CHAPTER 5: CONCLUSIONS & FUTURE WORK

The investigation has looked into the removal of oil from oily wastewater using two different adsorbents in recovery and treatment sections. The findings from this investigation are summarized in this chapter.

5.1 Recovery Section

- The present study showed that human hair has good oil adsorption ability as well as oil recovery ability. Some part of oil is adsorbed to human hair permanently such that it cannot be recovered by pressing. Other part of oil is retained by hair such that it can be released by pressing.
- Experiments revealed that human hair can recover 70.5% oil from oily water and 1.35 mL of oil was recovered per gram of hair. Permanently adsorbed oil amount is around 0.8 mL/g of hair.
- By using human hair particles, all most of all free oil layer can be removed from waste oily water and dissolved & emulsified oil cannot be removed using human hair.
- This oil recovery unit can be applied to oil spillage management in sea or reservoirs.

5.2 Treatment Section

- This study showed that adsorption capacity of carbonised rice husk is high compared to raw rice husk and raw saw dust. Therefore the thermally treated rice husk (carbonised rice husk) is an effective adsorbent for treating oily wastewater.
- Adsorption capacity of carbonised rice husk is optimum at optimum values of process parameters which are shown in Table 5.1.

Table 5.1: Optimum Values of Process Parameters

Parameter	Optimum value
Adsorbent dosage	9g/L
Particle size	500 – 710 µm
Solution pH	7

- Adsorption of oil was optimum at pH of 7 and if the pH is lower than 2 oil adsorption onto carbonised rice husk diminishes. Adsorption efficiency increased with increasing the adsorbent dosage, contact time and initial oil concentration.
- Kinetic data tended to fit well in Second order model; $^{t}/_{Q} = 0.63\,t + 5.67$, confirming the chemisorption of oil particles onto carbonised rice husk.
- The Langmuir isotherm; $^{1}/_{Qeq} = 1.63\ ^{1}/_{Ceq} + 0.17$, best represent the adsorption of oil onto carbonised rice husk confirming the monolayer adsorption and Monolayer oil adsorption capacity of 2.24 mg of oil/ g of carbonized rice husk was observed.
- The treatment section can be implemented for treating the oily wastewater in small scale oil based industries where oil content is relatively low.

5.3 Integrated system

- This system is a combination of oil recovery unit and oil treatment unit for recovering and treating oil in oily wastewater with efficiencies of 75% of oil recovery after 30 rotations of the belt and 84% of emulsified and dissolved oil in oily wastewater within one hour. The over all efficiency of the system is 97%.
- The integrated system can be applied to oily wastewater which has thick oil layer such as effluent coming from petroleum industries. This process is an effective and reliable technology that provides an environmentally compatible method for treating large amount of oil.

5.4 Future Work

In this research, the measurement of oil in water after treating the oily water using carbonized rice husk has been a difficult task. The test procedures to determine oil and grease concentration in water samples as described in Section 2.3 are accurate only if the water contains significant amount of oil and the readings are highly depend on the quality of the oil. At times the same oil variety come with little differences of composition and in this occasion, the readings of these methods are different. Therefore, after treatment section, non of these methods were found to be suitable in measuring the remaining oil which is in the low ppm range.

In these experiments, the remaining oil amount after treatment section was measured with respect to the COD reduction. There is a correlation of emulsified and dissolved oil with the solution COD. Using this correlation, all experiments were analyzed by measuring initial and final COD values. Although this method is comparatively accurate for measuring synthetic oily water samples, there are several limitations and defects when analyzing real oily water samples which contain different oil components.

Therefore, good oil analysis technique must be developed to analyze the oily water samples in lab scale in future. The Skalaer Fluo-Imager analyzer (Skalar, 2007) is one of the novel analyzer which can be used to oil in water analysis.

5.4.1 Skalar Fluo-Imager analyzer

The Skalar Fluo-Imager analyzer is one of the good analyzer to oil in water analysis and it is capable of detecting oils in the low ppm ranges and it can also distinguish between different types of oil present in a water sample. The principle of the Skalar Fluo-Imager analyzer is based upon a fluorescence measuring method. At an excitation wavelength an emission spectrum is measured with a CCD-camera (Charged Coupled Device). After this spectrum is measured the excitation wavelength shifts 5 nm and the emission spectrum is measured again. This process continues until an excitation range from 240 nm till 360 nm has been scanned. When these emission spectra are plotted out against the excitation wavelengths a 3-dimensional picture is produced. This literally adds an extra

dimension to this fluorescence method. Because every compound has different excitation and emission wavelengths, the image will be a “fingerprint” of that compound. Different oils contain different components, and thus every oil has its own distinctive “fingerprint”. This makes it possible for the software of the Fluo-Imager to recognize different oils and distinguish between the different oils present in a particular sample. For this to be possible each oil has to be present in the Fluo-Imager’s library with its own calibration curve. This makes it possible not only to qualify but also to quantify different kinds of oil present in the sample.

The Infra Red (IR) analysis and Gas Chromatography (GC) analysis which are widely used for the determination of oils in water require an extraction solvent to determine the oil amount and their calibrations are not sufficient to cover all different oil types. This is one of the advantages of the Skalar Fluo-Imager analyzer in that it requires no sample pre-treatment and it uses its library to calibrate for every different kind of oil.

Due to the simplicity of the method and the use of no solvents, the Skalar Fluo-Imager analyzer is a low maintenance unit, which is available as a batch, an on-line, and a mobile unit. All this makes the Skalar Fluo-Imager analyzer a more “complete” oil in water analyzer which can be used in a wide variety of application. Therefore Skalar Fluo-Imager analyzer can easily replace the current standard methods with the several advantages.

This is an example of a technique to be used in future work in better system design for large scale unit of the prepared technical scheme as for maritime use.