CHAPTER 10

WATER AND SEWAGE TREATMENT SYSTEMS

10-1. Description of water and sewage treatment systems

A description of a typical potable water supply, process water supply, and small and large scale sewage treatment systems follows. Additional information on water and sewage treatment equipment and systems is presented in paragraph 10-3, General water and sewage treatment equipment description and operation.

a. Facility potable water and process water supply. The water supply to a facility normally meets potable (drinking) water standards. The water supply is separated from facility potable water with a back flow preventer and from the facility process water with a second back flow preventer.

(1) A typical water system is shown in figure 10-1, Schematic of a typical potable and process water system. The system consists of the water supply, isolation valves, strainer, back flow preventers, drain, pressure regulators, and gages.

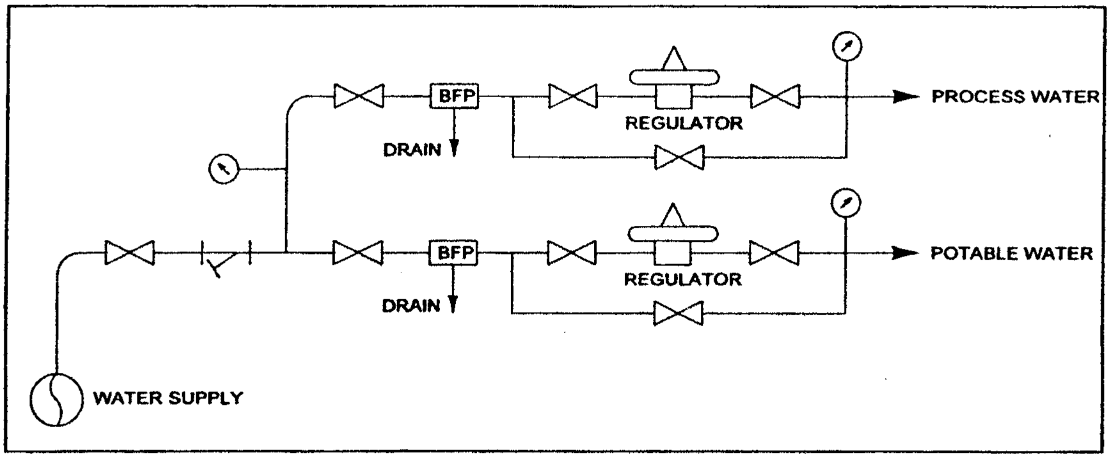

Figure 10-1. Schematic of a potable and process water system

(2) Water treatment is needed for process water used in chilled water, heating water, and steam and cooling tower systems. The type of treatment depends on the quality of the water supply and the types of equipment in service. The typical systems presented elsewhere in this technical manual include a chilled water system and a heating water system. Process water is used for fill and makeup water on both of these systems.

(3) Process water for closed loop chilled and heating water systems needs to be treated to control corrosion, scale formation, growth of biological agents, and pH. In the closed cooling water system, treatment of the water for dissolved oxygen (O_2) to prevent corrosion is needed during filling or when opened for maintenance. Scale is usually not a problem in chilled water systems. In the closed heating water system, monitoring is needed for corrosion from dissolved O_2 and scale formation from precipitation of minerals in the water. A typical process water treatment system is presented in figure

10-2, Process water treatment schematic. Process water treatment consists of a pot feeder, feeder fill point, isolation valves, and chemicals.

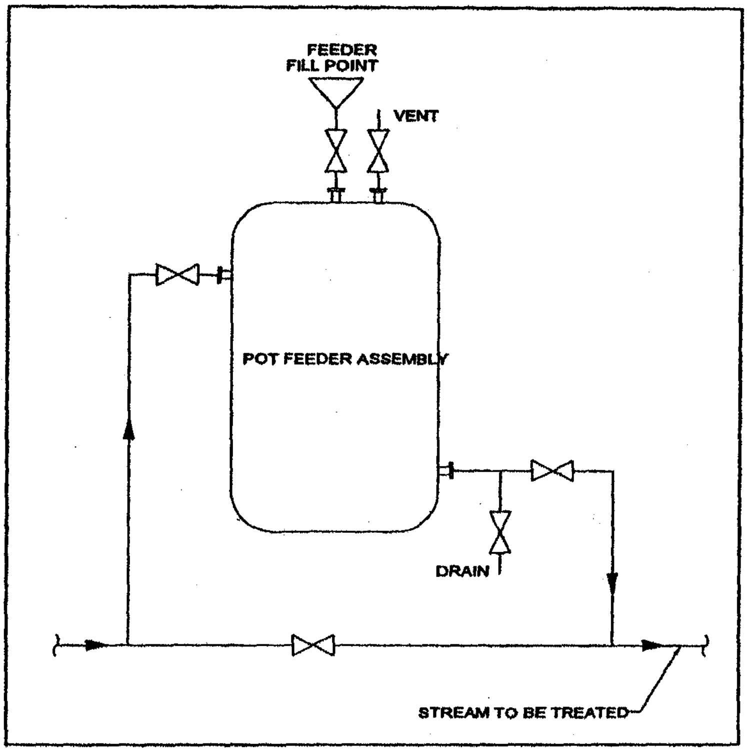

Figure 10-2. Schematic of a process water treatment system

b. Sewage treatment systems. Sanitary sewage is any liquid waste containing animal matter, vegetable matter, and/or certain chemicals in suspension or solution. It excludes storm, surface, and ground water. Sewage treatment removes impurities so that the remaining water can be safely returned to the natural water cycle.

(1) Sewage treatment for small facilities in remote or rural areas involves a septic tank and drain field. Refer to figure 10-3 for a cross section of a septic tank.

(2) Sewage treatment for larger facilities and facility complexes can consist of source, preliminary, primary, secondary, and advanced treatment operations.

(3) Treatment at the source of wastewater to render it safe for sanitary sewage treatment can vary greatly depending on the chemical, manufacturing, or operational processes which produce the waste water. In the sewage treatment facility, preliminary treatment is provided to protect downstream equipment and minimize operational problems. Preliminary treatment includes neutralization, screening, grit removal, and temperature adjustment. Primary treatment at times requires chemical addition but mainly involves physical treatment of the waste to remove settleable and floatable materials. In primary treatment, settling tanks are used for solids removal.

(4) Secondary wastewater treatment relies on naturally occurring microorganisms acting to break down organic material and purify the liquid. Secondary treatment brings air and therefore O_2 in contact with sewage to encourage micro-organisms to grow, thereby removing substantial quantities of dissolved

organics and colloidal materials. This results in purified water. The process or combination of processes used in advanced sewage treatment systems are dictated by effluent quality standards which exceed established secondary treatment standards.

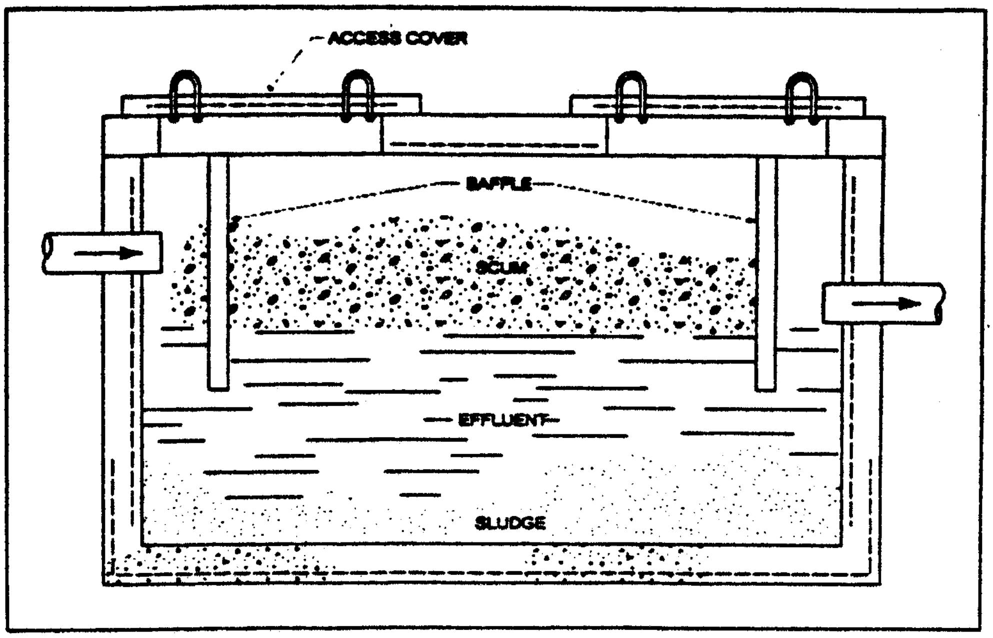

Figure 10-3. A cross section of a septic tank

(5) The typical sanitary sewage waste treatment system selected for discussion in this manual is the trickling filter process shown in figure 10-4, Sewage trickling filter process. The system consists of a preliminary treatment system, primary sedimentation tank, high rate trickling filter, secondary sedimentation tank, disinfection unit, sludge thickener, sludge dewatering tank, and sludge digestion unit.

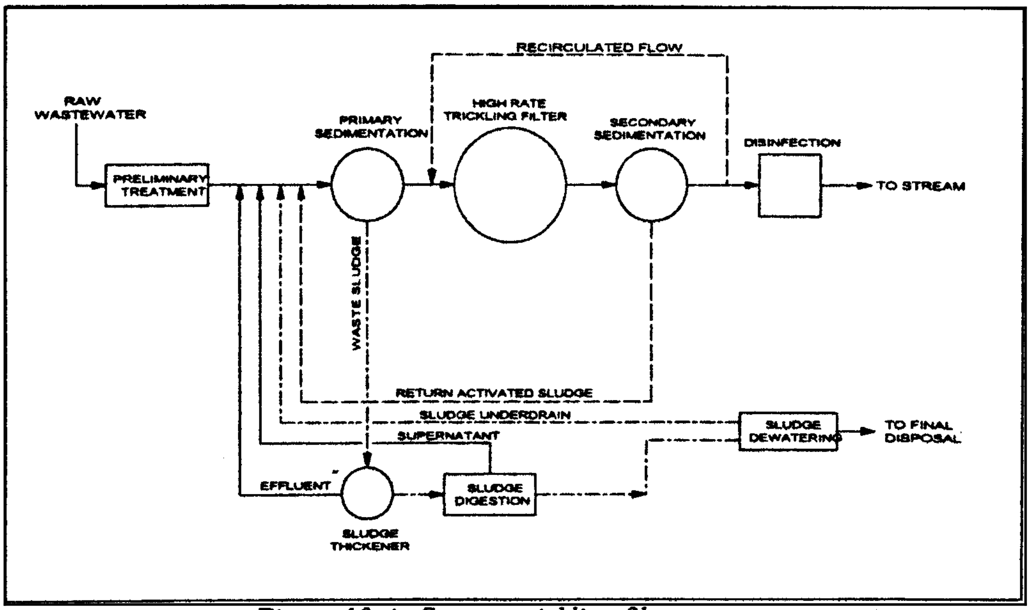

Figure 10-4. Sewage trickling filter process

c. Water and sewage treatment systems. More information on design, maintenance, and testing of water and sewage treatment systems is found in the Management of Industrial Pollutants by Anaerobic *c. Water and sewage treatment systems.* More information on design, maintenance, and testing of water and sewage treatment systems is found in the Management of Industrial Pollutants by Anaerobic Processes by Alan W. Obayashi and Joseph M. Gorgan, Rensselaer Polytechnic Institute, May 1984, the Department of the Army: TM 5-692-1 Maintenance of Mechanical and Electrical Equipment at Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Facilities, Recommended Maintenance Practices, chapters 13 and 18, and TM 5-692-2 Maintenance of Mechanical and Electrical Equipment at C4ISR Facilities, System Design Features, chapters 13 and 18.

10-2. Operation of water and sewage treatment systems

A discussion on the operation of the typical potable water supply, process water supply, and small and large scale sewage treatment systems follows.

a. Potable water system, operation. For both the facility potable water and process water, the water supply to the facility flows through a shutoff valve, strainer, isolation valves, back flow preventer, and pressure regulator. The strainer removes particles from the water and can be back flushed for cleaning. Valves are located up and down stream of the pressure regulator and a bypass installed as needed for change out of the regulator. The back flow preventer incorporates a drain to bleed off water which back flows as a result of back pressure and a malfunction with one of the check valves contained within the unit. This protects the water supply from contamination by preventing facility potable and process water from flowing backward into the water supply.

b. Process water treatment system, operation. An analysis of the water supply and process water in the chilled and heating water systems determines the type of treatment and chemicals needed.

(1) To treat process water, chemicals are fed into a pot feeder and introduced into the process water system by manipulation of isolation valves which allow process water to flow through the pot, mix with the chemicals, and flow back into the system.

(2) Manufactured chemical products contain combinations of proprietary chemicals and different forms of generic chemicals to enhance water treatment performance. Water treatment chemical suppliers tailor chemical treatment needs to local water conditions and establish procedures for safe chemical storage and handling. Some basic chemicals include: sodium hydroxide (NaOH) which increases alkalinity, chelants (EDTA, NTA) which control scaling, and sodium sulfate (Na_2SO_3) and Hydrazine (N_2H_2) which prevent O_2 corrosion. More chemical selection information is presented in Department of the Army: TM 5-692-2 Maintenance of Mechanical and Electrical Equipment at C4ISR Facilities, System Design Features, Chapter 13.

c. Small scale sewage treatment system, operation. In a septic system, sewage from a small facility flows into an underground septic tank. Solids settle out as sludge on the bottom of the tank and are anaerobically digested. Gases produced by digestion are vented back through the plumbing of the facilities through vent stacks in the roof. A scum forms on the top and an almost clear effluent develops in the middle as solids settle and separate. An inlet baffle aids the separation of suspended solids and provides minimal agitation of the sludge for anaerobic digestion. An outlet baffle prevents scum from entering the outlet pipe and clogging the drain field tile. The outlet pipe is connected to a drain field which consists of a perforated, usually plastic pipe or tile, which may run several hundred feet underground depending on the ability of the ground to percolate water. The sloped drain tile is embedded in layers of sand and rock to facilitate percolation and is located below the frost line.

Construction of septic systems is monitored by local authorities to insure proper construction and therefore proper operation of these passive sewage treatment systems.

d. Large scale sewage treatment system, operation. In the larger capacity typical sanitary sewage trickling filter process, the preliminary treatment system utilizes bar screens to remove wood, plastic, rags, paper, and other large solid objects from sewage influent. Sand and grit which can damage pumps are also removed. A primary sedimentation tank is next in the process. It allows sufficient settling time to permit approximately 50 to 70 percent of the remaining solids to settle out and removes 30 to 40 percent of the biochemical O_2 demand (BOD).

(1) Next a high rate trickling or percolating filter provides an environment encouraging aerobic microorganisms to feed on bacteria in the sewage. Sewage is pumped through spray bars and is trickled over stones in an open air tank. The trickling and the drops falling from one stone to the next provide exposure of the liquid to air, and the rocks provide a surface for microorganisms to live on. These conditions promote aerobic microorganism growth and consumption of sewage bacteria thus removing the remaining BOD and suspended solids.

(2) A secondary sedimentation tank provides residence time to separate biological sludge from the purified water exiting the trickling filter. To destroy pathogenic organisms, the water is disinfected with hypochlorate, ozone (O_3), or ultraviolet (UV) light and discharged to a stream or natural body of water. Periodic unannounced sampling by local authorities insures that the discharge remains within safe and legal limits.

(3) Sludge from the secondary sedimentation tank consists of 90 percent organic matter and 2 to 4 percent solids and is pumped back to the primary sedimentation tank.

(4) Sludge from the primary sedimentation tank is mostly water containing organic matter. It is pumped to a sludge thickener. In the thickener, sludge volume is reduced to half and effluent is recycled to the primary sedimentation tank. The sludge is then pumped to the digestion unit. In the digester, organic matter in the sludge is decomposed by anaerobic bacteria which further breaks down the sludge rendering it inert and eliminating health concerns. Anaerobic bacteria does not require free O_2 to decompose organic matter. It does allow separation of solids and water, reduces sludge volume, increases sludge density, and produces combustible methane gas in combination with other gases.

(5) Sludge produced in the digester consisting of relatively stable inert organic and inorganic compounds continues on to a sludge dewatering system and then disposal. It can also be sold as soil conditioner. The supernatant liquids (usually a clear liquid overlying material deposited by settling or precipitation) produced are returned to the primary sedimentation tank and the gases are cleaned and stored. The combustible gases can be used to generate heat for local processes or sold as combustible fuel.

(6) Monitoring of sewage flow and effluent discharge is required by the Environmental Protection Agency (EPA) when National Pollution Discharge Elimination System (NPDES) compliance is required as part of the discharge permit.

10-3. General water and sewage treatment equipment description and operation

There are many ways to treat water to be used in industrial processes and for human consumption. In addition there are also many ways to treat sanitary sewage so that it can be safely returned to the natural water cycle. Following is a discussion of some of the equipment and systems available to treat water and sewage.

a. Water disinfection. Chlorination is the traditional disinfectant used in municipal water treatment. It is a strong oxidizing agent, inexpensive, reliable, easy to use and monitor, and safe when handled properly. Chlorination with chlorine gas is the oldest method of continuous disinfection method used in public water supplies. It was initially introduced in 1904. Disinfection by chlorination has been studied extensively, and is the standard by which other disinfection procedures are judged. Disinfecting forms of chlorine are hypochlorites, chlorine dioxide, and products of chlorine-ammonia reactions.

(1) Simple diffuser systems are adequate for distributing chlorine into water, with warming of the supply tank required for high feeding rates. Hazards of working with chlorine include explosions of pressure vessels (especially if corrosion weakens them) and violent reactions when chlorine comes in contact with oxidizable substances.

(2) Chlorination is the final step for most wastewater treatment plants. In addition to disinfection of the effluent, BOD is reduced because reaction with chlorine substitutes for reaction with O_2. The residual chlorine discourages iron bacteria that form slimes in effluent conduits, and insects are also killed. Most smelly compounds in treatment plant effluents are easily reacted with chlorine, usually to odorless products. Unfortunately, the products of chlorination may be hazardous, and some are known carcinogens. Concentrations in the environment may be much higher than in the effluents because microorganisms or other life forms ingest and store chlorinated organic compounds.

(3) O_3 is also used for disinfection. O_3 is a colorless gas at room temperature, and has a peculiar, pungent odor. O_3 is unstable and cannot be produced and transported. It is generated at its point of use by an electrical corona discharge or UV irradiation of dry air or O_2. O_3 can be injected or diffused into the water supply stream.

(4) Advantages of O_3 over chlorine include the following.

(a) Safety problems of chlorine storage, handling, and transportation are eliminated. O_3 is produced on-site.

(b) O_3 destroys both bacteria and viruses, while chlorine is not very effective against viruses.

(c) O_3 has shorter treatment times (1 to 10 minutes for O_3 versus 30 to 45 minutes for chlorine).

(d) There are lesser pH and temperature effects with O_3.

(e) High dissolved O_2 concentration from ozonation improves receiving stream quality.

(f) No toxicity to aquatic life has been found in studies of O_3 disinfection.

(g) No buildup of bioaccumulatable residuals has been observed in O_3-treated effluents.

(h) There is no increase in total dissolved solids in O_3-treated water.

(i) Wastewater quality improvements such as turbidity reduction and effluent decolorization accompany O_3 treatment.

(5) The disadvantages in using O_3 to treat water include the following.

(a) It is costly to produce O_3, for both capital equipment and operating power requirements.

(b) O_3 is toxic. The Public Health Department has set the maximum safe working concentration at 0.1 ppm.

(c) There is great difficulty in accurately determining the concentration of O_3 in water. The best method thus far has an error of ± 1 percent .

(6) UV light is another method of disinfection. UV light used for disinfection occupies the spectral range from just below visible light to soft X-rays. UV radiation at about the center of the range has been found to kill or deactivate many pathogens. UV treatment does not necessarily kill the target organism, instead the radiation alters cell DNA so that the organism is sterilized. This serves to inactivate the pathogen so that it cannot proliferate and cause disease.

(7) Bacteria are the easiest group to treat and differ the least in amount of radiation required. Viruses are most resistant and variable. Cysts and worms are unaffected by UV light so if present they must be treated by another procedure.

(8) UV treatment adds nothing to the water and does not require the addition of treatment materials as long as the system used is maintained in good operating condition. Extensive contact time is not required in this process making it a time efficient treatment option.

(9) The major disadvantage is that there is no residual for treatment beyond the device. If contaminants enter after treatment, another disinfection method such as chlorination must be used to sanitize the system and treat the water. Some pathogens deactivated by UV light may be reactivated when exposed to O_2. UV light is easily absorbed by solids, including particulate matter in the water or deposits on the lamp surface. As a consequence, UV light treatment should only be attempted on clear water. Water systems which store potable water for long periods may require disinfection to control the growth of biological contaminants and algae. Water samples taken are tested to determine the amount and strength of hypochlorite solution treatment needed. Disinfection can be accomplished by directly injecting hypochlorite into the water, adding hypochlorite into a recirculating side stream, or a combination of both.

b. Process water treatment. Open process water systems in cooling towers are constantly exposed to air and with constant evaporation, raw water is continually being introduced. As a result the cooling water can contain large amounts of dissolved O_2 and the concentration of impurities/dissolved solids increases significantly over time. Frequent water quality monitoring is needed to control corrosion, scale formation, growth of biological agents, and pH. The dissolved solids are usually removed with controlled periodic blowdown of the system. Treatment methods can be as simple as an operator adding slugs of chemicals to a pot/tank or can be as sophisticated as using a continuous analyzer to automatically control operation of chemical metering pumps. The pumps inject chemicals into the water stream to maintain uniform water quality. The analyzer reads output signals from instruments/probes in the process water stream to measure pH, conductivity, dissolved solids concentration, raw water flow, and corrosion. The analyzer signals metering pumps to inject appropriate quantities of chemicals in the water to adjust quality. In less sophisticated systems where periodic sampling has indicated changes to water quality are slow and fairly constant, fixed doses of chemicals can be injected by metering pumps run on timers.

(1) Steam boilers above 600 psig may have problems with water foaming and caustic embrittlement of metal components. For these boilers water quality is typically accomplished by a combination of chemical treatment, deaeration, and blowdown.

(2) Deaeration is the removal of dissolved gaseous carbon dioxide (CO_2) and O_2 from supply water. These gases greatly increase corrosivity and when heated in boiler systems combine with water to form carbonic acid. Removal of O_2, CO_2, and other non-condensable gases from boiler feedwater is vital to boiler equipment longevity as well as safety of operation. Carbonic acid corrodes metal, reducing the life of equipment and piping. It also dissolves iron which when returned to the boiler precipitates and causes scaling on the boiler tubes contributing to reduced life and also increased energy consumption to achieve heat transfer.

(3) Mechanical deaeration is typically utilized prior to the addition of chemical O_2 scavengers. In mechanical deaeration boiler feedwater is heated with steam. This scrubbing action releases O_2 and CO_2 gases which are then vented. Trace O_2 is removed with a chemical O_2 scavenger such as Na_2SO_3 or N_2O_2. Free CO_2 can be removed by deaeration, but this process only removes small amounts of combined CO_2. The majority of the combined CO_2 is removed in the steam, subsequently dissolving in the condensate, and causing corrosion problems. These problems can be controlled through the use of volatile neutralizing amines or filming amines.

(4) Water softeners are used to remove dissolved solids for reduced foaming and scale formation. Water softeners contain a plastic bead or zeolite in a column. The zeolite is saturated with sodium chloride, salt. When water is passed through the column, the calcium and magnesium in the water is replaced with sodium. The water is said to be soft at this point. The sodium compounds do not settle out and cause scale or other problems of the hard water. The column is regenerated with a strong salt/brine solution and backflushed.

(5) Ion exchange units have a cation exchange column to remove metals and hardness and an anion exchange column to control alkalinity and reduce corrosion, embrittlement, hard scale, and foaming. Each exchange column uses a treated resin bed to collect contaminants through a chemical exchange process. When the beds become saturated they are back washed, treated with an electrolyte, rinsed, and placed back in service. Duplex columns are used to achieve continuous operation.

c. Water treatment piping. For water treatment systems common pipe, valve, and pump materials include cast and forged carbon and stainless steel. Low pressure systems can use plastic materials such as polyvinyl chloride (PVC).

d. Sewage treatment processes. Other methods for treating sanitary sewage are discussed in the following paragraphs.

(1) The plug flow activated sludge process is another process used to treat sanitary sewage. This process meets secondary treatment effluent limits. The process includes a bar screen as preliminary treatment and a comminutor (a device which reduces material to minute particles, pulverizer), a grit chamber, and oil and grease removal units. The primary aerated wastewater and acclimated micro-organisms are aerated in a tank. Flocculent activated sludge solids are separated from the wastewater in a secondary clarifier. The clarified wastewater flows forward for further treatment or discharge. A portion of the clarifier sludge is returned to the aeration tank for mixing with the primary-treated influent to the basin and the remaining sludge is pumped to the sludge handling portion of the treatment plant.

(2) Another sanitary treatment process is the stabilization or oxidation pond process. This process uses a relatively shallow body of wastewater in an earthen basin to treat a variety of wastewater and functions under a range of weather conditions. The ponds can be aerobic or layered with aerobic and anaerobic layers. They can be used in combination with other treatment processes. Their operational and maintenance requirements are minimal.

(3) Advanced wastewater treatment achieves pollutant reductions by methods other than sedimentation, activated sludge, and trickling filters used in conventional treatment. Advanced treatment employs a number of different unit operations, including ponds, post-aeration, micro-straining, various types of filtration, carbon adsorption, membrane solids separation, land application, biomass growth, soil biota growth, nitrification/de-nitrification, and other treatment processes. Phosphorus and nitrogen removal processes can consist of additional treatment ponds; post-aeration through advanced methods; and the addition of minerals, lime, metal salts, and polymers for removal through flocculation (mass formed by the aggregation of a number of fine suspended particles) or precipitation.

e. Sewage treatment ancillary equipment. Following is a description of some of the types of ancillary equipment needed for the treatment of sewage.

(1) Sewage flow measurement is needed to assure compliance with permits and to evaluate and adjust treatment processes. Flow can be measured with weirs, Parshall flumes, and magnetic and ultrasonic flow meters.

(2) Sewage sampling is needed to assure compliance with permits and to evaluate and adjust treatment processes. Proportional flow, composite, and grab-sample collection sampling is done at several locations in the process for this purpose.

(3) Monitoring equipment is used to indicate and/or record flow quantities and pressure, temperature, liquid levels, velocities, dissolved O_2, biochemical O_2 demand, total suspended solids, ammonia, nitrate, and pH.

(4) Sewage lift stations and sump pumps are needed where there is not enough elevation drop available for the sewage to flow by gravity all the way to the septic tank or treatment plant. Lift stations provide pits or sumps with submerged centrifugal motor driven pumps or compressed air driven ejector pumps.

10-4. Pre-functional test plan and functional performance test plan for water and sewage treatment systems

This manual assumes that individual components and packaged equipment have been tested by the manufacturer. As part of the commissioning effort each component should be checked for damage, deterioration, and failures by a procedure using inspections and tests as defined by the specific equipment manufacturers. Equipment manuals from manufacturers identify the minimum required receipt inspections, handling and installation procedures, drawing and wiring verification, field inspection and installation checks, verification of removal of shipping braces, inspection of installation against drawings and nameplates, inspection of components for damage and cleanliness, inspection of insulators and grounding, inspection of anchorage and alignment, adjustment checks, mechanical operation and interlock checks, lubrication application, and verification that local safety equipment is in place.

a. Chemical selection verification. As part of the commissioning effort proper selection and dose quantity of chemicals for treatment of water and sewage need to be verified. A procedure must be followed to insure proper chemical treatment and water quality.

b. Safety, water and sewage treatment systems. Many tests on equipment involve the use of chemicals, combustible gases, high voltages, high currents, pressurized water, and rotating or moving equipment. These conditions can be dangerous to personnel and damaging to equipment. A procedure must be followed to insure adequate safety rules are instituted and practiced to prevent explosion and/or injury to personnel performing the tests and other personnel who might be in the local area. Sanitary manholes contain harmful gases and are considered confined space. Confined space entry safety procedures must be followed and adequate ventilation provided before entering a manhole.

c. Test equipment, water and sewage treatment systems. It is important that in any test program the proper equipment is used. The equipment should be calibrated, in good condition, and used by qualified operators as required by a procedure. Any test equipment used for calibration shall have twice the accuracy of the equipment to be tested. All equipment should be operated in accordance with its instruction manual. A procedure defining installation inspection and a system test needs to be provided.

d. Inspection checklists for water and sewage treatment systems. Inspection checklists for the typical water and sewage treatment systems are presented in figure 10-5, Example of a completed DA Form 7487-R, Water supply and treatment system inspection checklist, and figure 10-6, Example of a completed DA Form 7488-R, Sewage treatment systems inspection checklist.

10-5. Possible failures and corrective measures for water and sewage treatment systems

Table 10-1 on page 10-13 lists general problems that may arise during the testing of equipment and systems along with possible troubleshooting techniques. For all problems, consult equipment and component manuals for troubleshooting directions. Check fuses/lights/breakers/etc., for continuity, check equipment calibration and settings, check for clogged filters, strainers and lines, check for closed manual shut off valves, check for improperly adjusted valves and equipment, and look for faulty equipment and connections.

WATER SUPPLY AND TREATMENT SYSTEM INSPECTION CHECKLIST

For use of this form, see TM 5-697; the proponent agency is COE.

SECTION A - CUSTOMER DATA

1. PLANT	2. LOCATION	3. JOB NUMBER
Building 42	Washington, DC	B42-105
4. EQUIPMENT	5. SYSTEM DESIGNATION	6. DATE (YYYYMMDD)
	WPT 22	20030117
7. TEST EQUIPMENT		8. TESTED BY
Water test kit 22, Pro-Master equipment		Charles Gray

SECTION B - EQUIPMENT DATA

9. BACK FLOW PREVENTER MANUFACTURER	10. MODEL NO	11. SERIAL NO	12. FLOW RATING
PVC	PV-4300	543622	4 inch pipe
13. PRESSURE REGULATOR	14. MODEL NO	15. SERIAL NO	16. FLOW RATING
PVC	PV-8900	653466	As required sizing
17. CHEMICAL FEED POT MANUFACTURER	18. MODEL NO	19. SERIAL NO	20. CAPACITY
PVC	PV-9200	987676	As req'd for system ops

SECTION C - VISUAL AND MECHANICAL INSPECTION

21. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
EXTERIOR OF EQUIPMENT	A		IDENTIFICATION	A	
COMPLETENESS OF ASSEMBLY	A		BRACING/SUPPORTS	A	
INTERLOCKS	A		LABELING AND TAGGING	A	
INSTRUMENTS	A		WORKING SPACE	A	
PROPER GROUNDING	A		ANCHORAGE	A	
PROPER INSULATION	A		COMPARISON TO DRAWINGS	A	
TIGHTNESS OF BOLTED CONNECTIONS	A		WELD INSPECTION	A	
LEAKS	A				

SECTION D - CALIBRATION AND SETTING

22.	DESCRIPTION	NOTES
BACK FLOW PREVENTER	Perform required test procedure to confirm operation	
PRESSURE REGULATOR	Perform required test procedure to confirm operation	
GAGES	Check against standard	
LIMIT SWITCHES AND LINKAGES	Check for operation, corrosion, etc.	

SECTION E - SYSTEM TESTS

23.	PASS	FAIL	COMMENTS	NOTES
WATER QUALITY	X			
HYDROSTATIC TEST	X			
STRAINERS/FILTERS	X			
SYSTEM TEST	X			

24. NOTES

*CONDITION: A - ACCEPTABLE; R - NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C - CORRECTED; NA - NOT APPLICABLE

DA FORM 7487-R, DEC 2002 USAPA V1.00

Figure 10-5: Example: DA Form 7487-R

SEWAGE TREATMENT SYSTEM INSPECTION CHECKLIST

For use of this form, see TM 5-697; the proponent agency is COE.

SECTION A - CUSTOMER DATA

1. PLANT	2. LOCATION	3. JOB NUMBER
Building 43	Washington, DC	B43-106
4. EQUIPMENT	5. SYSTEM DESIGNATION	6. DATE (YYYYMMDD) 20030112
7. TEST EQUIPMENT		8. TESTED BY Charles Gray

SECTION B - EQUIPMENT DATA

9. SEPTIC TANK MANUFACTURER	10. MODEL NO	11. SERIAL NO	12. FLOW RATING GPD
Various	2200	UK534	2000
13. PUMP MANUFACTURER	**14. MODEL NO**	**15. SERIAL NO**	**16. FLOW RATING GPM**
Gould	G270	LM987	250
17. SLUDGE DIGESTER	**18. MODEL NO**	**19. SERIAL NO**	**20. FLOW RATING GPD**
ATC	25	HN976	2000

SECTION C - VISUAL AND MECHANICAL INSPECTION

21. CHECK POINT	COND*	NOTES	CHECK POINT	COND*	NOTES
EXTERIOR OF EQUIPMENT	A		BRACING	A	
COMPLETENESS OF ASSEMBLY	A		LABELING AND TAGGING	A	
EQUIPMENT ROTATION	A		TIGHTNESS OF BOLTED CONNECTIONS	A	
ELECTRICAL/MECHANICAL INTERLOCKS	A		LEAKS, LINE BLOCKAGES	A	
SAFETY INTERLOCKS	A		WORKING SPACE	A	
INSTRUMENTS	A		ANCHORAGE	A	
PROPER GROUNDING	A		INSTALLATION AND LINE SLOPE	A	
PROPER INSULATION	A		COMPARISON TO DRAWINGS	A	
PROPER LUBRICATION	A		CONTROL SYSTEM	A	
EQUIPMENT IDENTIFICATION	A				

SECTION D - CALIBRATION AND SET POINT

22	DESCRIPTION	NOTES
SENSORS	Check against standard and proper operation	
CONTROLLERS	Check for full operation	
ACTUATORS	Check full operation range	
FLOW METERS	Check against standard and proper operation	
MONITORING EQUIPMENT	Compare reading with manual readings	
SAMPLING EQUIPMENT	Check for cross contamination and completeness of package	
METERING PUMPS	Check for accuracy and compare to standard	

SECTION E - SYSTEM TESTS

23	PASS	FAIL	COMMENTS	NOTES
FLOW	X			
DIGESTER OFF GAS	X			
EFFLUENT SAMPLE TESTS	X			
SYSTEM TEST	X			

24. NOTES

*CONDITION: A - ACCEPTABLE; R - NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C - CORRECTED; NA - NOT APPLICABLE

DA FORM 7488-R, DEC 2002 USAPA V1.0

Figure 10-6: Example: DA Form 7488-R

Table 10-1. Possible failures and corrective actions for water supply, water treatment and sewage treatment systems

	Areas to Check
General Controls	
Devices will not close/trip	Check mechanical alignment of limit switches Check interlocks and safeties Check relay and protective device settings and operation Check for mis-wired circuits Check the control circuit Check controller set point
Devices trip inadvertently	Check relay and protective device settings and operation Check for mis-wired circuits Check the control circuit Check for system overload or short Check grounds
Water supply and treatment systems	
Water will not flow	Check city water supply pressure Check filters and strainer Check interlocks, safeties Check for closed shut off valves Check pressure regulator setting
Poor water quality	Check for correct chemicals Check for correct quantity of chemicals added
Sewage treatment systems	
Will not start or shuts down	Check PLC and program Check power supply Check power supply to pumps and equipment Check controls, switches, starters, and disconnects Check controller set point Check sensors, actuators, and indicators Check safeties and interlocks
Sewage, sludge or water will not flow or backs up	Check power supply to pumps and equipment Check check-valve installation direction Check motor rotation and ampere load Check controls, switches, starters, and disconnects Check controller Check safeties and interlocks Check for clogged or stopped-up waste, drain, or vent piping Check septic tank for clogged inlet or discharge lines
Odor coming from the system or improper effluent quality	Check PLC Check controls, sensors and actuators Check chemical metering pumps Check trickling spray bars for proper spray pattern Check sludge levels Check vents Check gas collection system Check influent for toxic material, grease, bleach, gasoline, etc. Check aeration rates