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Domestic wastewater and excreta treatment

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1.0 INTRODUCTION

Kajang is a small town located about 25 kilometers south of Kuala Lumpur. Due to it's strategic location, the Kajang township has grown tremendously in the last ten years. Presently, it is the main trading, administrative, housing plus scores of other activities in Ulu Langat District. Figures 1 and 2 show the study area and the sampling locations respectively.

1.1 MATERIAL AND METHODS

The study was divided into four parts. The first part involves surveying the study area to identify the types of sewage treatment and domestic wastewater disposal systems for residential and business premises. The second part of the study was the analysis of water samples taken from the six sampling stations. The next part of the study was the water quality analysis of the effluent taken from three selected sewage treatment systems i.e an Imhoff tank, an oxidation pond and a septic tank. The Imhoff tank is located at Kampung Sri Jambu and it has been operating for six years. It serves a total of 26 houses. The oxidation pond selected for the study was located at Taman Kajang Baru and Sungai Jelok and it serves 523 houses. The effluent from the septic tanks was taken at Taman Mahkota from each individual houses.

The last part of the study was the analysis of domestic wastewater. The water samples were taken at the effluent pipe of Kajang Police Station Flats.

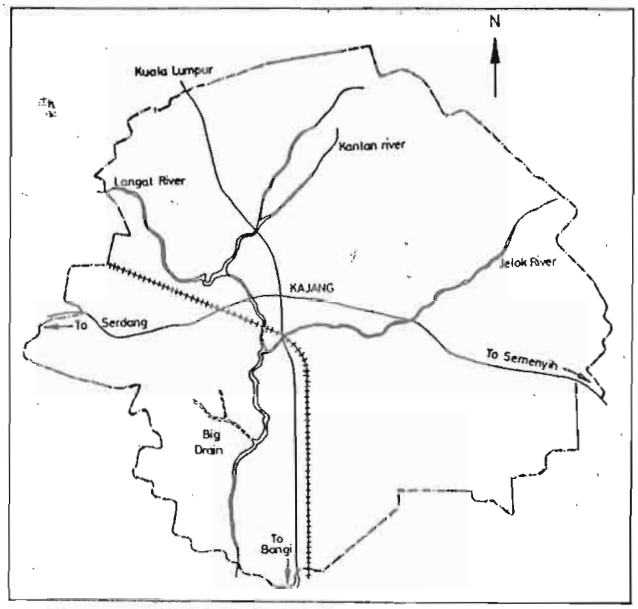

Figure 1 The area of study (Kajang Town)

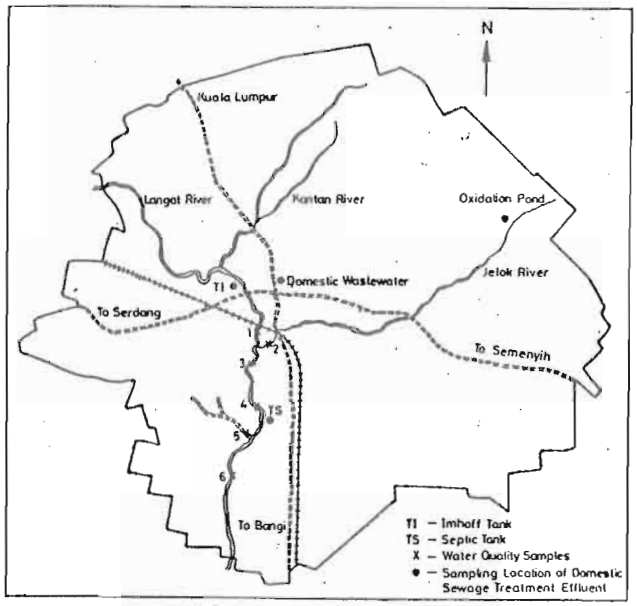

Figure 2 Sampling station on Langat River and wastewater effluent.

1.2 Water quality parameters

The parameters measured in the study are included temperature, pH, dissolved oxygen, conductivity, alkalinity, turbidity, 5-day B.O.D, total coliform, total nitrogen, C.O.D, suspended and dissolved solids. The parameters such as pH, temperature, dissolved oxygen and conductivity were measured in situ and whenever possible were verified in the laboratory. The other water quality parameters like suspended solids, total solids, biochemichal oxygen demand, chemical oxygen demand, alkalinity, turbidity, total nitrogen and total coliform were analysed in the laboratory. All analytical methods were based on Standard Methods (APHA, 1985).

2.0 RESULTS AND DISCUSSION

2.1 Sewage treatment systems

There are four types of treatment systems available. They are the septic tanks, Imhoff tanks, oxidation ponds and bucket laterines (night soil are later

treated by the Majlis Daerah Hulu Langat). However, a significant number of houses did not have any waste treatment system; raw sewage is released directly into the Langat River. Table 1 shows the number of houses with different treatment systems while Table 2 shows the water quality data for the whole study.

2.2 Sungai Langat water quality

On the average, the dissolved oxygen concentration was within the expected values except for sampling station number 5 which has dissolved oxygen levels of 3.4 mg/l i.e relatively low when compared with other stations. This low dissolved oxygen content might be due to the high organic load recieved from the huge moonsoon drain which is located upstream. This is more evident when we examined the BOD5 value of 22.1 mg/l, which is about 100 percent more than that of other stations.

The COD levels for all stations is within the range of 27.8 mg/l to 68.6 mg/l. However, station number 5 again showed the highest concentration. For dissolved and suspended solids all stations showed a high range of 42.8 mg/l to 152.4 mg/l for suspended solids and 86.0 to 226.8 mg/l for dissolved solids. As for organic nitrogen, station 5 showed the highest level with 13.0 mg/l. Station 5 recieve discharges from the monsoon drains which contain domestic wastewater and solid wastes. This tend to increase organic nitrogen concentration in the water (Witt et. al, 1974).

Other parameters worth mentioning here is total coliform where all stations showed high total counts. This indicates that the Sungai Langat is contaminated with fecal metaerial. At this juncture it is very important to know the sources of contamination, whether it is due to the inefficiency of the treatment systems or due to the disposal of untreated sewage into the river or both.

Let us now look at the effluent quality from various sewage treatment systems sampled (Table 3). From Table 3, shows that the oxidation pond has the highest dissloved oxygen value of 2.9 mg/l. Septic tank has the highest BOD5 value of 81.6 mg/l while that of oxidation pond has the lowest value of 31.5 mg/l.

The effluent from the septic tank has the highest dissolved solid concentrations while the lowest value is the effluent from the oxidation pond. As for turbidity, again the septic tank shows the highest value.

For the conductivity levels, the effluent from the oxidation pond has the highest value of 328 umho/cm while that of Imhoff tank show the lowest value 196 umho/cm.

Table 1 Number of Houses with Different Treatment Systems

Treatment Systems	Number of Areas	Number of Houses	% Total
1. Septic tanks	28	4162	75
2. Imhoff tanks	5	611	11
3. Oxidation ponds	1	523	9
4. Night soil	1	30	1
5. Pit laterine	-	220	4

Table 2 Water Quality at Different Sampling Stations

	Stations					
Parameters	1	2	3	4	5	6
D.O (mg/l)	7.5	6.6	7.5	8.6	3.4	7.1
BOD5 (mg/l)	7.2	9.6	7.8	6.7	22.1	10.2
COD (mg/l)	27.8	34.6	28.6	30.8	68.6	36.8
S.S (mg/l)	141.0	112.0	138.0	152.4	42.8	134.2
D.S (mg/l)	104.4	86.0	91.2	84.4	226.8	90.2
Turbidity (FTU)	67.8	63.2	63.0	63.4	39.0	60.0
Conductivity (umho/cm)	39.2	45.2	39.4	38.6	83.2	54.4
pH	6.7	6.8	6.7	6.7	6.6	6.8
Temperature (C)	26.6	26.6	26.6	26.6	25.8	26.6
Alkalinity (mg/l as CaCO3)	5.5	10.7	5.0	4.3	4.9	6.1
Total Nitrogen (mg/l)	8.2	3.8	8.9	5.6	13.0	5.1
Total Coliform (X 1000/100 ml)	1.1	1.5	1.3	1.0	1.5	1.1

D.O = Dissolved Oxygen
BOD5 = Biochemical Oxygen Demand (5 days)
COD = Chemical oxygen demand
S.S = Suspended solids
D.S = Dissolved solids

3.0 CONCLUSION

This study has shown that the effluent from wastewater treatment systems and domestic wastewater has increased the value of certain parameters in the Sungai

Table 3 Effluent Quality for Various Treatment Systems

	Treatment Systems			
	A	B	C	D
Parameters				
Dissolved Oxygen (mg/l)	0.7	2.9	1.6	0.7
BOD5 (mg/l)	80.0	31.5	35.2	81.6
COD (mg/l)	257.6	95.4	115.4	254.8
Suspended Solids (mg/l)	688.2	85.0	103.0	671.4
Dissolved Solids (mg/l)	312.8	117.4	248.4	363.0
Turbidity (FTU)	47.2	16.4	14.0	47.6
Conductivity (umho/cm)	196.0	328.0	296.0	206.0
pH	6.7	6.7	7.1	6.7
Temperature (C)	26.4	25.9	26.0	26.8
Total Coliforms (X 100 000/100 ml)	9.2	5.0	5.7	10.3

A = Imhoff Tank
B = Oxidation Pond
C = Domestic Wastewater
D = Septic Tank

Langat. Wastewater disposal into Sungai Langat had reduced the dissolved oxygen concentrations and conversely had increased the BOD. Pyrde (1974) had also shown similar pattern in his study. Depletion of dissolved oxygen levels may result in fish kills and other undesirable effects to Sungai Langat.

This study has also shown that a sizeable number of Kajang population used septic tanks for wastewater treatment. With proper maintenance, this type of treatment is quite good. Qualitative analysis of the effluents from the various treatment systems, showed the effluent from the oxidation ponds has the best quality having values of BOD, COD, suspended solids, dissolved solids and total coliforms of 31.5 mg/l, 95.4 mg/l, 85 mg/l, 117.4 mg/l and 50,300 counts/100 ml respectively.

It is therefore recommended that Kajang township should upgrade their wastewater treatment facilities in order to reduce the organic loads from the wastewater to the Sungai Langat. It is also recommended that oxidation ponds be selected as a suitable the treatment systems since it has been shown to have the best effluent quality.

4.0 BIBLIOGRAPHY

1. American Public Health Association. Standard Methods for the Examination of Water and Wastewater. APHA, New York, 16th Edition, 1985.

2. Pyrde L T. Environmental Chemistry: An Introduction. Lummings Publishing Company, Men Lo Park, California, 1973.

3. Witt M. et. al. Rural Household Wastewater Charaterization; Home Sewage Disposal. Proceeding of the National Home Sewage Disposal Symposium, ASEA, Michigan, 1974.

SESSION II
WASTEWATER TREATMENT

Chairman: Associate Professor Dr Fauzi bin Abdul Samad
Deputy Dean, Research & Consultancy Unit
Universiti Teknologi Malaysia

PAPERS PRESENTED

NIK FUAAD NIK ABLLAH
Package treatment plant utilizing RBC

Dr R AHMAD, R ABDUL AZIZ and A HUSSEIN
Palm oil mill effluent treatment

Dr A SUKI, H JENNY and MD RASHID
Efficiency of oxidation ponds

NASIMAN SAPARI
Municipal wastes disposal in ground water

MOHD PAUZI ZAKARIA and MD FIAH BIN MD JAMIN
Domestic wastewater and excreta treatment

DISCUSSION

NIK FUAAD NIK ABLLAH

1. Professor BLAKEBROUGH commented that RBCs were not an attractive visual feature of householders' compounds compared with underground septic tanks. He asked if they would give rise to odour problems.

2. Mr NIK FUAAD explained that RBCs could also be situated underground. Reinforcement needed to be provided in peripheral walls. If properly maintained, RBCs produced less smell than oxidation ponds, percolating filters and septic tanks.

3. Mr KOLSKY asked if there was any information on treatment efficiency in terms of pathogen or bacterial removal. He suggested that the first responsibility of public health engineers, in considering treatment efficiency, must be in terms of pathogen removal and not the removal of COD or ammonia. In public health terms it is not clear that RBC systems are an improvement on bucket systems as pathogens may not be removed before their dispersion into the environment. Pit privies may be preferable in at least isolating the waste. He asked how it was intended to dispose of the effluent.

4. Mr NIK FUAAD replied that they had not investigated the bacterial removal efficiency but said that did not mean this system did not have the ability to remove bacteria. Organic matter was just as important since it could cause water pollution and could cause the rivers to die.

5. Mr KOO HOCK SONG commented that Majlis Perbandaran Pulau Pinang had approved the installation of an RBC package treatment plant at Wayton Development, Paya Temboing. It was in operation and the effluent quality was good but this may be because it had not been loaded to its design capacity. Sludge would be removed by the Council on request until the plant was handed over to the Council for maintenance. However, Mr Koo considered that the RBC was not suitable for small developments.

6. Mr NIK FUAAD said the RBC had been proven to be an efficient treatment system for large or small housing schemes but was probably not economical for less that 100 units due to its high capital and running costs. He explained that their efforts had been to produce a compact on-site treatment plant. The RBC had many advantages although it was expensive to operate.

7. Mr RICHARDSON asked if there was any information on capital and operating costs of RBCs in Malaysia.

8. Mr NIK FUAAD replied that the one that had been assembled had cost about M$4000. If they were mass produced the capital cost should be about M$2000. The operating cost would be approximately M$3.00 per month for electricity for the motor only.

9. Mr RICHARDSON also wished to know if there was any practical experience of their application in Malaysia, excluding research.

10. Mr NIK FUAAD stated that there were several used for small housing schemes. In Penang State there were three in operation.

Dr R AHMAD

1. Mr PIGGOT presumed that, as the peat used in the process was readily available cheap material, regeneration may not be cost effective or necessary. He wished to know what consideration was being given to the disposal of colour and metal contaminated spent peat.

2. Dr AHMAD explained that the peat could be regenerated by an acid treatment process. In the case of metal contaminated spent peat, the regeneration process was relatively cheaper than producing freshly prepared modified peat. Colour contaminated spent peat could also be reactivated but that was less viable.

Dr A SUKI

1. Mr HUTTON noted that in Table 1 the first tritium count was measured after 40 hours and asked if this was the first sample. He asked if Dr SUKI had considered the work of Mr J P Arthur published by the World Bank. (ARTHUR J P. Notes on the design and operation of WSP in warm climates of developing countries, UD Technical Paper No 6, World Bank Publication 1983). He said that tritium is a useful tracer for tank hydraulics and suggested it could be used for future modifications made to tank design.

2. Dr SUKI said the first point/sample count was after 24 hours. He had not considered the work of J P Arthur but would make a note of it. He said he intended to carry out tracer studies with tritium for further studies on tank design modifications.

3. Dr KAWAMURA asked for some information about the effluent standards of some typical parameters, for example, from wastewater plants of industrial and residential areas.

4. Dr SUKI explained that there were three effluent discharge regulations in Malaysia. One was specifically for the rubber industry, another was for the palm oil industry and the third was for other industries, including the discharge from sewage treatment works. For the sewage effluent there were two standards A and B. The former was for rivers used as drinking water sources and the latter for rivers not used for drinking water sources downstream. The BOD levels for standards A and B were 25 and 50 mg/l respectively and the COD levels 50 and 100 mg/l respectively. The level for SS was similar to that of COD.

5. Mr TANG commented that in the paper it was mentioned that the ponds studied regularly failed to meet the standard A requirement. What would the author anticipate if the retention time was, say, doubly increased, ie from 9 days to 18 days for Wardieburn STP.

6. Dr SUKI replied that increasing the retention time may not be a good way to meet the standard. The difficult standard to meet was the COD and SS values and this would not necessarily improve with long retention time as the problem was mainly due to algae growth. The BOD removal could be improved with retention time. This was best carried out by improving the hydraulics and reducing short circuiting. There was no point in increasing the pond size if there was serious short circuiting. In this case the actual mean residence time could still be quite short.

7. Mr TSEN wished to know how to design an oxidation pond to comply with the Malaysian Effluent Discharge Standard A under Malaysian conditions.

8. Dr SUKI explained that with a better pond design in terms of flow it was possible to remove/reduce BOD to the standard A requirement. However, it was difficult to remove/reduce COD and SS because with the present process algae was not removed. A process to do this was still being studied.

MOHD PAUZI ZAKARIA

1. Dr COTTON wished to know if the septic tank effluent discharged into the river, or into soakaways. He commented that oxidation ponds would only be the optimum solution if septic tank effluent went to the river. In addition, oxidation ponds required a local sewerage network which had be incorporated into the cost benefit analysis.

2. Mr MOHD said that the septic tank effluent was discharged into the river. He agreed with Dr COTTON's other comments.

3. Mr KOLSKY asked if there was any reason why total coliforms were used as a measure in preference to fecal coliforms.

4. Mr MOHD said there was no reason for this.

5. Mr KOLSKY queried how one could conclude that oxidation ponds were effective treatment in comparison with other systems of treatment, without knowing the influent concentrations.

6. Mr MOHD said that he was only looking at the effluent quality and not the efficiency of the treatment systems.

7. Mr PIGGOT commented to all the authors in this session that the general practice in Asia was to connect septic tanks directly to monsoon drains/watercourses. This practice was strongly discouraged by WHO etc. He also said that proliferation of single household treatment plants (RBC, small dissolved air extended aeration plants etc) could be a major operations and maintenance problem for the future.