DEUTSCHE GESELLSCHAFT FÜR INTERNATIONALE ZUSAMMENARBEIT (GIZ)

FOSTERING AND ADVANCING SUSTAINABLE BUSINESS AND RESPONSIBLE INDUSTRIAL PRACTICES IN THE CLOTHING INDUSTRY IN ASIA

TRAINING PROGRAM FOR OEPRATORS OF EFFLUENT TREATMENT PLANTS

DAY 3

SESSION 3: PRIMARY TREATMENT

Hand out:

Operation, Maintenance, Record Keeping and troubleshooting of Primary Treatment

Primary treatment inside the ETP comprises of the following:

- Screening
- Grit removal
- Flow equalisation
- Chemical coagulation and sedimentation.

Screening

The purpose of screening is the removal of coarse suspended solids, so that: (a) the subsequent units in the ETP will not be overloaded; (b) no damage will occur to mechanical equipment like pumps, floating aerators, etc, due to the abrasion effect of the solids; and (c) to reduce the chances of choking of pipe lines and pumps.

Some ETP s have got mechanical screens, which will remove finer solids.

Control measures for these units are:

- Regular cleaning of the screens,
- Prompt removal and proper disposal of the screenings
- Maintenance of good lubrication of mechanisms, if any
- Good housekeeping, especially keeping the screens clean and with corrosion resistant coatings.

Grit removal

Grit removers are erected in the ETP for the separation and removals of grits, ie, sand-like materials. While small ETPs have stilling chambers, with no mechanisms to remove the grit, larger ETPs have mechanical Detritors with special arrangements to convey the settled grit outside.

The control of grit removers means observing the following:

- Keep the flow rate into the grit remover within the specified flow rate limit.
- Keep the mechanism, if any, in good condition by ensuring proper oiling and greasing
- Prompt removal of solids and proper disposal of the same
- Protection of equipment against corrosion

Equalisation

The equalisation tank in a ETP is an important component in treatment control. The purpose of equalisation is:

- To get the raw effluent homogenised in order to get effluent of uniform composition for the subsequent treatment steps, so that control of chemical and biological reaction is easy.
- To control the flow rate to the subsequent units in the ETP to be uniform and distributed over a period of 24 hours, so that the subsequent treatments especially the biological treatment units will not be overloaded, both in hydraulic load and organic load.

Usually the equalisation tanks are provided with aeration either with floating aerator or with some other type of aerators such as ejector type aspirator aerators.

The aeration also helps to oxidise the sulphides present in the raw effluent. In some ETPs, equalisation tanks have provision for adding $MnSO_4$.

The process control of equalisation generally consists of:

- Wherever there are two equalisation tanks or a tank divided into two compartments, the tanks should be loaded alternatively so that sufficient detention time can be ensured.
- Wherever floating aerators are installed, correct alignment of the aerator is to be ensured, as otherwise the possibility of bearing failure will be increased.
- The inlet and outlet points of the equalisation tanks should be as distant as possible, otherwise channelling of effluent will be created, resulting in poor equalisation.
- Wherever inadequate oxidation of sulphides are noted, proper dosage of $MnSO_4$ is to be calculated based on lab studies and the same dosage should be maintained. The effluent being pumped out from the equalisation tank is to be checked daily with the lead acetate paper to ensure the complete elimination of sulphides in the equalisation tank.
- Ensure that there is no settlement of sludge in the tank, especially in the corners of the tank. In the case of a floating aerator being used, the position of the aerator is to be adjusted so as to purge out the solids.
- Pumping lines from the equalisation tank should extend to the bottom of the tank, so that effective detention time in the equalisation tank can be ensured.

Chemical treatment

Chemical treatment in a ETP for tanneries is generally done using common coagulants like alum and lime. The chemical treatment results in the following:

- Reduction of suspended solids in the raw effluent by 80-90%
- Reduction of BOD/COD. by 20-40%
- Almost complete removal of trivalent chromium
- Reduction of colour due to dyes substantially.

Control of chemical treatment

This involves the following:

- Form a comparative list of chemical dosages required for raw effluent of a particular characteristics. This exercise is to be done as a first part of preparation activities for commissioning of a ETP. For this, several, possibly 100 raw effluent samples of varying concentrations of pH, suspended solids and COD. are to be treated with various dosages of coagulant chemicals and the reduction rate is to be found out. These results then form the basis of the control of chemical treatment in future. For this purpose, a chart of all the results from the experiment- *equating reduction rates to various chemical dosages*- should be prepared and this forms the reference for determining chemical dosages in chemical treatment in ETP.
- It should be explicitly understood that the purpose of chemical treatment in the ETP is to reduce the pollution load in raw effluent to *such an extent that the subsequent biological treatment will not be overloaded.*
- The correct dosages of chemicals are to be worked out based on the above point using the chart prepared earlier .
- Based on the calculations, the plant-in-charge can work out the chemicals to be charged every day and give instructions accordingly.

Importance and Extent of Proper Monitoring

The monitoring of an effluent treatment plant consists of measuring/recording the following:

- The flow rate to and from the effluent treatment plant
- Working time of pumps and other equipment
- Treatment control parameters such as chemical dosages, aeration details etc.
- Maintenance features of the plant including details of repairs, preventive maintenance,
- spare parts, stock details etc.,
- Laboratory analysis reports

Flow rate

Many effluent treatment plants do not have proper flow measurement systems and some of these effluent treatment plants have installed flow meters which give local indications.
The following are the points to be noted to ensure proper monitoring flow:

- Proper system : Though flow measurement units like 'V' Notches are used in some plants, such arrangements are suitable for places where the flow is of constant rate. The same may not be suitable for a effluent treatment plant where the flow rates can vary from time to time.
- The system should be of suitable type : The flow meter should be compatible with the point of installation: As a example, if a flow meter must be installed in the inlet of a treatment plant, where the flow rates are highly fluctuating, a flow meter, which works on level difference such as Parshal flume type, is not suitable. Such types of meter may be installed in the treated effluent line, but it should be ensured that the meter gives cumulative readings also and not just local indications.
- The flow meter should be accurate and the scale of measurement should correspond to the actual flow rate.

It is desirable to have a recorder facility to give recordings of the flow rates. Also, the ease of installation of flow meter must be considered while selecting a flow measurement system. Some flow meters, such as the electromagnetic flow meters, require a pumping line for effective performance, hence the suitability of pumping must be considered before selecting the flow meter. Some flow meters require a lower diameter of the pipeline at the point of measurement and it must be ensured that such an installation will not block the flow rate through it. Such meters therefore may not be suitable for small ETPs and for effluents with high amounts of grit and other particles.

It is desirable to have a flow meter at the inlet and outlet of the treatment plant.

Monitoring of operation of pumps and equipment

Operating hours of pumps and other equipment must be continuously recorded. Such data will give the plant operator the exact idea regarding the flow rate through individual units in the effluent treatment plant. Protective maintenance measures of equipment can be planned as per these observations. Furthermore, the effluent treatment plant operator will know whether any equipment in his plant is working beyond its normal working hours or whether any equipment is lying idle. Necessary modifications in the operation of equipment can be done based on the readings.

Monitoring plan

It is suggested having the following pattern of monitoring for an effluent treatment plant:

- Data regarding operation and process control should be maintained by the plant operator
- Data regarding analysis results should be maintained by the chemist in laboratory
- Data regarding maintenance features should be maintained by a maintenance engineer.

Once every day, the plant manager should review the data regarding the operational conditions and lab reports and, based on the above, decide necessary adjustments to be done in the operation of the plant.

Once a week, the plant manager, engineers, operators and chemist should sit together and review the data obtained during the week and necessary modulation in operation and maintenance of the plant must be incorporated.

Once a week, the maintenance engineer should prepare a comprehensive note on the list of maintenance work carried out during the week and list of spares purchased during the week. Based on the above, the financial outlay for maintenance can be planned. Also the troublesome areas inside the plant should be identified and special care should be taken to find out the possible reasons for frequent complaints from the area(s).

Once a month, the plant manager should meet with the directors of the company, where he should explain the major events during the month. He should also present the calculations regarding (1) The total flow to the plant and (2) the operation and maintenance cost of the plant, giving break-ups for power, labour, chemicals, sludge treatment, maintenance and administration. A review should be made on all of the above factors to ensure that the situation is normal and genuine.

Based on the above, financial aspects for continued operation can be planned and factors such as cost to be shared among the tanner members can be calculated during the meeting.

The meeting should also formulate strategies on various issues on ETP operation such as achieving results set by PCB, new modifications that can be incorporated, research and development studies that can be done (e.g., sludge utilisation) and in general operations and maintenance of the ETP.

Trouble Shooting in ETP Operation

For a successful operation of an effluent treatment plant, operational disorders and problems should be identified and necessary corrective measures taken without any delay. In this section, an attempt has been made to list out certain problems as well as the possible reasons, with remedial measures.

Chemical treatment

Section	Nature of the Problem	Possible reasons	Remedial Measures
Chemical lines	No chemical slurry coming, the chemical lines seem to be choked	1. Higher level of insoluble matter in alum. 2. Higher % of sand in lime.	Use chemicals of high quality.
	Chemical concentration is decreasing after some time	Agitation in chemical mixing tanks may not be enough	1. Increase agitation 2. Increase frequency of chemical charging
	Chemical slurry leaking in chemical pumps	1. Lime slurry is having high amount of sand 2. Loose gland packing	1. Use good quality lime 2. Put new gland packing.
	Chemical agitator failing	1. High amount of sand in chemicals used. 2. Agitator alignment is wrong.	1. Use good quality chemicals 2. Correct the motor alignment

Section	Nature of the Problem	Possible reasons	Remedial Measures
Flash Mixer	Excessive foam in flash mixer	Effluent inlet pipeline discharges the effluent above water level in the flash mixer	Lower the pipeline so as to get effluent discharge below the water level.
	Flash mixer overflows during operation	1. Insufficient capacity of flash mixer 2. Low free board	1. Increase the volume of tank. 2. Decrease flow rate 3. Increase the free board.
Clari-flocculator	Solids are floating on the top of the water layer instead of settling.	1. Low pH 2. Sludge removal is not sufficient.	1. Keep proper pH range in chemical treatment. 2. Increase the sludge removal rate.
	Settling is good, but some solids are not settling in some parts of the tank	Poor flocculation of chemicals	Ensure good mixing of chemicals and flocculation.
	Solids are coming up to the surface in the form of globules	Anaerobic digestion of settled sludge.	Increase the frequency of sludge draw out.
	Solids are settling, but after some time rise to the top	Longer detention time inside the tank	1. Increase the flow rate 2. Increase the sludge draw off from the tank

Section	Nature of the Problem	Possible reasons	Remedial Measures
Clari-flocculator (continued.)	Solids settling is not taking place at all	Settling time is not enough	1. Reduce the flow rate 2. Use polyelectrolytes
	Solids rise to the top even with frequent sludge withdrawal	Clarifier mechanism is not functioning properly	Check the mechanism and its operation conditions.
	Solids overflow from one side of the clari-flocculator	Improperly arranged 'V' notch weirs.	Arrange the weirs uniformly.
	Tank surface is unsightly due to accumulation of scum	Scum remover is not working	Install proper scum remover system.