8

Operation and maintenance

8.1 START-UP PROCEDURES

Pond systems should preferably be commissioned at the beginning of summer so as to establish as quickly as possible the necessary microbial populations to effect waste stabilization. Prior to commissioning, all ponds must be free from vegetation. Facultative ponds should be commissioned before anaerobic ponds: this avoids odour release when anaerobic pond effluent discharges into an empty facultative pond. It is best to fill facultative and maturation ponds with freshwater (from a river, lake or well; mains water is not necessary) so as to permit the gradual development of the algal and heterotrophic bacterial populations. If freshwater is unavailable, facultative ponds should be filled with raw sewage and left for three to four weeks to allow the microbial population to develop; a small amount of odour release is inevitable during the period.

Anaerobic ponds should be filled with raw sewage and seeded, where possible, with digest*ing* sludge from, for example, an anaerobic digester at a conventional sewage treatment works or with sludge from local septic tanks. The ponds should then be gradually loaded up to the design loading rate over the following week (or month if the ponds are not seeded). Care should be taken to maintain the pond pH above 7 to permit the development of methanogenic bacteria, and it may be necessary during the first month or so to dose the pond with lime or soda ash. If, due to an initially low rate of sewer connections in newly sewered towns the sewage is weak or its flow low, it is best to by-pass the anaerobic ponds until the sewage strength and flow is such that a loading of at least 50 g/m^3 d can be applied to them. (It is also necessary to by-pass an anaerobic pond whilst it is being desludged (Section 8.4), so the by-pass should be a permanent facility: see Section 7.7).

8.2 ROUTINE MAINTENANCE

The maintenance requirements of ponds are very simple, but they must be carried out regularly. Otherwise, there will be serious odour, fly and mosquito nuisance. Maintenance requirements and responsibilities must therefore be clearly defined at the design stage so as to avoid problems later. Routine maintenance tasks are as follows:

(a) removal of screenings and grit from the inlet works;

(b) cutting the grass on the embankments and removing it so that it does not fall into the pond (this is necessary to prevent the formation of mosquito-breeding habitats; the use of slow-growing grasses minimises this task – see Section 7.2).

(c) removal of floating scum and floating macrophytes, e.g. *Lemna*, from the surface of facultative and maturation ponds (this is required to maximize photosynthesis and surface re-aeration and prevent fly and mosquito breeding);

(d) spraying the scum on anaerobic ponds (which should not be removed as it aids the treatment process), as necessary, with clean water or pond effluent, or a suitable biodegradable larvicide, to prevent fly breeding;

(e) removal of any accumulated solids in the inlets and outlets;

(f) repair of any damage to the embankments caused by rodents, rabbits or other animals; and

(g) repair of any damage to external fences and gates.

The operators must be given precise instructions on the frequency at which these tasks should be done, and their work must be constantly supervised. The supervisor/ foreman should be required to complete at weekly intervals a pond maintenance record sheet, an example of which is given in Figure 8.1. The operators may also be required to take samples and do some routine measurements (see Section 9).

8.3 STAFFING LEVELS

In order that the routine O&M tasks can be properly done, WSP installations must be adequately staffed. The level of staffing depends on the type of inlet works (for example, mechanically raked screens and proprietary grit removal units require an electromechanical technician, but manually raked screens and manually cleaned grit channels do not), whether there are on-site laboratory facilities, and how the grass is cut (manually or by mechanical mowers). Recommended staffing levels are given in Table 8.1 for WSP systems serving populations up to 250,000; for larger systems the number of staff should be increased *pro rata.*

Table 8.1 Recommended staffing levels for WSP systems

Population Served	10,000	25,000	50,000	100,000	250,000
Foreman/ Supervisor	-	-	1	1	1
Mechanical engineer[a]	-	-	-	1	1
Laboratory technician[b]	-	1	1	1	2
Assistant foreman	-	1	2	2	2
Labourers	1	2	4	6	10
Driver[c]	-	1	1	1	2
Watchman[d]	1	1	2	3	5
Total	2	6	11	15	23

[a] Dependent upon amount of mechanical equipment used.
[b] Dependent upon existence of laboratory facilities.
[c] Dependent upon use of vehicle-towed lawn mowers, etc.
[d] Dependent upon location and amount of equipment used.

Source: Arthur (1983).

POND MAINTENANCE RECORD SHEET

Pond location: .....

Date and Time:..... Air temperature:.....°C

Weather conditions: .....

Pumping station (if there is one):

- elapsed time meter reading: No. 1..... No. 2.....
- electricity meter reading: .....
- observations: (flooding) .....

.....

Access road: state (vegetation, damage) maintenance carried out .....
.....
.....

Pond site: state; maintenance carried out .....
.....
.....

Pretreatment works: state; maintenance carried out
- screen(s):.....
- other (grit, grease removal):.....

VISUAL INSPECTION OF PONDS

POND NUMBER	1	2	3	OBSERVATIONS
Colour of water (green, brown/grey, pink/red, milky/clear)				
Odour				
Scum, foam				
Rooted macrophytes				
State of embankments (erosion, rodent damage, vegetation)				
Inlet and outlet (blockage)				
Water level (high, normal, low)				

GENERAL OBSERVATIONS, other maintenance carried out: .....
.....

Figure 8.1 Example of a routine pond maintenance record sheet (CEMAGREF, 1985)

8.4 DESLUDGING AND SLUDGE DISPOSAL

Anaerobic ponds require desludging when they are around one third full of sludge (by volume). This occurs every n years where n is given by:

$$n = V_a/3Ps \quad (8.1)$$

where V_a = volume of anaerobic pond, m^3
P = population served
s = sludge accumulation rate, m^3/ caput year

A slightly conservative value for s is 0.1 m^3/caput year. This value is suitable for winter temperatures below ~ 10°C; at higher temperatures lower values may be used (for example, 0.04 m^3/caput year at 20°C). Mara (1993) showed that the desludging interval can be calculated from:

$$n = r\,B / \lambda_v\,s \qquad (8.2)$$

where r = fraction of pond full of sludge prior to desludging
B = BOD contribution, g/caput day
λ_v = design volumetric BOD loading, g/m^3 day

Thus, for example, with B = 50 g/caput day and λ_v = 100 g/m^3 day, desludging could be done every second year when the pond was 40 percent full of sludge. The precise requirement for desludging can be determined by the "white towel" test (Section 9.2), but it should be borne in mind that a task to be done every year has more chance of being done on time than one to be done at less regular intervals.

Sludge removal can be readily achieved by using a raft-mounted sludge pump. These are commercially available (e.g. Brain Associates Ltd., Narberth, Pembs., SA67 7ES, UK); or they can be assembled locally (Figure 8.2 shows one such unit being used on a primary facultative pond in France). The sludge is discharged into either an adjacent sludge lagoon or tankers to transport it to a landfill site, agricultural land or other suitable disposal location. Although pond sludge has a better microbiological quality than that from conventional treatment works, its disposal must be carried out in accordance with any local regulations governing sludge disposal.

Figure 8.2 Pond desludging in northern France using a raft-mounted sludge pump. Detail: sludge suction head