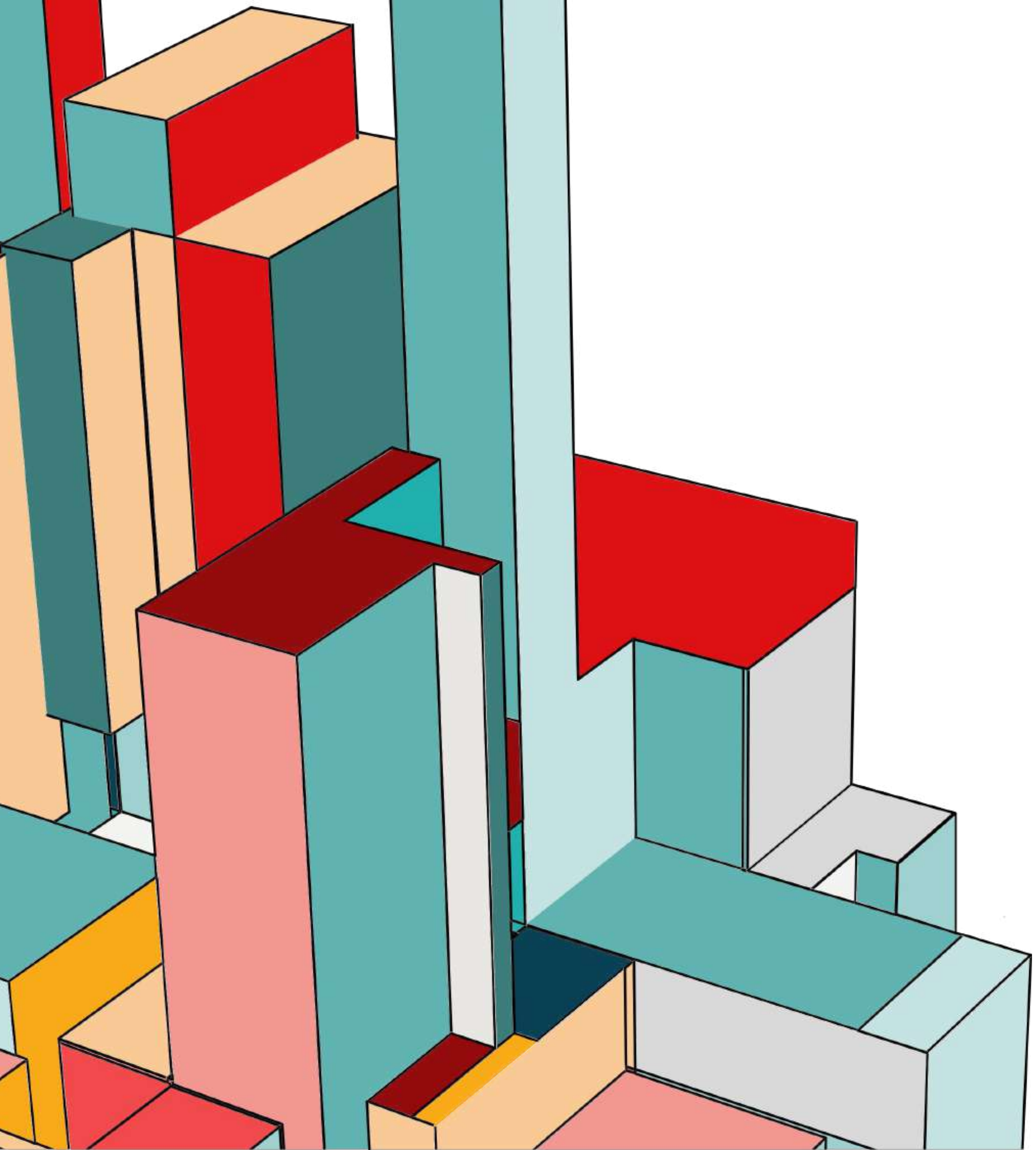

PROJECT JALSAKSHAM

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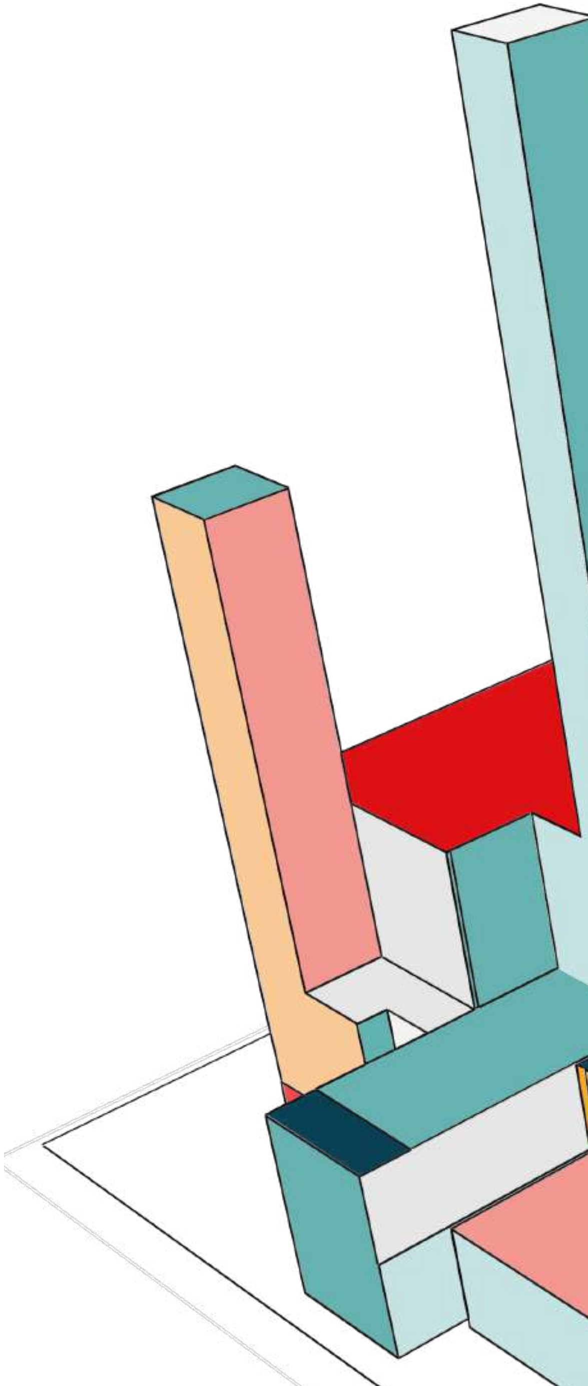
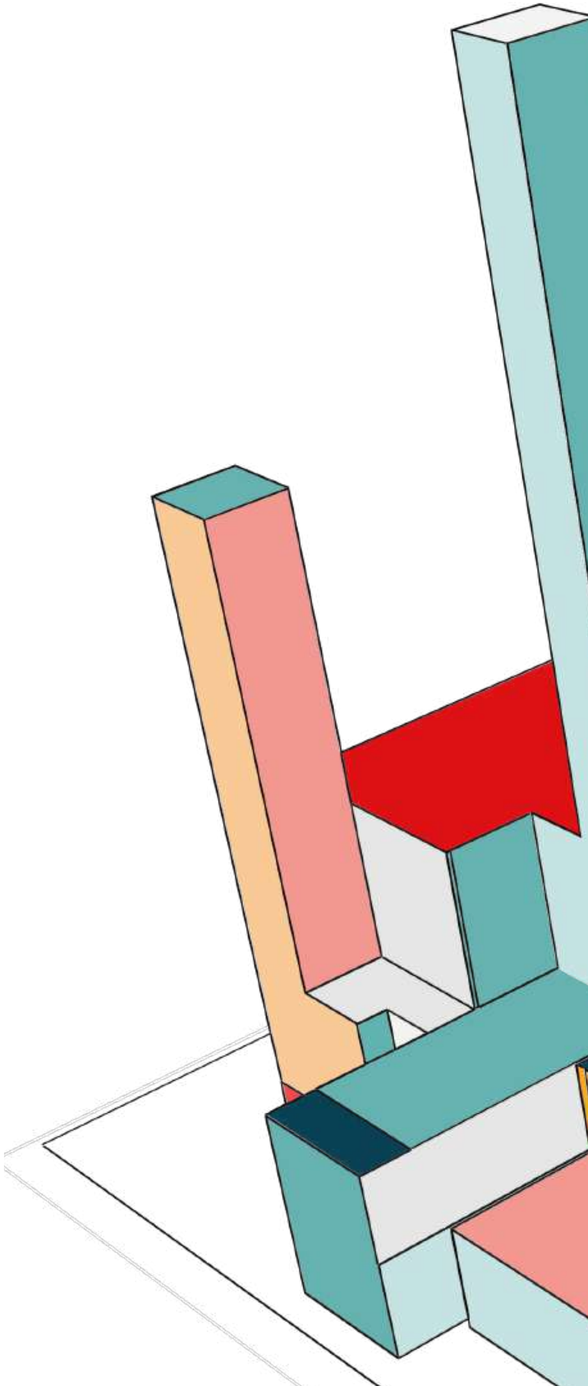


STP OPERATOR ASSISTANT & PUMP TECHNICIAN

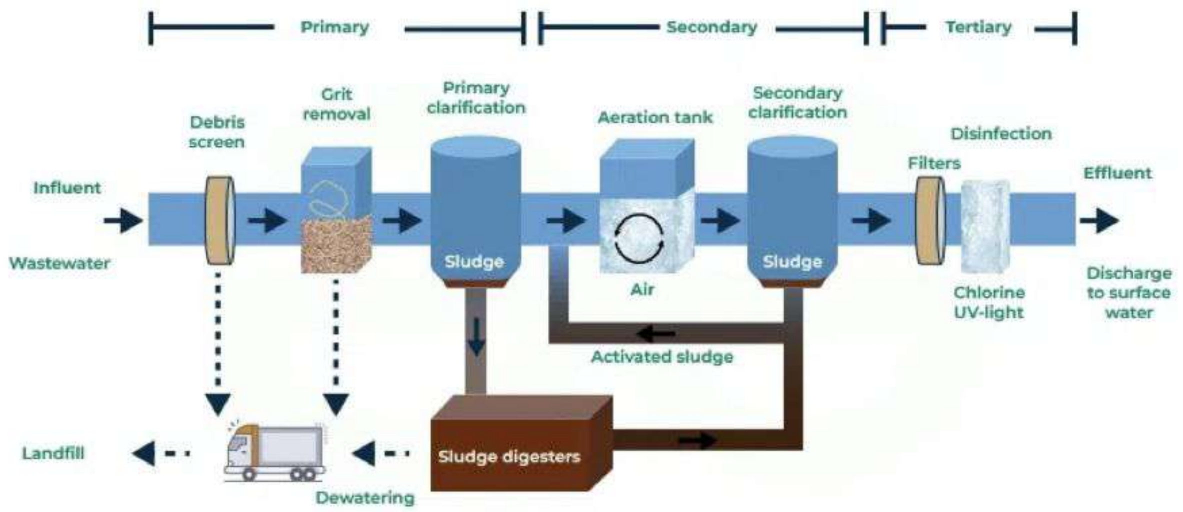
(ENTRY LEVEL) TRAINING MANUAL

MODULE 1: INTRODUCTION TO SEWAGE TREATMENT & SAFETY



OVERVIEW OF SEWAGE TREATMENT

- Wastewater (sewage) from homes, businesses, and industries carries pollutants and organic matter. If released untreated into rivers or lakes, it threatens human health and the environment.



- *primary* (screening, grit removal, settling of solids)
- *secondary* (biological treatment)
- *tertiary* processes (advanced treatment).

- Each stage cleans the water further; for example, secondary treatment “removes organic matter and suspended solids using biological processes”.
- Wastewater treatment helps meet standards. Before discharge, effluent (treated water) must be clean enough to protect public health and wildlife. Proper treatment reduces pollutant loads and ensures compliance with regulations. Instructors should explain the overall flow: from raw sewage inlet, through screens, grit chambers, primary clarifiers, aeration tanks, secondary clarifiers, and finally disinfection (e.g. chlorine contact) before discharge.

PRELIMINARY AND PRIMARY TREATMENT

Screening: Large debris (rags, plastics) is removed by mechanical bar screens or sieves to prevent damage downstream. Screen cleaners or grinders may operate automatically or manually. Operators must clear screens regularly and use tools (hook, rake) safely, keeping hands away from moving parts.

Grit Removal: Sand and small stones settle in grit chambers. Remove grit routinely to prevent abrasion on equipment. Grit channels often use water jets or vortex flow.

Primary Settling: Water flows slowly into large tanks. Heavy solids settle to the bottom as sludge and are scraped into hoppers, while grease/floatables rise to the surface and are skimmed off. Operators monitor tank levels and remove settled sludge to sludge hoppers for further handling. Insert diagrams of primary clarifier and sludge scraper here.

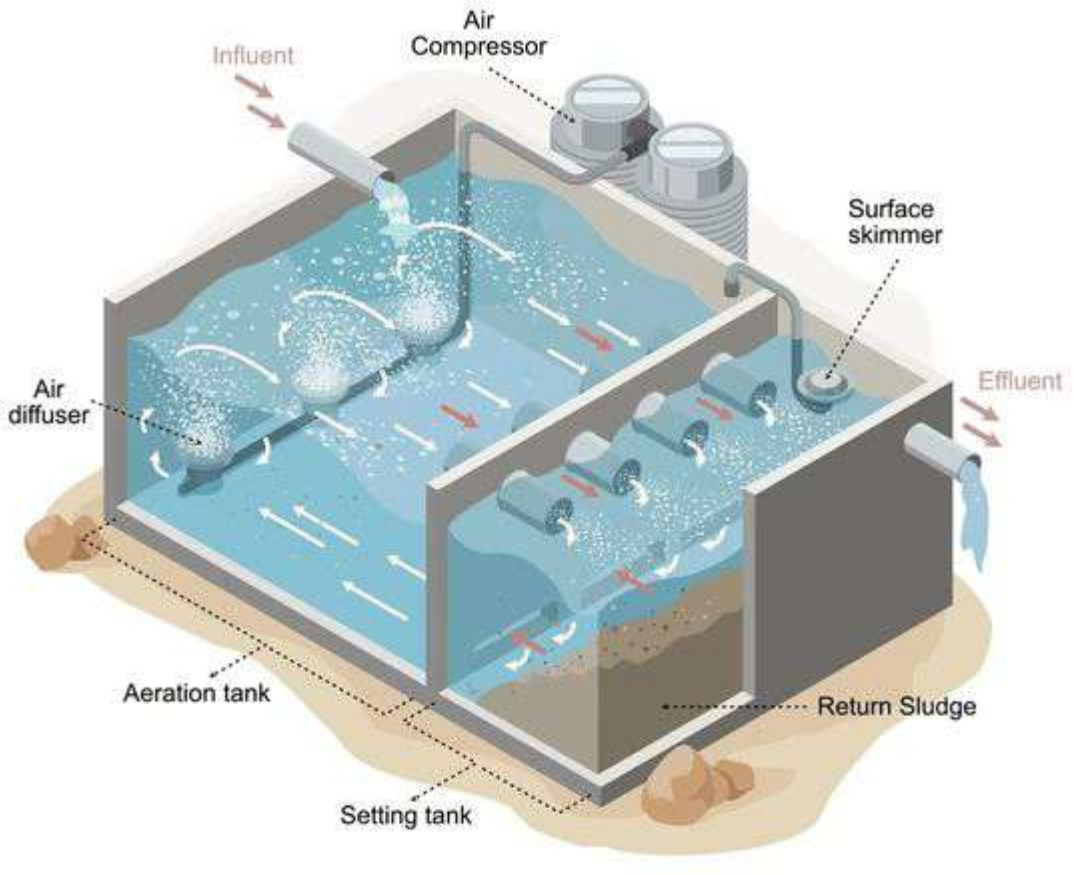
Safety note: Screens and grit systems involve moving parts. Always lock out power before cleaning or unclogging. Use gloves and face shields for splash protection when working in wet areas.

SECONDARY (BIOLOGICAL) TREATMENT

Secondary treatment relies on bacteria ("bugs") to consume dissolved organic matter. In aeration tanks, air or pure oxygen is introduced to support aerobic microorganisms.

- The mixed biomass (activated sludge) and wastewater flow into these tanks.
- Maintaining proper dissolved oxygen (DO) levels (~2 mg/L) is critical so all microbes (even those inside flocs) get air.
- If DO drops below about 2 mg/L, microbes at floc centers die and treatment fails.

Operators must monitor blower operation, check DO with meters (calibrated daily), and adjust airflow.



TERTIARY TREATMENT AND DISINFECTION

Tertiary treatment removes remaining impurities. Common steps include sand filtration or nutrient removal (e.g. adding iron or alum to bind phosphorus). Disinfection (e.g. chlorination or UV) kills pathogens. Chlorine gas or sodium hypochlorite is often dosed into a contact tank. Operators must measure and adjust chlorine feed to achieve target residual (e.g. 0.2–0.5 mg/L free chlorine) without overdosing.

Chemical Safety: Chlorine and other chemicals (acids, alkalis, coagulants) are hazardous. Always wear acid-resistant gloves, goggles or face shield, rubber boots and aprons when handling

Follow “buddy” procedures (two-person handling) for toxic gases. Have eyewash and safety showers operational near dosing areas. Label all chemical containers clearly and store according to MSDS/SDS instructions

1.1 SAFETY AND PERSONAL PROTECTIVE EQUIPMENT

- Maintaining a safe work environment is mandatory. A hazard assessment of the plant should determine risks (slips, falls, electrical shock, chemical exposure) and appropriate PPE. Essential PPE includes safety glasses or goggles, hard hats, chemical-resistant gloves, and protective boots. In wastewater areas, wear rubber gloves, aprons, and face masks to prevent contact with

- Other safety protocols: use lockout/tagout when servicing pumps or electrical panels – ensure equipment is de-energized. Beware of confined spaces (tanks, pits) – enter only after testing air and following confined-space procedures. Report any spilled chemicals immediately and clean up with appropriate absorbents while wearing PPE.

1.2 BASIC INSTRUMENTS AND MONITORING EQUIPMENT

- Operators use simple instruments for process control. Key devices include:
- **pH Meter:** Measures acidity. Calibrate daily with standard buffers (pH 4.0 and 7.0) before use. Rinse electrode between samples and follow the manufacturer's calibration routine for accuracy.
- **Turbidity Meter (NTU meter):** Assesses water clarity (higher NTU means more suspended solids). Use it to check filtration efficiency and final effluent clarity. Follow instructions: use clean cuvettes, insert undisturbed sample, and record the reading.
- **Dissolved Oxygen Meter:** Checks DO in aeration tanks. Calibrate sensor in air (100% saturation) and zero solution (or as directed by the instrument). Clean probe regularly to prevent fouling.
- **Operators also read flow meters, pressure gauges (suction/discharge), and level sensors daily**. Record all readings in the logbook (see Module 6). Keeping track of these parameters helps detect trends and issues early (e.g. a drop in DO may signal a blower fault).

1.3: PLANT OPERATIONS AND ROUNDS

- Daily rounds ensure all systems run smoothly. An operator should check:
- **Pumps:** Verify motors are running at correct speed, no unusual noise or vibration. Ensure suction and discharge valves are open and gauges read expected values.
- **Valves and Piping:** Inspect for leaks or blockages. Open/close valves slowly to prevent water hammer.
- **Electrical Panels:** Confirm all indicators are normal. Any tripped breakers should be reported and reset only after verifying safety.
- **Housekeeping:** Clear debris, remove sludge buildup, and clean around equipment. Good housekeeping prevents hazards and equipment corrosion.
- **Maintain a routine schedule** of inspections (morning, evening shifts) and always wear appropriate PPE. During rounds, also monitor raw influent levels, check screen baskets, and remove collected debris promptly.

1.4 SUMMARY AND ASSESSMENT TASKS

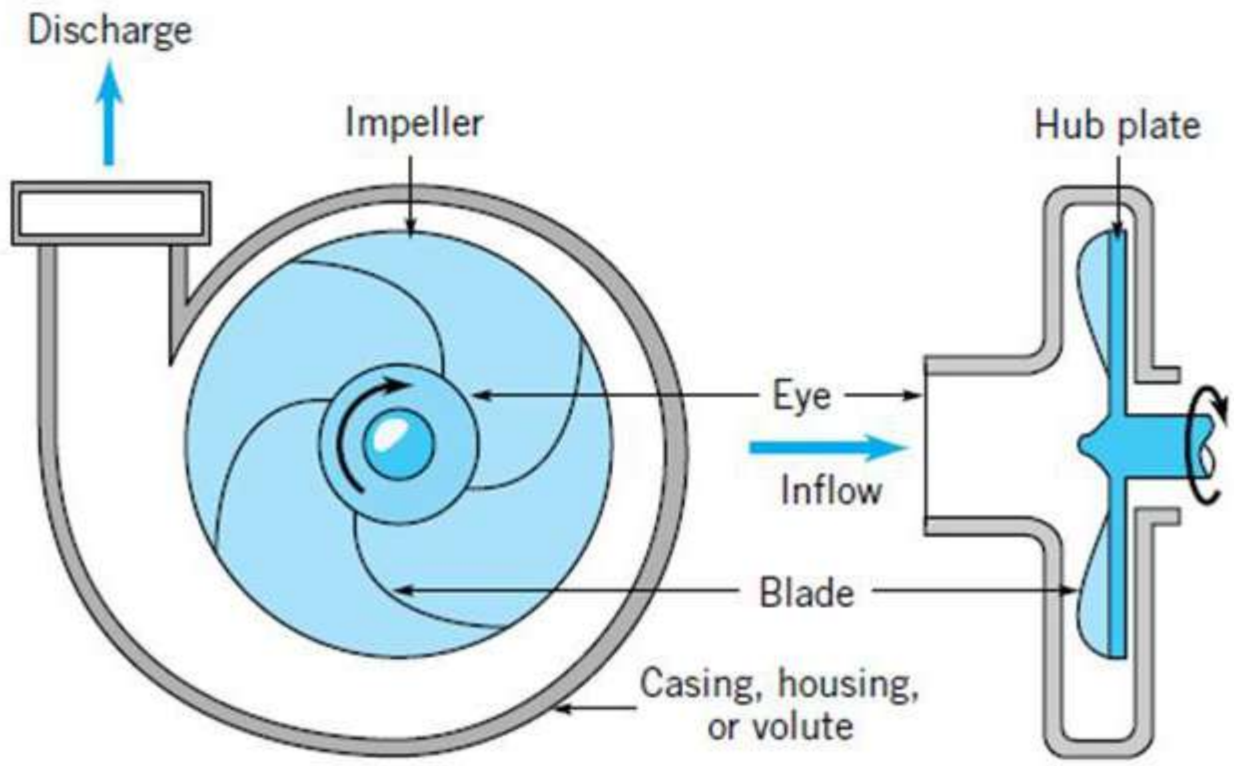
- Key points: STP operations include preliminary, primary, secondary, and tertiary treatment. Safety is paramount – always use PPE and proper procedures. Fundamental tests (pH, turbidity, DO) guide adjustments. The operator’s role includes regular checks of equipment and plant conditions.
- Practice Tasks: Perform a guided tour of the STP layout. Sketch the process flow diagram. Demonstrate correct PPE for handling a chlorine cylinder. Identify PPE for sampling raw sewage. Prepare a sample log entry with pH, turbidity, and chlorine results.

- Assessment: Quiz on STP stages, hazards
  - Name five PPE items osha.gov), and basic testing equipment.

MODULE 2: CENTRIFUGAL PUMP FUNDAMENTALS

2.1 CENTRIFUGAL PUMP BASIC

- Centrifugal pumps are widely used in STPs to move water and sludge. They convert rotational energy into fluid flow.



Key parts of a standard centrifugal pump include an impeller, volute casing, shaft with coupling, bearings, and mechanical seal or packingThe impeller (attached to the shaft) spins and accelerates fluid outward.

- The volute casing (or diffuser) catches this flow and converts velocity into pressure.
- Bearings support the shaft and maintain alignment.
- Mechanical seals (or gland packing) around the shaft prevent the fluid from leaking out

2.2 PUMP INSTALLATION AND PIPING

- Proper installation ensures reliable pump performance. Mount pumps on a solid, level foundation (usually concrete) to minimize vibration. Align the pump-motor assembly so that the motor's coupling mates squarely with the pump shaft (see Module 3 for alignment details).
- Install foot valves or check valves on suction lines to keep the pump primed and prevent backflow. Suction piping should slope upward to the pump to avoid air pockets. Keep suction strainers or filters clean to avoid clogging. Discharge piping must include a non-return (check) valve if needed, and a gate or globe valve for flow adjustment or isolation.
- Priming: Before startup, ensure the pump casing and suction line are filled with fluid (no air). Air trapped in the pump will cause cavitation or failure to pump. Fill the suction line and casing manually if the pump is not self-priming.

2.3 PUMP OPERATION AND MONITORING

When running a pump, watch the following:

- Pressure and Flow: Use pressure gauges on suction and discharge. The difference gives pump head. Confirm it matches the pump’s design curve. A sudden drop in flow or pressure indicates blockage or leakage.
- Noise and Vibration: Unusual sounds (gravel-like noise) or excessive vibration signal trouble. Cavitation – caused by low suction pressure – often sounds like marbles in the pump.
- Temperature: Check bearing housing temperature with a non-contact thermometer or by touch (carefully). Overheating means lubrication or load issues.
- Always start pumps under no-load (open discharge valve slightly) then gradually open fully to operating flow. Never run the pump dry or with the inlet closed. Document operating readings in the logbook every shift.

2.4 COUPLINGS, ALIGNMENT, AND VIBRATION

- The pump and its driver (motor) are usually connected by a coupling (flexible or rigid). Proper alignment of shafts is crucial. Misalignment can quickly wear bearings, seals, and cause leakage. After installation or any disassembly, realign shafts: measure axial and radial offset and adjust. Use tools like feeler gauges or dial indicators; laser alignment tools give the most precise result.
- Pump-motor assemblies should be firmly bolted down. Check and torque foundation bolts periodically. Isolating the assembly on vibration pads can reduce transmitted shocks.
- Vibration analysis is a powerful tool: increasing vibration levels often precede failure. Regularly feel for unusual pulses at pipe hangers or foundations. If vibration increases, investigate alignment, balance, or bearing conditions immediately.

2.5 PUMP PRIMING AND SHUTOFF HEAD

- A pump must be primed (filled with liquid) before starting, or it will only circulate air and can cavitate. Ensure suction line has no air leaks (even small air leaks can break the prime). Foot valves and wet wells help keep the pump primed.

- Know the shutoff head (maximum head at zero flow) of your pump from the manufacturer's curve. If flow is throttled completely, pressure will rise to shutoff head – avoid running at zero flow continuously. Conversely, operating too far to the left of the curve (low flow, high head) can also cause cavitation and overheating.

2.6 ROUTINE PRE-START CHECKS

- Before starting a pump, perform these checks:
- Ensure the pump shaft can rotate freely (no jammed debris) by hand-turning the coupling.
- Check oil or grease level in bearing housing – top off if needed.
- Verify mechanical seals or packing are properly lubricated and not leaking.
- Confirm all valves are in correct position (suction open, discharge closed for start-up).
- Look for any visible damage or loose parts.
- If any issue is found, fix it before energizing the pump. Lockout/tagout the power, drain the pump, and repair as necessary.

2.7 BASIC PUMP TROUBLESHOOTING

Common pump problems include:

- No Flow: Check that pump is primed and valves are open. Inspect suction strainer for clogs.

- Low Flow or Pressure: Impeller may be worn or clogged. Check discharge piping for obstructions. Ensure motor is running at full speed.

- Leaking: A worn seal or packing ring can leak fluid. See Module 3 on seal maintenance.

- Overheating Bearings: Usually caused by insufficient lubrication or misalignment. Immediately shut down and check oil/grease level.

Begin every troubleshooting step by isolating and securing the pump, then perform visual inspection. Often, fixing a simple clogged filter or valve solves the issue.

SUMMARY AND ASSESSMENT

- Key points:

Learn pump components (impeller, casing, shaft, bearings, seals) and their functions. Proper installation and alignment prevent many problems. Always primed, monitor pressure/flow and avoid cavitation. Perform pre-start checks diligently.

- Practice Tasks:

Identify parts on a real pump and match them to the diagram. Practice priming a pump and verify it draws water properly. Align a simple coupling using a feeler gauge. Use a tachometer or run-up test to confirm motor speed.

- Assessment:

Quiz on pump parts and operation. Given a scenario (e.g., “pump won’t prime”), list diagnostic steps.

MODULE 3 : CENTRIFUGAL PUMP MAINTENANCE

3.1 ROUTINE INSPECTION AND LUBRICATION

- Regular inspection extends pump life. Daily/Shift Checks: Listen for unusual noise, feel for vibration at the pump and motor bearings, and look for leaks at seals and gaskets. Record any changes. Check bearing housing temperature; a hot bearing signals poor lubrication.
- Lubrication (Bearings):
- Oil-lubricated bearings: Keep oil at the correct level (typically midpoint of sight glass). Use recommended non-foaming, non-detergent oil. Overfilling is as bad as under-filling. Change oil per schedule (e.g. after first 200 operating hours, then every 3–6 months).
- Grease-lubricated bearings: Use the correct grease type. Do not mix greases. Before adding grease, ensure old grease is clean – wipe off contaminants. Grease bearings lightly and run the pump briefly to distribute grease; avoid over-greasing.
- Lubricant quality is critical. Water or dirt in the oil/grease accelerates wear. If lubricant turns milky or foams, drain and refill.

3.2 SEAL AND PACKING MAINTENANCE

- The mechanical seal (or packing) prevents pumped fluid from leaking along the shaft. Most modern STP pumps use mechanical seals.

- Inspect seals daily: even a small drip. If a seal is leaking, schedule its replacement – do not run it completely dry, as this will damage the seal faces.

- To replace a seal or packing: isolate and drain the pump, lockout/tagout power, and carefully disassemble the casing. Follow proper reassembly procedure: clean all mating faces, replace O-rings, and tighten gland nuts evenly for packing (do not over-tighten packing – it should just weep slightly to lubricate the shaft). For mechanical seals, handle faces by the non-polished area to avoid scratches.
    - Inspection tips: Look for scoring or cracks on seal faces and impeller shaft. Pitting indicates contamination. Replace seals at the first sign of wear to prevent fluid loss or more damage.

3.3 IMPELLER AND CASING WATER

- Over time, impeller vanes and the pump casing wear from abrasion (especially if the water has sand or grit). Inspect the impeller during maintenance: look for erosion, corrosion, or buildup. Clean any debris, and if vanes are worn down by more than ~1/8 inch, replace the impeller.
- Also inspect the volute or diffuser casing: worn casings reduce efficiency. If casing wear is severe (grooves or thinning), consider replacing or re-lining the casing. Check wear rings (if fitted): loose wear rings can cause internal recirculation.
- After reassembly, note any increase in flow or pressure (compared to “pump curve”) – this can indicate rebuild correctness. Maintain records of wear parts replacement in the logbook.

3.4 PUMP ALIGNMENT AND VIBRATION MONITORING

- Misalignment between motor and pump shaft causes excessive wear. Check alignment after any pump-motor repositioning or foundation settling. Use a straightedge and feeler gauges for rough check, and dial indicators or laser tools for precision. Adjust by shimming motor feet: horizontal shims for vertical offset, and twisting foot bolts for horizontal movement. A well-aligned shaft runs with minimal vibration.

- Monitor vibration regularly. Sudden changes in vibration magnitude or frequency spectrum can signal imbalance, looseness, or bearing failure. Use a simple vibration meter if available. If high vibration persists, shut down and re-

3.5 CAVITATION AND FLOW MONITORING

Cavitation: When inlet pressure is too low (below liquid vapor pressure), vapor bubbles form and implode on impeller surfaces. Signs include a gurgling or rattling noise (“gravel” sound) and high vibration. To prevent cavitation: ensure sufficient Net Positive Suction Head (NPSH) – keep pumps primed, avoid high suction lifts, and operate pumps within their intended range.

Flow and Pressure: Regularly check pump operating points. Install pressure gauges on suction and discharge. A significant drop in pump flow (with no change in speed) indicates issues like clogged filters or partially closed valves. Excessive discharge pressure suggests closed or blocked discharge piping. Operators should compare readings to design values every shift. Minor deviations can be corrected immediately (e.g. opening a stuck valve or clearing a strainer).

3.6 PREVENTIVE MAINTENANCE SCHEDULE

Develop a maintenance calendar: daily, weekly, monthly, quarterly tasks. For example:

- Daily: Check pump operation, lubrication level, and leaks; clean any debris around pump. Listen for unusual noise. Record data (pressure, amp draw, etc.).

- Weekly: Top up lubricant if needed; check tightness of foundation bolts and coupling bolts. Inspect pump base and motor mounts.

- Monthly (or ~2000 operating hours): Change oil (new pumps) or grease bearings fully. Perform a detailed inspection: coupling guard off, examine coupling for wear, check seal flush lines.

- Quarterly: Check alignment with tools; inspect coupling and update coupling shim packs if needed.

- Annually: Do a thorough overhaul – isolate power, clean pump interior, replace seals and bearings as preventive measure. Compare pump performance (flow/head) to original baseline to detect wear.

- Record all maintenance activities in the logbook. Keep spare parts (seals, bearings, impellers) on hand to minimize downtime.

3.7 TROUBLESHOOTING COMMON PUMP FAILURES

- **Pump runs but does not move fluid:** Likely air leak or lost prime. Check suction line fittings for tightness and leaks. Ensure foot valve is not stuck open/downstream.
- **Reduced flow/output:** Check for closed discharge valve or clogged piping. Inspect impeller for clogging or breakage. Verify voltage supply and motor health.
- **Overcurrent / Overheating motor:** Possibly locked rotor or blocked impeller. Shut down immediately, check coupling alignment, and remove any obstructions.
- **Leakage:** Small leaks from seals or flanges may indicate worn gaskets or seals. Tighten cover bolts gradually or replace faulty seals. Major leaks require shutdown and seal overhaul.

Always diagnose safely: first isolate the pump electrically, then investigate mechanical issues. Use a checklist to systematically eliminate potential causes.

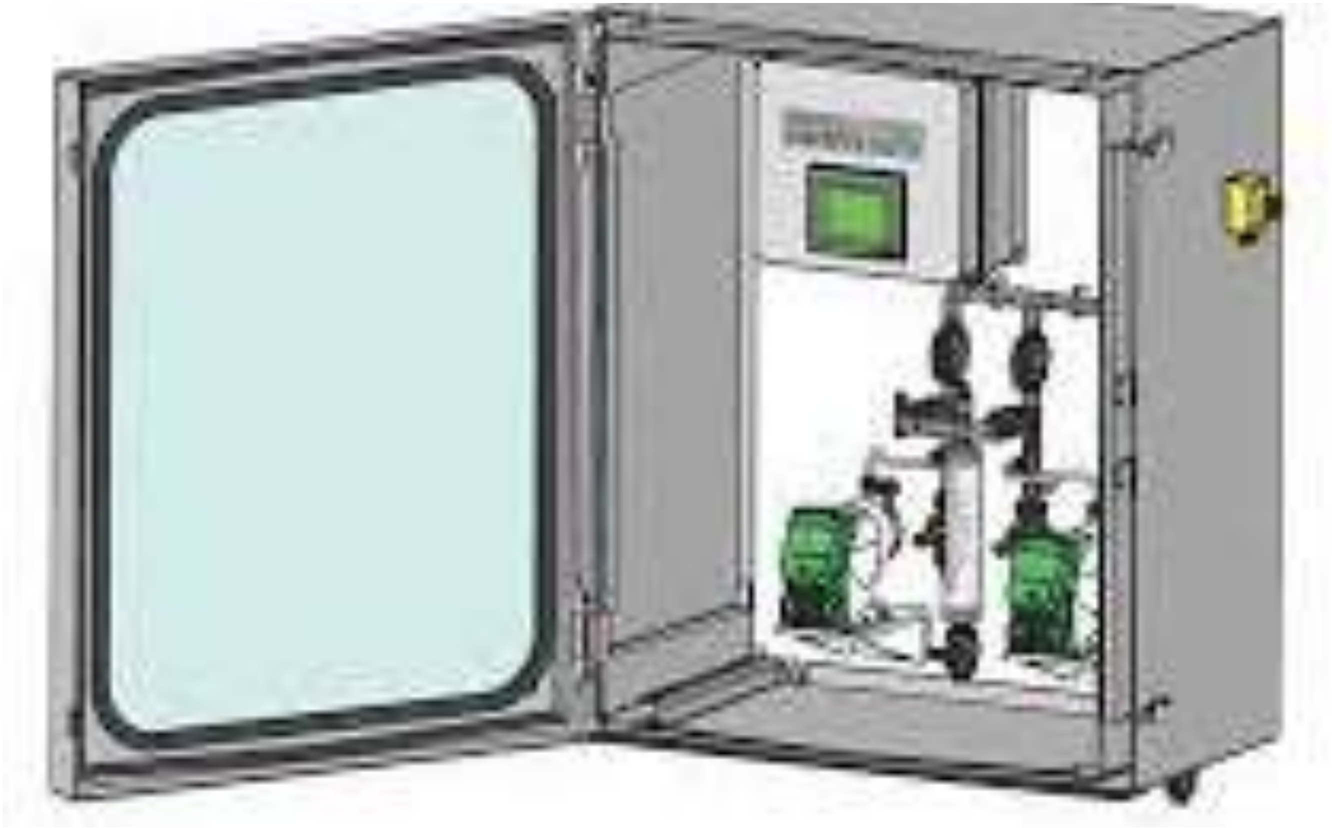
SUMMARY AND ASSESSMENT

- Key points: Effective maintenance includes daily inspection, proper lubrication, seal care, and alignment. Regular preventive work prevents breakdowns.

- Practice Tasks: Disassemble a coupling and re-align shafts using shims. Perform a mock oil change on a bearing housing. Replace packing on a small pump (or simulate with slackened bolts). Use a vibration meter (or app) to measure pump vibration before and after alignment.

- Assessment: Given pump symptom scenarios, write down maintenance checks to perform. Quiz on lubrication intervals and signs of bearing failure.

MODULE 4 :
CHEMICAL DOSING SYSTEMS & SAFETY



4.1 INTRODUCTION TO CHEMICAL DOSING

- Chemical dosing systems add precise amounts of chemicals for processes such as disinfection, pH adjustment, and coagulation. Common chemicals in wastewater treatment include: chlorine (for
- disinfection), acids/bases (for pH control), coagulants like alum or ferric chloride (for phosphate removal), and polymers (for sludge conditioning). Dosing systems typically consist of a **chemical reservoir** or tank, a **metering pump**, and injection points in the process.
- Dosing pumps can be of different types: **diaphragm (plunger) pumps** or **peristaltic (hose)** pumps. Each has advantages. Diaphragm pumps are more complex (with inlet/outlet valves) but handle a range of pressures and are energy-efficient. Peristaltic pumps are simpler (no check valves) and excel at pumping viscous or solids-laden chemicals because the fluid contacts only the hose. However, peristaltic hoses wear over time due to constant flexing.
- Choose pump type based on the chemical's viscosity and required pressure. For example, peristaltic pumps resist clogging and are self-priming (ideal for muds or slurries), while diaphragm pumps can achieve higher pressure for long injection lines.

4.2 OPERATING DOSING PUMP

- Dosing pumps are set by adjusting stroke length and frequency or speed to achieve the desired dose (flow rate). Before operation: prime the pump by filling the suction hose and pump head with chemical; air in the line will prevent proper dosing. Many dosing pumps have manual or automatic priming modes.

- Monitor dosing rate using a calibration cylinder or scale. For safety and accuracy, calibrate the pump on installation and after maintenance: run the pump for a set time, measure delivered volume, and adjust settings as needed.

- Always check suction filters and line strainers – clogged inlet lines cause loss of prime. Inspect valves and foot valves (if installed) that keep the pump suction primed. Keep spare tubing for peristaltic pumps on hand, and diaphragm seals and valves for plunger pumps.

4.3 COMMON TREATMENT CHEMICALS

- **Chlorine:** Used for disinfection, often stored as sodium hypochlorite (liquid bleach) or chlorine gas. Chlorine dosing systems include day tanks and gas analyzers. Chlorine is highly toxic; leaks trigger immediate evacuation and alarm. Monitor chlorine residual in effluent (aim for ~0.2–0.5 mg/L).
- **pH Adjustment (Acids/Bases):** Acids (e.g. sulfuric or hydrochloric) or bases (e.g. sodium hydroxide) are dosed to maintain pH in the optimal range (usually 6.5–8.5). For example, if secondary effluent pH is high, add acid before discharge. Always **add acid to water, not water to acid** to prevent exothermic reactions. Use plastic pumps and lines to resist corrosion.
- **Coagulants/Flocculants:** In tertiary filters or sludge treatment, coagulants (like alum, ferric salts) help settle particulates or remove phosphorus. Polymer flocculants (cationic or anionic) aid sludge dewatering. Dosing rates depend on lab jar-test results. Store dry polymers in sealed containers and mix fresh daily; liquid coagulants are pumped from drums.

4.4 CHEMICAL HANDLING AND STORAGE SAFETY

- Labeling and SDS: All chemical containers must be clearly labeled with continents and hazard symbols. Follow Safety Data Sheets (SDS) for each chemical. Ensure Material Safety Data Sheets (now SDS) are accessible to all workers.
- Storage: Store chemicals in a cool, well-ventilated area. Keep incompatible chemicals separated (e.g. acids and bases apart). Secondary containment (tray or bund) prevents spills. Minimize quantities of hazardous chemicals (e.g. chlorine cylinders) onsite.
- Personal Safety: When handling chemicals, always wear appropriate PPEosha.gov: chemical-resistant gloves (material chosen per chemical type), goggles or face shield, and aprons or suits. For strong acids/bases or chlorine, a full acid suit or respirator may be needed in case of leaks.
- Emergency Prep: Keep emergency equipment handy: eyewash stations, showers, spill kits, and fire extinguishers. In the event of a spill or leak, evacuate the area if necessary, and follow the plant’s spill-response plan. Always rinse off any chemical splashes on skin immediately with water.

4.5 DOSING PUMP MAINTENANCE AND TROUBLESHOOTING

Maintain dosing pumps carefully:

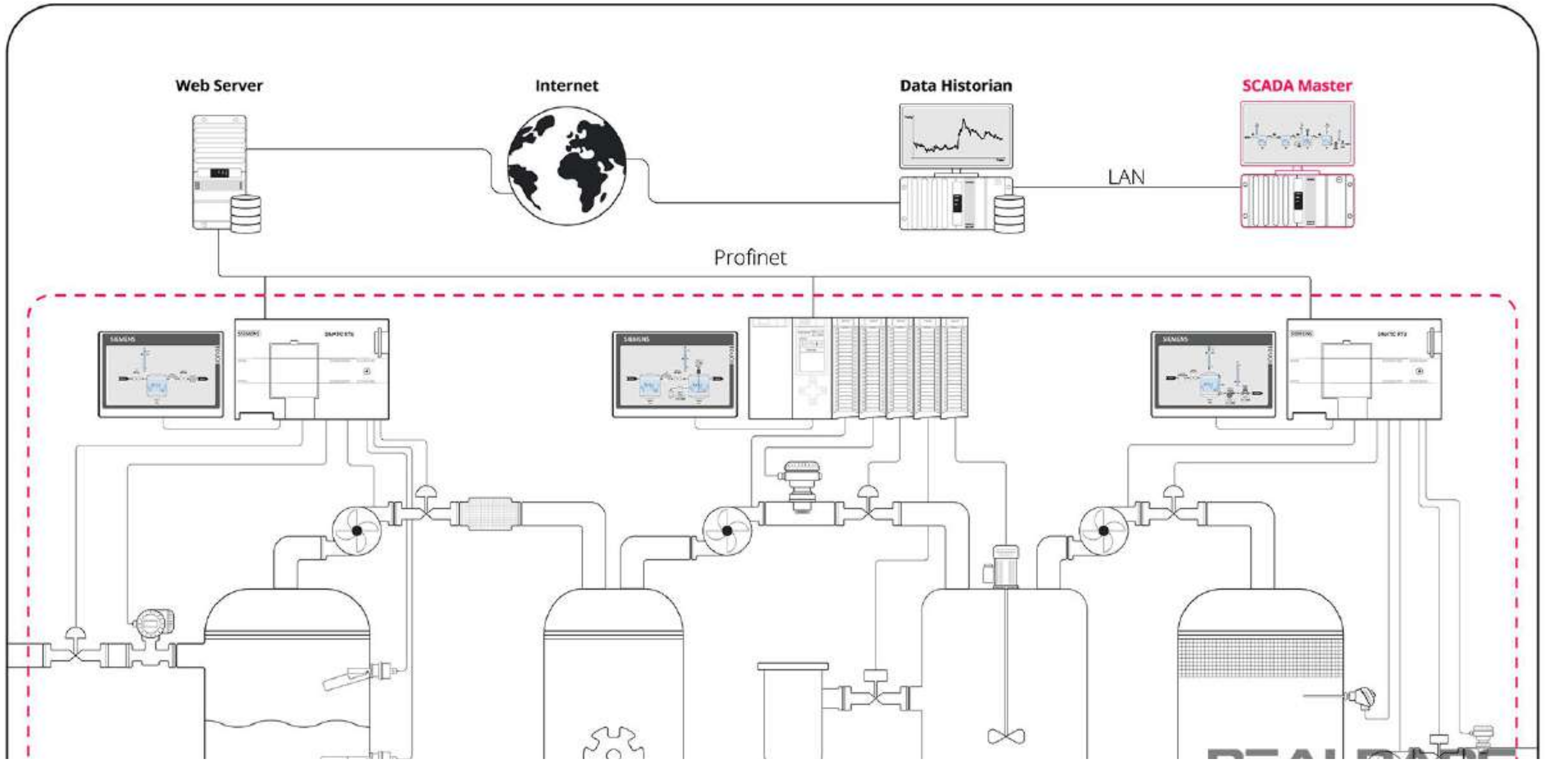
- Clean pump heads and tubing at scheduled intervals to prevent clogging. Chemicals (especially salts) can crystallize. Rinse pump internals with clean water when switching chemicals.
- Inspect pump hoses for wear (peristaltic) or diaphragms for fatigue (diaphragm pumps). Replace wear parts as preventive maintenance.
- Check that check valves or balls inside the pump are free-moving; stuck balls mean lost suction.
- Calibrate stroke settings monthly: prime pump, measure output, and adjust calibration.
- If a dosing pump pulsates irregularly, verify that suction line is airtight and at proper depth in the chemical.
- If dosing volume suddenly changes, check for air in lines or worn pump components. Also ensure no leaks at injection point. Record any maintenance in the logbook and note dosage consistency.

4.6 RESERVOIRS AND DILUTION

- Day tanks or reservoirs hold chemicals at the correct concentration. For example, sodium hypochlorite may be diluted to a safe strength before storage. Ensure reservoirs are mixed (by circulating pump or stirrer) to maintain uniform concentration. Install level sensors or sight glasses to monitor chemical levels; refill chemicals before tanks run dry.

- For powdered chemicals (e.g. alum), dissolve in a separate mixing tank with agitation. Strain the solution to remove undissolved particles. Pumps should draw from the bottom of these tanks (where concentration is highest). Clean tanks periodically to avoid sludge buildup.

4.7 SCADA SYSTEM INTEGRATION AND EXAMPLES



- Discuss example: if chlorine residual is low, operator increases feed rate slightly and monitors effect. For pH control, linking a pH probe to a dosing pump can automate adjustment (though manual monitoring is typical for entry level).

SUMMARY AND ASSESSMENT

- Key points: Identify uses of chemicals: disinfection, pH control, coagulation. Understand pump types (diaphragm vs peristaltic) and their maintenance. Always handle chemicals with PPE and SDS
- Practice Tasks: Label a mock chemical tank (e.g. HCl, alum) with GHS pictograms. Perform a dosing pump calibration: run the pump for 1 minute into a graduated cylinder and verify dose volume. Demonstrate correct dilution of a chemical (e.g. making 10% NaOCl from concentrated solution, using a spill tray).
- Assessment: Describe safety steps for adding acid to an effluent stream. Given a peristaltic pump, list how to replace its hose. Quiz on matching chemicals to their purpose.

MODULE 5 : PROCESS MONITORING & WATER QUALITY TESTING

5.1 WATER QUALITY PARAMETERS

- Operators monitor several parameters to assess treatment performance. Common on-site tests include:
- pH: Indicates acidity/alkalinity. Most biological processes operate optimally near neutral (pH 6.5–8.5).
- Turbidity (NTU): Measure of water clarity (suspended solids). Higher turbidity means more solids left in water.
- Chlorine Residual: Confirms disinfection efficacy (measured as mg/L free or total chlorine).
- Dissolved Oxygen (DO): Particularly in aeration tanks, to ensure microbes have enough oxygen (see Module 1).
- Temperature: Affects microbial activity (not always measured but useful).
- Operators should take samples from influent, intermediate, and effluent points regularly (e.g. daily to weekly). Before testing, ensure sampling bottles are clean, and collect water mid-stream to avoid surface films.

5.2 PH AND ALKALINITY TESTING

- pH Meter Usage: Rinse electrode with distilled water, then immerse in the sample. Wait for reading to stabilize. Ideally calibrate the pH meter before each shift: use at least two standard buffer solutions (commonly pH 4.0 and 7.0). Calibration ensures accurate, drift-free readings.
- Alkalinity: This is measured by titration in a lab (not typically on-site for operators). However, be aware that high alkalinity (meq/L) stabilizes pH. If pH drifts, it may be due to low alkalinity (use quicklime to increase alkalinity). Record pH readings with date/time in the logbook.

5.3 TURBIDITY AND SOLID TESTS

- Turbidity: Use a portable turbidity meter. Fill a clean tube with sample, wipe the outside, and place in the meter. Record the NTU reading. Typical treated effluent turbidity should be low (e.g. <5 NTU). High turbidity indicates poor clarification.

- Settleable Solids: If needed, the 1-L Imhoff cone test measures solids that settle in a set time. (Pour sample, wait 1 hour, read volume.) This can help assess sludge handling efficiency.

- Total Suspended Solids (TSS): Usually done in a lab: a measured volume of water is filtered through a pre-weighed filter, dried, and re-weighed. For operators, understanding TSS is enough; rely on lab reports for exact values.

5.4 DISSOLVED OXYGEN AND BIOLOGICAL ACTIVITY

- As noted in Module 1, DO is crucial in aeration tanks. Use a DO probe: turn on and allow it to warm up. Calibrate the probe in air-saturated water (or with a zero-oxygen solution) as per the meter's instructions. Then insert in the mixed liquor and record mg/L. Aim for about 2 mg/L in aeration tanks. If DO is low, increase airflow or reduce organic loading.

- **Sludge Monitoring:** Watch MLSS (mixed liquor suspended solids) visually for foaming or filamentous bulking. Lab tests (e.g. Sludge Volume Index) help diagnose bulking problems, but operators should report frothing or sludge washout signs.

5.5 CHLORINE RESIDUAL TESTING

- Chlorine (Cl_2) testing is done with a colorimetric test (DPD method) or test strips: add reagents to a water sample until color develops. Portable colorimeters give digital mg/L readings.
    - Measure both free chlorine and total chlorine if needed. Record the free chlorine residual in the final effluent; it should meet the disinfection target but not be excessively high.
    - If residual is low or zero, increase dosage or check contact time.
- Handle reagents and samples in a well-ventilated area. Rinse glassware after use to prevent contamination.

5.6 PROCESS SAMPLING AND RECORD-KEEPING

- Take water samples from consistent points: e.g., influent after screens, effluent after disinfection, and sludge or return streams. Use clean bottles and label them with date, time, and location. Avoid contamination (do not touch inside of bottles).

- Record each test result immediately in the logbook (or computer). Note the time of measurement. Trends over time reveal process changes (e.g. decreasing effluent BOD). Keep copies of any lab analyses (BOD, COD, nutrients) filed. During shift handover, verbally report any out-of-range values. The logbook is a legal document; be clear and accurate.

5.7 TREND ANALYSIS AND QUALITY CONTROL

- Compare current readings with historical values and regulatory standards. For example, if turbidity suddenly spikes, inspect filters or clarifiers for malfunction. If pH drifts, adjust dosing pumps. Use control charts if available to visualize long-term trends.

- Ensure testing equipment is calibrated: we covered pH calibration. Similarly, check turbidity meter calibration per manufacturer. Record maintenance of testing equipment in logs. Use reagent expiration dates (discard expired DPD tablets). Good data allows proactive operation.

SUMMARY AND ASSESSMENT

- Key points: Regular monitoring of pH, turbidity, chlorine, and DO is vital to control the treatment process. Proper sampling and calibration ensure reliable results. Trends in these parameters indicate when to adjust operations.
- Practice Tasks: Calibrate a pH meter using buffer solutions, then measure the pH of a given sample. Use a turbidity meter on clear vs. muddy samples. Perform a DPD chlorine test on a sample with a known chlorine solution. Log all results with timestamps.
- Assessment: Given a set of sample data (e.g. pH=6.2, turbidity=15 NTU), interpret whether process adjustments are needed. Quiz on calibration steps for pH and DO meters.

MODULE 6 : OPERATIONS, RECORD-KEEPING & WRAP-UP

6.1 THE OPERATIONS LOGBOOK

- The logbook is a critical tool. It is a *legal record* of plant activities. Record everything significant: date, time, operator’s name, shifts, and each operational step. Entries must include pump starts/stops, chemical doses, equipment adjustments, test results, and any faults or repairs. In the logbook words, “If it is not recorded, it is as if it did not happen”.
- Always sign entries with legible handwriting using indelible blue or black ink (no pencil, no white-out). For mistakes, cross out with a single line and initial the change. Keep the logbook in a fixed location and transfer any handover notes via memo or separate file, not by scribbling between s.

6.2 RECORD-KEEPING BEST PRACTICES

- Besides the logbook, maintain logs for maintenance and calibrations. For each pump, record dates of oil changes, alignments, and part replacements. For dosing systems, log chemical quantities added to each tank (date, volume, concentration). These records help schedule future maintenance and verify compliance.

- Plant ID and operator license number should be on the first . Include weather conditions (e.g. heavy rain) and any unusual events (power outages, alarms). Always enter test results (even if normal). A new operator reading past logs can quickly learn plant status and any recurring issues.

6.3 ROUTINE DUTIES AND HOUSEKEEPING

- An operator's routine includes scheduled rounds and cleaning. Examples:
- Screening: Clean bar screens daily; leak any solids must not pass into the plant.
- Sludge Handling: Keep sludge hoppers and conveyor belts clean to prevent jams.
- Chemical Areas: Wipe spills immediately; check for leaks in chemical lines.
- Yard and Vegetation: Mow grass around lagoons, trim trees to prevent fall hazards.
- Tank Inspection: Check open tanks or clarifiers for odors, foam, or foaming that indicate process upset.
- Good housekeeping prevents corrosion and accidents. For example, walking areas should be dry and non-slip. Store tools and spare parts in designated areas.

6.4 EMERGENCY RESPONSE AND SAFETY REVIEW

- Revisit safety plans: in case of fire, earthquake, or major spill, know the evacuation routes and assembly point. Each operator should be familiar with first-aid kits and how to neutralize spills (e.g. using lime or soda ash for acid/base spills). Practice a drill for a chlorine leak scenario: shut off the feed, don SCBA if needed, and ventilate the area. Review SDS sheets for key hazards regularly.

- Emphasize that even in routine tasks, PPE and caution are never optional. For instance, if flushing an aeration blower's filter, wear hearing protection due to noise.

6.5 TEAM MANAGEMENT & CERTIFICATION

Team Communication and Handover

- Good communication between shifts keeps the plant running smoothly. In handovers, walk through any ongoing issues and review logbook entries. Highlight critical events (e.g. a pump tripped last night, a noted odor, any process exceedance). Document who is responsible for follow-up tasks.
- Maintain a professional attitude: arrive on time, aware of safety gear, and ready to assist colleagues. If any equipment is out-of-service, tag it clearly and notify supervisors.

Maintenance of Skills and Certification

- An STP operator assistant should continue learning. Attend periodic refresher trainings on CPR, confined-space safety, and equipment updates. Stay informed about new regulations or technologies (e.g. membrane treatment, bioaugmentation). Safety drills and competency tests may be part of ongoing certification.

6.7 COMPLETION AND CERTIFICATION

- Congratulations – you have covered all essential topics for an entry-level STP Operator Assistant and Pump & Dosing Technician. Understanding these systems, maintaining safety, and keeping diligent records will make you a valuable asset in any water treatment plant.
- Key Takeaways: Always prioritize safety (PPE and lockout/tagout)osha.gov. Maintain and monitor equipment (pumps, meters) per procedures. Keep clear, accurate logs. Seek help when unsure, and continue learning – water treatment is a dynamic field.
- Practice Final Tasks: Simulate a shift handover: take over from a colleague, read the last log entries, and plan the next shift's tasks. Conduct a mock emergency drill (spill cleanup or pump failure) with the team. Demonstrate one hands-on skill of your choice (e.g. pump alignment, meter calibration, chemical titration) to your instructor.

THANK YOU

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