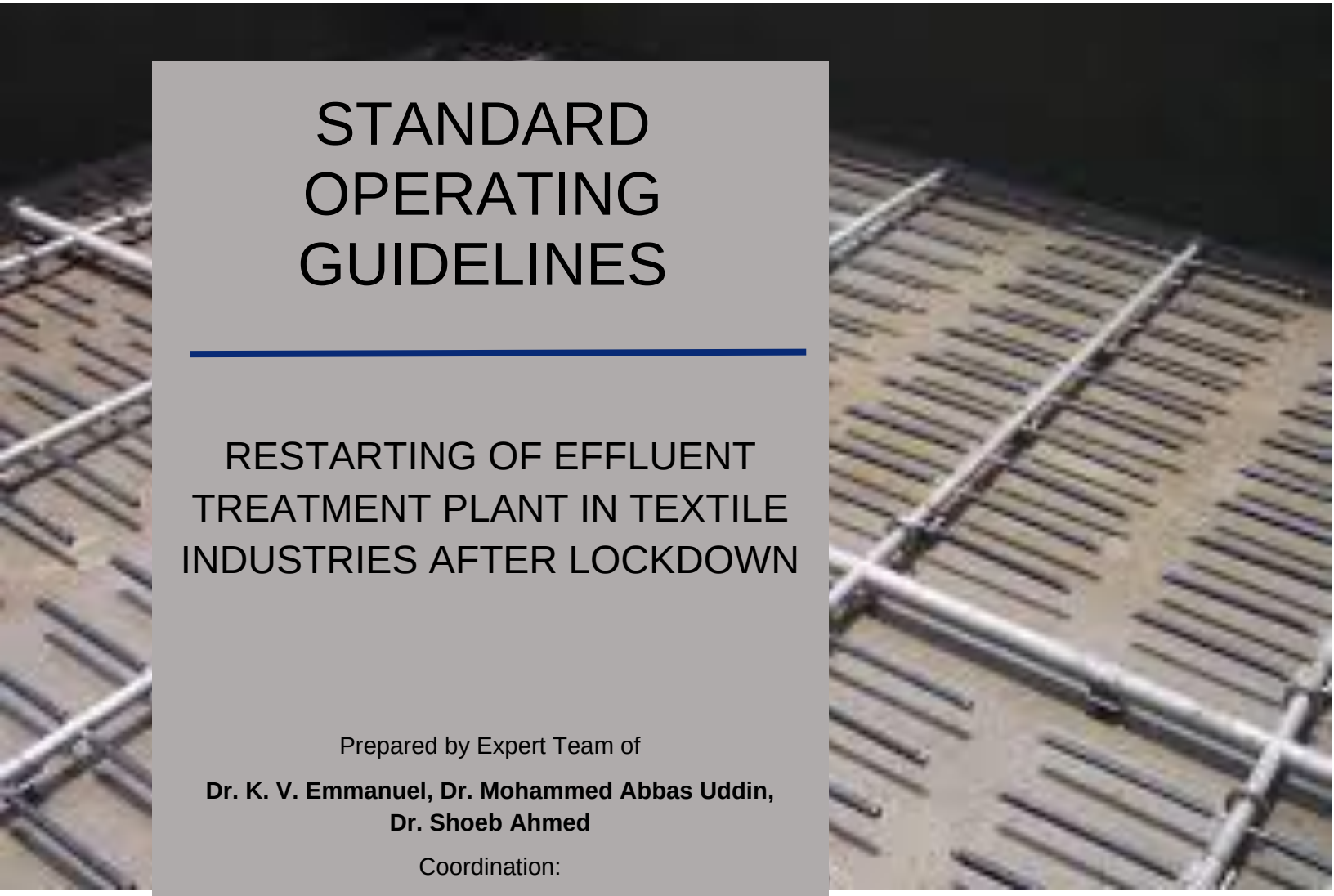

STANDARD OPERATING GUIDELINES

RESTARTING OF EFFLUENT TREATMENT PLANT IN TEXTILE INDUSTRIES AFTER LOCKDOWN

Prepared by Expert Team of

Dr. K. V. Emmanuel, Dr. Mohammed Abbas Uddin, Dr. Shoeb Ahmed

Coordination:

Dr Jürgen Hannak

adelphi

ADELPHI CONSULT GMBH

ALT-MOABIT 91, 10559 BERLIN/GERMANY

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ABBREVIATIONS AND SYMBOLS

BOD_5	:	Biochemical Oxygen Demand, 5 days, 20°C
COD	:	Chemical Oxygen Demand
Covid-19	:	Corona Virus disease pandemic
CFM	:	Cubic feet per minute
cm	:	Centimeter(s)
°C	:	Degree Celsius
%	:	percent
d	:	Day(s)
DO	:	Dissolved Oxygen
DoE	:	Department of Environment, Government of Bangladesh
EPDM	:	Ethylene Propylene Diene Monomer (synthetic rubber)
ETP	:	Effluent Treatment Plant
F/M	:	Food to Microorganism ratio
GIZ	:	German International Co-operation
GoB	:	Government of Bangladesh
h	:	Hour(s)
HCl	:	Hydrochloric acid
H_2S	:	Hydrogen Sulphide (gas)
kg	:	Kilogram(s)
kW	:	Kilowatt
kWh	:	Kilowatt hour
km	:	Kilometers
l	:	Litre (s)
m	:	Meter(s)
mm	:	Millimeter
m^3	:	Cubic meter(s), 1000 litres.
m^2	:	Square meter
mg/l	:	Milligram(s) per litre
MLD, mld	:	Million liters per day
MLSS	:	Mixed liquor suspended solids
MLVSS	:	Mixed liquor volatile suspended solids
MSDS	:	Material Safety Data Sheet

O&M	:	Operation and maintenance
OSHA	:	Occupational Safety and Health Administration
pH	:	Negative logarithm of hydrogen ion concentration
ppm	:	Parts per million
PID	:	proportional integral derivative
PSES	:	Programme for Promotion of Social & Environmental Standards
RCC	:	Reinforced cement concrete
s	:	Second(s)
SS	:	Stainless Steel
SVI	:	Sludge Volume Index
Tk	:	Bangladesh Taka
Tonnes, tons	:	1000 kilograms
TSS	:	Total suspended solids
W	:	Watts

FOREWORD

In Bangladesh, the textile factories suddenly closed following the country-wide lockdown due to the sudden spurt of the pandemic Covid-19 in the country. Along with the factories, the operations of their effluent treatment plants (ETPs) also stopped abruptly. With the factories being allowed to restart their operations, the ETPs are also getting restarted. However, abrupt re-starting of the ETP may pose many risks, mainly related to safety, performance and life of the ETP equipment. Hence, to minimize these risks it is essential to follow a proper protocol to restart the ETP operations.

In many ways, the restarting of an ETP is even more difficult than starting a new ETP. During the startup of a new ETP, (a) there shall be professional guidance (often from the supplier/consultant), (b) a great deal of attention and interest from the company management, (c) there is no much of time pressure so that every component can be started in sequence with physical tests, dry runs, wet runs etc. and if any addition or modification is needed, the ETP manager can delay the commissioning and (d) the ETP units shall be clean and in good shape, (e) since ETP itself is new possibility of a failure of a unit is low, (f) finance allowed to the ETP manager to do any service work may be relatively good and (g) finally, if any shutdown occurs the ETP manager can even postpone the commissioning citing time needed for stabilization.

In the case of re-starting of an ETP which was earlier abruptly stopped, (a) the ETP manager will have to manage issues mostly by himself without much external support, (b) management will be busy in re-starting the production, (c) in many cases ETP area will be filthy with already accumulated sludge and effluent which need to be removed and disposed, (d) many of the components would be old, rusty and may fail, (e) availability of funds would be limited, and (f) the management, already impatient to restart factory, may not allow any time for re-starting. Added to all these, absence of a proper protocol makes the job even more difficult.

Under these circumstances, the GIZ-PSES felt that it would be useful to prepare and distribute a simple guide which highlights important general precautions to be taken during the re-starting of the ETP and used the expertise made available through adelphi Consult GmbH to prepare this document. The expert team is led by Dr. Jurgen Hannak and consists of Dr. K. V. Emmanuel, an International Expert, ably supported by the renowned environmental specialists Dr. Mohammed Abbas Uddin and Dr. Shoeb Ahmed from Dhaka.

Important points to be taken care of during the re-starting of the ETP are presented here. The list is not comprehensive and no way technically perfect. It is solely intended to assist the management of ETPs to plan the activities during the shut-down period and prepare for recommissioning of ETPs and should not be confused with a manual or protocol. The views and recommendations presented here belongs to the authors and not necessarily shared by GIZ-PSES.

Even those ETPs which already restarted their operations can gain some practical guidance to ensure safety of the equipment and to get optimum performance. In general, the authors also recommend to keep the concepts presented herein in mind for eventual future shut-downs.

This document focuses on aerobic biological treatment plants with diffused aeration as the secondary treatment. There are a handful of ETPs with anaerobic treatment and other aeration

systems as wells as tertiary treatment units. Since number of such plants is small their issues are not specifically addressed here. Any specific requests for assistance from any such units shall be considered separately.

The authors would like to express their gratitude to GIZ-PSES office in Dhaka, especially to Mr. Faisal Rabbi and his team, for all the encouragement and support in preparation of this document.

1 OVERVIEW OF ISSUES IN RE-STARTING ETP OPERATIONS

The abrupt closure of the ETPs and an equally impromptu restarting of the same may result in multiple challenges for the operators to cope with such as risk to safety and health, failure of mechanical equipment and adverse impact on performance. The subsequent chapters of this short guide provide short descriptions about these challenges at hand and outline preventive or precautionary measures to be taken, so the facilitate the smooth restart of ETP operations.

For example, certain safety and health risk may occur when the residual effluent and sludge are allowed to remain in pipelines, manholes, tanks etc. when the plant has to shut down. The sludge may degrade in short time resulting in generation of poisonous hydrogen sulphide (H_2S) gas. As part of the restarting measures, workers may be engaged to clean manholes and tanks of the ETP. While entering such confined spaces as part of the cleaning operation may result in exposure to H_2S gas which be present in these parts. Other safety risks may be because electrical shocks, since the insulation of cables and control panels may have got damaged during prolonged disuse. Also, there are many reports of accidents, for example injuries from falls or broken metallic parts (such as tank platforms, handrails) which got damaged due to corrosion.

Similarly, if the ETP operation is being restarted abruptly without proper prior checks and maintenance, mechanical damage to ETP components may happen. For example, an abrupt shutdown may result in the settling of sludge on diffusers in equalization tanks and aeration tanks. If the same are restarted without prior cleaning, the diffusers may break. Also, many of the moving parts of machines may have got jammed due to dust, rust etc. and restarting them without cleaning and proper oiling/greasing may result in breakages.

Finally, as the treatment in most ETPs in/around Dhaka are of biological nature, if the restarting is done without following proper re-commissioning procedure, the available bio-mass in the aeration system may die out and performance of the ETP may get very badly affected. It may take a long time to recommission the system.

From the foregoing, it is essential that the restarting of ETPs follow a standard operating procedure (SOP) to ensure safety of workers, good condition of machinery and achieving planned performance of the ETP. Since the lock down due to the Covid-19 related circumstances has been an unprecedented scenario, most ETP suppliers may not have provided the factories with such a protocol or factories themselves have not prepared for such a situation b formulating corresponding procedures.

While the information provided herein is not meant to provide a complete SOP, it does give important guidelines to be considered during the re-starting.

2 DEALING WITH SAFETY AND HEALTH ISSUES WHILE RE-OPENING AN ETP

This section specifically looks into safety and health issues, which may pose a risk to ETP staff during the start-up phase of the ETP. In particularly, the section looks into how to deal with possible presence of hydrogen sulphide (H_2S) gas and electrical safety aspects.

2.1 Safety issues with Hydrogen Sulphide gas

One of the common safety and health risks in effluent treatment plants is the possibility of generation and release of hydrogen sulphide (H_2S). It is a highly toxic, colorless gas, heavier than air, invisible and has a strong unpleasant odour in low concentration (commonly described as “rotten eggs”).

The effect on the human beings who inhale this gas ranges from minor symptoms such as drowsiness or headaches to more severe effects such nerval problems or loss of consciousness. In the case of very concentration death may occur.

The characteristics of the gas enable one to smell it so long as it is in very low concentration (below 15 ppm), without having an adverse effect on health of a human being. Adverse health effects occur at higher concentrations only. Above concentrations of around 15 ppm, the person loses the ability to smell it, often leading to the wrong assumption that no H_2S gas is present. According to OSHA a concentration of H_2S gas at or above 100 ppm is considered Immediately Dangerous to Life and Health (IDLH).

Concentration	Possible effects
Upto 15 ppm	No effects reports, depending on individual sensitivity
15 to 100 ppm	Exposure for about 15 minutes may create issues such as headache, nausea, general weakness, pain in legs etc.
200 ppm - 500 ppm	Exposure even for one-minute results in serious irritation of nose and throat, vertigo, blurring of vision, loss of consciousness lasting a few minutes.
500-900 ppm	Exposure even for a minute results in profound coma, convulsions, disorientation even after recovery.
Above 900 ppm	Exposure of just a minute results in immediate death.

In an ETP, the gas may be generated and present in the following areas:

- Any manhole and opening of the raw effluent channels, particularly below ground level.
- Collection wells and screen chambers.
- Anaerobic tanks, if any such systems are present.
- Valve chambers and any other pits
- Any tank containing some sludge, even if nearly empty

Detailed guidance and training on how to address the risk associated have been published by many organizations such as United Nations Industrial Development Organization (UNIDO) and a gist of their recommendations have been presented here. Links to references are available at the end of this section.

It should be noted that as much as possible, no manual cleaning of the above-mentioned tanks/pits should be done, and mechanical cleaning should be resorted to. If a manual entry is absolutely unavoidable, it should be done with all precautions indicated below.

While entering a confined space, a worker must be attached to an independent lifeline for adequate fall protection and retrieval.

A complete retrieval system should consist of:

- A winch to be attached to the personnel during the cleaning operation.
- Tripod
- Full Body Harness
- Work Winch to raise and lower materials only.
- Personal protective equipment including helmet, working gloves, suit etc.
- H2S detector or at least lead acetate paper.
- Self-contained Breathing Apparatus.

It is possible the worker or employee assigned for the cleaning job may not be aware of the correct usage of these measures. Hence, the persons should be trained in inspection of the tanks and use of fall protection equipment as well as general safety protection issues, usually always under a qualified supervisor.

Safe management of cleaning of high-risk areas such as manhole also involves preparatory steps including (a) checking and verifying the presence and level of hydrogen sulphide in such confined areas and (b) have risk areas well ventilated all the time to dilute the concentration of H_2S gas. Throughout the cleaning work, H_2S levels need to be monitored. Experience shows that the build-up of gas can occur suddenly, since pipelines and active sludge often contain pockets of such gas.

In the case with manhole covers, the opening immediately must be guarded with a railing, temporary cover or some sort of barrier to prevent an accidental fall into the space. All workers, not just those entering the confined space, need to be outfitted with fall protection. An employee inadvertently may become overwhelmed by fumes when the cover is removed, which could result in loss of consciousness. Therefore, it is important for those working near the opening to wear either a restraint rope, preventing them from reaching the edge of the opening, or a lifeline, to stop a fall in progress. These measures should be taken before starting any cleaning operation, before even opening of manhole cover.

The measurement of H_2S can be done using portable meters, which are available in Bangladesh at cost less than Tk 50,000 (some portable low-cost meters are available Tk 5000-8,000, but a good one might cost more). Such meters are compact and lightweight yet rugged. Most detectors have a display indicating the prevalent gas concentration, and audible, visual and vibrating alarms in case of achieving limited concentration of hydrogen sulphide. If there was no meter available,

for low risk areas, lead acetate papers (comes with instructions and colour chart on it) could be used. Similar to pH papers these strips show coloration to indicate gas presence, though they not very reliable compared to a meter.

If an area is identified with high generation of hydrogen sulphide, before attempting cleaning, the following measures may be attempted:

- Usage of chemicals known to neutralize hydrogen sulphide. It is advised to sprinkle oxidizing chemicals such as sprinkle hydrogen peroxide. Since many textile factory ETPs have ferrous sulphate in their ETP, it can also be used to neutralize H_2S which immediately make the mixture black.
- Ventilate low areas. Blowing air into such place will help. However, use of pure oxygen is not advised since it can react strongly with hydrogen sulphide gas.

Even, if no gas has been detected, make sure of the following:

- The worker, when entering the risk areas, is wearing (a) a safety harness with an attached lifeline, (b) gloves, boots, goggles, (C) respiratory apparatus all the time.
- Another worker outside the risk area is holding the loose end of the lifeline.
- Both workers have a clear way of communicating with each other in case of an emergency.

As a ready reckoner, the following table is given to manage H_2S.

Possible locations	Type of exposure	Symptom	Preventive measures	First Aid measures
Any wastewater channels Tanks with sludge Deep pits and tanks	Inhalation	Cough, dizziness, headache, sore throat, lung oedema unconsciousness	Ventilation, local exhaust or breathing protection;	fresh air; rest; artificial respiration; medical attention
	Eyes	Redness. Pain.	Safety goggles, or eye protection in combination with breathing protection	Wash with fresh water, rest.

It is recommended that Plant Managers get specifically trained in these matters by joining training sessions dealing with these subjects. Also, it would be highly advisable that he and some members of his team get trained under the First Aid measures.

Further reading and reference

UNIDO Pocket book “How to deal with H_2S gas in ETPs	https://open.unido.org/api/documents/4670868/download/How%20to%20deal%20with%20hydrogen%20sulphide%20gas%20in%20tanneries%20and%20effluent%20treatment%20plants
UNIDO Safety Video	www.youtube.com/watch?v=xQkXMyetLfM&t=157s

UNIDO e-learning	https://leatherpanel.org/content/unido-line-course-how-deal-hydrogen-sulphide-gas

2.2 Ensuring safety of electrical installations

A detailed discussion on the same is not attempted here, since the requirements are generally covered by the rules laid down by the Chief Electrical Inspector of Government. Only the general guidelines are referred to in this section. Electrical safety is an issue in ETPs at any time. However, during the start-up period special attention needs to be paid to electrical installations, since they may have been damaged during the time of the shut-down.

Specific suggestions with regard to ensuring safety of electrical installations during the ETP start-up phase:

☐ Check all cables for any breakage, damage to insulation etc. In many cases, it has been observed that prolonged disuse results in damage of cable insulation (sometimes by rodents) increasing the risk of electrocution of workers if the system is restarted without checking.

☐ Check all control panels and clean the same from such things like spider webs and dust.

☐ Check, clean and tighten all terminations, test telemetry/alarms, observe the voltage and ensure correctness.

☐ Check and ensure adequate earthing.

☐ Check Electrical - Low Voltage Breakers, especially with regard to the following aspects:

- Before any testing, switch off all major loads and switch off capacitors.
- Take few mock operations of incomer ACB's/Switches and ensure their proper operation.
- Remove dust, spider nets with help of vacuum cleaner or manually.
- Ensure power supply at proper voltage at incomer.
- Take a megger before charging the panel and make measurements during both star and delta operations of the motors.
- If possible, do a visual inspection of panel from inside.
- Switch on only lighting load first.
- Gradually increase load one by one.
- Once all loads are on, add capacitor bank.
- If tripping happens, please check on which fault it has tripped and inform Service engineer accordingly.

The permission to start ETP should be given only after, preferably written clearance by the electrical person has been obtained.

3 GENERAL MECHANICAL EQUIPMENT CHECKING

While most operation and maintenance manuals listed the checking and commissioning instructions of equipment in the plant, restarting instructions are seldom found. Though often ignored, spending a couple of hours for checking the equipment in ETP before re-starting shall ensure soundness of the equipment and prevent unnecessary shutdowns and down time later.

In case of motor drives, a simple check involving manually rotating the drive shaft and motor fans before switching on the unit will indicate any jams and immediate corrective measures may be taken. After start up, during dry and regular runs observe for any abnormal noise or vibrations in the drives. Stop operation and repair if any such incidents occur.

Points to be noted in major equipment in the ETP are outlined in subsequent subsections.

3.1 Checking and maintenance of pumps in the ETP

☐ In case of submersible pumps, before starting the unit, pumps may be lifted, checked, cleaned and installed back. Check for any wear/breakage in bearings, seals etc. Apply lubricants and re-install.

☐ Before re-starting the ETP, the raw effluent pump may be checked as follows:

- Open all centrifugal pump covers and manually clean with water properly, for avoiding any foreign particles in the pump.
- Flush the impeller with fresh water.
- Check for al interlocks and confirm the function of each interlock.
- Check the fitness of the seal provided.
- Find any jam in the rotor and motor fan.
- Open suction valve and prime pump. Afterwards, close airlock on pump.

☐ After reinstallation, check the pumps with short dry run and wet run. Observe any vibrations, seal monitor warnings in control panel.

☐ Observe the amperage taken by the pump and compare the same with rated amperage (mostly given in the plate in front of the unit). Higher amperage indicates overloaded motor due to reasons such as drag on impeller due to particles such as rags, yarn etc., blockage or clog or Impeller clearance being too tight. Lower amperage indicates closed discharge valve, partially clogged check valve or air in the force main. The pump should be re-started only after servicing.

☐ Most submersible pumps are water cooled and is preferably installed in a pump pit, below the bottom level of tank. In any case, a submersible pump should be started only after the water level in the tank reaches above the pump level.

3.2 Checking and maintenance of blowers

- ☐ Soak the lobe using diesel for at least 1 hour before starting the blower and rinse it completely, clean using cotton waste and by running the blower in no-load condition i.e. after opening suction and discharge, run for at least 40-50 minutes so as to remove corrosion, dust or any foreign particle to attain the smooth functioning of rotors and blower.
- ☐ Check the area around the unit and ensure that is clean. Remove any dust and wipe off any leaked oil from the floor.
- ☐ Check the belt condition. It must not be loose or worn out. Correct the tension or replace if it is required to do so, if using old belts clean the belts and pulley grooves through compressed air in order to remove dust or any other foreign particles.
- ☐ Check the pulley alignment of both motor and the blower mechanism
- ☐ Replace the grease in bearings through grease nipples, keep filling the grease until new grease did not start coming from grease vent hole.
- ☐ Top up the oil if the level is below red line mark in Oil level Indicator and replace it completely if condition of oil is too bad. We recommend replacing the oil completely.

3.3 Checking and servicing of clarifiers

- ☐ Corrosion of metallic part is a major problem in clarifier during prolonged disuse. If the clarifier walkway is made of mild steel, make sure that that bridge and handrails are not corroded and strong enough. Brush any corroded part to remove rust and get a complete repainting if possible.
- ☐ Flush the rake arm with fresh water. Make sure that the rubber squeegees in the bottom are not worn out and properly attached to the metallic arm. If necessary, replace the squeegees. While re-fixing the squeegees, make sure the bottom of the same, sweeps the concrete floor evenly.
- ☐ Check for all interlocks to be free from rust. Wherever necessary, lubricate and paint the unit.
- ☐ Check the worm-gear boxes, pulleys and belts as the case may be and ensure smooth operation. Even if anyone of the belts appears loose, replace all the belts.
- ☐ Find any jam in the rotor and motor fan by rotating the same manually before energizing the unit. Thereafter switch on in no-load condition and ensure smooth operation.
- ☐ Check the area around the unit for dust, dried up sludge etc. and ensure that is clean.
- ☐ Prior to starting check feed well drum alignment and if found necessary, correct any tilting to one side manually.
- ☐ Replace the grease in bearings through grease nipples keep filling the grease until new grease did not start coming from the grease vent hole.

- ☐ Top up the oil if the level is below the red line mark in Oil level Indicator and replace it completely if the condition of the oil is too bad. For any stoppage for more than a month, it is recommended to replace the oil completely.

- ☐ Check whether the torque controller for clarifier mechanism is in good condition and service the same if necessary.

3.4 Checking and servicing of filter press

- ☐ If the filter press was stopped abruptly without thorough cleaning of the filter cloths, a day before re-starting the filter, cloths should be taken out and to be cleaned with Hypo and acid and then rinsed with fresh water using a jet pump.

- ☐ If the filter cloths had gone brittle due to prolonged disuse or torn on the sides, replacement of the same might be needed.

- ☐ Lubricate the moving parts prior to re-starting using recommended oil and grease as per the supplier's manual.

- ☐ Check for pneumatic hose of the power pack and ensure that the same is without leak and strong.

- ☐ Top up the oil in the power pack unit. If the stoppage was for a prolonged period, replace the same.

- ☐ Check for any leakage at the hydraulic cylinder. During the dry run, ensure if the rated pressure is developed.

- ☐ Conduct a wet run using freshwater before admission of sludge. Any leaks through the plates and dripping may be checked.

3.5 Checking of all agitators in the ETP

- ☐ Agitators are there in many parts of ETPs such as chemical preparation tanks, flash mixers and sludge storage tanks etc.

- ☐ To re-start the unit after an abrupt shut-down, make sure that no sediment from the earlier operations is there in the tank and if any, should be physically removed before re-starting. Any solidified sediment could result in breakage of the unit.

- ☐ Before re-starting, flush the arm with freshwater.

- ☐ Check the agitator platforms. Platforms are generally constructed in stainless steel of in RCC. If the platform is made of mild steel, make sure that that platform and handrails are not corroded and strong enough. Brush any corroded part to remove rust and get a complete re-painting.

- ☐ Check for all interlocks and ensure that they are free from rust.

- ☐ Physically check the drive. Find any jam in the rotor and motor fan before energizing these units.

- ☐ Check the area around the unit and ensure that it is clean. In particular, lime preparation tanks can have sprinkled powder solidified on the tank wall and near the unit. These need to be cleaned off before wetting the unit again.
- ☐ Replace the grease in bearings.

4 CHECKING AND CLEANING OF DIFFUSERS IN THE ETP

4.1 Usage of diffusers in ETP

As observed in ETPs in/around Dhaka, air diffusers are commonly used in the equalization tank as well as in aeration tanks. While there are different types of diffusers, the most common types in use are fine bubble diffusers made of EPDM. Shutdown period is the opportunity to clean the diffusers and regain optimum performance.

During shutdowns, in many of the cases, the diffuser gets scaled with inorganic salts and covered with organic slime. While the organic scum may be removed by general washing, inorganic salts (mostly calcium carbonate) are coated on the surface of the diffusers and would not get removed easily. The best way to remove this scaling is to use acid.

4.2 Checking and cleaning of diffusers

- ☐ If the tank is empty or the diffuser installation is of retrievable type, take out the diffuser and inspect them thoroughly. Any torn diffusers or that has become very brittle need to be replaced. The rest may be cleaned.

- ☐ Remove the diffuser from the lateral pipes and brush the diffuser surface with dilute HCL (10% - 15%) until the scaling/biofilm is detached from it.

- ☐ If the lateral pipes of the diffusers are not retrievable type, use formic acid to clean the diffusers, which may be introduced through a misting nozzle into the main airline. The air will then carry this acid mist to the diffusers in which it will then eat away at the Calcium Carbonate and other salts.

- ☐ Generally, EPDM rubber diffusers do not get affected by the formic acid. The polyurethane tubes and air distribution panels shall be slightly affected by the acid, but also get cleaned in the process. If there is any specific procedure listed in the operation and maintenance manual, the ETP can follow the same.

- ☐ If diffuser assembly is not of the retrievable type and formic acid is difficult to obtain, the diffuser can also be cleaned by removing the air delivery line, injected with dilute HCL (5% - 10%) @ 0.4 - 0.6 bar. Make sure that the tank has adequate water, say 0.5 m to prevent the resultant acidic water corrode the concrete tank.

- ☐ Before re-starting the unit, check the airline, valves etc. for any leaks and also ensure that the pressure of blower is in the prescribed range.

5 RESTARTING GUIDELINES FOR TREATMENT UNITS IN ETP

5.1 Raw effluent channels, screens and manholes

- ☐ During shut-downs, make sure that raw effluent drains are emptied and cleaned. Any effluent/sludge accumulated shall result in foul smell, safety risks and scaling.
- ☐ Before shut-down, remove all screenings from the screen, clean the bristles of the screen, and flush it with fresh water.
- ☐ Before a prolonged shut-down, make sure that manholes are empty, manhole covers are firmly covered. If possible, wrap the manhole cover handle with a cello tape.
- ☐ After shut-down, before re-opening, clean the shallow and open drain channels with a broom. Pipelines may be flushed with fresh water.
- ☐ No manual entry into manholes or pits unless absolutely necessary. In such a case, all safety precautions, as mentioned earlier, need to be adhered to.
- ☐ If the effluent channel has removable covers, all cover slabs may be opened before cleaning and exposed to air for about 30 minutes before cleaning.
- ☐ Any manholes in the lines should be checked before starting of the factory itself. The manhole covers shall be lifted and kept open for 30 minutes before checking.
- ☐ Before starting the screens, any dried screenings in the screen and/or in the cleaning brushes shall be removed using a wires brush. Any fibre like substances from the bristles may be manually removed.
- ☐ Perforations in the screening platform may be checked to ensure proper draining of water from screenings.
- ☐ Jet nozzles in the cleaning spray system too should be checked for any blockages and cleaned if necessary.
- ☐ The drive shaft of the screens shall be checked for any jamming due to dust or dried solids. The motor gear and drive shall be oiled and greased before startup. The unit may be tested for a dry run for 30 minutes before re-starting the effluent feeding.
- ☐ Any manually cleaned screen should be thoroughly cleaned before re-starting. If the screen is not stainless steel or PP, the screen bars/mesh may be re-painted at least a day before the re-starting. Ensure that rakes for the manually cleaned screens are available and is in good condition.

5.2 Collection tanks, sumps or lift stations

- ☐ Prior to shut-downs all collection sumps, pits or lift stations should be emptied and flushed.
- ☐ If this was not done due to the abrupt shut-down, during the shut-down period, it should be done before the re-starting.

☐ No manual cleaning of the sump should be attempted. If desludging of the tank could not be done due to any reason before re-starting the ETP, the tank may be stirred with water, and bottom contents may be pumped out prior to admission of fresh effluent.

5.3 Equalization/Balancing tank

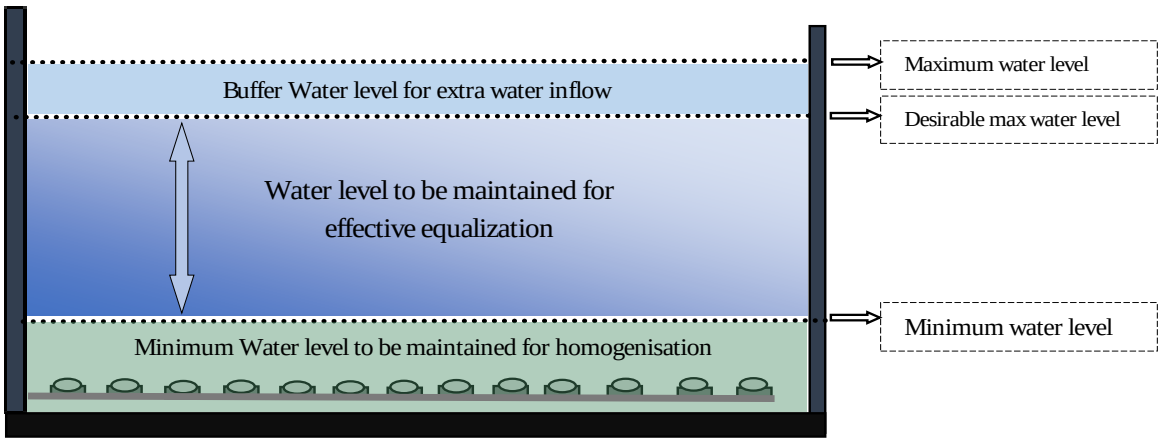
☐ It is preferred that, prior to restarting, the equalization tank is emptied and cleaned. This is not difficult since the equalized effluent transfer pump should be able to pump out all the liquid quickly.

☐ Any sludge settled in the bottom could be stirred using jet of freshwater and taken out. Under no circumstances, any person entry into the tank shall be permitted. In rare cases where the manual entry becomes unavoidable (e.g. any broken pipe at the bottom) the tank should be emptied and any sludge fully removed and the worker takes all safety precautions as narrated earlier.

☐ Equalization serves two purposes in the ETP. On the one hand, it provides the storage volume to balance different batches of discharge at the inlet to the ETP, coming at 10-12 hours in a day, to the 24 h/d pumping to the next treatment unit. Secondly, it ensures that different type of effluents mix together to form a homogenized effluent, amenable for easy treatment.

☐ Too low a level in the tank does not ensure proper homogenization, whereas too high a level is risky not providing adequate storage volume for any emergency, resulting in possibilities of overflow from the tank or stoppage of the pump, resulting in overflows elsewhere.

☐ In order to ensure proper homogenization, the tank level may be maintained as in the following sketch.



☐ Prior to restarting, it is essential to check the diffusers. For this purpose, fill up the tanks to at least 50 cm above the diffuser level (in case of pipes with nozzles, 50 cm above nozzle levels). Run the blowers and check the aeration for any coarse bubbles (broken diffusers) and no aeration (blocked diffuser) and then replace or re-clean the diffusers after pumping out the water.

- ☐ After ensuring the integrity of the system, effluent can be admitted into the tank.
- ☐ To restart the operation of equalization, switch on the aeration/maxing as soon the effluent level reaches above the diffusers.
- ☐ Wait till the tank fills up to half of its volume before starting pumping. Maintain at least one-third of the tank volume all the time to ensure homogenization.

5.4 Re-starting of primary treatment

- ☐ While many of the ETPs for textile industries in Dhaka are all-biological treatment, there are some ETPs which has both primary treatment as well as secondary biological treatment. Some units have only primary treatment.
- ☐ It might be possible that the units still have some effluent or sludge when they were switched off. Before restarting, remove all sludge and effluent from flash mixer, flocculator and clarifier. Empty the units using portable pump and clean the same. Before restarting the clarifiers, it is essential to check the underflow pipes and remove any blocks in the sludge pipes. There were many cases, the clarifiers were filled, and later it was noticed that the underflow pipes are blocked, and the clarifier had to be emptied again, stopping the ETP. A simple check before starting could prevent this.
- ☐ Remove all dust from overflow launder. In most units, the portion would be filled with dried sludge. Remove all these using a broom.
- ☐ It is essential to check and adjust the V notches in the overflow weir. In many working plants, it could be seen that the level of V Notches is uneven (in some cases, the V portion is broken), resulting in clarifier overflow only through some areas. Since the efficiency of the clarifier is proportional to the weir loading rates, it is essential that the V Notches are adjusted prior to restarting and overflow water is uniform throughout the periphery.
- ☐ Adjustment of V notch can be done simply by (a) loosening the fastening screws, (b) allow the water to fill up and overflow and (c) mildly hammer the V notches in areas with no overflows and (d) after ensuring uniform overflow, lower the water level and tighten the screws again.
- ☐ In some cases, it is seen that after restarting the clarifier shows a sagging of the walkway bridge. This is more in case of full diameter bridges and due to the ‘pulling down’ of the bridge in operation. In such cases, the scraper blades may start touching the bottom and may get damaged. If sagging is noticed, the bridge may need replacement, and if a replacement is not possible/needed, the position of scrapper blades may be slightly elevated.
- ☐ In case of other settling units such as tube settlers or lamella clarifiers, take out the tubes/plates, wash the same and re-install them prior to re-starting. It is essential to ensure that the tubes or plates are evenly placed and at the angle as per the manufacturer’s instruction (40 or 60 degrees in most cases).

- ☐ In the case of tube settlers or lamella clarifiers too, during the test runs, check the overflow weir level, so that overflow water flows without turbulence and is even along the periphery of the weir. If any adjustment is needed, unscrew the same and lower, tilt or elevate the weir as needed and reinstall. If the overflow is still not uniform, that indicates misalignment in construction and in such cases replace the weir box itself.

- ☐ Many ETP managers add chemicals in the primary treatment without understanding the function of chemicals and without distinguishing between coagulants and flocculants. Use coagulants only if colloidal solids in the raw effluent are high. It is possible to check the approximate quantity of colloidal particles in the effluent by filtering the same through different filter papers. First, filter the effluent through a 1.2 microns filter paper (which removes the general suspended solids and then filter the filtrate through another filter paper of 0.45 microns. The weight in the second filter paper gives the approximate level of colloidal particles. Though the small size filter paper than 0.5 microns filter paper would have better, the test would be more difficult.

- ☐ For a more accurate analysis of colloids, it is possible to get the particle size distribution (PSD) analysis done in any external laboratory.

- ☐ It may be noted that Ferrous Sulphate is used in primary treatment, mostly for decolourization of reactive dyes. For non-reactive dye effluents, ferrous sulphate does not provide any additional advantages over other coagulants like alum or poly aluminium chloride (PAC). For building up of flocculants, variety of flocculants are available in the market, mostly with trade names. Anionic and non-ionic Polyelectrolytes are widely used in ETPs for textile dye effluents to build up the flocs.

- ☐ Re-starting of the ETP offers a good opportunity for the plant manager to take a re-look at usage of chemicals, select the most useful ones and fix correct dosages.

- ☐ The ETP manager should check and compare the efficiency of different chemicals (including the proprietary ones) through laboratory tests. The efficiency of different chemicals may be tabulated in a simple chart and select the chemicals accordingly.

- ☐ In most ETPs, the manager follows the dosages as suggested by the original consultants of the ETP or as per various literature. This would be an unwise practice and may result in excess cost, higher sludge production or lower efficiency. Instead of following fixed dosages, plant manager should do jar tests and re-starting time of the ETP provides a good opportunity to do the same.

- ☐ When combination of chemicals (e.g. alum, lime, poly) are used, charts may be prepared with different dosage combinations, keeping one chemical dose constant in each case. Based on the chart, most optimum dosages may be selected.

- ☐ While dosing ferrous sulphate, the same may be dosed till the effluent colour turns into pale green. Avoid excess dosage since unlike ferric sulphate (the product of reactive dye reduction), ferrous sulphate is more soluble and may remain in the clarified effluent. Later, when it is exposed to oxidation through the air, the excess ferrous sulphate in the chemically treated effluent may get oxidized, and the effluent itself may turn into reddish in colour.

- ☐ Many ETPs make the mistake of dosing excess alum or ferrous sulphate when the pH is high since both these chemicals are acidic in nature. One should not use Alum/FeSO4 as neutralizing agent. This practice will result in wastage of these chemicals as they are comparatively milder in acid, more costly and may produce much more sludge. For neutralization of raw effluent always use mineral acid like hydrochloric acid.

- ☐ While re-starting the ETPs, many ETP management makes the mistake of modifying the chemical dosage, often due to financial difficulties and considering that the quantity to be treated is less. It should be understood that too low a dosage of coagulants or flocculants is useless. For instance, alum or ferrous sulphate at a lower dosage, say, less than 50 ppm may have no effect on the flocculation of effluent.

- ☐ Too high dosage of coagulants will result in wastage of chemical and result in excess sludge. Always select the optimum dosage through jar tests. The jar tests should be repeated periodically and should be done at least every month.

- ☐ While operating high rate sedimentation systems such as lamella clarifier or tube settler, care should be taken to withdraw the sludge frequently. This is because, unlike the conventional gravity clarifiers, these units have no built-in thickening sludge storage volume.

- ☐ In many ETPs, it was noted that they keep fixed slurry concentration for all coagulants and flocculants used in the plant. It would be advisable to keep the slurry concentration of alum or ferrous sulphate at about 10-15%, while that of lime may be kept at 5-10%. Too high concentration may result in wastage of chemicals. Too low concentration would result in lower efficiency and wastage of fresh water for chemical slurry.

- ☐ Few ETPs adopted the practice of using treated effluent for mixing of chemicals instead of freshwater. While this practice may help conserving fresh water, it may interfere with the function of chemicals and reduce the effectiveness of primary treatment. Always check and compare such usages with fresh water before adopting such practices.

- ☐ Many (mostly small) ETPs resort to dosing of chemicals by gravity through manually controlled valves. This will result in improper control of chemical dosing, and it is preferred that the chemicals are dosed through a proper metering pump instead of gravity feed.

- ☐ It would be a good practice to use two separate tanks for chemical preparation and dosing. When one tank is used for dosing chemical slurry to the flash mixer, the other may be used for the preparation of the chemical slurry. The agitator in the slurry preparation tank should be kept running to ensure good mixing and prevention of any sedimentation of the chemical slurry.

- ☐ Under no circumstances, the chemical slurry feeding should be done with running feed water added to the dosing tanks. This will result in the concentration of chemical slurry varying the duration of dosing and results in loss of efficiency, wastage of chemical and production of excess sludge.

- ☐ Polyelectrolytes are generally manufactured to be dosed in low concentration (often 0.5-1%). Dosing the same at higher concentration would be difficult (due to high viscosity) and results in wastage of the costly chemical. Always use one stock preparation tank to prepare a poly solution of say, 5% and then a separate solution preparation and dosing tank at a lower concentration, say 0.5%.

- ☐ While evaluating different chemicals for the ETP as mentioned earlier, compare the results in totality. Often, cost of chemicals like polyelectrolytes may be higher per kg, but since the dosages needed are very low, the total cost per cubic meter of effluent or cost per m^3 of effluent may be lower than common coagulants, which though cheaper per kg, need a much higher dosage. Further, some chemicals may be costlier in dosing but may generate much less sludge, saving money in sludge disposal. All factors, including ready local availability, need for high stock and reliability of the source, etc. need to be considered while evaluating and selecting a chemical.

- ☐ Always ensure that the chemicals are dosed at the proper dosage point. Dosage point is essential. Dose coagulants only in a flash mixer (preferably in two flash mixers or two different points in the mixer, preventing their mixing before reacting with the effluent).

- ☐ Dose polyelectrolytes only in flocculation tank and not in flash mixers.

- ☐ Some ETPs use ordinary centrifugal pumps for dosing chemicals such as alum to the flash mixer. This will result in less control in dosage and it is preferable to use a metering pump with accurate dosage for dosing acid, ferrous sulphate, alum, polyelectrolytes, poly aluminium chloride etc. Since there is a possibility that in case of some chemicals such as lime, the chemical slurry with high impurities of sand etc. may block and damage metering pumps, centrifugal pumps may be used for dosing them.

- ☐ Many ETPs use cheap chemicals such as low-quality lime. The active content in such chemicals are much less and the so called ‘cheap’ chemical may prove itself to be costly. Also, impure chemicals add to excess sludge generation. It is always preferred to use high purity chemicals in the ETP. It will be useful to link the price of such chemicals to its purity.

- ☐ It would be beneficial to use automatic pH control in the ETP while dosing. This can be done using an online pH meters and a PID controller liked dosing pump. While this arrangement may cost some money for installation, the savings in chemical and associated benefit in sludge generation will ensure pay back of the investment in few months.

- ☐ It will be a good idea to ask for material safety data sheet (MSDS) of branded chemicals to know more about their safe handling and management. In any case, this may be also already a requirement by the factory`s buyers with regard to overall chemicals management.

- ☐ Always calculate primary treatment efficiency and match it to F/M requirements in the aeration tank. This is particularly important during restarting of the ETP. Calculate the BOD/COD load admissible to the aeration tank and increase or decrease the level of chemical treatment accordingly.

- ☐ After restarting of the ETP, if the raw effluent volume is too low, lesser chemical treatment may be needed. If quantity is high and the pollutant concentration is higher than what can be admitted into the aeration tank at that point of stabilization, higher dosages of chemicals may be needed.

5.5 Recommissioning of the aeration tank

- ☐ Restarting strategy in aeration system may depend on (a) how long the shut-down was, (b) whether the bio-sludge was kept alive with continued aeration during shut-down and (c) the microbial activity of the MLSS remaining in the aeration tank(s).

- ☐ If the shutdown was done for a shorter period (e.g. up to one month) and the unit was kept under minimal aeration, some MLSS may be available. If there is no active MLSS available in the tank, do external seeding, bringing bio sludge from a good working ETP. The quantity of bio-sludge need depending on the size of the ETP and biomass condition in the donor ETP, often few tankerloads of bio-sludge may suffice. If bio-sludge from a similar industrial ETP is not available, try seeding biomass from an operational sewage treatment plant. If even this sludge is not available seeding with ready-made specialty microbial package may be considered. If none of these are feasible, the traditional method of seeding the aeration tank with fresh cow dung may be considered.

- ☐ During re-commissioning of biological system, some readily degradable organics such as molasses may be fed to the system. Initial dosage may be kept around 2 g/l to 5 g/l. Once sufficient MLSS is built up in the plant, the plant manager may discontinue the feeding of molasses since it adds to the pollution load.

- ☐ During restarting of the aeration system, maintain lower feeding in the beginning: proportional to whatever MLSS available in the aeration tank.

- ☐ During re-commissioning, relatively higher F/M, in the level of say 0.3-0.4 may be maintained in the tank. This can be easily calculated by the ETP manager.

- ☐ For instance, if the aeration tank has MLSS of only 300 mg/l for an aeration tank of volume 1000 m^3, the total biomass available would be about 300 kilograms in the tank. If the maximum F/M to be maintained is 0.4, the maximum organic load (BOD or COD, depending on the type of COD) should be 120 kg/d. Calculate the load per day from the effluent analysis report and the flow rate and admit only the permissible quantity to the aeration tank. In the above example, if the analysis shows the organic load as 500 mg/l (0.5 kg/m^3), the maximum quantity which can be admitted into the aeration tank will be 120 ÷ 0.5 kg/m^3 = 240 m^3/d

- ☐ During re-commissioning, it is advisable to keep higher nutrient level in the aeration tank. Normal nutrient addition needed for the stabilised operation shall be BOD: Nitrogen: Phosphate as100:5:2.5. However, during re-starting a higher nutrient level of BOD: N:P at 100:8:4 where N stands for nitrogen and P represents phosphates may be maintained to stimulate the growth of biomass.

- ☐ The plant manager may calculate the quantity of Diammonium phosphate and/or Urea needed as nutrients, with the understanding that Urea has about 46% Nitrogen, Diammonium Phosphate (DAP) has 18% Nitrogen and 46% Phosphates.

- During re-commissioning it is advisable to maintain a higher dissolved oxygen (3-4 mg/l) in the aeration tank for growth of healthy biomass. The dissolved oxygen level during regular operation may be around 2 mg/l and in the final effluent, after post aeration, around 4 mg/l.

- During re-commissioning, if two aeration tanks are present in the ETP, commissioning only one of them can be planned first. After full stabilisation of the first tank, bio-sludge developed in this tank can be used for quickly commission the second, by diverting re-circulated biomass to the second tank.

- During re-commissioning, many plant managers hesitate to waste any sludge citing that the MLSS is lower than the desired level of 3000-3500 mg/l. Even if MLSS is low in aeration tank, sludge wasting could be started when MLSS level reaches >1000 mg/l. This will stimulate the growth of the new bio-mass.

- After few weeks of start up, the plant manager can start calculating sludge volume index (SVI) to determine the nature of settling and chance of sludge bulking. It is calculated by dividing the settleability of bio-sludge after 30 minutes (SV30) by the MLSS or more preferably by MLVSS. An SVI of 110-120 ml/g is good, whereas that above 150 ml/g indicates potential bulking.

5.6 Typical problems encountered during re-commissioning

- During re-commissioning most aeration tank shows heavy foaming, which is mostly white in colour. This is natural and generally not a cause of alarm if the same is excessive or do not start flying around. The form can be generally controlled with water spray. If the foam is still high, dosing of some defoamer may be done. However, care should be taken to use only bio-degradable defoamer or only silicone-based one.

- In the beginning, there are many cases of bio-sludge not settling in the secondary settling tank. The bio-sludge may get washed off along with the clarifier overflow. This is natural and may be controlled by increasing the return activated sludge flow back to aeration tank.

- During re-commissioning, it is advised to keep the return activated sludge (RAS) level at about 150%. This means, if the flow to the aeration tank is 1000 m^3/d, the return activated sludge rate should be 1500 m^3/d. Once MLSS level builds up >1000 mg/l, the RAS level may be kept around 100% or as per original design.

- If the re-commissioning was initiated with cow dung, filamentous organisms may develop, causing bulking. This results in poor settling and washing out of the biomass. To control the bulking, the plant manager may adjust return activated sludge levels. If the problem of bulking persists, he may choose to dose low dosages (say 100 mg/l) of poly aluminium chloride at clarifier inlet.

- If the problem of sludge bulking is very high, the plant manager may consider dosing about 5-15 ppm of chlorine in return activated sludge line. Sodium hypochlorite (about 20-30% chlorine content) may be used for the purpose. Care should be taken not to dose the chemical in excess than mentioned above since the chlorine can also kill the active micro-organisms in the aeration tank.

☐ Many of the ETPs in/around Dhaka use a settling polymer at the inlet of the secondary settling tank (this chemical is also sold as colour removal agent). Most of the plant dose this chemical on random basis or as suggested by the supplier. The actual dosage needed should be checked through jar testing and optimum dosage should be arrived at, both during re-commissioning and later during regular operation.

☐ At times, low MLSS level is observed even after a prolonged period of re-commissioning, the possible reason must be found out, and necessary corrective measures are to be taken at the earliest. The common causes of low MLSS include:

- Low dissolved oxygen in the aeration
- Insufficient nutrients in the system.
- Insufficient return of bio sludge from settling tanks.
- Over/underfeeding disregarding the biomass level in the tank.
- Torn/blocked diffusers, dead spots resulting in settling of biomass in the aeration tank.

☐ It is better not to use any speciality bacteria in the aeration system, once it is commissioned. Composition of most of such products, yet many of them appears packaged speciality microbes with or without enzymes. Dosage of speciality bacteria usually kills normal micro-organisms in the aeration tank such as *Pseudomonas*. Most of these products also need permanent periodical re-dosage.

6 RECOMMENDED MONITORING OF ETP CONTROL PARAMETERS

For ensuring proper restarting of the aeration system, it is necessary to monitor the important parameters. Some of the important aspects have been indicated herein.

- ☐ Check MLSS level in the aeration tank every day. It is basically checking only suspended solids and can be done even in the smallest laboratory, equipped with an analytical balance.

During the design of an ETP, the aeration tank volume is designed based on the quantity of MLSS required in the system. Hence, the first step in the monitoring of the aeration tank is the measurement of MLSS in the tank. An MLSS level of above 1000 mg/l shows good biological activity, and once the MLSS reaches above 2000 mg/l, the plant may be deemed as fully re-commissioned and stabilised.

It may not be easy in an effluent treatment plant to check the presence of micro-organisms in the system by bacteriological studies using a microscope, colony counter etc. A parameter called MLVSS is checked to estimate the percentage of organic portion of the total MLSS which will give an idea regarding the 'active part' of MLSS. If the ETP has a muffle furnace, it can be checked in-situ. Or else, this can be checked in an external lab, at least once in two weeks during re-commissioning and once in three months during regular operation.

An MLVSS percentage in MLSS of around 60-80% is considered as the indication of a healthy microbiological population.

- ☐ Check the pH of the aeration tank every day. Maintain it in the range of 7-8 for effective biological activity. This testing can be done using a portable pH meter or at least by a pH paper.

- ☐ In every shift, the plant operator should measure the settleability of the bio-sludge in the aeration tank. The settled volume of bio-sludge in a one-litre beaker after 30 mins, SV (30), gives an idea about the bio-mass available in the system (though MLSS measurement gives a better idea). The SV (30) in a well-operated plant usually will be between 300-450 ml/litre. This measurement may then be used for measurement of sludge volume index (SVI) by dividing it by MLSS, which in turn gives the idea about the settling characteristics of the sludge.

Other operation parameters such as mean cell retention time (MCRT), solids retention time (SRT) are not discussed, being beyond the scope of this document.

- ☐ Check the dissolved oxygen every day. The dissolved oxygen level may be checked using a portable DO meter or at least by Winkler's method in the laboratory. As already mentioned, the DO level during the recommissioning period should be higher than usual.

- ☐ Check for nutrients. If the laboratory in ETP does not have the provision, the Nitrogen and Phosphate levels may be checked in external laboratory. This test needs to be done certainly in the initial days of re-starting and maybe once in 2-3 months afterwards.

The plant manager should acquire the practice of recording of monitoring results in a proper fashion. Only by proper monitoring at the treatment process by way of keeping records and adjusting the treatment process based on the data, the optimum efficiency of the treatment can be obtained.

The proper monitoring of an effluent treatment plant should consist of measuring/recording the following:

- Working time of pumps and other equipment
- Flow rate to and from the effluent treatment plant
- 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

In the monitoring of biological treatment, the following are important aspects to be noted and consulted to adjust and control the treatment:

- Dissolved oxygen in the aeration tank
- MLSS and MLVSS in the aeration tank
- Percentage of bio sludge returned to the aeration tank
- Amount of bio-sludge wasted
- Nutrients in the aeration tank
- Settleability of secondary sludge

Based on the data recorded for the above, the plant manager can endorse any corrective measures required in the operation. For example, if the MLVSS percentage in the MLSS is observed to very low, wasting of bio sludge may be increased.

☐ Every day, the ETP in-charge 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.

☐ On a weekly basis, identify the troublesome areas inside the plant. Take special care to find out the possible reasons for frequent complaints from the area(s).

☐ Once a month, the ETP in-charge may meet with his superior in the factory and 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.

7 HANDLING AND DISPOSAL OF SLUDGE

A detailed discussion of this aspect will not part in this document, as the Department of Environment (DoE) has already published a simple and detailed manual for handling and disposal of the sludge. The manual can be accessed at the following website: http://www.doe.gov.bd/site/publications/f60e3b23-1329-4b8b-84cf-a5df8f2d4294/bd-Standards-and-Guidelines-for-Sludge-Management

8 PREPARING FOR AND MANAGING FUTURE SHUTDOWNS

If by any reason, a shut-down of ETP is required in future, it is recommended to spend some time to stop the plant properly. A proper shut-down may take 2 - 3 days. The following important aspects may be taken care of during any such shut-downs.

- ☐ Keep all raw effluent channels empty, clean and dry.
- ☐ Clean the screens manually and if need be covering the drive with a plastic sheet.
- ☐ After effluent flow stops, clean all manholes and put the covers on manholes and drains tightly. For easy retrieval and prevent corrosion, it may be useful to cover the metallic grip on manholes with insulation tape.
- ☐ Since thefts are quite common during any shutdowns, the manager should ensure that all costly and removable electronic parts may be detached and kept in safe custody till restarting.
- ☐ Empty tanks such as lift well, equalization, primary clarifier etc.
- ☐ Any sludge needs to be stirred with water and pumped out the treatment section. Remove all sludge in primary settling tanks and dewater the same and keep it dry.

After shutdown of the primary units, only aeration and secondary settling tank will be in operation. The operation of secondary clarifier and return sludge pump may continue till there is overflow from the aeration tank. Once the level in the aeration tank goes down below the overflow level, close the outlet of aeration, pump remaining bio-sludge in the secondary settling tank back to the aeration tank and any clear water in the settling tank may be pumped for discharge.

The MLSS available in the tank will get quickly exhausted if full aeration is maintained. Since feed is not available, any excess aeration will result in digestion of the MLSS itself by the microbial population and result in quick elimination of the bio-sludge. Instead, it is suggested to provide only minimal aeration, just to sustain the biomass, not for excess activity.

Note: The minimum aeration requirements during shutdowns, before re-starting has been estimated as the mixing power of about 30 w/m^3 of tank. This would mean a 1000 m^3 aeration tank may need approximately 30 kW of mixing power to be operated for a minimum period of 20 hours per day.

Periodical painting, routine maintenance like oiling and greasing with the correct grade is a must even during shut-downs. It is advised that an oiling and greasing chart for various equipment with the periodicity may be prepared and maintained.