Guide to On-site Wastewater Management for Industrial and Commercial Establishments and other Institutions

Guide for Vehicle Service Station Owners and Managers

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WASPA ASIA

Wastewater Agriculture and Sanitation for Poverty Alleviation

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Priyanka Dissanayake, Mangala Tennakoon and Johannes Burmeister

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The authors: Priyanka Dissanayake is an Environmental Scientist at the International Water Management Institute (IWMI) in Colombo, Sri Lanka. Mangala Tennakoon is the Deputy Project Director of the Greater Kurunegala Sewerage Project, Kurunegala, Sri Lanka. Johannes Burmeister was an intern at the International Water Management Institute (IWMI) in Colombo, Sri Lanka.

More information about the project, including downloads of project documents, can be found at **www.iwmi.cgiar.org/waspa**

International Water Management Institute (IWMI)

127, Sunil Mawatha, Pelawatte,Battaramulla, Sri Lanka.

Tel: +94 11 2787404

E mail: p.dissanayake@cgiar.org

a.clemett@cgiar.org

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ABBREVATIONS and ACRONYMS

API	American Petroleum Institute
BOD	Biochemical Oxygen Demand
BMP	Best Management Practices
CEA	Central Environmental Authority
COD	Chemical Oxygen Demand
CP	Cleaner Production
CPHI	Chief Public Health Inspector
DO	Dissolved Oxygen
EMS	Environmental Management Systems
FOG	Fat, Oil and Grease
MC	Municipal Council
MLVSS	Mixed Liquor Volatile Suspended Solids
O&G	Oil and Grease
PHI	Public Health Inspector
RO	Reverse Osmosis
SS	Suspended Solids
TSS	Total Suspended Solids
WASPA	Wastewater Agriculture and Sanitation for Poverty Alleviation in Asia

1. Introduction

The pollution of the canal water (in Beu Ela and Wan Ela) in the WASPA project area in Kurunegala can be attributed to both point and non-point source pollution including:

- Small-scale industrial effluent discharged to canals;
- Wastewater and sewage discharged into canals;
- Dumping of solid waste into canals;
- Open defecation on canal banks and in open areas that washes into canals;
- Urban runoff and rainwater; and
- Chemicals and other wastes from upstream agricultural lands.

The assessment phase of the WASPA project identified approximately 3000 industrial and commercial buildings, as well as institutions such as schools, in the catchment area of the two canals Wan Ela and Beu Ela. However there are no large scale industries in the project area that drain into the canals and most of the wastewater appears to be of domestic origin. The hospitals, vehicle service stations, slaughter houses and meat stalls, hotels and restaurants, schools, technical colleges and tuition classes were identified as significant sources that generate wastewater in

the area. The non-wastewater generating units were also catalogued as their other wastes, especially solid waste, can cause indirect pollution in the canals.

A centralized treatment system is in the process of being developed by the Greater Kurunegala Sewerage Project and should be operational in the next few years; however, the system will not be able to accommodate untreated wastewater from some sources, especially commercial units. Therefore, in future, on-site wastewater management for pollutant load reduction will be a requirement prior to discharging.

To address the wastewater management issue of medium to small-scale industries and other commercial establishments and institutions the WASPA Project has developed a series of booklets for selected sectors. This booklet is written as a guideline on wastewater management for vehicle service stations. It is intended to serve the reader as a reference in understanding how to manage the wastewater on-site. It provides guidelines on Best Management Practices (BMPs) and Cleaner Production (CP) options which can lead to a reduction of pollutant loads and cost savings to the owners or managers. Furthermore, it guides the owners and managers in selecting the treatment system that suits the wastewater characteristics of their businesses; and for those who already have a treatment system, it provides guidance on how to maintain the system without interruption.

A list of the names of wastewater treatment experts and commercial consultants and their contacts is provided at the end of the booklet. They can assist you by designing your treatment system and maintaining your treatment system once structurally in place and functioning.

Some of the pollution prevention measures could be applied without resulting in excessive effort and cost to the facility owner while wastewater treatment options require construction of treatment facilities, capital cost and cost of maintenance. The industries are therefore encouraged to start by implementing these measures as much as possible to minimize the investments required in end of pipe treatment of wastewater. Wastewater management at the source is vital as wastewater quality is expected to comply with the general standards for discharge of effluents into inland surface waters. This improves the potential for the effective reuse of wastewater discharged into the canals for agriculture and other purposes, as well as the aesthetic appeal of the canals for residents and visitors to Kurunegala.

2. Pollution Prevention or End of Pipe Treatment?

Up to about 20 years ago pollution control measures concentrated on what is commonly referred to as “end-of-pipe” treatment, which focuses on what to do with the waste once it has been generated. Recently the focus has changed towards pollution prevention, which directs attention towards the elimination or reduction of pollutants within the process itself before treatment. Elimination and Reduction is generally achieved by improvement of housekeeping procedures and modifications to the processes, to reduce water and energy consumption and to segregate highly polluted streams for point source treatment. Best management practices for the most part are common sense, good housekeeping measures that can be implemented without resulting in excessive effort and cost to the facility owner or operator but which lead to the reduction of pollution.

2.1 What is Cleaner Production?

Cleaner Production is the continuous application of an integrated preventative environmental strategy to processes, products and services to increase eco-efficiency and reduce risks to humans and the environment.

- Production Process: Conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity of toxicity of all emissions and wastes at the source.
- Products: Reducing negative impacts along the entire life cycle of a product, from design to ultimate disposal.
- Services: Incorporating environmental concerns into designing and delivering services.

Cleaner Production requires changing attitudes, exercising responsible environmental management and evaluating technology options.

2.2 Benefits of Cleaner Production

The environmental benefits of pollution prevention and CP directly coincide with economical interests. In the long term, pollution prevention through waste minimization and CP is more cost effective and environmentally sound than traditional pollution control methods.

2.3 Source Reduction Techniques

Source reduction prevents the generation of wastes and environmental releases and conserves natural resources. There are six techniques that are most commonly

used in source reduction: process efficiency improvements; material substitution; inventory control; preventive maintenance; improved housekeeping; and in-process recycling.

Table 1 defines and provides some examples of each of the six source reduction techniques. These are just some of the many methods of reducing waste at source.

Table 1: Source Reduction Techniques

Source Reduction Technique	Description	Examples
Process efficiency improvements	A method of doing more with less by designing new systems or modifying existing ones; the most effective means of conserving materials and resources	High volume, low pressure spray guns for painting operations; centralized fluid distribution systems; water flow restrictors; energy-saving light fixtures
Material substitution	Replace hazardous chemicals with less toxic alternatives of equal performance	Using water-based paints instead of solvent-based paints; replacing solvent degreasers with aqueous cleaning systems
Inventory control	Reduce product losses due to product expiration and over-stocking	Restricting access to supply areas; maintaining accurate inventory records to prevent over-stocking
Preventative maintenance	Includes any activity that might prevent equipment malfunctions and environmental releases	Routinely inspecting equipment and storage containers; fixing problems immediately; following standard operating procedures
Improved housekeeping	Keeping a cleaner shop conserves resources and materials, prevents product losses and, prevents spills leaks	Keeping aisles clear; cleaning up spills and absorbents immediately; maintaining storage shelves in good order
In-process recycling	In-process recycling is considered source reduction if materials are not removed from the process or if materials are redirected back into the process	Counter-current rinsing in the electroplating process; water recirculation; multi-pass coolant systems

2.4 Cleaner Production in Sri Lanka

The National Cleaner Production Centre

The National Cleaner Production Centre (NCPC) in Sri Lanka is promoting CP in the country and as well as capacity building for the successful application of CP in industrial and commercial establishments and other institutions. The contact details of NCPC are given in Appendix B. The NCPC performs the following activities:

- In-plant assessment including integrated CP and Environmental Management System (EMS) assessment;
- Awareness raising;
- Training;
- Dissemination of technical Information;
- Promotion of CP investments; and
- Policy advice.

Industrial Services Bureau

The Industrial Services Bureau (ISB) of the North Western Province has been actively participating in energy and environmental management activities since its inception in 1990. As a natural extension to well established energy and environmental management activities, ISB is now actively engaged in the introduction of “Cleaner Production” to Sri Lankan industries, particularly those which are operating in the Kurunegala area in the North Western Province. The contact details of ISB are given in Appendix B.

3. What is on-site wastewater treatment?

Any treatment process that removes contaminants from wastewater at or near the point of generation, with dispersal of treated wastewater nearby, is considered “onsite” . The most common type of onsite wastewater treatment system is the septic system. On-site wastewater treatment is also called decentralized wastewater treatment, to distinguish it from centralized treatment (at municipal sewage treatment plants).

3.1 Wastewater Treatment Methods and Processes

Wastewater can be treated in a number of different ways depending on the level of treatment required. These levels are known as preliminary, primary, secondary and tertiary or advanced. The contaminants in wastewater are removed by physical, chemical and biological means. The possible treatment levels and their sequence are presented schematically in Figures 1 and 2. A detailed description of important contaminants of concern in wastewater treatment, the treatment levels and processes are presented in Appendix A.

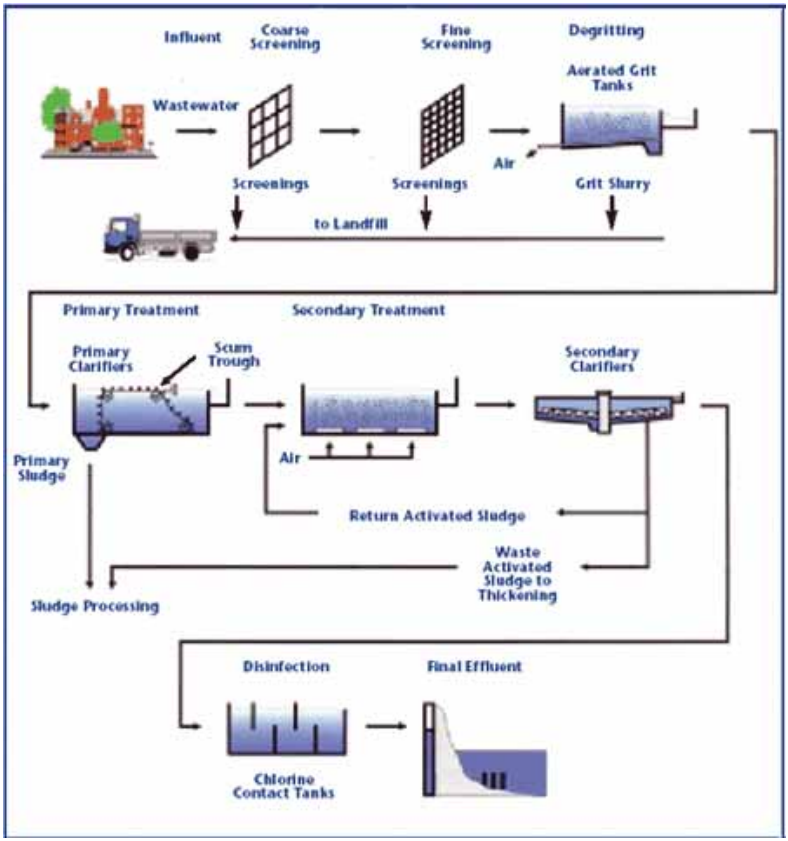

Figure 1. Treatment Levels
Source: Environment Canada www.ec.gc.ca

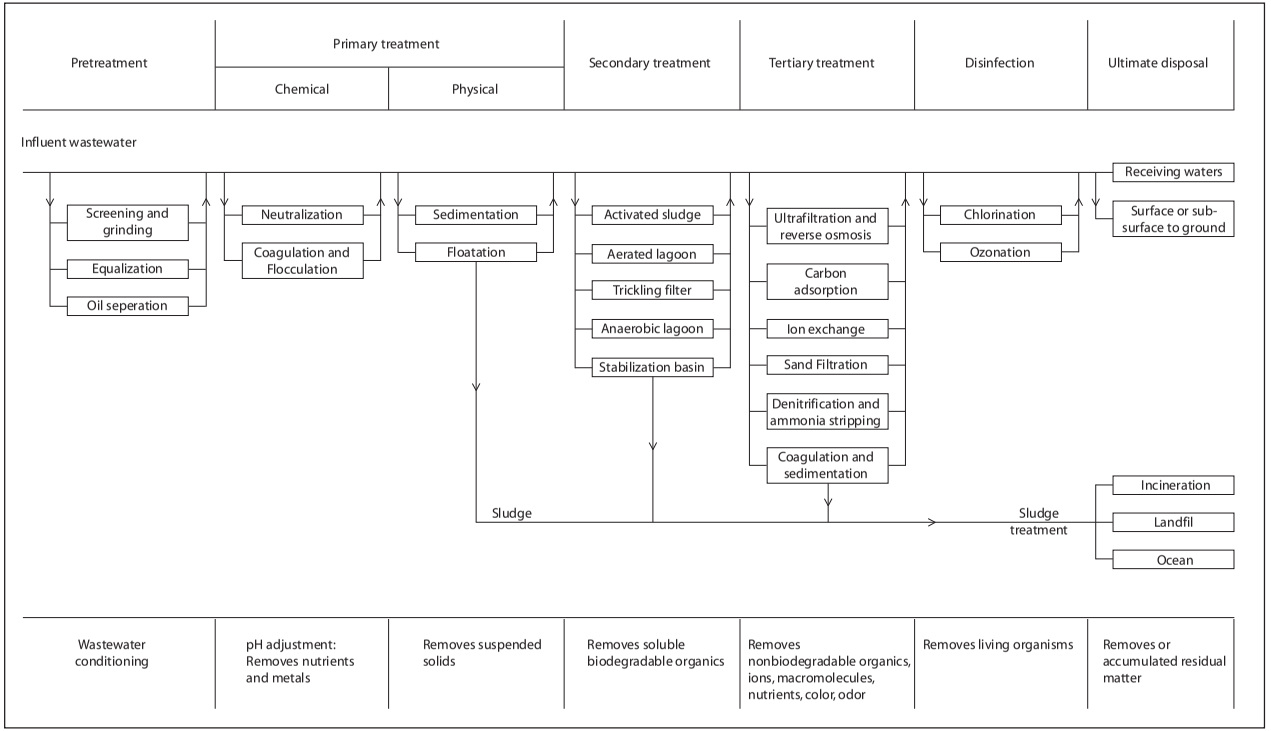

Figure 2. Possible Choice for Wastewater Treatment and Their Sequence

3.2 Septic Tanks

Septic tanks have been used in Kurunegala and across Sri Lanka for many years as the most suitable form of primary treatment of sewage. Septic tanks are used for wastewater with a high percentage of settleable solids, typically from domestic sources (mostly toilet wastewater). Private households and public buildings such as schools and hospitals currently use individual on-site and small-scale septic systems (up to about 50 households).

Septic tanks, when correctly designed and built, properly operated and regularly emptied, are a very effective device to treat wastewater. However, many of the septic tanks in the area are badly designed and are only serving the purpose of storing wastewater.

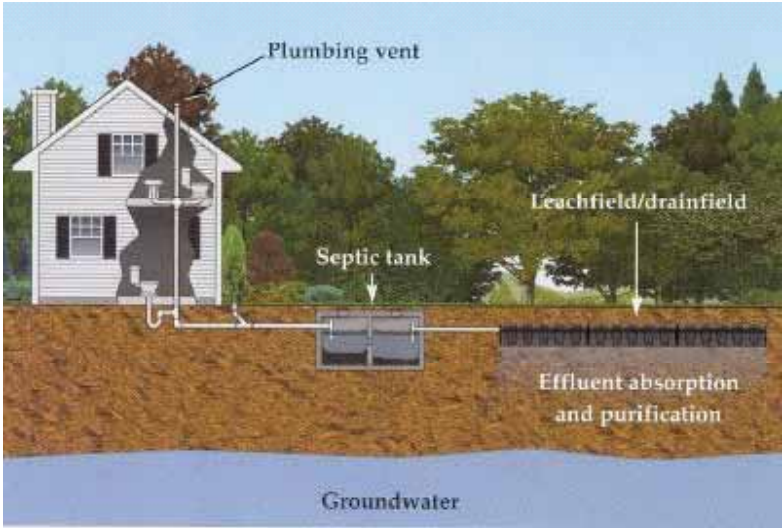

Figure 3. Components of a Septic System
Source: www. thenaturalhome.com

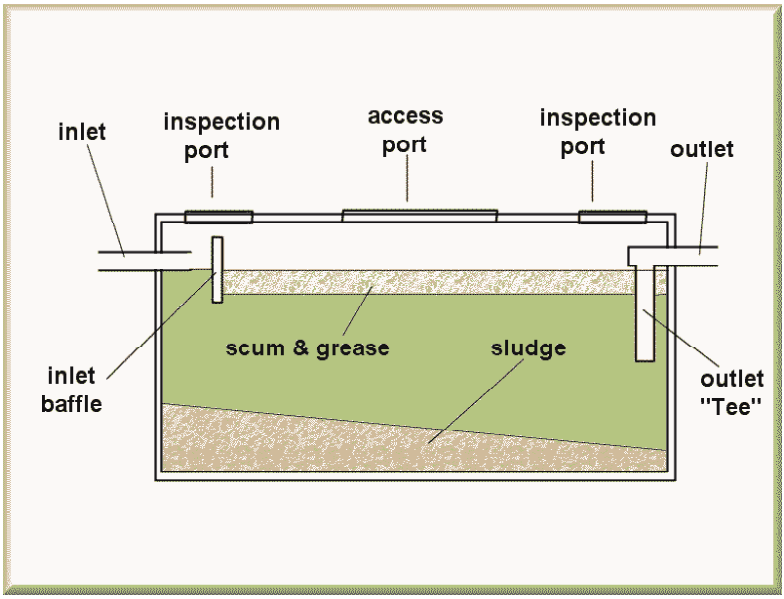

Figure 4. Components of the Septic Tank
Source: www.septictankinfo.com

3.3 Tips for Maintaining Your Septic System

The following are general tips that are applicable to a range of public buildings and private households that use septic tanks. Therefore, some may not be applicable to service stations.

A. Minimize the Liquid Load.

The less wastewater you produce, the less the soil will have to absorb. Water conservation is the cheapest and easiest way to protect your septic system. The volume of the septic tank must not be exceeded in any one day. This can be achieved by:

1. Repairing leaky fixtures.
2. Washing clothes only when you have a full load. Avoid doing several loads in one day.
3. Take short showers instead of baths. Do not turn the shower on all the way and turn off the water while lathering. Install a water-saving device in the shower system.

4. Use a water-saving device in your toilet tank and do not flush it unnecessarily.
5. Do not let water run while washing teeth, hands, vegetables, dishes, etc. Use a stoppered basin.
6. Many other ways of conserving water exist. Use water-saving devices where feasible. Be alert and institute other water-saving ideas.

B. Minimize the Solids Load

Do not use your septic system for anything that can be disposed of in some other way. The less material you put into your septic tank, the better the quality of the effluent going to the leaching system.

1. Collect grease in a container near the sink rather than pouring it down the drain.
2. Minimize the discharge of paper products. Non-degradable items, such as sanitary napkins and paper towels are especially harmful.
3. Basically three products should go into the septic tank: human wastes, toilet paper and water from toilets. Water from bathing fixtures, kitchen sinks and laundry washers may or may not go into the septic tank. In most cases the grey water goes into a soakage pit.
4. Ordinary use of household chemicals will not affect the bacteria in your system if not used in excessive amounts. Do not use your tank to get rid of oils, paints, insecticides or other poisonous liquids.

C. Additional Means to Protect the Installed Septic System

1. Do not plant large trees over the absorption system. Small feeder roots will enter the drain holes of the leachfield drain lines and form a mat within the drain line. This mat blocks the flow in the level drain line rendering the remainder of the line unusable. Large roots may displace the drain line.
2. Ideally the leachline or bed systems should be left in uncovered open sunny areas so as to be provided maximum evaporation.
3. Do not allow rain water or drainage water to pond over the leachfield. Maximum saturation and temporary failure may occur until the ponding dissipates.
4. Do not construct walkways, patios, swimming pools, permanent structures or parking lots, over or within the leachline or bed areas. This would prevent maximum evaporation, may cause damage to the system and may cause premature failure.

5. Keep vehicles off your leachline or bed system; driving over them repeatedly can damage underground pipes and soil porosity.
6. Your tank should be routinely pumped at least every three years or once a year if a commercial establishment. The duration of the pumping period can take longer, if you perform some preventative maintenance.

Emptying of the Septic Tanks in Kurunegala

The Kurunegala Municipal Council (MC) provides services for emptying and maintenance of septic tanks in the Kurunegala city limits. Anyone who requires this service should contact the Chief Public Health Inspector (CPHI) at the Kurunegala MC. The present CPHI is Mr. Upali Weerasooriya, who can be contacted on 037-2222272.

Sri Lanka Standards 745 of 2002 is the most comprehensive document in Sri Lanka regarding the on-site disposal of excreta related wastes and it is recommended that the MC refers to this in designing and maintenance of the septic tanks in the area.

Figure 5. Emptying of the Septic Tank

D. Steps to Consider if Your Leaching System Fails

If a competent professional (from the MC or elsewhere) has determined that your leaching system has failed the old system need not be abandoned completely. If your leaching system requires repair or replacement the MC can help you. The PHI may advise you to simply add a new seepage pit to the existing system. This is referred to as a “Series Connection”.

4. Guide to Best Environmental Management Practices and Treatment Options

Vehicle service facilities such as repair shops, body shops, gas stations, car and truck rental companies, car dealerships, and car washes have a high potential to impact storm water and sewer wastewater with contaminants. They generally contribute to Oil and Grease (O&G), Suspended Solids, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) in the wastewater, of which O&G is the most difficult to treat. Large amounts of oil and grease in the wastewater cause trouble in the collection system pipes. Oil and grease also hamper effective treatment at the wastewater treatment plant. Therefore, the ways to cut down on your grease output to avoid costly maintenance of your treatment system and inappropriate disposal when there is an interruption in the treatment are discussed here.

4.1 Sources of Pollutants and Pollutants of Concern

Sources of Pollutants	Pollutants of Concern
There are several activities that could potentially cause the discharge of pollutants to the storm drainage system from these facilities. **The activities of concern include:** • Facility maintenance and management (storage, spills, outdoor waste receptacle areas). • Changing oil and other fluids. • Cleaning engines and parts, and flushing radiators. • Washing cars and other vehicles. • Body repair and painting. • Fuel dispensing.	Some of the pollutants of concern from these facilities are: • Oil and grease - engine oil, brake oil, gear oil, kerosene oil and grease. • Petrol and diesel. • Solvents. • Metals - copper, zinc, chromium, nickel, and lead. • Detergents. • Grit and mud.

4.2 Best Management Practices to Reduce Oil and Grease Load

The pollutants in wastewater streams which represent the problem of oil and grease include free oil, oil coated solids, mechanical dispersions, emulsions and dissolved oil. There is a number of BMPs that can reduce the oil and grease load effectively.

Best Management Practices for the most part are common sense, good housekeeping measures that can be implemented without resulting in excessive effort and cost to the facility owner or operator, that lead to the reduction of oil and grease load in the wastewater. The BMPs that can be used in general are summarized below and they are explained in detail for each activity in the following sections.

- Purchase reusable or recyclable products whenever you can;
- Reduce or eliminate the hazardous materials that you use;
- Consider switching to water based cleaners instead of chlorinated solvents;
- Spent water based cleaners may not be discharged to the storm drain or sanitary sewer;
- Materials that have the potential to be recyclable include the following: oil, coolants, cleaning solvents, oily rags, and batteries; and
- Some materials can be reused for energy, such as fuels, paints, and absorbents.

Recycling is not only good for the environment, it is good for business. Often, it is cheaper to recycle and you may even be able to get a return on your recycled goods.

The specific BMPs for each activity of concern in the service station sector are given in the following section in detail.

Body Repair and Painting

- Carefully calculate the amount of paint and paint thinner needed to reduce the amount of waste paint. More paint can be obtained if needed whereas having a surplus could result in the unnecessary transport of hazardous material and treatment costs. Be sure to use the appropriate sprayer size.
- Wastewater emanating from painting operations including paint gun cleaning wastes should not be discharged into the sewer or storm drain.
- Whenever possible, conduct all body repair and painting work indoors or under cover.
- When receiving damaged vehicles, inspect for leaks. Use drip pans if necessary.
- When cleaning auto body parts before painting, do not use hose-off degreasers. Brush off loose debris and use rags to wipe down parts.
- Use dry cleanup methods such as vacuuming or sweeping to clean up dust from sanding metal or body filler. Debris from wet sanding can be allowed to dry overnight on the shop floor, then swept and vacuumed. Liquid from wet sanding should not be discharged to the storm drain.
- Minimize waste paint and thinner by carefully calculating paint needs based on surface area and using the proper sprayer cup size.
- Maintain fuel dispensing areas using dry cleanup methods such as sweeping.

Changing Oil and Other Fluids

- Whenever possible, change vehicle fluids indoors and only on floors constructed of non-porous materials. Avoid working over asphalt and dirt floors – surfaces that absorb vehicle fluids.
- If vehicle fluids must be removed outdoors, always use a drip pan. Prevent spills from reaching the street or storm drain by working over an absorbent mat and covering nearby storm drains, or working in an area with a small barrier or dam.
- When draining fluids into a drain pan, place a larger drip pan under the first drain pan to catch any spilled fluids.
- Transfer fluids drained from vehicles to a designated waste storage area as soon as possible. Drain pans and other open containers of fluids should not be left unattended unless they are covered and within secondary containment.
- Store waste containers of antifreeze and oil within secondary containment.
- Antifreeze and waste oil should be stored separately and recycled, or disposed of as hazardous waste.
- Never pour vehicle fluids or other hazardous wastes into sinks, toilets, floor drains, outside storm drains, or in the garbage. These substances should be kept in designated storage areas until recycled or safely disposed of. There are companies that will collect and recycle these substances.
- Drain fluids from leaking or wrecked vehicles as soon as possible, to avoid leaks and spills.
- Never discharge wastewater, solvents, or aqueous cleaners from engine, brake cleaning, and parts cleaning or radiator flushing to the storm drain or sewers.

Cleaning Engines and Flushing Radiators

Parts washing and brake cleaning is typically accomplished with either organic solvents or aqueous cleaning solutions.

- Steam cleaning of engines must be done in a closed-loop water recycling system. No steam cleaning water should be discharged to drains or water bodies.
- Designate specific areas or service bays for engine, parts or radiator cleaning. Do not wash or rinse parts outdoors.
- Use self-contained sinks and tanks when working with solvents, and keep them covered when not in use.
- Inspect degreasing solvent sinks regularly for leaks and make necessary repairs immediately.
- Avoiding soldering over drip tanks. Sweep up drippings and recycle or dispose as hazardous waste.

- Rinse and drain parts over the solvent sink or tank, so that solvents will not drip or spill onto the floor. Use drip boards or pans to catch excess solvent solutions and divert them back to a sink or tank.
- Collect and reuse parts cleaning solvent solutions and water used in flushing and testing radiators. When reuse is no longer possible, these solutions are hazardous wastes unless otherwise determined, and must be disposed of properly.
- Certain types of solvents and aqueous cleaners can be recycled through a service vendor. This can cut down on treatment costs and is a better renewable resource option.
- Organic solvents that cannot be recycled should be disposed of as hazardous waste.
- Aqueous cleaners, in general, are less toxic than organic solvents. Aqueous cleaners range from mild soap and water to concentrated chemical solutions. If mild soap and water solutions are used to clean parts, both the cleaning solution and the rinse water may be discharged to the sewer if the sewer is connected to a treatment facility. When using concentrated cleaning solutions (these may be caustic, acidic or chelated solutions), only the rinse waters may be discharged to the sanitary sewer and then only if a treatment system exists. The concentrated cleaning solutions may not be discharged directly without pretreatment.
- Never discharge wastewater from steam cleaning, or engine cleaning to a street, gutter, storm drain or water bodies.
- Many brake cleaning solvents contain n-hexane, which has been proven to cause serious health problems for mechanics. Switch to an aqueous, recirculating brake-cleaning system to avoid these problems.

Fuel Dispensing

- Maintain fuel dispensing areas using dry cleanup methods such as sweeping for removal of litter and debris, or use of rags and absorbents for leaks and spills. Fueling areas should never be washed down unless dry cleanup has been done and the wash water is collected and disposed of in the sanitary sewer system.
- Fit underground storage tanks with spill containment and overfill prevention systems.
- Fit fuel dispensing nozzles with “hold-open latches” (automatic shut-offs).

Spill Control

The best spill control is prevention! Spills are cheaper to clean up when quickly contained. Write a Spill Response Plan.

- Maintain a spill response plan and ensure that employees are trained on the elements of the plan and practice to ensure that employees can put the plan into action safely.
- Minimize the distance between waste collection points and storage areas.
- Contain and cover all solid and liquid wastes – especially during transfer.
- Purchase and maintain absorbent materials and procedures for containment and cleanup of different spills, and make sure they are easily accessible anywhere in the shop. Saturated absorbents generally must be disposed of as hazardous waste.
- Clean leaks and drips routinely on the spot. Leaks are not cleaned up until the absorbent is picked up and disposed of properly.
- Check floor drains to ensure that they are not connected to or discharge to the storm drain system.
- Adequate spill prevention and clean-up materials must be kept on-site and readily available for use. Examples of such materials are the following.
    - Rags (for laundering).
    - Absorbent mats – ensure that the material you have chosen will absorb the appropriate fluids. Some only absorb water-based fluids or solvents, while others absorb oil and grease. There are also absorbents that neutralize as well as absorb for acids or bases.
    - Drain blockers – rubber mats that are generally stored on the walls and can be quickly thrown down to cover a drain to prevent a spill from going into the drain.
    - Absorbent “sacks” - these can be used as a temporary barrier.
    - Consider using an oleophilic (oil absorbing) mop for cleaning up oil leaks and spills. This enables the oil to be more easily recycled.
    - Drums or other containers for any wastes generated during cleanup.
    - Personal protective equipment such as gloves, overalls, safety goggles and face shields.
    - Dry sweep brush and dustpan.
    - Hydrophobic mops

Floor Drains and Floor Cleaning

Floor drains in work areas should not be constructed, unless the work area is only used for washing of vehicles’ exterior, in which case the drain must connect to the sanitary sewer and a treatment system.

- Utilize dry clean-up methods wherever possible. Clean up spills by sweeping, special oil mops or by using rags or dry absorbents.
- Collect all metal filings, dust, and paint chips from grinding, shaving, and sanding and dispose of properly. Collect all brake pad dust and dispose of properly. Never discharge brake pad dust to the storm drain or sanitary sewer.
- Remove all unnecessary hoses to discourage employees from washing down floors and outdoor paved areas. Once the dry clean up is complete, floor and paved areas may be mopped.
- Mop the floor using a bucket of non-corrosive cleaner and water diluted as specified on the label. If possible, only spot mop the area that requires cleaning.

Washing Cars and Other Vehicles

If car washing is a central activity of your business, the most desirable option is to treat and recycle the wash water.

- Designate a vehicle washing area and wash cars and trucks only in that area. This area should have a low barrier to prevent discharges to storm drains.
- Cover outside wash areas to reduce the amount of rainwater reaching the sanitary sewer.
- Acid-based wheel cleaners and other specialized cleaners may be prohibited or require additional treatment before discharge to the sewer.
- If soap is used in washing, the wash water must be collected and treated because even biodegradable soap is toxic to fish and wildlife. This water cannot be discharged to a storm drain or open water body.
- Do not allow spray-on acid-based wheel cleaners to enter a street, gutter or storm drain.
- If cleaning the exterior of **new vehicles** with water only, the discharged water may go to the storm drain directly unless the vehicle has been coated. Always protect the storm drains from solvents used to remove protective coatings from new cars. Discharges of these solvents must receive adequate treatment.

5 Treatment Options for Service Stations

Unless treatment facilities exist that the service station can be connected to treatment options will require construction of treatment facilities, which of course involves capital costs and cost of maintenance. To minimize these costs the best management practices should be implemented first. Parameters that need to be considered when planning treatment facilities are:

- Free oil and oily solids - these are generally separated by physical means. Free oil will rise to the surface of the water, given time, and oily solids will settle to the bottom of the water.
- Mechanical dispersions are fine oil droplets spread throughout the water which do not easily separate out on their own.
- Emulsions are fine droplets which cannot be separated physically because of other chemicals in the water, such as soap.
- Dissolved oil is no longer in droplet form so that physical removal is impossible. Therefore, further treatment is necessary to eliminate these components.

Table 2: Treatment Options for Service Stations

Treatment process and description	Advantage	Typical Risks and Problems
Gravity separation	**Removes free O&G.** Simple design Handle larger capacity. Minimum mechanical and electrical equipment requirements. Low operation and maintenance cost.	Large area requirement due to relatively low flow or large tank Limited to removal of free O&G (no removal of oil droplets < 0.02mm or soluble oil)
Air floatation, dissolved air floatation, induced air floatation or mechanical floatation	**Remove both free and emulsified oil. Reduces TSS and COD.** Remove both floating and settable solids. Very small and light particles can be removed completely in short time.	High chemical consumption. Relatively high sludge formation
Chemical flocculation with gravity separation or air floatation	**Removal of high levels of suspended solids.**	Chemical sludge produced
Filtration: sand, anthracite, multimedia, crushed graphite, oleophilically coated ceramic, hollow fiber membrane cartridge (ultrafiltration)	**Removal of suspended solids, separation of free, dispersed and emulsified oil.**	Backwashing, which requires subsequent treatment
Coalescence fibrous membrane	**Removes total O&G.** Small and compact Easy operation and maintenance. Low cost.	Limited capacity. Partial removal of emulsified oil Extensive pretreatment required; high potential for fouling; not practical for full scale operation
Membrane process reverse osmosis, ultrafiltration, hyper filtration	**Removal of soluble oil.**	Membrane fouling and limited life; extensive pretreatment; low flux rate; not practical for full-scale operation
Biological processes: activated sludge	**Effective soluble oil removal. TSS and BOD reduction.**	Extensive pretreatment required to reduce the influent oil levels to 40mg/l
Carbon adsorption	**Effective removal of all oil components**.	Expensive; Extensive pretreatment required; carbon must be regenerated; or replace; not practical for full scale operation

Source: Vanathy et al. 2002

5.1 Do I need a grease trap or interceptor?

Any establishment that introduces grease or oil into the sewage system in quantities large enough to cause line blockages or hinder sewage treatment should install a grease trap or interceptor. Grease interceptors are usually required for high volume establishments whilst smaller service stations may only need a grease trap.

Grease Traps – how they work

At present most service stations in Kurunegala and other areas in Sri Lanka do not use grease traps for the removal of oil and grease from wastewater. However, a simple grease trap is adequate to treat the wastewater with a high oil and grease content, and some services stations in Kurunegala already have this. A trap is a small reservoir built into the wastewater piping a short distance from the grease producing area. Baffles in the reservoir retain the wastewater long enough for the grease to congeal and rise to the surface. The grease can then be removed and recycled or disposed of properly.

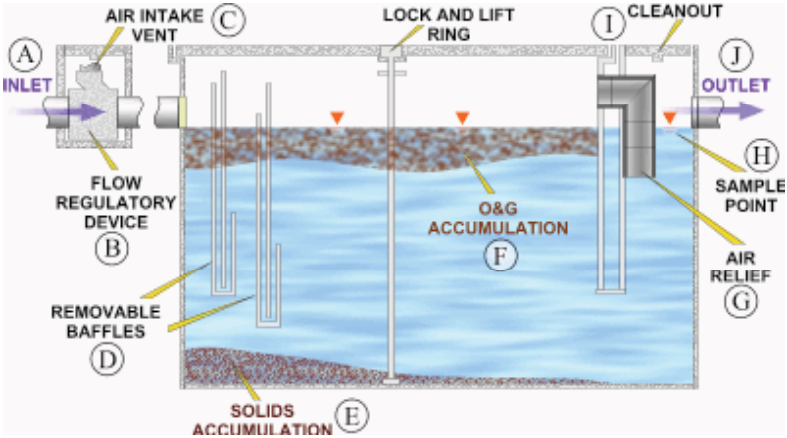

Figure 6. Grease Trap- How it works.
Source: www.govlink.org

A Flow from the service station enters the grease trap.

B An approved flow control or restricting device must be installed to restrict the flow to the grease trap to the rated capacity of the trap.

C An air intake valve allows air into the open space of the grease trap to prevent siphonage and back-pressure.

D The baffles help to retain grease towards the upstream end of the grease trap since grease floats and will generally not go under the baffle. This helps to prevent grease from leaving the grease trap and moving further downstream where it can cause blockage problems.

E Solids in the wastewater that do not float will be deposited on the bottom of the grease trap and will need to be removed during routine grease trap cleaning.

F Oil and grease floats on the water surface and accumulates behind the baffles. The oil and grease will be removed during routine grease trap cleaning.

G Air relief is provided to maintain proper air circulation within the grease trap.

H Some grease traps have a sample point at the outlet end of the trap to sample the quality of the grease trap effluent.

I A cleanout is provided at the outlet or just downstream of the outlet to provide access into the pipe to remove any blockages.

J The water exits the grease trap through the outlet pipe and continues on to the grease interceptor or to the sanitary sewer system.

Grease Interceptors – how they work

An interceptor is a vault with a minimum capacity of between 500 and 750 gallons that is located on the exterior of the building. The vault includes a minimum of two compartments and flow between each compartment is through a 90 degree fitting designed for grease retention. The capacity of the interceptor provides adequate residence time so that the wastewater has time to cool, allowing any remaining grease not collected by the traps time to congeal and rise to the surface where it accumulates until the interceptor is cleaned.

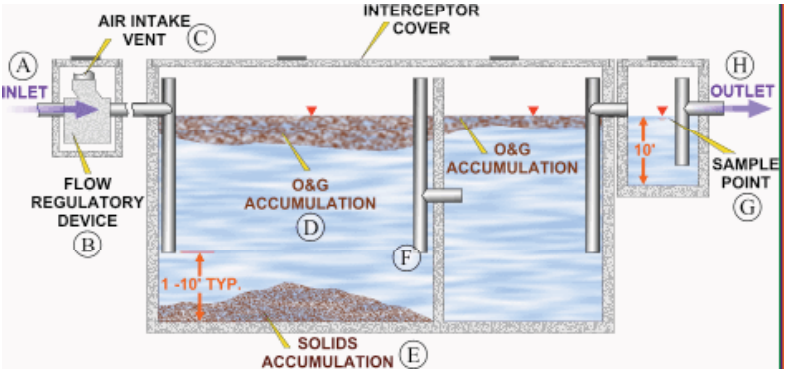

Figure 7. Grease Interceptor.
Source: www.govlink.org

A Flow from the service station enters the grease interceptor. Generally all flow entering the interceptor must enter through the inlet pipe.

B Optional not required in most cases.

C An air intake valve allows air into the open space of the grease interceptor to prevent siphonage and back-pressure.

D Oil and grease floats on the water surface and accumulates behind the grease retaining fittings and the wall separating the compartments. The oil and grease will be removed during routine grease interceptor cleaning.

E Solids in the wastewater that do not float will be deposited on the bottom of the grease interceptor and will need to be removed during routine grease interceptor cleaning.

F Grease retaining fittings extend down into the water to within 12 inches of the bottom of the interceptor. Because grease floats, it generally does not enter

the fitting and is not carried into the next compartment. The fittings also extend above the water surface to provide air relief.

G Some interceptors have a sample box so that inspectors or employees of the establishment can periodically take effluent samples. Having a sample box is recommended but not required.

H Flow exits the interceptor through the outlet pipe and continues on to the sanitary sewer system.

Grease trap and interceptor maintenance

Many service station owners face the difficulty of the treatment system failing due to poor maintenance. Therefore, maintenance of the system is vital for the continued functioning of the treatment system.

Grease trap maintenance is generally performed by maintenance staff or other employees of the establishment. Grease interceptor maintenance, which is usually performed by permitted collectors or recyclers, consists of removing the entire volume (liquids and solids) and properly disposing of the material in accordance with the environmental laws. When performed properly and at the appropriate frequency, grease interceptor and trap maintenance can greatly reduce the discharge of FOG into the wastewater collection system. The required maintenance depends greatly on the amount of FOG a facility generates as well as any BMPs that the establishment implements to reduce the FOG discharged into its sewer system. In many cases, establishments that implement BMPs will realize financial benefit through a reduction in the frequency of required grease interceptor and trap maintenance.

WARNING! Do not use hot water, acids, caustics, solvents, or emulsifying agents when cleaning grease traps and interceptors.

Conventional grease traps may not be able to adequately remove the FOG from the hot wastewater streams.

To properly maintain a grease trap:

1. Remove the accumulated grease from the interceptor and deposit in a watertight container.
2. Remove baffles if possible.
3. Scrape the sides, the lid, and the baffles with a putty knife to remove as much of the grease as possible, and deposit the grease into a watertight container.
4. Remove solids from the bottom with a strainer or similar device.
5. Replace the baffle and the lid.
6. Record the volume of grease removed on the maintenance log.
7. Arrange for grease to be recycled or collected for disposal. In the absence of such service discuss possible disposal options with the MC.

Oil Water Separators

The American Petroleum Institute (API) oil-separator system and the parallel plate separator are more effective at removing oil and grease than the grease traps and grease interceptors described above. The oil separator design is also based on the specific gravity (density) difference between the oil and the wastewater. The API

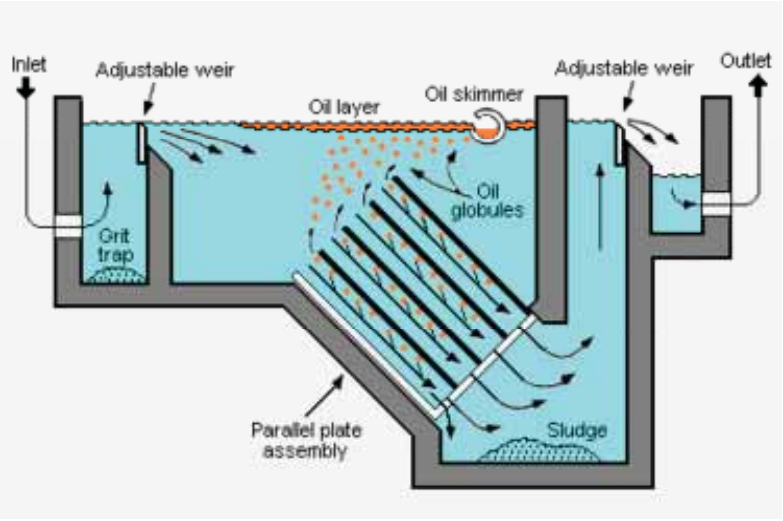

Figure 8. Parallel Plate Separator
Source: http://en.wikipedia.org/wiki/Image:Parallel_Plate_Separator

oil-water separator which is designed to separate the oil and suspended solids from oil refineries, petrochemical plants, chemical plants, and natural gas processing plants that commonly contain gross amounts of oil and suspended solids in their wastewater effluents.

Parallel plate separators include tilted parallel plate assemblies (also known as parallel packs). The parallel plates provide more surface for suspended oil droplets to coalesce into larger globules. Such separators still depend upon the specific gravity between the suspended oil and the water. However, the parallel plates enhance the degree of oil-water separation. The result is that a parallel plate separator requires significantly less space than a conventional API separator to achieve the same degree of separation.

5.2 Wastewater Treatment at a Vehicle Service Station in Kandy

The MAG City (Pvt) Ltd, a service station in Kandy, services approximately thirty vehicles per day. The treatment system at the MAG City comprises of a grease interceptor with four compartments, and flow between each compartment is through a 90 degree fitting designed for grease retention. The flow from the grease interceptor goes through chemical flocculation and sedimentation. Filtration further improves the quality of the wastewater before it is discharged to the nearby river. The oil and grease levels are monitored to make sure that it is within the Central Environmental Authority (CEA) discharge limits for inland surface waters. The construction cost of this treatment was Rs.1,000,000 and maintenance costs are Rs.25,000 per month. The maintenance is done by the staff of MAG City (Pvt) Ltd. The used oil is sold as furnace oil to the brass handicraft makers.

The service stations in Kurunegala could adopt a similar treatment system. The National water Supply and Drainage Board and the treatment experts given in Appendix B could provide relevant guidance.

It is important that a used oil collection system is established in Kurunegala with the involvement of the Municipal Council. One option that has been suggested is to sell the oil to the Holcim (Pvt) Limited (a cement factory in the North Western Province) but other options should be investigated.

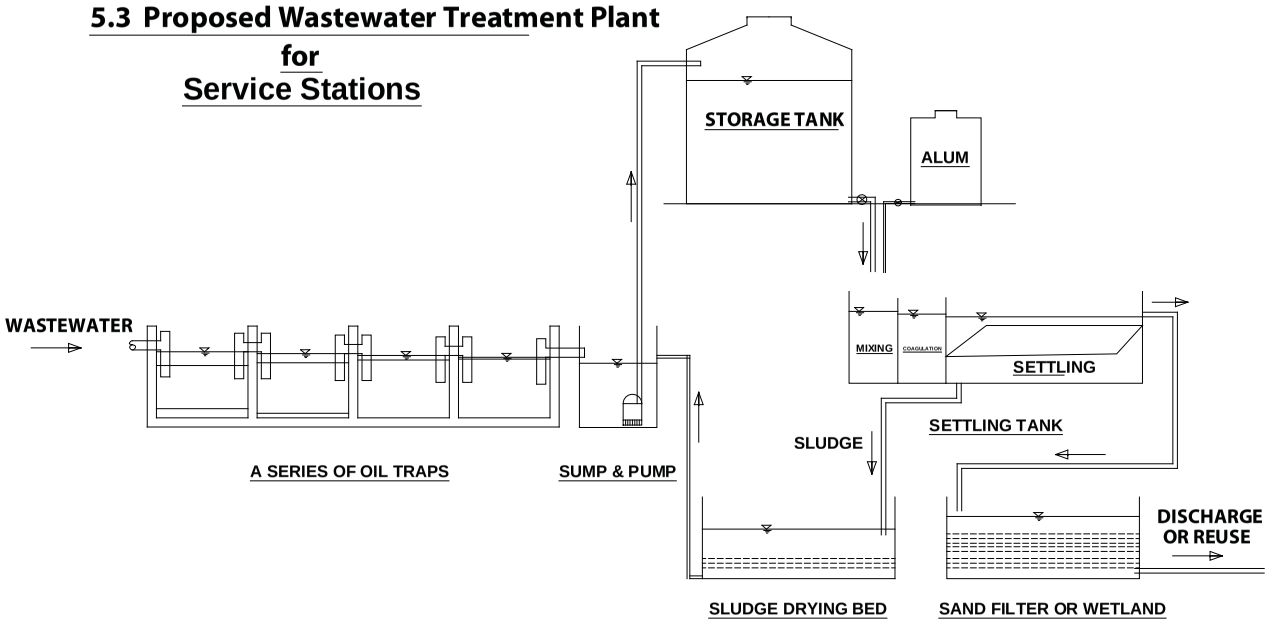

Figure 9. Proposed wastewater treatment plant for vehicle service stations

APPENDIX A: Contaminants of concern in wastewater treatment, the treatment levels and processes

Contaminants	Reason for importance
Suspended solids	Suspended solids can lead to the development of sludge deposits and anaerobic (absence of oxygen) conditions when untreated wastewater is discharged in the aquatic environment.
Microorganisms	Some of them pose a danger to human health (pathogens); some of them are not harmful but create difficulties in water treatment (clogging of filters, taste and odour problems). Waterborne microorganisms can be responsible for diverse public health problems including bacterial diseases such as cholera and gastroenteritis, viral infections such as hepatitis, amoebic dysentery or diarrhea originating from protozoa, and parasitic helminthes (worms) infections.
Nutrients	Both nitrogen and phosphate, along with carbon, are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When discharged in excessive amounts on land, they can also lead to the pollution of groundwater.
Priority pollutants	Organic and inorganic compounds selected on the basis of their known or suspected carcinogenicity, mutagenicity, teratogenicity, or high acute toxicity. Many of these compounds are found in wastewater.
Refractory organics	These organics tend to resist conventional methods of wastewater treatment. Example: agricultural pesticides.
Heavy metals	Heavy metals (E.g. mercury) can be discharged to wastewater from commercial and industrial activities and have to be removed if the wastewater is to be reused.
Dissolved inorganics	Inorganic constituents such as calcium, sodium, and sulfate are added to the original domestic water supply as a result of water use and may have to be removed if the wastewater is to be reused.

Source: Metcalf and Eddy 2003.

Treatment levels and Processes

Preliminary Treatment

Preliminary treatment protects equipment from large or abrasive objects in the influent stream (screening and grit removal) and, in some cases, conditions wastewater (by mixing and deletion) to ease subsequent operations. As industrial wastewater enters a plant for treatment, it flows through a screen, which removes large objects such as rags and sticks that might clog pipes or damage equipment. After wastewater has been screened, it passes into a grit chamber, where cinders, sand and small stones settle to the bottom.

Primary Treatment

Sedimentation is currently the most widely used primary treatment operation. In a sedimentation unit, solid particles are allowed to settle to the bottom of a tank under quiescent conditions. Chemicals may be added in primary treatment to neutralize the stream or to improve the removal of small-suspended solid particles. Primary reduction of solids reduces oxygen requirements in a subsequent biological step and also reduces the solids loading to the secondary sedimentation tank. After screening is completed and grit has been removed, sewage still contains organic and inorganic matter along with other suspended solids. These solids are minute particles that can be removed from sewage in a sedimentation tank. Primary treatment alone has proved to meet some industries demands for higher water quality in order to comply with environmental regulations for effluent discharge to various water bodies.

Secondary Treatment

Secondary treatment generally involves a biological process to remove organic matter through biochemical oxidation. The particular biological process selected depends upon such factors as quantity of wastewater, biodegradability of waste and availability of land. The principal secondary treatment techniques used are the activated sludge process and the trickling filter. In the activated sludge process, wastewater is fed to an aerated tank where microorganisms consume organic wastes for maintenance and generation of new cells. The resulting microbial floc (activated sludge) is settled in a sedimentation vessel called a clarifier or thickener. A portion of the thickened biomass is usually recycled to the reactor to improve performance through higher cell concentrations. Trickling filters (bio-filters) are beds packed with rocks, plastic structures, or other media. Microbial films grow on the surface of the packing and remove soluble organics from the wastewater flowing over the packing. The activated sludge process speeds up the work of the bacteria by bringing air and sludge heavily laden with bacteria into close contact with sewage. After the sewage leaves the settling tank in the primary stage, it is

pumped into an aeration tank, where it is mixed with air and sludge loaded with bacteria and allowed to remain for several hours. During this time, the bacteria break down the organic matter into harmless by-products. The sludge now activated with additional billions of bacteria and other tiny organisms can be used again by returning it to the aeration tank for mixing with air and new sewage. From the aeration tank, the partially treated sewage flows to another sedimentation tank for removal of excess bacteria.

Tertiary Treatment

Many industrial effluent standards require tertiary or advanced wastewater treatment to remove particular contaminants or to prepare the water for reuse. Some common tertiary operations are removal of phosphorus compounds by coagulation with chemicals, removal of nitrogen compounds by ammonia stripping with air or by nitrification – denitrification in biological reactors, removal of residual organic and color compounds by adsorption on activated carbon and removal of dissolved solids by membrane processes (reverse osmosis and electrodialysis). The effluent water is often treated with chlorine or ozone to destroy pathogenic organisms before discharge into the receiving waters (but the use of chlorine is not recommended). Tertiary treatment is intended primarily for upgrading the quality or polishing of effluent and to remove further the suspended solids, BOD_5 and excess nutrients. The various processes of tertiary treatment applied to industrial effluents are: coagulation and sedimentation; activated carbon adsorption; electro-dialysis; biological nitrification; ion exchange; and ultra-filtration. In general, tertiary treatment requires considerable sophistication in design, construction and operation.

Sludge Treatment

Selection of a treatment sequence for sludge depends upon the nature of the sludge, environmental factors and ultimate disposal options. Wastewater treatment processes generate significant quantities of sludge from suspended solids in the feed, biomass generated by biological operations and precipitates from added chemicals.

Sludge conditioning by chemicals or heat improves rates of dewatering. In dewatering operations, the water content of sludge is reduced to a level where they can be handled as damp solids. Vacuum filtration, centrifugation and sand beds are the most common dewatering methods. Thermal processes, such as heat drying and incineration are used to either dry the sludge or to oxidize its organic content. Residual sludge and ash from sludge treatment processes must be disposed of. Some of the options for ultimate disposal on land are landfill, land reclamation and crop fertilization.

Source: Metcalf and Eddy 2003.

APPENDIX B: Relevant Contacts

This is a list of available experts and companies in Sri Lanka. They are in no particular order and the WASPA project does not especially endorse any of them.

National Cleaner Production Center
No. 4, Charles Way, Off 5th Lane, Colombo 3
Tel: 011 2375730, 2375732, Email:ncpcsl@ncpcsrilanka.org
Contact: Mr.Sena Pieris or Mr.Samantha Kumarasena

National Engineering Research and Development Center (NERD)
2P/ 17 B, Industrial Estate, Ekala, Ja-Ela.
Tel: 011 2236284, 011 2233152, Fax: 94 11 535497
E-mail: red@nerdc.lk, wickramasinghe@nerdc.lk
Contact: D.A.Wickramasinghe, Head Department of Renewable Energy

Industrial Services Bureau
141, Kandy Road, Kurunegala. Sri Lanka
Tel: 037 22 23 721-3, Fax: +94 37 22223562, Email:isbnwp@sltnet.lk
Contact: Ms.Banduni Premarathne

Watercare Engineering (pvt) Ltd
73F, kandy Road, Dalugama, Kelaniya
94-112-911499, 94-112-811823, Fax 94-114-811823
Hot Lines 94-712-718516, 94-777-358017
Contact: Ms. Subashini Bandara

Thurul Safe Environment Research and Development Bureau
Priya sevana, Nainamadama
Tel:+94-776222992; Email:thurulenv@gmail.com, www.thuruls.com
Contact: Mr.Thurul

Chemical Industries (Colombo) Ltd Nalco Department
77, Sri Sasanajothi Mawatha, Ratmalana
Tel: 011-2610858, 011-2636818, Fax: 011-4204377
Email: fmohd@nalco.com
Contact: Mr.M.J.M.Fouz

A.K.K.Engineers (pvt) Ltd,
Water and Wastewater Treatment,
115, Parliament Road, Battaramulla
Tel: 011 4305662, Fax: 011 4305650

Puritas Limited Wastewater Treatment,
25, Foster Lane, Colombo 10
Tel: 011 2683963, Tel/Fax: 011 2687721, Fax: 011 2699630
puritas@haycarb.com
Contact: Mr. Dimuth Nawaratna

Enviro Water System (Pvt.) Ltd
512/5, Bokundara Road, Arewwala, Pannipitiya
Tel : 011 4319923, Fax : 0112848705
Email: envirows@envirows.com, www.envirows.com

Engineering Services Ltd
481, T B Jaya Mawatha, Col 10
Tel: 011 2665946, 2665947, 2665951, 4736981, 4736982, 4736984
Fax: 011 2665947, 2698489, Hot Line: 0777355691, 0777373862
Email: eslt@sltnet.lk, www.engsevltd.lk

Industrial Technology Institute (ITI)
363, Bauddhaloka Mawatha, Colombo 7
Tel : 011 2693807/9, 2698621/3, Fax : 2686567
Email : info@iti.lk, www.iti.lk
Contact: Mr. H.N.Gunadasa

Greater Kununegala Sewerage Project Office,
National Water Supply & Drainage Board, Kurunegala
194/4, Kandy Road, Kurunegala
Tel: 037-2233661
Contact: Ms.Mangala Tennakoon, Deputy Project Director

Laboratory, National Water Supply & Drainage Board, Kurunegala
Wathhimiya Road, Kurunegala
Tel: 037-2220839
Contact: Ms.Rupa Jayasinghe

Department of Civil Engineering
University of Moratuwa, Katubedda, Moratuwa.
Tel: 011 2650567/8, email: niranrat@civil.mrt.ac.lk
Contact: Prof. N. Ratnayake, Head Division of Environmental Engineering

Department of Chemical and Processing Engineering
University of Moratuwa, Katubedda, Moratuwa.
Tel: 011 2650301, 2650281, Fax: 2650 622, Email: ajith@cheng.mrt.ac.lk
Contact: Dr.Ajith De Alwis or Dr.Suren Wijeyekoon

Glossary

Activated Carbon: highly absorbent carbon obtained by heating granulated charcoal to exhaust contained gases, resulting in a highly porous form with a very large surface area.

Activated Sludge: sludge that results when primary effluent is mixed with bacteria laden sludge and then agitated and aerated to promote biological treatment.

Advanced Wastewater Treatment: any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids.

Adsorption: an advanced method of treating waste in which activated carbon removes organic matter from wastewater.

Ammonia Stripping: process that removes ammonia from wastewater.

Anthracite: a filtration medium.

Baffles: static devices that regulates flow.

Biochemical Oxygen Demand: a water quality indicator of biologically degradable waste.

Biological Nitrification: biological process that converts Nitrogen from one form to another.

Carcinogenicity: ability to cause cancer.

Centrifugation: removal of solids by rotating motion.

Chemical Oxygen Demand: water quality indicator of chemically degradable waste.

Coagulation: a clumping of particles in wastewater to settle out impurities. It is often induced by chemicals such as lime, alum, and iron salts.

Coalesce: to grow together, fuse.

Comminution: to reduce to powder.

Disinfectant: a chemical or physical process that kills pathogenic organisms in water.

Effluent: a discharge of liquid waste.

Electrodialysis: chemical separation process.

Flocculation: the process by which clumps of solids in water or sewage are made to increase in size by biological or chemical action so that they can be separated from the water.

Gastroenteritis: infection or irritation of the stomach and intestine.

Greywater or sullage: washing water e.g. personal, clothes, floors, dishes.

Heavy Metals: metallic elements with high atomic weights, e.g. mercury, chromium, cadmium, arsenic and lead. They can damage living things at low concentration and tend to accumulate in the food chain

Hepatitis: a viral disease that spreads from wastewater and contaminated food.

Incineration: a special burning process that coverts the burned material into ashes.

Ion Exchange: a chemical separation process.

Landfill: a method of solid waste disposal in which refuse is buried between layers of soil. Waste is usually contained and efflement is collected and treated.

Mutagenicity: ability to cause changes to cells in the human body.

Nitrification and Denitrification: a processes that convert Nitrogen from one form to another.

Pathogen: an agent that causes disease.

Protozoa: one cell animals that is not visible to the naked eye.

Residence time: time the wastewater is held.

Sewage: wastewater that is contaminated with feces or urine, but is often used to mean any wastewater. “Sewage” includes domestic, municipal, or industrial liquid waste products disposed of, usually via a pipe or sewer or similar structure.

Sedimentation: letting solids settle out by gravity during wastewater treatment.

Settleable Solids: Materials heavy enough to sink to the bottom of a wastewater treatment tank.

Skimming: removing oil or scum from the surface of water.

Screening: Use of screens to remove coarse floating and suspended solids from sewage.

Sludge: semi-solid material such as the type precipitated by sewage treatment.

Storm drain: drains, usually along roads, that carry storm water.

Suspended Solids: small solid particles which remain in suspension in water.

Teratogenicity: the development of physical defects in the embryo (unborn child).

Total Suspended Solids: water quality indicator of solids.

Ultrafiltration: a special filtration process.

Wastewater Treatment Plant: a facility containing a series of tanks, screens, filters, and other processes by which pollutants are removed from water.

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Vehicle Service facility Best Environmental Management Practices: *http://www.dpw.co.santa-cruz.ca.us/Pretreatment/BMPsVehicleServiceFacilities.pdf* accessed on December 14, 2007 & January 31, 2008

http://www.a1cesspool.com/maintenancesuggestions.html accessed on January 31, 2008 & February 22, 2008


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INSTITUTE


IRC


NGO FORUM