OIL AND GREASE REMOVAL FROM THERMAL POWER PLANT EFFLUENT USING ELECTROCOAGULATION

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DECLARATION

I hereby declare that this submission is a result of a work carried out by me and to the best of my knowledge, it contain no material previously written or published by another person nor material which has been accepted for the award of any degree or acceptable qualification of a university, or other institute of higher learning, except where the due reference to the material is made.

UOM Verified Signature

....

Mr. K. A. P. U. Karunarathna

(8th February 2007)

To the best of my knowledge, the above particulars are correct.

....

Dr. S. L. J. Wijeykoon

(Supervisor)

ABSTRACT

The fuel oil used in thermal power plants mainly falls into the category of low grade fuel such as Heavy Fuel Oil (HFO). They cannot be readily burnt in engines of thermal power generation and need to be further refined. They are refined at the power plant itself. The outcome of this refining process is wastewater rich in heavy oil particles. This has an enormous impact on the country's environment, thus cannot be readily discharged into the environment.

Therefore, this study was mainly focused to investigate a scientifically based and an economically viable solution to removal of the oily wastewater. In this case, application of the novel and emerging technique "Electrocoagulation (EC)" for the treatment of oily wastewater generated in thermal power plants was tried out. This technique has been tested successfully for several wastewater treatment solutions in the world (Appendix). However, it has to be noted that EC method has been applied for only a few applications of oily wastewater treatments.

In this study, a laboratory scale EC reactor was made using a glass beaker as shown in Fig: 3.1) and results so obtained would help to design an industrial scale EC reactor. Different operation parameters such as influent pH, current density, initial oil concentration and electrode material were examined. During this examination, effect of one parameter for electrocoagulation was studied keeping the other parameters constant. For example, effect of pH on the electrocoagulation was studied keeping the other parameters such as current density, type of electrode material, and initial concentration of the oily wastewater constant. Further, effect of pH on electrocoagulation was examined by using range of pH from 2 to 12, effect of current density was evaluated by varying 2.33 mA/cm^2 to 46.8 mA/cm^2, effect of initial concentration of oily wastewater was varied from 66 mg/L to 419 mg/L and effect of type of electrodes material was investigated using C and Al electrodes. In addition, performance of the method was mainly tested in terms of COD removal efficiency.

The effect of pH on the performance of the method was not significant in the range of pH - 4 and pH - 10. However, a sharp decrease of COD removal efficiency was not observed when pH was less than 4 and greater than 10. Optimal current density was found as $4.6\, mA/cm^2$, and it was found that there was a little effect of initial oil concentration. Further, Aluminum was found as the most appropriate electrode for anode and there was no effect of cathode material on the efficiency of the EC method. According to the results, it appears that the Electrocoagulation method could be applied for oily wastewater treatment solution to obtain sustainable result.

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Abbreviations

1. **MW**-Mega Watt
2. **CEB**- Ceylon Electricity Board
3. **GWh**- Giga Watt hours
4. **rpm**-Revolution per minutes
5. **HFO**- Heavy Fuel Oil
6. **LFO**- Light Fuel Oil
7. **ppm**-Parts per million
8. **MSDS**-Material Safety Data Sheet
9. **BOD**- Biochemical Oxygen Demand,
10. **COD**- Chemical Oxygen Demand
11. **TOC**- Total Organic Carbon
12. **TOD**- Total Oxygen Demand
13. **DAF**- Dissolve Air Flotation
14. **TDS**- Total Dissolved Solid
15. **HT**- High Temperature
16. **LT**- Low Temperature
17. **dB**-Decibels
18. **cst**- Centistokes
19. **mg/L**-Milligrams per litter
20. **%**-Percentage
21. **f**- Fahrenheit
22. **C**-Carbon atom
23. **H**-Hydrogen atom
24. **O**-Oxygen atom
25. $Cr_2O_7^{-2}$-Dicromate ion
26. H^+- Hydrogen ion
27. Cr^{+3}-Cromic ion
28. CO_2-Carbon dioxide
29. H_2O-Water
30. Ag_2SO_4- Silver sulfate
31. $HgSO_4$- Mercuric sulfate

32. **$K_2Cr_2O_7$**- Potassium dichromate

33. **$CaC0_3$**-Calcium carbonate

34. **H_2S**- Hydrogen sulfate

35. **OH^-**Hydroxnium ion

36. **e**-Eletrone

37. **Cl^-** -Chloride ion

38. **HOCl**-Hyporchlores acid

39. **Cl_2** – Chlorine atom

40. **Fe**-Metal iron

41. **Al**-Metal Aluminum

42. **Al^{3+}** -Aluminum ion

43. **Ca^{2+}** - Calcium ion

44. **Mg^{2+}** - Magnesium ion

45. **E**- Electrical Potential

46. **E_0** Electrical potential at stranded condition

47. **R**- Universal gas constant

48. **T**-Temperature

49. **n**- Valiancy of elements

50. **F**- Faraday constant

51. **B**-Final concentration

52. **A**-Initial concentration

53. **mA**-Mill Ampere

54. **cm^2**-Square centimeter

55. **V** - Velocity of rise ($cm\ sec^{-1}$),

56. **g** - Acceleration of Gravity ($cm\ sec^{-2}$),

57. **r** - "Equivalent" radius of particle (cm),

58. **d_1** -Density of particle ($g\ cm^{-3}$),

59. **d_2** -Density of medium ($g\ cm^{-3}$),

60. **μ**- Viscosity of medium ($dyne\ sec\ cm^{-2}$)

61. **NaCl**- Sodium Chloride

62. **μs**- Micro siemens

63. **DC**-Direct Current

64. **FAS**- Ferrous Ammonium Sulfate

65. **A**- Ampere

66. **H_3O^+**-Hydronium ion

67. **H_2**-Hydrogen atom

68. **Ag_2 SO_4**- Silver sulfate

69. **$Al(OH)_4^-$** -Aluminum hydroxide