Key note 5.1: Operation and Maintenance of Faecal Sludge Treatment Plants

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Related course material | Chapter 11 in the FSM book;  
Presentation  
Assignment
I. Plant Layout
II. Asset management
III. Monitoring and Reporting
IV. Operator Health and safety
V. Staffing and human resources
VI. Site security
Plant layout

Process flow and hydraulic profile
Plant layout and process description

Plant layout of the Baliwag, Philippines septage treatment facility. The diagram shows:

- Automated septage receiving station
- Maceration and primary screening
- Thickening and dewatering
- Biological treatment using the SBR technology
- Disinfection
- Storage of the treated effluent for reuse activities

Provides workers with information on each step in the treatment train. Includes:

- Written description
- Operating requirements
- Technical specifications

Useful for orienting new workers and as a reference guide for seasoned staff.
The Hydraulic profile helps with the visualization of the flow pattern within the plant from one component to the next. It is useful for contractors during the layout and construction phase to ensure proper depths of tank holes, and can be useful in troubleshooting operational problems.

*Lime stabilization septage treatment plant, Tacloban City Philippines.*
Asset management

Operations and maintenance planning, routine and emergency repairs, financing for replacement equipment.
Infrastructure asset management is the combination of management, financial, economic, engineering, and other practices applied to physical assets with the objective of **providing the required level of service in the most cost-effective manner**. It includes the management of the entire lifecycle of physical and infrastructure assets including:

- Design
- Construction
- Commissioning
- Operating and maintaining
- Repairing, modifying, replacing
- Decommissioning/disposal.

**Maximizes long term effectiveness of the treatment plant at the lowest possible cost.**

Asset management considers:
- Asset Inventory
- Level of Service
- Critical Assets
- Life Cycle Costing
- Long term funding strategy

Operators maintain records of each asset (piece of equipment) and determines what tasks will be need to operate and maintain the equipment cost effectively. Consideration of the life of the equipment is made as well as a plan for replacing critical equipment before its useful life is over.
Asset management for critical equipment

Plan (start here)
- Cost/benefit analysis
- Select equipment
- Design specifications
- Plan for emergency operations if unit fails.

Acquire
- Sustainable financing
- Bids and awards
- Receive, inspect and approve

Deploy
- Installation
- Start up
- Commission
- Test and certify

Manage
- Routine and preventative maintenance
- Staff training
- Emergency repairs as needed

Replace
- Spare parts on hand
- Financing available for repairs or replacement
- Trained staff on installation of replacement equipment

Update plan based on lessons learned

Example of process critical unit – screw press for Baliwag system
Some septage treatment equipment may be highly specialized and expensive. **Make sure to follow all manufacturer’s recommendations to meet all warrantee requirements.** Spare parts and replacement financing should be in place if critical mechanized equipment is utilized.

This is an image of a screw press in use at Manila Water’s South Septage Treatment Plant. It requires infrequent but critical maintenance as well as cleaning and lubrication. Not shown is the polymer tank (helps increase dewatering) and the chemical feed equipment. Procedures for servicing the equipment and mixing the polymer are detailed in the plan O&M manual.
Equipment warrantee and special requirements

This is a multimedia filter used at Manila Water’s South Septage Treatment plant. It has an automatic backwash cycle that is controlled by electrical solenoid valves. **Valves and mechanisms require routine cleaning and adjustment.** Operators also must check the media and replenish as needed.

Pressure gauges are provided so that the operator can determine when the media is getting plugged. Good operators **record pressure readings in the log book** so they can be used as reference points that indicate when service is required.
Operations

Regular, scheduled and proactive tasks that keep the system running as designed.
Operation and Maintenance Plan

Primary goal: To assure long term functionality of the treatment system while avoiding and mitigating the consequences of system breakdown or failure.

A written document that workers can refer to that includes:

- Plant layout and process description
- Preventative maintenance and asset management
- Routine scheduled tasks
- Staffing and job descriptions
- Emergency operations procedures
- Monitoring & evaluation
The manifest form is a written record of the fecal sludge delivery. It tracks the waste from the origin to the treatment plant requiring a signature from the homeowner or regulatory official at the source. It specifies:
- Source location
- Type of waste
- Volume
- Information related to the desludger

Operators at the plant should review the form carefully before accepting the load. They can spot check by drawing a sample and checking for excess grease, color and odors indicating chemical contamination.
Receiving

Automated septage receiving station

Records:
- Driver/operator
- Date and time of discharge
- Volume of waste discharged
- Source of waste.

Driver uses unique identifier code and enters data through a key pad interface.

Automated receiving stations simplify paperwork and help ensure accuracy of the data collected.
The **operators’ log book** is a permanent record of all activities at the plant. It contains summaries of the daily receiving and operations records, visitors, deliveries and incidents. Use a bound logbook with sequentially numbered pages. It is considered a legal record and must be kept for a minimum of 5 years.
Lime mixing station in Tacloban City, Philippines. For this septage treatment system, they use the **lime stabilization process**. For each batch of septage to treat, operators weigh and mix hydrated lime into a slurry and mix it into the septage using paddles. It is then thoroughly mixed using coarse bubble aeration equipment.

Hydrated lime is an irritant and must be handled appropriately. For this task, workers should wear:
- Rubber gloves
- Long sleeve protective shirts
- Eye protection
- Dust mask
Routine tasks

Lime stabilization works by raising the pH of the septage through the addition of hydrated lime. pH 12 is maintained for between 30 minutes and 2 hours depending upon the end use of the biosolids.

Keeping track of the pH is a necessary operational requirement. This is done through a hand held pH meter.

Workers use standard pH solutions to periodically calibrate the pH meter. Proper care of the meter is required and is another routine task for the operators. They:

- **Clean the meter after each use**
- **Remove the batteries when not in use**
- **Replace the sensor bulb when needed**
Routine tasks

The image shows a septage receiving station with primary screen and grit chamber. Routine maintenance includes cleaning the screens and removing the accumulated grit.

**Screenings should be collected and stored in covered containers and disposed as solid waste.** Grit should be sent to the drying beds where it can be dewatered, dried and landfilled.
Routine maintenance

Screening system and grit chamber for septage management plant when newly constructed.

The same screening system, full of sludge and neglected. When maintenance is performed routinely, it is simplified.
Routine tasks

Biosolid management may be the biggest expense and most time consuming task. When sand drying beds are used, operators must:

- Properly load the beds in 10 cm – 20 cm lifts
- Monitor % moisture (often done by visual assessment)
- Remove biosolids when dry enough to shovel (usually about 2-3 weeks in tropical climates)
- Provide secondary treatment such as composting or stockpiling
- Rake the sand and replace when depleted or clogged.
Routine tasks

Construct wetlands used for effluent treatment at the Dumaguete City Septage Treatment plant. Routine maintenance includes removing the dead leaves, and periodically flushing out the solids by raising the water level at the outlet structure.
Worksheets and toolkits help operators verify initial design parameters. This is useful when troubleshooting operational problems as the operator can verify if current loading meets or exceeds design parameters.

There are a variety of toolkits and worksheets specific to septage treatment facilities. Check the website listed below for some popular examples.

https://www.pca.state.mn.us/water/wastewater-worksheets-and-spreadsheets-operators
Monitoring

Sampling, testing, evaluating and reporting
<table>
<thead>
<tr>
<th>There is a written sampling plan</th>
<th>Y</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of samples, the analytical tests, and the sampling locations have been identified in the plan.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>The laboratory that will do the analysis has been contacted, procedures have been reviewed, and services have been scheduled.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>All sampling bottles, sample preservatives, labels, ice chests, and Chain of Custody forms have been received.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>The person(s) who will conduct the sampling has been trained in proper procedures.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Health and safety training, as well as the required personal protective equipment, has been provided.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Access to the sampling locations is open and unrestricted.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Transport of the samples to the laboratory has been arranged and will be done within the required hold times.</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>The laboratory is licensed to conduct the required work and that they have a QA/QC plan.</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>
Management may hire a contract laboratory for sampling and analysis or perform this duty in house if properly equipped and staffed.

This image shows the field preservation of an effluent sample that will be tested for chemical oxygen demand (COD).

In this case, 2 ml of sulfuric acid is added per liter of sample to retard the growth of microorganisms. Sulfuric acid is hazardous. Gloves and (unlike this technician) eye protection is required and should always be worn.
Monitoring

**Sludge Volume Index test** being run at Manila Water’s South Septage Treatment Plant, as a means of monitoring the activated sludge process in use.
## Section A: Required Client Information

- **Company:** [Redacted]
- **Address:** [Redacted]
- **Email To:** [Redacted]
- **Phone:** [Redacted]
- **Fax:** [Redacted]

**Requested Due Date/TAT:** [Redacted]

## Section B: Required Project Information

- **Report To:** [Redacted]
- **Copy To:** [Redacted]
- **Project Name:** [Redacted]
- **Project Number:** [Redacted]

**Requested Analysis Filtered (Y/N):** [Redacted]

## Section C: Invoice Information

- **Company Name:** [Redacted]
- **Address:** [Redacted]
- **Reference:** [Redacted]

**Site Location:** [Redacted]

## Section D: Valid Matrix Codes

### Matrix Codes

- **Product:** [Redacted]
- **Soil/Solid:** [Redacted]
- **Oil:** [Redacted]
- **Air:** [Redacted]
- **Wipe:** [Redacted]
- **Other:** [Redacted]
- **Tissue:** [Redacted]

### Sample ID

- **Sample ID:** [Redacted]

**Sample IDs MUST BE UNIQUE**

### Valid Matrix Codes

- **DIN:** [Redacted]
- **Preservatives:** [Redacted]

## Additional Comments

- **Date:** [Redacted]
- **Time:** [Redacted]
- **Sample Condition:** [Redacted]
Worksheets and toolkits help operators verify initial design parameters. This is useful when troubleshooting operational problems as the operator can verify if current loading meets or exceeds design parameters.

There are a variety of toolkits and worksheets specific to septage treatment facilities. Check the website listed below for some popular examples.

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Operator health & safety

Personal protective equipment, immunizations, safety practices.
Operator Health and Safety

No Smoking sign at Dumaguete City septage treatment plant. Smoking is always prohibited at septage plants as:
- Hand to mouth contact can transmit disease
- Some flammable chemicals may be in use
- Methane may accumulate in low areas or tanks that may be in use

Well operated septage treatment facilities take operator health and safety seriously. Not only is it the right thing to do, it saves money as well. Lost time due to injury or illness increases operations costs and decreases program efficiency.
Personal protective equipment

- Splash proof clothing
- Rubber gloves
- Rubber boots
- Face mask
- Eye protection – goggles for splash protection

No hard hat? Should be required.
Immunizations, health and safety

Health and Safety Plan
Septage is infectious material. Each plant should have a written health and safety plan with training for all personnel. The plan should include information on:

- Hand washing stations located throughout the facility
- Emergency showers and eye wash stations
- Emergency equipment such as buoys with rope for lagoon systems
- Personal protective equipment
- First aid equipment
- Emergency contact numbers

Septage workers should be immunized for:
- Tetanus
- Hepatitis A
- Hepatitis B
- Diphtheria
Electrical safety

Lock-Out Tag-Out Electrical Safety program
- Breakers for the equipment to be serviced are turned off and locked in the off position
- A tag is affixed to the breaker indicating it is turned off for service
- The tag is dated and signed by the mechanic
- Only the mechanic who signs to tag may remove it

Electrical safety must be taken seriously by senior management. Often high voltage equipment is utilized which can be deadly. Only trained and authorized electricians should be allowed to work on electrical equipment.
Confined space entry permit program

All **confined spaces** should be identified at the plant. Any time a worker needs to enter the confined space, a permit from the senior operator is required. The permit:

- Is entered into the operators log book
- The time and date the work will begin is noted
- A minimum of two people are required to work together for safety
- **Personal protective equipment** is utilized

**Workers may never enter a confined space unless:** i) it is absolutely necessary, ii) they are working with a buddy who can assist in case of an emergency (the buddy assists from outside the confined space), iii) they wear a safety harness and other personal protective equipment, iv) they check the atmosphere first, and v) inform senior management through a permit.
Staffing and human resources

Organizational chart, job descriptions, roles and responsibilities.
This is a typical org chart for a public utility for a city or municipality. It is useful to describe the lines of communication and inform employees where they fit in the overall organization.
Job descriptions

JOB DESCRIPTION

SENIOR WASTEWATER TREATMENT PLANT OPERATOR

DEFINITION
Under limited supervision from the Treatment Plant Supervisor and Lead Senior Operator, serves as the shift operator responsible for the operation and maintenance of the Wastewater Treatment Plant. This is a journey level position that performs related duties independently with a high degree of initiative, as assigned.

EXAMPLES OF DUTIES: (These examples are intended only as illustrations of the various types of work performed. The examples of work performed are neither restricted to nor all-encompassing of the duties to be performed under this job title.) *(Essential Duty; M=Major Portion of Time)*

- Assists in supervision and direction of other plant operations personnel. (M)
- Operate pumps, valves, and other equipment to direct or regulate the flow of wastewater. (E)
- Properly obtain various samples and perform basic wastewater laboratory tests. (E)
- Operate, adjust, and maintain chemical feed equipment. (E)
- Perform various recordkeeping and prepare special reports as required. (E)
- Inspect and maintain a variety of plant equipment. (E)
- Follow safe work methods and safety precautions related to the work. (E)
- Assist in periodic maintenance work, including disassembly and repair of pumps, valves, flow-rate controllers, chemical dispensers, bar screens, collectors, and other plant equipment. (E)
- Maintain buildings and grounds. (M)
- Work various shifts and flexible hours, including weekends and holidays, and be available on standby for callback as assigned. (E)
- Provide training to other operators. (E)
- Utilize Supervisory Control and Data Acquisition (SCADA) system to track operational and plant process control trends. (E)
- Perform other duties as assigned.

QUALIFICATIONS

Knowledge of:
- Current methods, techniques, and equipment used in sewage disposal.
- Various chemicals and compounds used in wastewater treatment, and safe and appropriate handling techniques for their use.
- Operation, maintenance, and repair of wastewater treatment plant equipment.
- Wastewater treatment principles, methods, and practices.
- SCADA and personal computer systems, with ability to operate as related to wastewater treatment.
- Recordkeeping and reporting procedures.
- Safety rules, codes, and regulations pertaining to the work.
- Basic first aid and CPR techniques.

Ability to:
- Read and interpret gauges and recording devices reflecting plant operations.
- Conduct and interpret laboratory tests.
- Maintain, repair, and adjust wastewater treatment equipment.
- Keep records and prepare reports.
- Understand and carry out oral and written directions.
- Perform mathematical calculations as related to the wastewater treatment process.
- Perform heavy manual labor and lift up to 50 pounds.

Job descriptions inform the employee about their specific role in the organization and what is expected of them. New employees sign the job description as a condition of employment verifying that they understand their role and responsibilities.
Security

Septage treatment facilities as critical infrastructure
Security

Septage treatment plants may be considered an attractive nuisance. Fencing helps keep trespassers out and to keep workers safe. Additional security measures as mentioned are in place to keep facilities operational during adverse conditions.

Physical security measures for septage treatment plants may include:

- Barriers, fencing and gates
- Security lighting
- Re-keying doors and locks
- Motion detectors, alarms or cameras
- Smoke and chemical detection systems
- Emergency back-up generators
- Locking manhole covers in critical areas
- Secured lift stations
- Personal safety equipment
- Computer firewalls