Chapter 5 : A Feasibility Study of Membrane Process

5.1 A Comparative Study on RO Membrane Process and Deionization

Apart from the recovery of heavy metals, reverse osmosis is also used to generate ultra pure water. The permeate of the reverse osmosis process provides ultra pure water which can be used in other processes. By using reverse osmosis process electroplating industries can reduce their operational cost to produce deionized water. Usually, the deionized water is produced by a separate unit known as automatic water demineralizer or deionozer. Since the deionized water is an essential component in the electroplating industry and water is required in large amount, reverse osmosis unit can provide an alternative way to reduce the cost of this process. A comparison on operational costs of a deionizer and a reverse osmosis unit of identical capacity was made in this study and the cost effectiveness of both units are given below:

5.1.1 An Automatic Water Demineralizer/Deionizer.

(Basis: capital and operating cost for one year)

- Cost of a unit (capacity 8 m^3/day) = RM 50,000.00

- Electrical power consumption (TNB, 1997)

  Electrical power of the unit = 4.5 kW

  Under Medium Industrial Tariff (E1):

  For each kilowatt of max. demand per month is RM 17.30

  For 4.5kW unit in the period of 10 months

  (RM 17.30x 4.5 kW x 10 months) = RM 778.50

  For all units (4.5 kW x 8hr x 300 days x RM 0.198) = RM 2138.40

- Chemical Consumption (AMC Deionizer, 1990)

  HCl 33% (2.4 L/day x 300 days x RM 0.91) = RM 655.20

  NaOH 50% (3.8 L/day x 300 days x RM 1.33) = RM 1516.20

- Raw water

  8 m^3/day x RM 1.20 x 300 days = RM 2880.00

- Others

  Prefilters (3 filters/month x 10 months x RM 21.00) = RM 630.00

  Carbon in carbon filter

  (1 filter/month x 10 months x RM 27)

  = RM 270.00

  Resin IR-120B and IRA-410 (1 year) = RM 1000.00

Operational cost for 1 year = RM 9868.30

Total cost = RM 59,868.30

5.1.2 Reverse Osmosis Membrane Unit

(Basis: capital and operating cost for one year)

- Cost of the Membrane unit = RM 50,000.00

- Electrical Power Consumption (TNB, 1997)

  Electrical power of the unit = 1.87 kW

  Under Medium Industrial Tariff (E1):

For each kilowatt of max. demand per month is RM 17.30

For 1.87 kW unit in the period of 10 months

(RM 17.30 x 1.87 kW x 10 months) = RM 323.51

For all units (1.87 kW x 8hr x 300 days x RM 0.198) = RM 888.62

- Reverse osmosis membrane (need to change every year)

= RM 2,000.00

Operational cost for 1 year = RM 3,212.13

Total Cost = RM 53,212.13

5.2 Conclusion

According to the above study, reverse osmosis membrane unit reduced the total cost of deionized water production by approximately RM 6656.17. Furthermore, the production of deionized water can be carried out simultaneously with wastewater treatment which also obviates the consumption of raw water. This makes the reverse osmosis membrane unit more attractive and environment friendly compared to other methods.