and hydrophilic groups in their molecules. The drilling water is changeable and complex with a high content of suspended solids, highly colored, high chemical oxygen demand (COD), and a certain content of oil (Li and Zhang, 2010; Fan et al, 2002), resulting in treatment difficulties (Bundschuh et al, 2011; Asatekin and Mayes, 2009). Sulfonated mud treatment agents are usually used in wells deeper than 3,000 m for their high temperature resistance. The deeper the well, the more types and quantities of the treatment agents, and correspondingly, the more complicated the components of drilling wastewater. The high concentration of pollutants in the drilling wastewater can make the system stable, and lead to a high content of suspended solids, resulting in difficulty in treatment of the drilling wastewater. The wastewater was deeply treated by a

chemical coagulation-centrifugal separation-ozone catalytic oxidation process in this work, and the influencing factors on the treatment effect were investigated.

2 Materials and methods

2.1 Materials and instruments

Drilling wastewater, from the Shengli Oilfield, East China; Coagulants: ferric chloride, aluminium chloride, polymeric ferric sulfate (PFS), polyaluminium chloride (PAC), polysilicate aluminium sulfate (PASS); Coagulant aids: non-ionic polyacrylamide, cationic polyacrylamide (molecular weight range: 4-10 million); Ozone oxidation catalyst: self-made (activated carbon supported by oxide nano particle of iron, manganese and copper). Drilling fluid additives: modified bitumen (KFT), valchovite (SPNH), sulfonated gilsonite (FT-1), sulfonated methyl phenolic resin (SMP-1), polyacrylamide (PAM).

pHS-3C acidimeter (INESA Scientific Instrument Co., Ltd, Shanghai, China); 5B-1 COD Rapid monitoring meter (Lanzhou Lianhua Environmental Protection Technology Co., Ltd, Lanzhou, China); HACH2100N turbidimeter (HACH, Danaher Corporation, USA); YQCF-G ozone generator (Yuqing Envirotech Co., Ltd, Changsha, China); CFY10 oxygen generator (Sumsun Ep Hi-tech., Co., Ltd, Beijing, China).

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