CHAPTER VII

CONCLUSIONS

The experiments performed at the selected service stations in Bangkok Metropolitan area were designed to serve the following purposes:

1. to determine washwater quality requirement for the business;
2. to determine the washwater consumption for the business;
3. to determine the effectiveness of the Reclamation System by means of filtration method making use of burnt rice husk as a filter medium;
4. to find the economic advantage of the Reclamation System against the two existing systems;and
5. to carry out sensitivity analysis of the Reclamation System in order to invent a cost guide.

Conclusions from the experiments and analysis can be summarized as follow:

1. Turbidity of washwater before use ranges between 4.7 and 16.5 JTU with the average value of 10.2 JTU; washwater turbidity after use ranges between 62.4 and 97.5 JTU with the average value of 77.5 JTU; and the filtration process with burnt rice husk as a filtering medium can be effective enough for reclaiming the used washwater for reuse purpose without any need of pretreatment process whatsoever.

2. The average washwater consumption of the service stations investigated serves as a guide-line in classifying service stations into 4 categories according to sizes of service, namely, 20 m^3/day, in case of a 12-hour-a-day-service station; and 40, 60, and 80 m^3/day,in case of 24-hour-a-day-service stations.

3. Filtration method using burnt rice husk alone as the filtering medium can produce the effluent quality satisfactory enough for the effluent to be recycled for the reuse purpose. The experiments even showed the effluent quality to satisfy drinking-water standards, as far as turbidity and pH are concerned.

4. The performance of the filter using burnt rice husk as the medium can be listed as follows:

Optimum filtration rate	:	1.25	$m^3/m^2/hr$;
Optimum depth of the medium	:	80	cm ;
Optimum duration of rum with a head loss of 1.20 m	:	152	hours;
Average effluent turbidity	:	0.78	JTU;
Average turbidity removal efficiency:	:	99.04 % ;	
Average effluent pH	:	7.28	
Amount of filtrate	:	190 m^3/m^2	of bed; and
Average rate of head loss	:	0.79	cm/hr.

5. The comparison of the alternative systems has been attempted on the basis of the following assumptions:

Percentage of operation : 100 % ;
Percentage of out-put capacity: 100 % ;
Interest rate : 8 % ;
Percentage of annual maintenance cost to the capital cost :

- 1 % in case of both ground water-source system and Reclamation System , and
- 4 % in case of public water source system;

Service life of equipment :

- 5 years for ground water source system,
- 10 years for public water source system,
- 30 years for concrete tank of Reclamation System
- 10 years for pipeline and pumping equipment of Reclamation System.

The results can be summarized as follows:

i) The Reclamation System is best among the three systems compared; groundwater source system at depths of 100, 150 and 200 m is better than the public water source system when the capacity of the system is in the ranges of 22-80, 25-80 and 34-80 m^3/day respectively.

ii) The annual cost of the Reclamation System is less than both the groundwater source system and the public water source system; and the higher the designed capacity the higher the annual cost of all the three systems.

iii) The total unit production cost of the Reclamation System is least among the three systems; and the higher the designed capacity the lower the total unit production cost for groundwater source system and the Reclamation System whereas no change is felt in case of the public water source system.

iv) The ratio of the difference of the unit production costs for the ground water source system and the reclamation system to the unit production cost for the reclamation system decreases with the designed capacity. But in case of the public water source system, the ratio increases with the designed capacity.

6. Based on the assumptions listed in item No. 5, the total unit production costs of the Reclamation System at the capacities of 20, 40, 60 and 80 m^3/day are 1.15, 0.67, 0.51, and 0.42 ฿/m^3 respectively, whereas the operating costs are 0.61, 0.40, 0.31 and 0.25 ฿/m^3 respectively.

7. Based on the assumption listed in item No. 5 again, the total unit production costs of the public water source system at the capacities of 20, 40, 60 and 80 m^3/day are 2.60, 2.59, 2.58 and 2.58 ฿/m^3 respectively whereas in case of the groundwater source system the costs are

2.79, 1.51, 1.08 and 0.86 ₱/m^3 respectively at 100 m depth, 3.15, 1.68, 1.19 and 0.95 ₱/m^3 respectively at 150 m depth, and 4.24, 2.23, 1.56 and 1.22 ₱/m^3 respectively at 200 m depth.

8. In the Reclamation System, changes of a variable or an assumption listed in item No. 5 can significantly affect the unit production cost. The most significant variable affecting the unit production cost is the percentage of operation.

9. The effects of variable changes on the unit production cost can be listed as follow:

i) the total unit production cost will decrease with the service life;

ii) it will decrease with the percentage of operation;

iii) it will increase linearly with the maintenance cost;

iv) it will increase linearly with the interest rate; but

v) it will decrease with the percentage of output capacity.

10. If conditions listed in item No. 5 are varied one by one while all the rest are maintained, the unit production costs at the capacities of 20, 40, 60 and 80 m^3/day will vary as follows:

i) when the service life of the whole system is reduced to only 5 years, the costs will be equal to 1.86, 1.03, 0.79 and 0.66 ₱/m^3 respectively;

ii) when the percentage of operation is reduced to 40 %, the costs will be equal to 2.46, 1.33, 0.98 and 0.80 ₱/m^3 respectively;

iii) when the annual maintenance cost is increased to 5 % of the capital cost, the costs will be equal to 1.35, 0.77, 0.59 and 0.49 ₱/m^3 respectively;

iv) when the interest rate is raised to 12 %, the

costs will be equal to 1.31, 0.76, 0.58 and 0.48 ฿/m^3 respectively; and

v) when the percentage of output capacity is reduced to 50 %, the costs will be equal to 2.02, 1.11, 0.83 and 0.67 ฿/m^3 respectively.

It is interesting to note that even under such unfavourable conditions, the unit production cost of the reclamation system is still lower than the corresponding cost of both the groundwater source and the public water source systems as stated earlier in item No. 7.

It is understandably from the results obtained that the Reclamation System has the advantages over both of the existing systems. The costs derived can be exploited to serve as a guide-line in estimating no matter what conditions may prevail. They will also enable one to decide whether the utilization of the reclaimed wash-water is worthwhile or not.