

## CHAPTER FIVE : SUMMARY AND CONCLUSIONS

A comparative study on the performance of three rubber glove manufacturing factories based on three main parameters i.e. BOD, COD and SS was carried out. From this study, it has revealed that the raw effluent of rubber glove manufacturing factories was similar and quite consistent. The pH of effluent ranged between 5.1 and 8.4. It had a fairly low BOD concentration, ranging from 85 mg/l to 1035 mg/l. However, the COD concentration in the raw effluent was found to be high and had a wider range, varied from 300 mg/l to 4360 mg/l. Generally the COD was noted to be two to four times higher than the concentration of BOD. This suggested that the effluent contained less biodegradable organic matter compared to the total organic. This was a norm as it was common to have more compounds that can be chemically oxidised than can be biologically oxidised in wastewater.

Observations indicated that Factory A had the highest removal efficiency for all three BOD, COD and SS, followed by Factory B and lastly Factory C. It was found that the actual BOD loading into the WWTP was below the design loading. For example, the actual BOD load was 259 mg/l, which were approximately 79% of the design average load of 328 mg/l to maximum load of 570 mg/l. This means that the factory does not operate at full load. Thus, the removal efficiency for BOD was very high, at an average of 98%. However, contradicting to this observation, Factory C exhibited a low COD removal despite the actual loading of COD into the WWTP which was only 58% of its design load of 600 mg/l to 1000 mg/l. Similarly the actual SS loading for Factory A has exceeded about three times the design load of 191 mg/l, yet the removal efficiency was as high as 98%. At present it is not possible to establish a

pattern as to confirm the removal efficiency for all three BOD, COD and SS based on the actual loadings into the WWTPs. On the surface it was observed that the performance of a WWTP decreased with the increased of design flowrate. However, it is also incorrect as detail analyses showed that Factory C with the highest design flowrate, had the lowest concentration of pollutants as compared to Factory A and B.

It was observed that different stages of treatment had different levels of removal efficiency. Between the primary treatment and secondary treatment, all three factories had exhibited higher removals of BOD, COD and SS by primary treatment. The results showed that the effluent from rubber glove manufacturing industries contained higher non-biodegradable organics, and was susceptible to chemical oxidation than biological oxidation. Factory A was the highest in removal of COD and SS with 89% and 93%, respectively, whereas Factory B had the highest removal of BOD, with 84%. The removal efficiency of all three parameters for Factory C was generally lower as compared to the other two factories but still acceptable. Even though the percentage of removal efficiency for the pollutants by biological treatment was seen to be lower as compared to primary treatment, this did not necessarily mean that the former was less effective. The biological treatment actually played a supporting role in removing the remaining organic matters that were not chemically oxidised in the primary treatment.

The treated effluent for all three factories was able to comply with the requirement DOE's discharge limit. This proved that the design with the combination of chemical flocculation with DAF system, followed by the extended aeration system was suitable to treat the effluent from rubber glove manufacturing industries. Despite the fact that

the actual loading of COD and SS into all three factories had exceeded the design loading approximately by 0.1 to 3 times, the WWTPs had still managed to handle these loading and removed a substantial pollutants from the effluent to a level well below DOE's allowable limit of discharge.

It is not possible to establish a certain trend of BOD, COD and SS removals among these three factories in this study. The inaccessible information on the actual manufacturing processes applied by these factories and the chemicals used in the processes may affect the operation of the WWTPs. Further studies, which include other parameters such as, zinc, Oil and Grease, may be able to help in creating a better understanding on the treatment of effluent from rubber glove manufacturing industry.