BIOLOGICAL - EXTENDED PHYSICO - CHEMICAL TREATMENT OF WASTEWATER

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TREATMENT OF WASTEWATER

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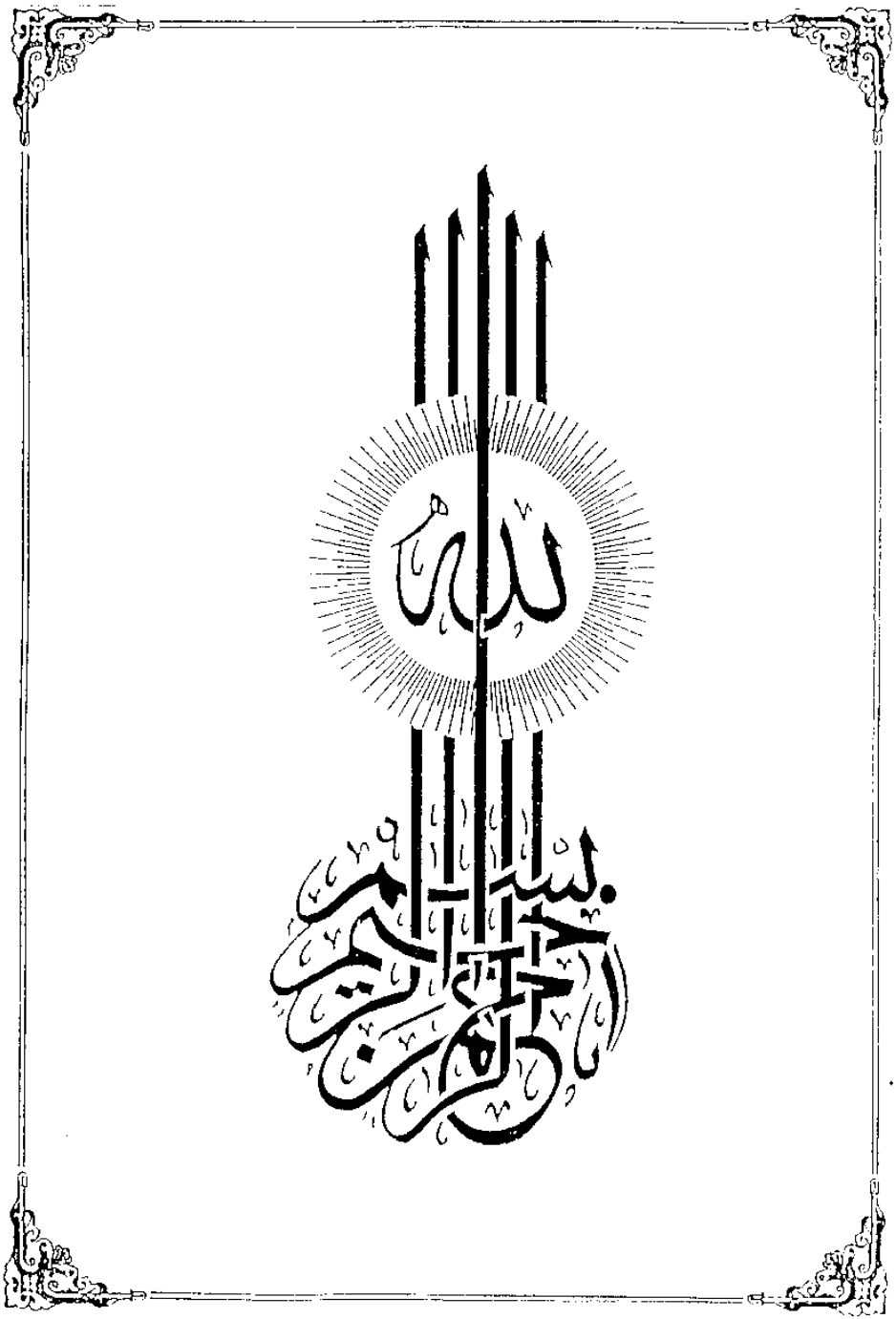

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ABBREVIATIONS AND SYMBOLS

BOD	Biochemical oxygen demand.
BOD (sol.)	Dissolved biochemical oxygen demand.
BOD_T	Total biochemical oxygen demand.
COD	Chemical oxygen demand.
COD (sol.)	Dissolved chemical oxygen demand.
ECD	Electron capture detector.
FID	Flame ionization detector.
m g d	Million gallon per day.
mg/l	Milligram per litre.
NSBE	Non-settled biological effluent.
P	Phosphorus.
RBC	Rotating biological contactor.
Res.	Residual.
r.p.m.	Rotation per minute.
R (%)	Removal percentage.
SBE	Settled biological effluent.
SS	Suspended solids.
S.V.I	Sludge volume index.
TR	Total residue.
VOM	Volatile organic matter.

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Summary

SUMMARY

It is now becoming evident that recycling and reuse of water should be given more consideration specially in arid and semi-arid areas. We can no longer afford the indiscriminate waste of our natural resources, neither should we accept the uncontrolled disposal of wastes.

Experience has, however, shown that health requirements must be given very careful attention from the initial planning stages to ensure that adequate health criteria are established to meet various water use objectives.

Reuse of municipal wastewater for agricultural irrigation is one of the oldest forms of water reclamation. In order to reduce the health risks associated with wastewater reuse in agriculture, the following three strategies are recommended:

The first is by various methods of treatment of wastewater before agricultural use in order to remove or reduce the number of pathogenic micro-organisms. The second involves various irrigation techniques to reduce or prevent direct contact between the crops and the wastewater. The third involves regulation of the type of crops or other forms of agricultural use; so that the risk of disease transmission is minimized.

The main goal of this study was limited to the first strategy. The overall objective was therefore, to produce,

based on local environmental conditions, engineering design data for domestic wastewater treatment.

It was decided to choose a biological treatment system with low power consumption. Low maintenance & operating skill requirements and ability to give the desired degree of treatment for this purpose a rotating biological contactor was selected to achieve the following specific objectives:

- To define the effect of the operational variables that could influence treatment efficiency. The understanding of the effects could contribute to the improved design and operation os such treatment systems.
- To determine the interactions between the variables.
- To formulate the relationship among the treatment efficiency and organic loading.

Being aware that biological treatment is not fully capable of removing harmful chemicals or microorganisms, the biological contactor was followed by chemical coagulation and/or chlorine disinfection.

Experimental investigations have been carried out on a pilot scale plant. It consists of primary, secondary and tertiary treatment. Assembling and operation of the pilot plant took place at a site of the National Research Centre (Dokki, Cairo) within a residential area where a connection to the sewerage system was available.

The primary treatment consists of:

1- Coars screen (20 mm bar width)

2- Fine screen (1.5 mm openings)

3- Pump sump.

4- Sedimentation tank (circular)

(i) Diameter 1.6m

(ii) Depth 1.0 m

The secondary treatment was a four stage Rotating Biological Contactor. Each stage consists of a 2-m diameter 25-discs which are fabricated from expanded polystyrene beeds. The total surface area of the entire unit was 628 m^2. The disks were rotated at 2 r.p.m. with approximately 45% of the surface area submerged in the wastewater. The total liquid volume of the system was 9.62 m^3.

The chemical treatment consists of one coagulation-flocculation unit and one chlorination reactor to be operated either separately or in series. The coagulants examined were ferric chloride and calcium oxide.

The chemical treatment units were designed for a 0.25 m^3/h effluent to be chosen from one of the four cascades.

The system was operated from November 1982 to Nov. 1985. During these three years, several series of experiments were conducted. The influent to the system and the effluent from each stage were monitored by collecting 24-hour composite samples at 20-minutes intervals during the period of steady-state operation.

To determine optimum operating conditions required to produce an effluent of the requisite standards for final disposal or reuse daily as well as seasonal variations in physico-chemical characteristics of sewage in the project area were determined.

Available data showed a wide variation in sewage characteristics. BOD_5 ranged from 224 to 855 with an average value of 502 mg O_2/l . Corresponding COD values were 409, 2338 & 1108, respectively.
In general sewage strength is above normal. A situation which may be attributed to low water consumption.

To assess the impact of the organic load applied to the system on the quality of the treated effluent, two organic loads were examined. The first ranged from 16.8 to 46.7 and the second ranged from 1.1 to 14:4 g. BOD/m^2/d.

The data obtained from the combined treatment of settled sewage may be summarized as follows:

1- Increasing the organic load applied to the system within the examined range exerted a slight effect on carbonaceous matter elimination BOD & COD removal values up to 94.9 & 95 percent were recorded. On the other hand, organic nitrogen removal was only around 48% and no nitrification took place.

2- To achieve high nitrification levels, ammonia load should not exceed 1.4 g NH_3-N/m^2/d. Also, high detention time is required.

3- Effective removal of the organic compounds present in the RBC effluent could be achieved when lime or ferric chloride were used at their optimum dose and without chaving the pH of the effluent. In addition the coagulation-flucculation process achieved significant removal of the phosphorus responsible for eutrophication in case of disposal by dilution.

4- Chemical treatment was slightly affected by increasing the organic load applied to the RBC.

5- Chlorination of RBC effluent brought about considerable reduction in viable bacterial counts pathogenic microorganisms. The results obtained showed that at constant chlorine dose of 15 mg/l, reauction in tested parameters is proportional to the detention time.

Percentage reductions in total bacterial counts, at 22°C and 37°C, total coliform counts and yeast counts were 99.6, 99.1, 99.8 & 96, respectively.

6- Chlorination resulted in the appearance of new chlorinated products & decrease in the concentration of some organic compounds.

Introduction and Literature Review