ABSTRACT

Reuse of Oilfields Produced Water Treated by Combined Coagulation- Flocculation and Microfiltration Technique

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The Southern Oil Company, operating in North Rumaila oil field located in Basrah/ Iraq represents one of the important companies in Iraq that produced about (130000- 170000) BBL/Day of water in (2012- 2013). Therefore the aim of the present work is to treat this produced water by hybrid methods of coagulation, flocculation and microfiltration technique/ ceramic membrane to mainly remove the oil and turbidity.

Different interaction parameters that affect the removal efficiency of oil and turbidity have been studied such as coagulant- flocculent doses and type, settling time, velocity gradient (G), and Camp number ($G\tau_f$).

The effect of the coagulation- flocculation process was studied on the removal efficiencies of turbidity. Three types of coagulants were used separately: poly-aluminum chloride, ferric chloride, and cationic polyelectrolyte and in combination; poly-aluminum chloride with cationic polyelectrolyte and ferric chloride with cationic polyelectrolyte. From jar test, for high removal efficiency of turbidity, the optimum dosage range of coagulants were (80-100) mg/L for poly-aluminum chloride, (10-15) mg/L for $FeCl_3.6H_2O$, (1-2) mg/L for cationic polyelectrolyte dosage, when used separately. Also it was found that the turbidity

removal efficiency was more than 99.6% when the doses of PAC and $FeCl_3.6H_2O$ combined with cationic Polyelectrolyte are equal to (20+ 0.6) mg/L and (10+0.6) mg/L, respectively.

The effect of adding coagulants doses on the oil content and total suspended solid was studied. The oil content achieved (2.7, 1.5, 2, 2.8) mg/L, when the optimum dose of PAC (20 mg/L) was combined with (0.4, 0.6, 0.8, 1) mg/L of PE, respectively, but the oil content was (5.2 & 1.6) mg/ L and (2.1 mg/L) when the optimum doses of $FeCl_3.6H_2O$ reaches (15) mg/L combined with (0.4 & 0.6) mg/L of PE and (10) mg/L combined with (0.8) mg/L of PE, respectively. It was found that the total suspended solid (TSS) was (15) mg/L (initial TSS= 333.2 mg/L), when the dose of $FeCl_3.6H_2O$ (10) mg/L was combined with PE dose (0.6) mg/L.

The effect of settling time on the residual turbidity was studied. It was found that (20 min) was the optimum time to give residual turbidity (0.97 NTU) at PAC dose (20) mg/L combined with PE dose (0.8) mg/L.

The effect of the velocity gradient (G) on the residual turbidity was studied; it appears that G of (54.5-78.5) s^{-1} is the most favorable speed of mixing of flocculation.

After coagulation- flocculation process, the treated sample was injected through a ceramic membrane filter (0.5 Micron) to improve the water quality. It was found that the oil content could be decreased to less than (5) ppm.

The experimental results were represented by mathematical empirical correlation using MATLAB computer program. For coagulation and flocculation method in which each coagulant used separately, the following general equation was obtained with a correlation coefficient of (0.9573):

$$\mathbf{R_{pre}=a + b_1*D_1^{n1} + b_2*D_2^{n2} + b_3*D_3^{n3} + c_1*D_1^{n4} + c_2*D_2^{n5} + c_3*D_3^{n6}}$$