PROGRAMME OBJECTIVE SERIES:
PROBES/81/2001-2002

GUIDELINES FOR MANAGEMENT, OPERATION AND MAINTENANCE OF COMMON EFFLUENT TREATMENT PLANTS

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FOREWORD

The scheme for Common Effluent Treatment Plants (CETP) has been evolved to provide cost-effective methods for treatment of effluents generated from clusters of small scale industries and in industrial estates. For effective performance of CETPs, it is necessary to ensure proper operation and maintenance of various constituents in this system.

The Central Pollution Control Board, studied the performance of various CETPs in different parts of the countries. Based on such studies, the "Guidelines for Management, Operation and Maintenance of CETPs" have been prepared. It is in sequence to the "Guidelines for Health & Safety of Workers in Wastewater Treatment Facilities", brought out by the Central Pollution Control Board.

My collegues Sh. N.K. Verma, Additional Director and Dr. D.D. Basu, Senior Scientist have collated the relevant information for bringing out this publication.

We hope, the guidelines will be useful to various stakeholders including the owners and operators of CETPs, funding agencies and regulatory bodies.

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CONTENT

LIST OF ANNEXURES

1.0 Management System

In order to ensure smooth functioning of the Common Effluent Treatment Plants (CETPs), there is a need for a comprehensive management plan. The management system shall comprise the following components:

a) Membership to the CETP
b) Wastewater collection system
c) Monitoring and performance of treatment units
d) Manpower requirement
e) Maintenance

2.0 Membership to the CETP

In India, there are of three types of CETP management existing - (i) private entrepreneurs, (ii) co-operatives and (iii) Govt. undertakings (State Industrial Development Corporations). In all cases the CETP Management shall submit the list of member units alongwith the affidavit of the each member units to the State Pollution Control Board (SPCB). In case of defaulting members, the CETP Management shall draw the attention of concerned SPCB, before expiry of membership. Without the consent of concerned SPCB, disqualification of membership shall not be done by the CETP Management. In the affidavit, each member unit shall furnish the wastewater flow (cubic meter per day) to be sent to CETP alongwith analytical report for the wastewater quality, its willingness to participate and commitment for paying fee/charges as fixed by CETP Management. Once the affidavit is submitted to concerned SPCB, the SPCB shall issue consent to the individual members for discharging their effluent as per the flow and characteristics of wastewater as indicated in the affidavit to the CETP Management. The CETP Management in turn shall take the consent from concerned SPCB for final disposal of treated effluent from CETP. The CETP Management shall evolve norms of accepting the effluents from the constituent members based on the design of CETP and the influent quality taken into consideration for design purpose Where CETP receives wastewater (effluent) exceeding the above treatment norms, the following penal charges shall be imposed.

a) *First Offence*: The CETP management shall be authorised to impose a penal charge of Rs. 1 per mg/l of critical pollutant for treatment (BOD in case of biological treatment plant) in

excess over the norms set for influent. This shall be subjected to a maximum of Rs. 5,000/day.

b) *Second Offence*: The CETP management shall be authorised to impose a penal charge of Rs. 2 per mg/l of critical pollutant in excess over the norms. This shall be subjected to a maximum of Rs. 10,000/ day.

c) *Third and subsequent Offence*: CETP management shall be authorised to impose a penal charge of Rs.4 per mg/l of critical pollutant over the norms. This shall be subjected to a maximum of Rs. 20,000/day. In case of subsequent offence (more than three), the CETP Management shall invite the attention of concerned SPCB and appeal for discontinuance of membership. SPCB in turn is required to take action under Water (Prevention & Control of Pollution) Act, 1974.

3.0 Collection System

It has been observed that there are two types of collection systems existing in our country. One is by transportation of wastewater through tankers and other by laying sewer/pipe lines. The following norms shall be considered for the both collection systems:

(i) ***Conveyance systems***: The major objective of the conveyance system through sewers/pipelines is to protect the sewer/pipeline from corrosion & silting/choking & explosion besides ensuring the compliance of pre-treatment standard for discharge of effluent into CETPs. Each industry shall have a collection tank within their premises before discharging the effluent into conveyance system. The CETP Management shall collect the sample from such tank of each industry, once in a month for non-toxic and/or non-biodegradable effluent and once in a week for toxic and/or persistent organic effluent. In case when CETP is to receive heterogeneous effluents, the SPCB shall grant consent once in three years and shall monitor the effluents atleast once in six months for non-toxic degradable effluent, for industries discharging wastewater less than 25 kl/day. In case of volume of wastewater discharge is more than 25 kl/day, the validity of the consent shall be limited for an year and the monitoring by SPCB shall be done atleast once in a three months. The same frequency shall be maintained for sampling in case of toxic and/or

persistent effluents. The penal charges for offence of non-compliance of treatment standards shall be applied, as indicated in para 2 (a), (b) and (c). SPCB may direct for closure of the industry, if a member unit is a continuing offender. In that case, consent shall be refused by SPCB for discharge of effluent to CETP and outlet be sealed.

The industry shall provide a tank/sump for storing and pumping of effluent to sewer junctions leading to CETP. In such junctions, automatic monitoring of pH and flow shall be arranged. In case of exceeding the limits, even at night, the records help to investigate the CETP Management for identifying violator in industrial group. There shall be a common sump at the inlet of the CETP where influent quality shall be monitored, by collecting both grab samples and composite samples. The selection of the parameters at the inlet shall be made as per the advice of SPCB.

(ii) **Collection through tankers**: The CETP Management should have dedicated tankers, duly labelled in accordance with the Motor Vehicles Act (with regard to transportation of hazardous waste), to collect pre-treated effluent and for transportation to CETP following the manifest system. The manifest system shall be applicable to all the member industries sending their effluent to CETP by tankers. A format for manifest system is given in *Annexure-I*, which needs to be followed.

4.0 Guidelines for operation of various units of CETP

(a) **Receiving sump(s)**: The receiving sump(s) at CETP should be of adequate capacity and should have arrangement for minimum three pumps, keeping one as stand-by. The pumps are required to have regular maintenance adopting preventive maintenance system. The leakages are required to be attended regularly and as per preventive maintenance system. The operator(s) are required to maintain a logbook for duration of operation of each pump and also the flow/quantity of wastewater pumped.

There should be separate sumps provided if a CETP has a provision to treat wastewater separately for chemical treatment

such as removal of toxic metals and separately for biological systems (anaerobic and aerobic).

(b) Equalisation Tank: The equalisation tank of minimum 24 hours detention time is a must for heterogeneous wastewater i.e. various kinds of industries, having varying quality of wastewater, discharging their effluent to CETP.

In case, where CETP receives wastewater from a particular sector of industry such as textile or tannery or dyeing/printing etc., the equalisation tank of minimum 8 hours detention period shall be provided. To prevent the settling of suspended matter, the equalisation tank should have an arrangement of either compressed air for agitation or mechanical agitator. The equalisation tank should be fitted with a pumping arrangement for a regulated feed to the subsequent treatment units. There should be one stand-by pump provided. For the wastewater from the chemical manufacturing units, it is desirable that there should be two equalisation tanks each of 24 hours detention period. While one is getting filled, the other should be used for pumping at a regulated flow and to ensure homogenised wastewater as a feed to subsequent treatment units.

(c) Arrangement of mixing of sewage to industrial wastewater:

The mixing of sewage in appropriate ratio with industrial effluent helps in biodegradability of effluent and also providing needed nutrient for better microbial activity for treating organic waste. Therefore, an arrangement to bring sewage by tanker or through a conveyance system should be provided, as necessary, depending on the treatability studies conducted

(d) Primary treatment: The basic objective of the primary treatment is to remove suspended and/or colloidal matters for this purpose, clarifloculator or air flotation units are provided. The coagulants are normally used for enhancing removal of suspended and colloidal matter. There should be a proper chemical/ coagulant dosing system provided, preferably with an automatic arrangement. Arrangement for pH correction, where necessary shall be provided.

Adequate storage of chemicals, for a minimum of three months requirement, shall be made and regular supply of power shall be ensured with arrangement of DG set of adequate capacity.

For handling the sludge from such unit(s), there should be a proper dewatering system (either centrifuge or vacuum drum filter). The dewatered sludge shall be transported to the designated area through trollies or tankers for storing and final disposal, as per authorisation obtained from concerned SPCB.

(e) Biological treatment unit(s): The biological treatment unit can comprise anaerobic system, aerated lagoon, activated sludge process, extended aeration, trickling filter etc. For operation of these systems, it is necessary to ensure that the wastewater is within the required range of pH, Total Dissolved Solids (TDS) and designed value of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and hydraulic load (flow). It is also to ensure that there is no toxic constituent, which could hamper microbial activity in the biological treatment plant. . As the input of sewage to the biological treatment unit enhances the treatability besides providing nutrient for biological activity, the addition of sewage at the inlet of biological system is advisable, wherever feasible. The proportion of industrial to domestic sewage should be based on availability of sewage and minimum requirement of sewage to effluent ratio.

The various operating parameters such as pH, sewage to industrial effluent ratio (where applicable), Mixed Liquor Suspended Solids (MLSS), Mixed Liquor Volatile Suspended Solids (MLVSS) and minimum Dissolved Oxygen (DO) in case of aerobic system should be maintained as per design. There is also necessity to record these parameters on day to day basis. Proper aeration throughout the area of the aeration tank needs to be ensured. The diffused aeration system ensures such distribution of aeration throughout the aeration tank.

The success of biological treatment depends upon secondary settling system for proper removal of suspended solids (bio-mass) sludge recycling/removal and dewatering system. The operator should maintain all the operating parameters as per design and also for recirculation of the sludge and its removal periodically (to have active biomass). The removed sludge

should be dewatered and such quantity recorded in the logbook. The sludge should be transported to an appropriate place as prescribed by concerned SPCB in the consent order under Water (Prevention & Control of Pollution) Act or as per authorisation under Hazardous Waste (Management & Handling) Rules.

(f) Tertiary system: The effluent may be required to be further treated before disposal, depending upon the recipient system and the local conditions and also in case of treated wastewater is to be reused. The tertiary system may comprise activated carbon and/or colour removal system by polyelectrolyte etc. or recovery of water through reverse osmosis with an arrangement for rejects to be subjected to evaporation for disposal as residue (solid waste).

All the operating parameters, as per the manual of CETP, should be maintained and the readings entered into the logbook including final wastewater quantity (flow) disposed of and/or reused.

(g) Treatment of high TDS wastewater: The CETP may also have a separate treatment system for segregated wastewater of high Total Dissolved Solids (TDS) content sent by industries either through separate tankers or separate conveyance system, for the purpose of giving specific treatment. The treatment of such wastewater may comprise solar evaporation or forced evaporation or multiple effect operators. It is desirable that such system should be installed atleast one metre above ground, in order to prevent leachate into sub soil and ground water. The sludge from evaporation system should be stored and disposed of as per authorisation obtained from the concerned SPCB.

5.0 Manpower Requirement

The CETP shall be headed by a qualified Manager, who shall be ex-officio Member of the CETP Board of Directors, as a Secretary. He should have a thorough knowledge of ETP operation, maintenance aspects and the environmental law. He shall be assisted by a qualified team of supervisor(s), scientific & technical officers and skilled operators. There should be separate laboratory. The assignment of the Quality Control Group is to monitor and to do

surveillance of the member industries and conducting performance evaluation of ETP on day-to-day basis. The Manager is solely responsible for records related to performance monitoring, maintenance and financial management of CETPs etc. The Quality Control Group shall be headed by a Chemist. Besides, there shall be an Operation & Maintenance Group to be headed by an Engineer, who shall be assisted by operators. The Manager should also be responsible for designing of training programme for Technicians, Chemist and operators, to be conducted on regular interval.

6.0 Monitoring and Performance

The Manager in consultation with the Incharge of Quality Control and the member industries shall design an elaborate monitoring network for surveillance monitoring. This will comprise frequency of monitoring, parameters to be monitored and location of monitoring. The monitoring results obtained shall be analysed statistically in order to evolve frequency of violation in case of each industry and as well as for treated effluent discharged from CETP. The compliance of effluent quality at the inlet of various treatment units are also to be checked by the Quality Control Group.

The general trend of effluent quality and its inter-relationship with design parameters should be determined and a performance audit shall be got conducted through an external agency, once in a year.

7.0 Maintenance

The Manager of CETP should ensure that preventive maintenance system (*Annexure II*) is followed for proper operation of all pumps, mechanical devices and monitoring equipment. Spare parts (commonly used) should be made available at the site. In case of break down, the same should be attended on urgent basis, and for that purpose adequate funds should be made available to the Manager of CETP.

8.0 Trouble Shooting

The operator of CETP generally faces problems in biological treatment plant. In order to deal with such problems, *Annexure III* may be referred for trouble shooting.

ANNEXURE I

WASTEWATER TRANSPORT MANIFEST THROUGH TANKER

NAME OF CETP

Manifest No.

PART A
To be completed by the producer of Waste

1. Name of Waste Producer

2. Occupier's Registration No.

3. Address

....

.... Pin Code

4. Waste Description

5. Quantity of Waste
rn kilolitres or DJ tonnes

6. Consistency 7. Waste Code 8. Contaminants
ⓈOLID rnrn
ⓁIQUID (Refer to List 1) rnrn
SLⓊDGE (Refer to List 2)

7. Occupier's Certificate
I hereby declare that the containers of this consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked and labelled in all respects in proper condition for transport by road according to applicable national government regulations.

Name :

....

Signature

....

Date

time am/pm

PART B
To be completed by transporter

8. Transporter's Registration No.

Vehicle Permit No.

9. Transporter's Acknowledgement

Name :..

Signature : .... Date

PART C
To be completed by the department receiving waste

10. Facility Name : (Name of CETP)

11. Facility Licence No.

12. Treatment Type (List 4)

13. Discrepancy Note Space : ....

....

14. Quantity of Waste Received 1 0 kilolitres or rn tonnes

15. Disposer's Acknowledgement of Receipt of Waste
I hereby acknowledge acceptance of the waste described in Part A.

Name : ....

Signature : ....

Date time am/pm

1) White colour forward to SPCB by the occupier
2) Light Yellow colour retained by the occupier
3) Pink colour retained by the facility owner
4) Dark Yellow colour handed over to the Transporter
5) Green colour forward to the SPCB by the facility owner/operator
6) Light Blue colour returned to the Occupier

Annexure-II

PREVENTIVE MAINTENANCE

S.No.	Name of the Company	Daily	Weekly	Fortnightly	Monthly	Remarks
1	AERATOR					Fifty four months of installation one aerator gear box requires replacement
a)	GEAR BOX					
i)	Greasing			√	-	
ii)	Oil checking	-	√	-	-	
iii)	Nuts and bolts tightness checking	-	-	-	√	
b)	IMPELLER					
i)	Nuts and bolts tightness checking		-	-	√	
c)	MOTOR					
i)	Greasing	-	-	√	-	
ii)	Nuts and bolts tightness checking	-	-	-	√	
iii)	Motor cable termination checking	-	-	√	-	
II	BLOWER					
a)	GEAR BOX					
i)	Oil checking	-	√	-	-	
ii)	Greasing	-	-	√	-	
iii)	Nuts and bolts tightness checking	-	-	-	√	
iv)	Belts tightness checking	-	√	-	-	
b)	MOTOR					
i)	Greasing	-	-	√	-	
ii)	Nuts and bolts tightness checking	-	-	-	√	
iii)	Cable termination checking	-	-	√	-	
III	PUMPSET					After three months mechanical seals are getting damaged. Mechanical seals are required to be replaced every three months.
a)	PUMP					
i)	Inspection of bearing housing and casing	-	-	√	-	
ii)	Inspection of coupling and bush	-	√	-	-	
iii)	Nuts and bolts tightness checking	-	-	√	-	
b)	MOTOR					
i)	Nuts and bolts tightness checking	-	-	√	-	
ii)	Cable termination checking	-	-	√	-	
IV	DIESEL GENERATION SETS					
i)	Filters and oil change for Volvo Penta					
ii)	Filters and oil change for Cummins					
iii)	Oil Checking	√	-	-	-	
iv)	Radiation water checking	√	-	-	-	
v)	Checking of distiller water in batteries	√	-	-	-	
vi)	Cleaning of radiator with compressed air	√	-	-	-	

S.No.	Name of the Company	Daily	Weekly	Fortnightly	Monthly	Remarks
vii)	Cleaning of alternator winding with dry compressed air	√	-	-	-	
V	MOTOR CONTROL CENTER AND POWER CONTROL CENTER PANNELS					
i)	In coming out going cables tightness checking	-	-	√	-	
ii)	Cleaning of starter feeders and Bus-bas chambers with dry compressed air	-	-	√	-	
iii)	Cleaning of contractor strips	-	√	-	-	
iv)	Cleaning of incoming and control fuses	-	√	-	-	
VI	CLARIFIER					
a)	SCRAPPER GEAR BOX					
i)	Oil checking	-	√	-	-	
ii)	Greasing	-	-	√	-	
b)	MOTOR					
i)	Motor cable termination checking	-	√	-	-	
ii)	Greasing	-	-	√	-	
VII	CLARIFLOCCULATOR					
a)	GEAR BOX					
i)	Oil checking	-	√	-	-	
ii)	Greasing	-	-	√	-	
b)	FLOCCULATOR					
i)	Greasing	-	-	√	-	
ii)	Motor cable termination checking	-	√	-	-	
VIII	THICKNER SCRAPPER					
a)	GEAR BOX					
i)	Oil Checking	-	√	-	-	
ii)	Greasing	-	-	√	-	
)	MOTOR					
i)	Greasing	-	-	√	-	
ii)	Motor cable termination checking	-	√	-	-	
IX	DECANTER CENTRIFUGE					After 12 months, large and main
a) i)	Gear box oil level	-	-	√	-	bearing get
ii)	Greasing	-	-	√	-	damaged. It needs to
iii)	Belt tightness checking	-	-	-	√	be replaced every
iv)	G.S. Clutch	-	-	√	-	year.
v)	Bowl assembly	-	-	√	-	
b)	MOTOR					
i)	Greasing	-	-	√	-	

TROUBLE SHOOTING

For properly running the activated sludge plant, the operator has to maintain the environment very congenial and comfortable to the viable bacteria that are our skilled workers. The pH between 6.8 to 7.4 and the temperature between 20 to 25 degree C and the DO around 2 to 2.5 mg/lit can be easily managed, but what is difficult to be managed is the incoming Load. This is not in the hands of the environmental group. It depends on the production activities. The shock can arrive to ETP in any or many of the following ways :

1. The effluent flow the same, but BOD load is excess (say double)

2. The effluent flow is in excess and so also the BOD.

3. The BOD is same as designed, but the flow is much in excess.

4. The BOD is the same as designed, but the nature of BOD is different (i.e. the bio-degradability, hazard characteristics, BOD rate constant etc.)

5. All the variations as the first four possibilities above, but instead of BOD the consideration this time here is the SS suspended solids (load and settling nature).

6. All the variations as the first four possibilities or fifth (four) possibilities, but here all the parameters i.e. flow, BOD and SS are behaving erratic simultaneously).

The operator this way faces the difficulties in a number of ways (though it is not much appreciated by the production group).

The most delicate point in running an activated sludge plant is the Sludge. The trouble starts here only and hence the single most important thing an operator must keep under inspection is the sludge and any variation in its nature. The operator has to keep a watch on a number of parameters. These are inter alia its colour, odour, the water that is left behind in upper portion of the glass cylinder in the settlometer or SVI test, the speed of sludge settling in the test, any entrapped gas or bound water in the sludge, and the microscopic scenario. By a combination of all

these observations, it is possible to label that sludge in a specific type. If this sorting and placing it into a specific slot is possible, the further improvement will be somewhat easy. In order to make the topic simpler, some of our senior operators have thought it better to divide the sludge in ten classes such as :

S.No	Type of Sludge	How to Identify?
1.	Normal and Floc-forming	Colour golden-brown, Odour musty, Supernatant is slightly turbid with a light brown or golden colour. The settling is good, SVl is 90 to 120, Settlometer test of 30 min. is 30 to 40%.
2.	Floc of size Pin point (excessive solids carryover)	Occurs sometimes as small size suspended sludge particles remaining in the supernatant. There are two sub-classes. (a) Colour grayish ash-like, inert, and the sludge is old. BoD is low. (b) Generally like the normal sludge, Colour brown, but a portion does neither settle down nor rise to the top. BOD is high and the sludge is young.
3.	Sludge riding on the waves, Billowing and sludge solids wash-out	This is a normal sludge but cannot settle because of excess incoming flow (hydraulic) load. (This can also happen due to unequal distribution either in the aeration tank or in the secondary clarifiers).
4.	Sludge Anaerobic	This is a septic sludge. Colour is dark brown to black. If sludge gets more time at a place without agitation or removal,the anaerobiosis sets in and CO2/CH4 methane gas generates. The entrapped gas lifts the sludge
5.	Sludge over-aerated	This is otherwise a normal sludge, but has entrapped air bubbles. This problem is caused where grease or oil has prevented the escape of the air bubbles.
6.	Dispersed Growth of microbes in the sludge	Colour is white, brown, gray, or even black. Does not settle and particles remain in uniform suspension even for 30 minute test period. Shows a lack of bacterial build up in the mixed liquor, the sludge is watery, certain to occur when the concentration of soluble organic matter is extremely high. Microscope shows filamentous growth.
7.	Broken or sheared floc, deflocculation	Otherwise a normal floc, but the sludge has undergone some sort of a shock; supernatant is extremely turbid and cells will not settle.

		Usually a passing phase and when shock passes by, again flocculation may take place.
8.	Sludge rising (entrapped Nitrogen Gas)	Settles well in 30 minutes but again rises to top becoming lighter than water. This is driven by entrapped gas bubbles. The sludge flats on water surface in large chunks of colour light brown, Hap pens especially in warmer months or warmer places, as denitrification is temperature dependent phenomena. If laboratory test is conducted on the outgoing effluent, it may show higher nitrogen compounds than shown usually. The pH may decrease and chlorine demand may increase.
9.	Sludge floating	If the sludge is floating for a small duration and small amount, may be taken as normal. This may be due to presence of some filamentous bacteria, or dead stalked ciliates, fungi or some dead higher animals like rotifers. Taken as normal if small and temporary.
10.	Bulking Sludge	Two types, both buoyant. (a) Bound Water. A flocculated sludge, with a high SVI and a low settling rate, the Sludge floc has a large area and contains bound water. Generally, an under-oxidised and young sludge. (b) Filamentous growth : Colour light brown, gray or white. Odour is sweet or fruity. Settling slow, SVI 180 or above. Supernatant is clear, but the height of the water layer is very little. Sludge particles have filaments extending from the clumps if observed minutely.

It may be seen that whatever the above 10 or 12 sludges we have seen above, the classification is essentially based on the settling characteristics. Apart from the "normal" sludge no other settles satisfactorily and stays settled. If we have a key to know as to why it so happens, the door will be opened and the process of treatment can be made to run on proper track. The main reasons responsible for inefficient settling are two viz. (1) The upset in the process or defect in the plant and (2) the nature of the biomass.

We have enlisted a number of sludge types in the table above. Out of these, those at serial number 2,3,4 and 5 (i.e. pin-point floc, billowing

cloud, anaerobic and over-aerated) are developed due to peculiar situation at the aeration tank; such as :

- Inadequate mixing or ununiform mixing in the aeration tank
- Erratic Dissolved Oxygen DO profile.
- Incorrect size of the aeration tank (either too big or too small)
- Excess solids
- Slow growth of the biomass
- Delayed removal of sludge, sludge stored in for longer time
- Gas getting entrapped in the sludge (whether carbon dioxide, nitrogen, oxygen, methane or bound water, depending on situation).

When you will observe for the first time that your sludge is not getting flocked and settled out normally, then immediately check your record of last two weeks. Find our whether any of the above causes appear in the daily log-book record of last two weeks. Find out whether any of the above causes appear in the daily log-book record e.g. the aerator number N2 was out of order on Monday, or sludge pump was choked for some time on Tuesday or there was an overload of Suspended Solids on Wednesday afternoon or there was a power failure on Friday etc.

Out of 10, we discussed 5 types in the above paragraph, leaving types 6,7,8,9 and 10 (i.e. dispersed growth, deflocculation, floating sludge, rising sludge and bulking sludge). These defects are dependent on the type of biomass cells or on their life style. It also depends on their reaction towards temperature, and influent floctuations. The filamentous types do not have a tendency to settle as easily as the ball shaped ones. It is not that the filamentous bacteria do not do the treatment, but they do not settle out in the secondary tank and are not available for returning. But why the filamentous microbes come in the first place ? Reasons :

- The BOD or Organic matter or the food is of two types viz. either in dissolved state or in suspended state. If the soluble BOD is more (like say carbohydrates in a sugar factory or starch industry) it encourages the presence and growth of filamentous microbes.

- This is also possible, if our aeration tank is immediately after an anaerobic unit such as a methane bio-digester, anaerobic lagoon, septic tank, etc. This is so because in upstream unit the sulplhate has turned into sulfides, and the sulfides destroy the round ball like microorgainsms (cocci). The sulfides, however, are not hazardous to filamentous organisms and hence yeast type can survive.

- This can also happen if the incoming food (BOD) is not uniform, i.e. some times too high and some times too less then the normal average.

- High temperature : If the temperature is high sphirotilus get established or even some times the nocardia having a number of branches and sub-branches all having a tendency to catch the foam and remain floating.

- The pH : The acid pH is harmful to the ball-shaped bacteria having a tendency to floc and settle out.

- Industrial wastewater : The bacteria of normal nature can get acclimatized to the municipal man-made sewage quickly, but takes time to accommodate the industrial effluents. If the fluctuations are more, the difficulties increase and give rise to typical organisms like fungi, lactic acid bacteria, toxothrix, vitriocilla etc.)

If we have to save our plant from the floating sludge, then we shall have to examine the above causes and try to nullify these. This is an uphill task, but eventually one will succeed. Following steps are suggested :

(1) *Check the influent* : The non-settling nature of the sludge having no settling nature may have a hidden cause in the nature of influent itself. It may be seen whether the influent itself can be rectified to remove the cause. As an example if it is coming from an anaerobic step, see whether it is possible to freshen it up, removing the sulfides or satisfying it in some other way. This may avoid harm to the round-shaped aerobic bacteria of our choice. Freshening up of the influent is an easy step rather than facing the problem later on.

(2) *Microscopic examination* : We can find out the presence of filamentous organisms and even can find the type of it (like

toxothrix, lactic bacteria, fungi etc.) and accordingly can identify the source or design the attacking strategy.

(3) *Fluctuations in the influent* : It is desirable that the influent is uniform in quality and quantity. If there are shocks, there should be avoided. An equalization tank of adequate capacity can normally do this job. In case some abrupt discharge is expected, which cannot be evened out by the equalization tank, one may think of a panic pond as well. (Examples are mother liquor releases in a heavy chemical industry or monthly cleaning day effluent in a sugar industry).

(4) *The capacity of sludge pumps* : An operator faces a great difficulty if the sludge pump is not of adequate capacity. It is then necessary to make a retrofit. There should be flexibility in operation. (By this we may not be able to adjust the SVI, but we can control the filamentous organisms).

(5) *Modification in process* : Modification by freshening up is already mentioned above. It is also possible to make certain change by adding small inert particles to serve as nuclei for settlement. At some places activated carbon or sponge pieces are introduced pre-secondary clarifier.

Now, the steps narrated above cannot give an immediate relief. These must be taken up as a long-range strategy. For quick tiding over the problem, however, the senior operators are suggesting certain measures, such as :

(1) "Use of bleaching powder : Make a pre-chlorination of the influent. Make also the pre-chlorination of the sludge, which is being returned to the aeration tank. The dose, which normally proves adequate, is stated as 10 to 20 mg/lit. A thumb-rule for this can be :

Cl.Dose = 0.68 x SVI x Q x Rs.

Where,

Cl. Dose	=	Dose of chlorine as kg. per day
SVI	=	Sludge Volume Index
Q	=	Effluent discharge in cum/day
Rs.	=	Solids concentration in return sludge, mg/lit.

(2) Vary the air supply.

(3) Add chemicals such as alum or ferric chloride to the clarifier influent or the mixed liquor or the return sludge to aid the settling. (The dose may be tried as 8-12 mg/lit of alum for 24 hours using fiberglass or plastic hoses).

(4) Hydrogen peroxide in place of chlorine. Dosages of upto 200 mg/lit for a 24-hour period may be taken up to control bulking to begin with. This is a costly proposition.

(5) Any other steps that are narrated in the tables given hereinafter for respective trouble-shooting.

Our Operator friends will certainly take precautions to see that no problem gets created in our ETP. Even then it is possible that some problems may come up and then the trouble starts. At such time, it is an immediate necessity to find a solution. It is, therefore, desired to know from our senior and experienced Operators as to what different troubles can creep in and how the trouble-shooting can be made? This Appendix is an attempt to assemble all such information and present in a tabulated format. This is only a beginning. The reader operator can add his own experiences of his ETP, which will be more vital. Let us first make a list of the anticipated troubles that are proposed to be discussed here.

Trouble	*Trouble Station*	*Trouble Appearance*
1.	AerationTank	Dissolved Oxygen either in excess or too short
2.	Aeration Tank	Foam Foam
3.	Settling Tank	The clouds of sludge going out
4.	Settling Tank	The sludge swells and the bulk rises to the top
5.	Settling Tank	The sludge lumps float on top
6.	Settling Tank	The outgoing water turbid, milky and not clear
7.	Settling Tank	Bacteria leaving out in the form of ash coloured pin points

We have now decided to find solutions to the above seven problems. As homework for this, the operator may please read this booklet once again. Not merely the portion related to Activated Sludge Process and its corresponding Appendix, but the other chapters too. We do now know where a problem will have its roots.

TROUBLE NO. ONE

DISSOLVED OXYGEN IN THE AERATION TANK, EITHER IN EXCESS OR TOO SHORT

OBSERVATION	POSSIBLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
1. Scene like a boiling water, Turbulence every where, bigger air bubbles of say 10 to 15 mm	(A) Oxygen is more than the need. Supply is more, blowers are running more.	(1) DO is high, 3 mg/lit or more. There is shock and splitting of bacteria	(1) Keep an eye on DO reading, reduce air supply. If there are a number of aerators, close some. Lower the running of blower
2. The turbulence is uneven and non-uniform. Somewhere too agitated and somewhere quiet and stand still. (Dead pocket)	(A) Some aperture holes in the pipe grid are choked and closed	(1) Refer the old register and check when last the pipe grid was cleaned.	(1) If found that it is not cleaned recently (say 8-10 months), arrange cleaning schedule. Implement
		(2) See whether only a small part of surface is showing quiescence and other is normal	(2) Need only clean the pipe grid coming directly below the quiescent surface and review.
	(B) The mechanism has failed to do proper air exchange. Under aeration resulting in low DO and/or septic odours.	(1) Collect sample. The DO is seen less than 1.5 mg/lit and even some portion has become black or smells.	(1) To increase DO, step up blower, or if possible speed of aerator or submergence. Check DO again.
		(2) Check the horse power efforts given for mixing.	(2) Ensure a motor horsepower as half HP for each 1000 cft of volume of the aeration tank; and 3 cfm air per foot length of the pipe grid. Review, prepare proposal, if less.
		(3) Check RAS quantity. Take a feeling, as to what is the thickness of the sludge layer at the bottom of the secondary clarifier.	(3) Change the rte of RAS to such a level, as the sludge layer will remain as 1 to 3 feet. (0.3 to 0.9 m).
Air rates being used with no age in organic or hydraulic	(A) Leaks in aeration system piping	(1) Check air pipe and joint connection; listen for air leakage	(1) Tighten flange bolts and/or replace flange gaskets.

to maintain adequate DO		or soap test flanges and watch for bubbling caused by air leaking	
	(B) Plugged diffusers. Air discharging from diffuser header blow-off pipes causing local boiling to occur on surface near diffuser header pipe.	(1) Check maintenance record for last cleaning of diffusers.	(1) If diffusers have not been cleaned in last 8-10 months, do so.
		(2) Spot-check diffusers in tank for plugging.	(2) If several are plugged, clean all diffuser in tank.
	(C) Insufficient or inadequate oxygen transfer	(1) Check aeration system performance. (i) Diffused aeration system should provide between 800 to 1500 cft air per pound of BOD removed (check with your design) (ii) Mechanical aeration system should provide between 1 to 1.2 kg BOD removed (check with your design)	(1) Replace with more effective diffusers or mechanical aerators.
			(2) Add more diffusers or mechanical aerators
	(D) High organic loadings (BOD, COD, Suspended Matter) from in-plant side steam flow.	(1) Check to see if organic loading from side stream flows contributes significantly to overall process loading.	(1) If loadings are greater than 25%, optimise operational performance or upgrading of other in-plant processes will be required.

TROUBLE NO. ONE

EXCESS FOAM IN THE AERTION TANK

OBSERVATION	POSSIBLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
1. On the mixed liquor surface of the Aeration Tank, we find whitish, thick,	(A) In the initial period, before the Activated Sludge process is well set, the	(1) Measure BOD, measure MLSS in the laboratory. From this calculate the	(1) It may come out that the MLSS today is less than the assumed design criteria or the

billowing (riding on waves) soap-like (sudsy) foam	BOD load is proved more to the un-acclimatized bacteria, which means low MLSS, high F:M	F:M ratio today.	F:M Ratio i s higher than desired. Do not worry, happens in the beginning. Stop WAS. Do not send sludge of secondary clarifier to the sludge drying beds, rather make it RAS and return to the Aeration tank.
		(2) The effluent leaving the secondary clarifier, is cloudy and turbid; when we expect a clear supernatant.	(2) In order to ensure that sludge should not be lost this way; increase the rate of RAS: especially during such period when the BOD load is more (Peak flow).
		(3) Collect a sample from Aeration Tank mixed liquor and find DO.	(3) Arrange that the DO is least more than 1.5 mg/lit or above to 3 mg/lit. and that too at all the places. For increasing the DO see Trouble No. 1.
	(B) If rate of WAS is kept more than desirable, then MLSS has become low. (This happens when instead of returning the secondary clarifier sludge, it is wasted and sent to SDB sludge drying beds)	(1) Examine and go on recording for some further days, the following and assess trend in: (1) MLSS (2) CRT (3) F:M Ratio (4) DO (5) WAS	(1) Daily go on reducing the volume of WAS by 10% and stop reducing when the normalcy is reached (2) Daily go on increasing the volume of RAS. For enabling this, keep a sludge layer at the bottom of the secondary clarifier of a thickness of 1 to 3 feet (30 to 90 cm). Keep increasing RAS till normalcy and then stop increasing. To judge on normalcy, estimate in laboratory the MLSS and the F:M Ratio.
	(C) MLSS concen-tration may get reduced due to other reasons like, entry of hazardous toxic,	(1) Take a sample of MLSS and check for para-meters like temperature, pesticides, heavy	(1) To face this difficult effluent. Our regular biomass is incompetent. Arrange to procure an acclimatized sludge

	poisonous chemical; or too hot or too cold effluent flow, heavy metals, pesticides etc.	metals, COD to BOD ratio etc. and keep a record.	from any other similar ETP or ready-made, which some vendors offer.
		(2) Likewise draw a sample of influent and check for the same parameters as above.	(2) Report this abnormal entry to the superiors. Find which section of the manufacturing department is capable to play this mischief. Arrange to fix responsibility on someone that such hazard will not repeat.
	(D) Due to sudden slug shock entry of excessive water, the hydraulic load increased to great extent, reducing the HRT and before the bacteria get an opportunity to settle in the secondary clarifier, they are pushed out (Wash-out).	(1) Measure the actual flow and compare the figure with the assumptions at the time of designing. Calculate especially the HRT in the Aeration Tank and overflow rate in the secondary clarifier. Whether satisfactory.	(1) Refer Trouble Three, Observation No. 1: and see whether the Corrective Action detailed under it can be made applicable here.
	(E) Though so expected, the incoming raw wastewater and the returned sludge RAS, is not getting distributed uniformly and together in all the places at the Aeration Tank, causing foaming in one or more aeration tanks.	(1) Collect sample from a number of places from the Aeration Tank and check the MLSS (may find different MLSS in each of the aeration tank).	(1) The distribution of influent and RAS be so equally ensured that the DO profile and MLSS count is uniform at all the places, vertically and horizontally.
			(2) In case you have two or more aeration tanks in parallel, then ensure whether the flow is distributed equally in the entry point of each, say correct Q/3 if there are three aeration tanks. Same case is true even

			if the tank is one but aerators are in two rows.
2. Appearance of foam in the aeration tank of blackish-brown colour with shining	(A) The BOD load arrived in the Aeration Tank is low today than the usual and the relative MLSS shows high. Aeration tank approaching underloaded condition.	(1) for some days estimate in the laboratory, the following parameters, and find how these are changing. Keep record. MLSS, CRT, F:M Ratio, DO, WAS.	(1) Increase the WAS volume by 10% everyday, till the normalcy returns. To judge whether the normalcy has returned, the tests mentioned in the side column will help. You will also feel that the colour of the foam has become fain
			(2) Refer to Trouble Number Five and Trouble Number Six, pick up from the corrective actions mentioned there-under, as per your judgement
			(3) If you have two or more Aeration Tanks running in parallel, take efforts to divide the flow equally in all these, and measure the flows. (Take similar efforts in case there is only one tank but two rows of aerators). Also measure that the flows coming out from the parallel tanks are also equal, as a double check. Also see Observation 1, Probable Cause 6.
3. Appearance of foam on the surface of the aeration tank, of a colour dark brown, nearly black, sudsy (soapy). The colour of mixed liquor also likewise. Smell septic.	(A) Anaerobic situation in the Aerobic Aeration Tank.	(1) Refer Trouble Number One, Examination No. 2 and 3 and follow accordingly.	(1) Refer Trouble No. One. Corrective Action No. 2 and 3 and implement suitable as per your judgement.

4. Thick scummy dark than foam on aeration tank surface.	(A) Aeration tank is critically underloaded (MLSS too high) due to improper WAS control programme.	▪ Check and monitor for trend changes which occur in the following: (1) Increase in MLVSS mg/lit	(1) Increase WAS rate by not more than 10% per day until process approaches normalcy control parameters and a modest amount of light-tan foam is observed on the aeration surface.
		(2) Increase in MCRT	(2) For additional checks and remedies refer to Trouble Number Five and Seven For multiple tank operation refer to this Trouble Number Two. Observation No. 1. Probable Cause E.
		(3) Decrease in F:M Ratio	
		4) DO levels maintained with increasing air rates	
		(5) Decrease in WAS rates.	
		(6) Secondary effluent nitrate level above 1.0 mg/lit.	
		(7) Increase in secondary effluent chlorine demand	
		(8) Decrease in aeration tank effluent pH.	

TROUBLE NUMBER THREE
BACTERIA GETTING LOST AND BILLOWING SLUDGE

OBSERVATIONS	PROBABLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
1. In the Settlometer Test, the sludge settles down as desired indicating normal situation, but in actual on the water surface of the	(A) Some parts of the equipments gone out of order.	(1) Refer Trouble Number One, Examination No. 1A, 2A and 2B and experiment accordingly in the laboratory.	(1) Refer Trouble Number One, and the Corrective Actions No. 1A, 2A and 2B, and see if those suggestions suits you.

secondary settling tank, at places clouds of sludge are seen rising up.			
		(2) Check certain machine parts such : - Flowmeter - Sludge pumps & pipelines - Sludge collecting scraper & riser (Chains, sprockets, squeegees, tubes)	(2) Make repairs & replacements accordingly. See whether preventive maintenance schedule is followed carefully, last time. The pumps & pipelines be cleaned.
		(3) Find the thickness of sludge layer which is settled at the bottom of the secondary Clarifier.	(3) The desirable thickness is between 1 to 3 feet (0.3 to 0.9 m). Adjust the pumping programme accordingly. If the speed of scraper is adjusted, that too has the same effect.
	(B) Gas or air bubbles get entrapped in the sludge particles making the mass to come up floating. May be a presence of nitrogen gas due to nitrification-denitrification process having set in	(1) Take a settlometer test. While doing this a sludge will separate. Lightly stroke the sludge by rod and check whether any small bubbles are evident.	(1) If the process is not nitrifying refer Trouble Number Seven and Observation No. 2, therein. You may get a clue from that.
		(2) Take a settlometer test as above. If bubbles seen, draw a sample from upper water. Analyse it for finding Nitrate in mg/lit.	(2) If you feel from the result of this analysis that the nitrification process has commenced, then refer Trouble Number Five, Observation No. 1, with its probable cause No. A and attempt whatever applicable.
	(C) A temperature water current (when the subsequent water entering in the tank is hot/warm or cold as	(1) Collect samples at a number of places in the secondary clarifier and estimate in	(1) If the difference in temperature between the upper and lower levels is about 1 to 2 degree Celsius, it will

	compared to the existing one)	laboratory, their temperatures and DO profile.	be workable. However, if it is higher, then a need of caution. (If you have an opinion that this can be a special problem with your production activity and similar situation will often repeat, then better to have two separate treatment systems of biological process or early stage temperature equalisation. Prepare a proposal and submit).
		(2) While the water enters the secondary clarifier or when it leaves, it is necessary to make this happen without turbulence and the velocity is made slow by getting very uniform distribution. For this purpose baffles are provided. Perhaps there is a defect in construction of baffles.	(2) Check the actual level of the launder. Clean it of any algae, leaves and paper. Try levelling by grinding stone. Check the efficiency of baffles. Repair it.
	(D) As the incoming water has come as a flood, it has not allowed time for the bacteria to settle. Those are pushed out quickly with very low HRT (and as such they are not available as sludge in sludge-pocket or sludge-sump not available for RAS).	(1) Check the design criteria and compare with the present day situation. Especially calculate the HRT in the Aeration Tank and overflow rate in the secondary clarifier.	(1) If you find this a permanent threat, the assumptions during design stage have been low, and the Trouble is bound to persist, better to prepare a proposal of permanent remedy and submit (for supplementary units).
			(2) Try to increase the sludge layer at bottom. Stop wasting and returning.
			(3) If you think that the

			problem is recurring or is going to be persistent, then discuss to alter the process itself and go for Contact Stabilisation or Sludge Re-aeration principle. Prepare such proposal and submit.
			(4) Please also read the Probable Causes mentioned as B1, B2 and C2 under this same Trouble and attempt if likely to be suitable.
2. When a settlometer test is done, the sludge settles very slowly and reluctantly. There are particles of sludge found remaining in the water which is left straggling behind in the upper portion of the cylinder. In actual surface of the secondary Clarifier, some lumps of sludge patches are seen drifting. Localised fluffy clouds.	(A) High BOD load has come in the aeration tank and the commensurate MLSS quantity is low. The bacteria are too young and the sludge density is low.	(1) Keep every day change under observation till normal situation returns. For assessing the normalcy, measure daily (1) MLSS (2) CRT (3) F:M Ratio (4) DO Keep record how the changes occurred.	Reduce the quantity of WAS by 10% everyday, till you find the plant running Normal. To adjudge normalcy conduct the tests mentioned by side. Make WAS steady and stop lowering when once Normal

TROUBLE NUMBER FOUR
THE SLUDGE BULKING SWELLS AND RISES TO THE TOP SURFACE

OBSERVATION	PROBABLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
1. Settlometer Test is taken. The sludge settles and migrates towards bottom, but it does occupy unusually more space. Does not compact. Water	(A) Either the DO is less or the BOD value and type is different than what was assumed at the time if design.	(1) Examine today and for a few days more the changes is following parameters. MLSS, CRT, F:M Ratio, DO, SVI. Keep record of changes.	(1) Reduce the quantity of WAS daily by about 10% every day upto the day when the normalcy comes back. To judge the normalcy see the tests mentioned in the side column. Stop any

layer is less but the supernatant is clear. The sludge is homogenous cloud. It tries to come up, float, ride on waves (billowing) and occupy the entire surface.			further lowering, once normal, retain the same quantity.
			(2) Increase the RAS volume for some time. This is to compensate the loss caused by jumping off of the sludge over the launder of the secondary clarifier. When normal situation comes, bring back the RAS volume to the original level.
			(3) See that in the Aeration Tank the DO is at least 0.5 everywhere, and be normally between 1 to 3 mg/lit.
	(B) Filamentous organisms	(1) Make micro-scopic exam. Of both (i) the mixed liquor from the Aeration Tank and (ii) the RAS. Whether there is a presence of filamentous bacteria, filamentous fungi or sphere-like?	(1) If the filamentous are not there, we are happy. See the Probable Cause A mentioned above under this Trouble only.
		(2) If the filamentous growth is from fungal growth, then one possibility is that a typical industrial effluent sub-stream is entering in. Check such possibility.	(2) Identify and keep special control on such production step and segregate the sub-stream. Consider above separately. To tide over the difficulty chlorinate RAS at a rate of 2 to 3 kg/day/1000 kg MLVSS.

		(3) If you notice the filamentous bacteria, then examine under microscope the influent as well. (Each suspected sub-stream as well).	(3) Give pre-chlorination to the incoming stream. The dose may be tried as 5 to 10 mg/lit. (Risky to increase more. If at all add in steps of 1 to 2 mg/lit, very cautiously).
			(4) Give chlorine to RAS too. The starting dose is found reasonable as 2 to 3 kilogramme chlorine per day per 1000 kilogramme of MLVSS.
			(5) If you have located the filamentous organisms in any particular sub-stream of influent, think of its segregation and propose separate treatment. Submit quickly.
	(C) Scarcity of nutrients or trace elements in the effluent.	(1) Examine again and again. Generally we wish to have the BOD:N:P Iron as 100: 5: 1: 0.5	(1) Whatever is the deficit of nutrients (the difference bet-ween desired pro-portion and found by actual test) be fulfilled by supple-mental fortification. For nitrogen, add anhydrous ammonia; for Phosphorous, add tri-sodium phosphate, and for iron, add ferric chloride.

		(2) Take settling test, every hour.	(2) See whether there is improve-ment in settling nature in the test, since starting needful addition of nutrients.
	(D) DO is less in the Aeration Tank	(1) Take samples everywhere, and draw DO profile.	(1) DO should never fall below 0.5 mg/lit. Arrange to increase it to a level between 1 to 3 mg/lit. Take help of blower.
			(2) If the DO level is somewhere zero and at other place 1 mg/lit, this is due to unequal distribution of air. In such case, refer Trouble Number One and read Observation No. 2 carefully to follow up.
	(E) The pH in the Aeration Tank is less than 6.5	(1) Check many times the pH of influent	(1) If the pH is less than 6.5 check the sub-streams too and arrange to make neutralisation at the spot very near to the segregated acidic sub-streams (or temporarily bye-pass with caution).
			(2) If such arrangement as stated above is not immediately possible, at least neutralize the combined effluent with special care just before its entry into the aeration tank by lime or caustic.
		(1) The process has gone towards nitrification. (Generally it happens in following possible cases:	(1) If we are not interested in Nitrification (and seldom we are), lower the biomass by increasing the WAS, (Step of 10% every day gradually, till normalcy).

		▪ Temperature high ▪ MLSS high ▪ F:M Ratio low ▪ Carbo-hydrate BOD is consumed early	(2) If we are interested in Nitrification, raise pH by adding an alkaline agent (caustic soda, lime) the aeration tank influent.

TROUBLE NUMBER SIX
THE WATER LEAVING THE SECONDARY CLARIFIER IS CLOUDY AND TURBID

OBSERVATION	PROBABLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
(1) Sludge clumps (from size of a table-tennis ball to as large as a basket ball) rising to and dispersing on clarifier surface. Bubbles noticed on clarifier surface. Mixed liquor in setltometer test settles fairly well, however a portion of an/or all of the settles fairly well, however a portion of and/or all of the settled sludge rises to the surface within hours after test is started.	A. Denitrification in clarifier.	(1) Check for increase in secondary effluent nitrate level.	(1) Increase WAS rate by not more than 10% per day to reduce or eliminate level of nitrification. If nitrification is required, reduce to allowable minimum.
		(2) Check loading parameters.	(2) Maintain WAS rate to keep process within proper MCRT and F:M Ratio.
		(3) Check DO and temperature levels in the aeration tank.	(3) Maintain DO at minimum level (1.0 mg/lit). Be sure adequate mixing is provided in the aeration tank.
		(4) Check RAS rates and sludge blanket depth in the clarifier	(4) Adjust RAS rate to maintain sludge blanket depth of 1 to 3 feet (0.3

			to 0.9m) in the clarifier.
	(B) Septicity occurring in clarifier	(1) Refer to Trouble Number One, Observation No. 2 above	(1) Accordingly
		(2) See 3 and 4 above in this Trouble.	(2) Accordingly.

TROUBLE NUMBER SIX
THE WATER LEAVING THE SECONDARY CLARIFIER IS CLOUDY AND TURBID

OBSERVATION	PROBABLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
1. The water is turbid and has suspended matter high. It is not clear, as it should be. If the Settlometer Test is taken, the sludge does ;not neatly migrate to bottom and the water left behind above is not clear, but is turbid.	(A) If the process is just commenced, then the MLSS is yet to get developed.	(1) Refer Trouble Number Two above and see under its Observation No. 1	(1) Accordingly
	(B) The BOD load may be found more	(1) Make microscopic examinations on slides made from the MLSS and the RAS. Find whether protozoa are identified.	(1) If the protozoan are not seen, it means that the reason may be that the BOD load has come sudden and high. The treatment has not gone to its desired level.
		(2) Take the BOD test and find as to how much the organic load has increased.	(2) Lower the volume of WAS step by step, everyday by 10% and at the same time increase the quantity of RAS, in such a way that at the bottom of the secondary Clarifier the sludge layer is about 1 to 3 feet (0.3 to 0.9 m). Then resume normal percent.
		(3) Find the value of DO everywhere in the Aeration Tank	(3) Bring the DO to a level between 1 and 3 mg/lit. Take the help of blower, if necessary.

	(C) Hazardous, toxic or poisonous matter has entered in with the influent	(1) Conduct micro-scopic examination both on mixed liquor and on RAS. Whether do you see any dead or decaying or inactive protozoa?	(1) If you find such protozoa, they are assaulted recently by such hazard. Make load investigation of the effluent and sub-streams, product discards etc. Report to superiors.
			(2) Also refer Trouble Number Two and read the Observation No. 1C Follow.
	(D) Due to excessive turbulence, agitation.	(1) See from microscope. Do you find	(1) Refer Trouble Number one, and read under Observation No. 1A. Follow.
	(E) The DO value in the Aeration Tank is not as desired.	(1) Refer Trouble Number One and read under Observation No. 2	(1) Take steps accordingly.

TROUBLE NUMBER SEVEN
THE SLUDGE IS DISPERSED IN A PIN POINT FLOC

OBSERVATION	PROBABLE CAUSE	EXAMINATION	CORRECTIVE ACTION
(1)	(2)	(3)	(4)
1. Small scattered all over throughout the clarifier pinpoint floc on surface, and at places floating islands, particles jumping over the launder. If settlometer test is taken, settles fairly well. Sludge is dense at bottom and fine floc suspended in fairly clear supernatant.	(A) The bacteria are in aged group. They are returned back many times already. The MLSS is too high as compared to the BOD. An underloaded condition	(1) Take repeatedly the following exams in the laboratory: (1) MLSS ▪ CRT (1) F:M Ratio (1) DO • WAS Influent load in terms of BOD, COD in raw.	(1) In order to lower down the MLSS, increase the quantity of WAS, but do not increase the step more than 10% at a time. When normal situation comes keep steady.
		(2) Check whether the Aeration Tank is foaming	(2) Refer Trouble Number Two and decide on suitable line of action.
			(3) Adjust the RAS rate in such a way that the sludge thickness layers

			at the floor of the Secondary clarifier becomes between 1 and 3 feet (0.3 to 0.9 m)
			(4) Also refer to Trouble Number One and decide the applicable line of action.
2. Small ash-like sludge particles seen on the surface of water of the secondary clarifier.	(A) May be the beginning of Denitrification stage.	(1) Take the settlometer test for 30 minutes. Take the floating sludge and slowly shake it.	(1) If after such mild shaking, the entrapped gas bubbles are seen released and if thereafter the sludge that was floating so far starts settling, then perhaps worthwhile to refer Trouble Number Five, Probable Cause No. 1. Consider the action (2) If it does not settle, refer to Probable Cause B below.
	(B)The quantity of grease is too high excessive in the mixed liquor contained in the Aeration Tank.	(1) Analyse in the laboratory and find the value of grease.	(1) Take the weight of grease, take the weight of MLSS. If grease component is less than 15% by weight, no panic. In any case, repair the baffles near the weir of the oil-grease trap and the outlet launder of the primary clarifier.
		(2) Check grease contents in the raw wastewater.	(2) We know as to what are the places in the production shop, where there is more use of oil-grease and from where such load can come. Arrange to keep control over there.
3. On the surface of water in secondary clarifier sludge is seen with particles/floc about 6 mm size and flows over the launder.	(A) There is less BOD in the Aeration Tank, thereby the supporting MLSS proves low in any change in organic load.	(1) Take a series of tests everyday (1) MLSS ▪ CRT (1) F:M Ratio (1) DO	(1) Reduce the wastage WAS step by step by 10% till normalcy is restored.

Extends throughout the clarifier. If we take a settlometer test, we find that the sludge settles fairly well but does become compact. The supernatant water looks clear, but there appear some floating patches (chunks) of flocs.		• WAS • Incoming BOD, COD Keep record daily	
		(2) Check whether there is foam in the Aeration tank.	(2) Refer Trouble Number Two, for foaming in aeration tank and infer on the action.
			(3) Adjust the RAS in such a way that the thickness of sludge layer on the floor of secondary clarifier is between 1 and 3 feet (0.3 to 0.9 m).
			(4) Check DO. Do not allow it more than 1 mg/lit now. Stop blower, stop some aerators. Refer to Trouble Number one for additional help

ABBREVIATIONS:

In the above discussions the following typical words are used

DO	Dissolved Oxygen	MLSS	Mixed Liquor Suspended Solids
CRT	Cell Residence Time	F:M	Food to Micro-organism Ratio
WAS	Wasted Activated Sludge	RAS	Returned Activated Sludge
HRT	Hydraulic Retention Time	ST	Settlometer Test
OUR	Oxygen Uptake Rate	SVI	Sludge Volume Index
RR	Respiration Rate		

Common Effluent Treatment Plants : EFFLUENT STANDARD
(Notified under the Environment (Protection) Rules, 1986)

A. Primary Treatment

Inlet effluent quality for CETP	Conc. in mg/l
pH	5.5-9.0
Temperature C	45
Oil & Grease	20
Phenolic Compounds (as C_6H_5OH)	5.0
Ammonical Nitrogen (as N)	50
Cynide (as CN)	2.0
Chromium hexavalent (as Cr_{6+})	2.0
Chromium (total) (as Cr)	2.0
Copper (as Cu)	3.0
Lead (as Pb)	1.0
Nickel (as Ni)	3.0
Zinc (as Zn)	15
Arsenic (as As)	0.2
Mercury (as Hg)	0.01
Cadmium (as Cd)	1.0
Selenium (as Se)	0.05
Fluoride (as F)	15
Boron (as B)	2.0
Radioactive Materials	
Alpha emitters, Hc/ml	10-7
Beta emitters, He/ml	10-8

Note :

1. These standards apply to the small-scale industries, i.e. total discharge upto 25 kld.

2. For each CETP and its constituent units, the State Board will prescribe standards as per the local needs and conditions; these can be more stringent than those prescribed above. However, in case of clusters of units, the State Board with the concurrence of CPCB in writing, may prescribe suitable limits.

B. **Treated Effluent Quality of Common Effluent Treatment Plant Concentration in mg/l except pH and Temperature**

Parameters	Into inland surface waters (a)	On land for Irrigation (b)	Into Marine Coastal areas (C)
pH	5.5-9.0	5.5-9.0	5.5-9.0
BOD_5 20°C	30	100	100
Oil & Grease	10	10	20
Temperature	Shall not exceed 40°C in any section of the stream within 15 metres down-stream from the effluent outlet	-	45°C at the point of discharge
Suspended Solids	100	200	(a) For process wastewaters – 100 (b) For cooling water effluents 10 % above total suspended matter of effluent cooling water
Dissolved Solids (inorganic)	2100	2100	-
Total residual chlorine	1.0	-	1.0
Ammonical nitrogen (as N)	50	-	50
Total Kjeldahl nitrogen (as N)	100	-	100
Chemical Oxygen Demand	250	-	250
Arsenic (as As)	0.2	0.2	0.2
Mercury (as Hg)	0.01	-	0.01
Lead (as Pb)	0.1	-	0.1
Cadmium (as Cd)	1.0	-	2.0
	(a)	**(b)**	**(c)**
Total chromium (as Cr)	2.0	-	2.0
Copper (as Cu)	3.0	-	3.0
Zinc (as Zn)	5.0	-	15

	Into inland surface waters	On land for Irrigation	Into Marine Coastal areas
Selenium (as Se)	0.05	-	0.05
Nickel (as Ni)	3.0	-	5.0
Boron (as B)	2.0	2.0	-
Percent Sodium	-	60	-
Cynide (as CN)	0.2	0.2	0.2
Chloride (as Cl)	1000	600	-
Fluoride (as F)	2.0	-	15
Sulphate (as SO_4)	1000	1000	-
Sulphide (as S)	2.8	-	5.0
Pesticides	Absent	Absent	Absent
Phenolic compounds (as C_6H_5OH)	1.0	-	5.0

Note : All efforts should be made to remove colour and unpleasant odour as far as possible.