NATIONAL WORKSHOP ON DESIGN, CONSTRUCTION
AND MAINTENANCE OF STABILIZATION PONDS
AND SEWERAGE SYSTEMS.

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OPERATIONAL CONTROL OF WASTEWATER STABILIZATION PONDS.

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INTRODUCTION

The operation of waste stabilization ponds is simple as compared with that of an activated sludge or trickling filter plant but it can not be neglected for very long. The waste stabilization pond system must operate continuously under all types of adverse conditions. Regular maintenance is necessary because it can rapidly become a liability if it is not properly handled. For effective operational control there is a need to specify maintenance practices and provide the funds for the purpose. The funds are required for repairs and for salaries that will attract competent and keen operators. This paper presents the data requirements and operational activities needed for the performance evaluation and proper functioning of waste stabilization ponds.

START-UP OF PONDS

The general plan of operation must include a programme of filling the pond and initiating stabilised operational conditions. A pond will not immediately accept the full load for which it is designed and an adjustment period equivalent to several detention periods may be required. Anaerobic ponds will operate most effectively at the start if some well digested sludge is placed in them. This sludge will provide the necessary seed organisms and an initial buffering capacity. If it is not possible to add digested sludge as a seed, it will be necessary to develop an environment

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conducive to methane fermentation. When the settleable solids are subjected to anaerobic environment, acid fermentation is followed by the desired alkaline fermentation phase. pH should be controlled between 6.5 to 7.0 during the acid fermentation phase while the pond is undergoing to methane fermentation phase.

Facultative ponds should be filled gradually during the initial start up. Initially the ponds should be filled upto a depth of about 15 to 30 cm only. Each day thereafter only a small quantity of raw sewage may be admitted to maintain the above level, till such time as algal growth establishes itself gradually. Alternatively the facultative pond is filled rapidly with wastewater to a depth of about 1 meter and then left undisturbed for a petiod of 10 to 20 days or until the pond turns greenish or bluishgreen. After the algal bloom has established itself further raw sewage may be admitted gradually till the entire pond is filled up. The pond may then be allowed to rest for 2 to 3 days to ensure that algal growth has firmly established itself. When the ponds develope a true greenish colour, the inlets and outlets are opened to accept the design loads.

TOOL AND MATERIAL REQUIREMENTS

For proper operation and maintenance a certain number of hand tools are required. The operator to whom they

are supplied should be responsible for their proper use and maintenance. The hand tools that may be most useful include lawn mowers, rakes, axes, spades, wheelborrows, saws, claw hammers, measuring taps,pliers., screwdrivers, wire cutting pliers, metal shears, pipe cutters, pipe seamers, pipe wrenches and scrubbing brushes. It may also be desirable to provide a potable petrol driven pump, light and heavy duty hoses, a potable insect spray applicator, a small rowing boat, grease guns, suitable grease and oils, a supply of paints and a stock of certain spare parts that are not readily obtainable.

STAFF REQUIREMENTS

The staff required for operation and maintenance is generally limited to the need of an operator (supervisor) and an adequate number of helpers or sweepers to assist in keeping the pond area clean and dressed. A suggested staff list by Arceivala for India is reproduced in Table 1 and can be used as a guideline.

Table-1

Population served	Operational Staff	
	Supervisor	Helper/Mali/Sweeper/Attendant
5,000	-	2
10,000	-	3
50,000	1	6
100,000	1	8

WHO (1987) suggests that one man should be able to manage with all the labour that is necessary to operate a pond serving about 20,000 people. A second operator would be required for a population up to 50,000. When pump houses exist, the pump operators can be conveiniently trained to inspect and look after the ponds in addition to their duties at the pump house.

OPERATIONAL ACTIVITIES

The operation and maintenance of waste stabilization ponds is generally so simple that it tends to be neglected. Therefore some vigilence on the part of the authorities is needed to ensure that the pond is well operated and maintained and the expected performance is attained. The day-to-day operational requirements may range from mere superficial inspection in case of small units to more elaborate requirements such as sampling, determination of BOD and other parameters and measurement of flow etc.

A small laboratory-cum-store housed in a single room in the immediate vicinity of the plant is desirable to accomplish rudimentry tests. The plant operator should be trained to perform simple laboratory investigations such as reading of thermometer, a flow meter, an Imhoff cone, a pH meter or indicating paper. This work will keep the operator

busy, happy and feel important. The plant operator should be trained to collect and label the samples from the pond as and when required to be sent to some other laboratory for examination.

In order to detect any abnormality in the plant operation the operator should walk around each pond at least once a day to note the general condition of the pond with special reference to odour and colour. A change in odour and colour may be pointer to a major change in the performance of the ponds and thereby help in taking preventive measures.

Embankments should be checked for seepage. They should be regularly inspected for erosion due to wind, wave action or surface runoff. Any necessary repairs to the embankments must be made immediately after the damage occurs. Inlets and interpond connections should be checked for clogging.

Trees will interfere with the performance of the ponds. Large trees will impede the natural wind action and may reduce the light intensity at surface of the pond. Moreover, leavesfalling into the pond will interfere with photosynthetic process, add to the BOD load and possibly create insect control problems. Whenever possible, large trees with in 40-60 m off the pond embankment should be removed.

Odoursare frequently associated with the decay of algal mats that have been blown to the banks or corners. Sludge mats also may rise from the bottom during periods of high water temperature to produce odours. Under anaerobic action, fermentation of the pond contents gives off hydrogen sulfide producing objectionable odours in the vicinity. A high content of sulphur in the waste has thus significant role in the production of odours.

Algal blooms occur very often in summer months. These produce a strong withdrawl of dissolved carbondioxide and bicarbonates and raise the pH in excess of 10. Such a high pH inhibits the bacterial activity and thus lowers the pond efficiency. In addition, heavy blooms of algae increase the turbidity of water and hence limit penetration of light and production of oxygen. In the pond effluent the algae present an additional pollutional load.

The degree of mosquito infestation in a pond is in direct proportion to the extent of emergent vegetation. Breeding of mosquitoes, flies and other insects is supported by the weeds that are found around poorly maintained and poorly constructed ponds. The floating scums are also helpful in promoting the growth of mosquitoes and other insects. Weeds normally grow around the shallow waters on the wet part of the inner slopes and also on the islands of silt and

sludge builtup under the inlet position. They also attract frogs, rodents and snakes. If water weeds are not periodically removed they may even affect the safety of the embankments through rats which are reported to dig tunnels thus causing embankments to collapse.

The above mentioned operational problems can be solved through careful operation and maintenance of the ponds. In the following section problems associated with various types of ponds are discussed separately.

Operational Problems of Anaerobic Ponds

In anaerobic ponds, the following disorders are of importance.

1. Odours

Anaerobic ponds are susceptible to odours. The odours are generally associated with high volumetric loading and low detention periods. The problems may be severe when volumetric loading exceeds 400 gm BOD per m^3 per day (WHO, 1987). Odours may also result due to the presence of toxic substances or inhibitors in the influent due to the inclusion of an industrial waste. Similarly a sudden drop in pH may also result in odours.

The solution to the odour problem lies in many ways. For example, the recirculation of a warm facultative or maturation pond effluent at the rate of one sixth of the incoming raw sewage over the surface of the anaerobic pond may be quite effective in reducing the odours. Spraying the effluent on the surface crust of sludge will also decrease the fly nuisance. However recycling is a costly technique and is not normally recommended for the treatment of domestic waste (ELLIS, 1980). The addition of lime to the influent has also been reported to help sometimes binding the hydrogen sulfide gas and neutralizing organic acids produced by acid fermentation. The pH must be raised to above 8 for an effective odour control. Another economical way to counter the odour problem would be to keep the scum layer on the surface of the pond. The scum mat would prevent the escape of malodorous gases into the atmosphere, (WHO,1987).

2. Mosquitoes and Other Insects

In anaerobic ponds the growth of weeds and grass inside the pond and the floating scum layer left for odour control purpose support the growth of mosquitoes and flies. Therefore the eradication of grass and weeds on regular basis is very necessary. In addition spraying pesticides, such as DDT, upon the scum layer is also quite effective for killing mosquito larvae. However care should be taken to avoid pesticide getting into the liquid mass.

In certain cases stirring up of the floating scum to cause larvae to drown has proven effective. However the technique can only be applied where odour problem is not intensive.

3. Weed Growth

Weeds must be eleminated periodically by cutting or using a herbicide. Elemination of weeds with sodium arsenite at a rate of 20g/sft has been reported by EPA,(1977). The cut plants must not be permitted to float on the pond for this will provide shelter to the mosquitoes. The weeds can best be controlled by the use of concrete slabs which are placed above and below the water line on the sloping banks. Such an arrangement would also protect the banks against wave erosion (ELLIS, 1980). In place of slabs, a rip rap 0.15 m thick and one meter wide laid by hand without mortar can also be employed although it is less effective at weed control. Rip raps are likely to entrap grease and other floating materials and it is for this reason that brick lining, at higher cost, is preferable to serve the purpose.

Operational Problems in Facultative and Maturation Ponds

Among the most annoying problems in facultative ponds are scum, odour and insest breeding.

Floating materials such as paper, plastics, oil and grease and algal mats may accumulate on the pond surface.

Fortunately wind drifts algal mats and other floating materials to one side of the pond from where these may be removed by a long handed rake. A water jet may also be helpful to disperse or sink the floating mats.

Odours in facultative ponds are likely to result due to overloading and short circuiting caused by wind action or silting. Overloading is always simultaneous with pH drop, a reduction in dissolved oxygen concentration and an effluent colour change from green to yellowish green. In addition gray patches may appear on the green surface of the pond. The remedy for overloading is to take the affected pond out of operation till it recovers. In the meanwhile the influent is either by passed or directed to the next parallel unit. To avoide short circuiting, a part of the effluent may be recirculated to the inlet by means of a transportable pump. If short circuiting is due to the excessive silting in the pond, the pond contents may be drained for desludging purposes.

Insects and mosquito breeding in facultative and maturation ponds may be overcome by similar methods as discussed for anaerobic ponds. In addition, scum destruction by a jet of water may prove effective. In the case of maturation ponds, depending upon the dissolved oxygen concentration available, special kind of fish may be reared for feeding

on larvae. The department of fisheries can be consulted for the type of the fish suitable for the purpose. Experience at IPHER pilot scale waste stabilization ponds indicates that with proper maintenance of the facility, the mosquito problem could satisfactorily be eleminated.

REFERENCES

WHO (1987) Wastewater Stabilization Ponds - Principles of Planning and Practice
WHO/EMRO Technical Publication No. 10

Ellis, K.V. (1980) Stabilization Ponds, Effect of Climate, Design Criteria, Land Requirements.
Waste Stabilization Ponds Design and Operation, WHO,EMRO Technical Publication No.3.

Ellis, K.V. (1980) Stabilization Ponds-Water Quality Preliminary Treatment and Pre-treatment.
Waste Stabilization Ponds Design and Operation
WHO, EMRO Technical Publication

Arceivala, S.J., et.el., (1970). Waste Stabilization Ponds. Design, Construction and Operation in India, CPHERI, Nagpur, India.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA), (1977)
Operations Mannual-Stabilization Ponds
Office of Water Programme Operations,
Washington D.C., USA.