Application of Electro-Coagulation for the Treatment of Wastewater from Vehicle Service Stations

I.R. Samarathunga* and D.G.G.P. Karunaratne

Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya

Introduction

Vehicle service stations generate considerable amount of wastewater and existing treatment methods in most of these facilities in Sri Lanka are not up to the required standards. Most of the methods employed, such as the use of fat traps, sand filters and charcoal filters, are limited to the physical treatment of wastewater. By physical treatment only free oil and grease are removed but the dispersed oil, which has a smaller particle size than the free oil, is not removed effectively. Therefore, a proper chemical treatment method should be implemented to reduce the oil content in the discharged wastewater from the vehicle service stations.

The intention of this study is to determine a suitable chemical treatment method and to optimise it to treat both free and dissolved oil and grease in the wastewater from vehicle service stations effectively. The chemical treatment methods tested in this study were electro-coagulation using aluminium and mild steel electrodes and the use of alum as a coagulant.

Materials and methods

Experiment planning

For electro-coagulation, the effect of reaction time, current density and the sedimentation time on oil removal was investigated. The other factors such as pH, the distance between the electrodes, and the conductivity of the mixture were kept constant at the optimum values reported in the literature. Accordingly, for every trial, the initial pH value was kept at 6, the conductivity of the wastewater sample was adjusted using 0.6 g/l of NaCl, and the distance between the plates was kept at 10 mm (Xu and Zhu, 2004). In addition, the contact area of the electrode plates was also kept constant.

Experimental method

Wastewater for the study was obtained from a service station, which has a reasonably good treatment facility, and the samples collected were effluents from the treatment plant. In electro-coagulation, the treatment of wastewater was examined by varying the current and the reaction time for each type of anode plate; aluminium and mild steel. Aluminium cathode was used in both cases. In chemical coagulation, effect of alum dosage on removal was studied at different reaction times.

Measurements

After a given reaction time, the turbidity was measured in 10 minutes intervals up to a total of 120 minutes of sedimentation time. The oil and grease test was carried out for samples which had been treated for a given reaction time and had been allowed to settle for a time period of 90 minutes.

The oil and the grease content of the wastewater sample were measured using the standard gravimetric method (Eaton and Awwa, 1995) and the Turbidity was measured using the turbidity meter in NTU.

Results and discussion

The turbidity and oil removal for different combinations of current density values and reaction times were measured for the three types of treatment methods tested. Figure 1 indicates the variation of turbidity removal with sediment time and reaction time when Al anode was used. Oil removal efficiency for these conditions is shown in Figure 2.

From the results obtained, it is evident that an increase in reaction time and current density will increase the removal of turbidity and oil for both types of anodes. For the chemical coagulation process, the removal of turbidity, oil and grease increased with the alum dosage.

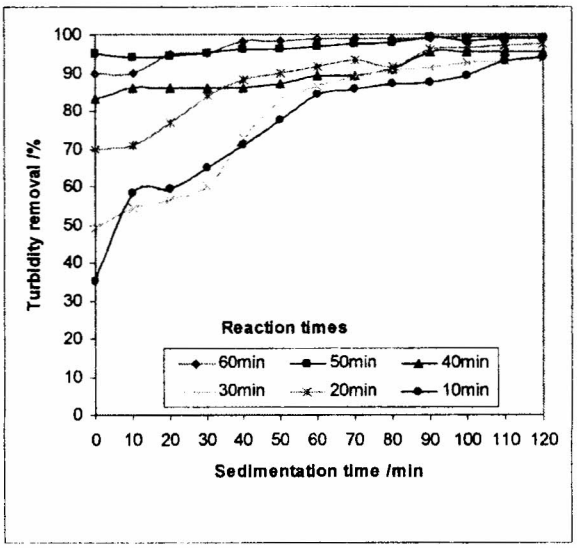

Figure 1. Turbidity removal vs sedimentation time for Al anode at different reaction times

It should be noted that the wastewater used in this study had already gone through the physical treatment process and most of the oil remaining is dispersed oil, which is difficult to remove. This is the reason for low oil removal in this study.

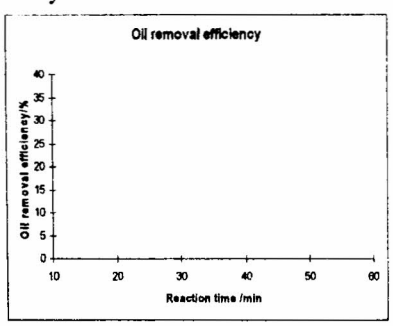

Figure 2. Oil and grease removal Vs Reaction time for Al anode

In this study, the maximum turbidity removal was archived with the use of aluminium anode at the conditions of a current supply of 3 A and 60 minutes of reaction time, while the maximum oil and grease removal was archived with mild steel anode at a current supply of 4 A and a reaction time of 40 minutes.

A comparison of the three treatment methods is as shown below in Figures 3 and 4. Hence, is not that suitable to use in daily applications.

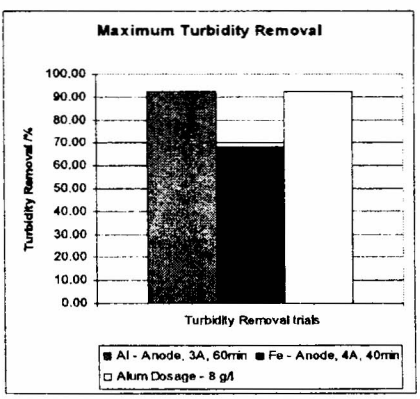

Figure 3. Maximum turbidity removal in three different treatment methods

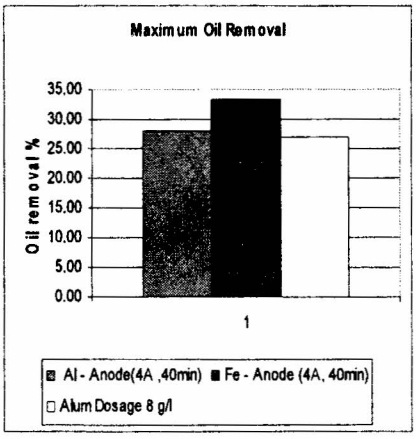

Figure 4. Maximum oil removal in three different treatment methods at 90 min sedimentation time

Conclusions

Considering both oil removal and turbidity removal, it can be concluded that, for the range of dosage used in the experiment, the Electro coagulation process is more efficient than the use of Alum for the treatment of wastewater discharged from a vehicle service stations.

In electro-coagulation method the oil removal efficiency was higher for mild steel anodes compared to aluminium.

References

Eaton, A. D. and Awwa, (1995) *Standard methods for the examination of water and wastewater.*

Xu, X. and Zhu, X. (2004) Treatment of refectory oily wastewater, *Electro-coagulation process, Chemosphere* 56.