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The use of electrooxidation for treating wastewater generated by automobile service stations

D. V. Karunagaran^{1*}, C. K. Jayasuriya¹ and J. K. Premachandra²

¹Department of Chemistry, University of Kelaniya, Sri Lanka

²Department of Chemical and Process Engineering, University of Moratuwa, Sri Lanka
karunaga_bs16064@stu.kln.ac.lk*

Automobile service stations are water intensive and discharge oils, greases, detergents, degreasers and heavy-duty cleaning products during their operations. Hence, treating this effluent before releasing it to the environment is absolutely essential to prevent environmental pollution. Treating the wastewater to a level at which it can be reused for its operations would be economically beneficial to the industry. Also, most importantly, it helps to conserve one of the earth's most precious resources, water. In this regard, several treatment methods have been proposed and some of those have been employed in Sri Lanka and around the world, including physical, chemical, biological and combined methods. Electrooxidation is an attractive method of treating wastewater, possessing several advantages over conventional treatment methods, such as offering relatively fast treatment, with no use of additional chemicals and no generation of sludge. For industrial applications, the use of graphite electrodes is very beneficial compared to other types of electrodes as they are relatively cheap and inert. The main objective of this study was to investigate the effectiveness of applying electrooxidation using graphite electrodes and sodium chloride as the supporting electrolyte to treat automobile service station wastewater. In addition, it was expected to optimise the applied voltage considering the number of electrodes and the treatment time. Further, it was evaluated whether gravity filtration using a filter of pore size 11 μm as a pre-treatment would improve the process efficiency. Wastewater samples obtained from a service station in Negombo, Sri Lanka, were analyzed for 3-day Biological Oxygen Demand (BOD_3), Chemical Oxygen Demand (COD), oils and greases (OG), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) and pH. The levels of COD and OG were detected as 356.70 mg/L and 2650 mg/L, respectively and their variation under different applied voltages (3 V, 5 V, 8 V), numbers of electrodes (2, 3, 4, 5, 6 electrodes) and treatment times (60 minutes, 120 minutes) were used as the basis to assess the efficiency of each treatment condition and select the optimum conditions. It was found that optimum conditions for the treatment process include applying 3 V, the use of 4 electrodes and 120 minute treatment time. The corresponding efficiency removal of the COD and OG were 73.0% and 97.1%, respectively, for the samples that were filtered. The percent removal efficiencies of the COD and OG were 62.2% and 70.4%, respectively by electrooxidation for unfiltered samples. The pH of the water was observed to be close to 7 after the electrooxidation of filtered samples. Further development of this method could be done by optimising other necessary parameters in order to fully improve the water quality up to the requirements for effluent discharge. An industrial scale study could be performed in order to study the applicability of this method to vehicle service stations of different scales, as well as the long-term costs associated with it.

Keywords: Automobile service station, COD, Electrooxidation, Oil and grease, Wastewater treatment