LESSON ASSIGNMENT

LESSON 4	Water Supply in the Field.
LESSON ASSIGNMENT	Paragraph 4-1 through 4-11.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

4-1. Match a list of terms related to water treatment with a list of corresponding definitions.

4-2. Identify the importance of water in the practice of sanitation.

4-3. Determine the required quantity of potable water for a unit.

4-4. Match a list of organizations with their respective responsibilities for the production of potable water in the field.

4-5. Identify the rules of water discipline.

4-6. Determine the best water source based upon the unit's situation.

4-7. Identify water treatment processes used in the field.

4-8. Demonstrate the knowledge of the steps for inspection of a 400- gallon water trailer.

4-9. Demonstrate the knowledge of the steps to perform chlorine residual monitoring.

4-10. Demonstrate the knowledge of the steps to disinfect water in the field.

4-11. Monitor bottle water operations.

LESSON 4

WATER SUPPLY IN THE FIELD

4-1. TERMS AND DEFINITIONS

a. **Palatable Water.** Water that looks, smells, and tastes good.

b. **Potable Water.** Water that is fit for human consumption.

c. **Water Treatment.** Procedures that are used to change the chemistry of water to improve its quality.

d. **Disinifection.** A process of killing infectious agents outside the human body by direct exposure to chemical or physical agents.

e. **Chlorination.** A treatment process that combines the water with chlorine or chlorine compound.

f. **Chlorine Dosage.** The total amount of chlorine or chlorine compound added to a given amount of water.

g. **Chlorine Demand.** The amount of chlorine dosage used or consumed by substances in the water.

h. **Chlorine Residual.** The amount of chlorine left in the water after the chlorine demand has taken effect.

i. **Parts per Million (ppm).** The parts of chlorine present in a given volume of water (concentration). This value may also be expressed as Milligrams per Liter (Mg/L).

4-2. IMPORTANCE OF WATER IN THE PRACTICE OF SANITATION

a. **Safe water is essential.** Safe water ranks in importance with ammunition and food. Its availability often has a direct bearing on the success or failure of a mission.

(1) When in the field, soldiers must be supplied with sufficient water to drink and maintain personal hygiene and maximum health.

(2) The water must be safe to drink and should be reasonably free of objectionable tastes, odors, turbidity, and color. (NOTE: Water that is turbid is opaque with suspended foreign particles.)

b. **Water is a vehicle in disease transmission.** Waterborne disease organisms are a contributing source of disease to soldiers in a field environment.

(1) Common waterborne diseases of man are hepatitis, typhoid, bacillary and amoebic dysentery, cholera, leptospirosis, giardia and schistosomiasis.

(2) No direct method has been developed for detecting the minimum infectious quantities of disease organisms in water. Therefore, it is necessary to resort to an indicator test to determine the bacteriological acceptability of water.

c. **Water is tested for the presence of coliform bacteria.**

(1) Coliform bacteria are found in great numbers in the excreta (feces) of humans, warm-blooded animals, and in the soil. Because of this, water may be contaminated many times between the point where it is produced the point of consumption.

(2) Although the presence of coliform bacteria in water may not prove fecal contamination, it is an indication that pathogenic (disease-carrying) organisms may be present. This test is the best indicator that contamination exists.

(3) Many military units in the field do not have the capability for determining the presence of coliform bacteria in water; so all water must be thoroughly treated and disinfected before use.

4-3. WATER REQUIREMENTS

The quantity of water required for soldiers varies with the seasons of the year, the geographical area, and the tactical situation.

a. A general guide for planning to meet the water requirements in an arid zone is 3-6 gallons per individual per day unless improvised showering facilities are made available. In this case the requirement should be increased to 15-gallons or more.

b. Additional amounts of water are required for personal hygiene and cooking.

c. You may think that soldiers working in a cold climate do not need as much water for mission success as soldiers deployed to a hot desert climate. But the type of mission impacts upon this general rule. For example, soldiers marching through deep snow may need more water than desert troops in stationary positions.

NOTE: Water requirement information is available in FM 10-52.

4-4. PRODUCTION OF POTABLE WATER IN THE FIELD

a. **Army Medical Department responsibilities.** The Army Medical Department (AMEDD) does bacteriological examinations of water. Under certain circumstances they will also check the chlorine residual and pH levels. The AMEDD also establishes standards for water quality, inspects water points or sources, advises the proper

authorities about water purification methods and approves water for consumption.

b. **Corps of Engineers responsibilities.** The Corps of Engineers selects water sources and establishes water points. The selection of water points may be based on examination of data provided by the AMEDD as well as the reconnaissance performed by engineers.

c. **Quartermaster Corps responsibilities.** The Quartermaster Corps sets up and operates bulk water treatment equipment. They procure, treat, and distribute the treated water. Sometimes the Quartermaster Corps units transport water to centralized distribution points (dry points) for pick-up by military units.

d. **Unit Commander responsibilities.** Water supply and water treatment in the units are responsibilities of the unit commander. The commander makes certain that the unit has an adequate supply of safe drinking water; enforces the rules of water discipline; and ensures that each individual thoroughly understands the danger of drinking unsafe water. It is the responsibility of the FST to assist the commander in making sure soldiers are aware of the rules of water discipline and that they make every attempt to follow them.

4-5. RULES OF WATER DISCIPLINE

Water discipline does not imply teaching soldiers to do without water. It means using water intelligently and not wasting it. For optimum safe water usage in the field, follow these guidelines.

a. Drink approved water only.

b. Prevent water waste.

c. Protect water sources with good sanitary practices.

4-6. WATER SOURCES

It is important to note that, although the selection of the water source is the responsibility of the Corps of Engineers, you may be called upon (in their absence) to assist in selecting a suitable site. Therefore, you must be familiar with the six sources of water and the factors you need to consider when selecting a water source.

a. **Surface water.** Surface water includes streams, ponds, rivers, and lakes. Surface water is generally the most accessible, and is commonly selected for use in the field. It is usually more contaminated and polluted than other water sources.

b. **Ground water.** Ground water includes wells and springs. When a surface source is not readily available, the engineers may select ground water for use. Even though ground water is usually less contaminated than surface water and requires less

treatment, it is extremely difficult to determine the quantity available. It is also difficult, costly, and time-consuming to drive or drill wells. Because of these disadvantages, the use of ground water in the field is limited unless existing native wells are available.

c. **Rainwater, ice, and snow.** Rainwater is obtained by collecting it from the roofs of buildings or from other surfaces into containers. Water is obtained from ice or snow by collecting it then melting it over a heat source.

d. **Sea water.** Water obtained from oceans or saltwater lakes or seas cannot be used for human consumption until it has been distilled or de-mineralized to remove the salt.

NOTE: Rain, melted snow or ice, and sea water are only used in special instances when neither surface nor ground water is available. In addition, water taken from any of the above six sources must be considered contaminated and, therefore, must be treated before use.

e. **Factors to consider when selecting water source.** Several factors must be taken into account when selecting a source for your unit's water in the field.

(1) The unit's military situation.

(2) The quantity of water needed.

(3) The accessibility of the source.

(4) The general quality of the source.

(5) The type of purification equipment available for use.

4-7. WATER TREATMENT

The objective of water treatment is to produce potable water. Treatment processes used in the field are the same as those commonly used in civilian water treatment. In areas of the world where amoebic, bacterial, or viral dysentery or infectious hepatitis are problems, chlorination requirements as recommended by the surgeon will be established by a command directive. The methods of water treatment are:

a. Coagulation and sedimentation to remove turbidity.

b. Filtration to remove the remaining turbidity and a large portion of the pathogenic organisms.

c. Disinfection to kill the pathogenic organisms that were not removed by sedimentation and filtration using chlorine compounds, iodine, or boiling of water.

d. Chlorine treatment. A relatively small quantity of chlorine and contact time of at least 30 minutes is required for satisfactory water disinfection.

(1) Under ordinary field conditions the chlorine residual required is 2 ppm at the point of production and distribution (i.e. the ROWPU storage tanks, 5000-gallon water tankers) and at least 1 ppm at the point of consumption (i.e. the 400-gallon water trailers).

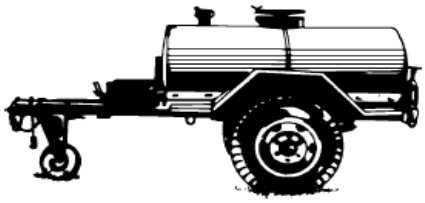
(2) The sudden disappearance of all chlorine probably indicates recontamination of the water.

e. Calcium hypochlorite treatment. Calcium hypochlorite is added to the water in the amount necessary to destroy the disease organisms present in the water (chlorine demand) with some remaining to serve as a continuing disinfectant (chlorine residual).

f. Reverse Osmosis Water Purification Units. Due to an increase in our use of Reverse Osmosis Water Purification Units (ROWPU) and reliance on bottled water, drinking water chlorination rules have been modified in recent years. If ROWPU are used to produce the drinking water, then the water must be maintained at 2 ppm at the point of production and distribution (i.e. the ROWPU storage tanks, 5000-gallon water tankers) and only 1 ppm at the point of consumption (i.e. the 400-gallon water trailers).

4-8. INSPECTING THE 400 GALLON WATER TRAILOR

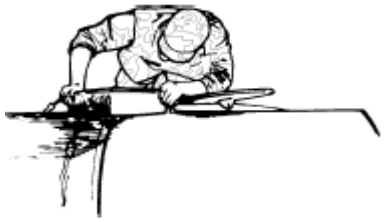
Water for use in the field is generally stored in a 400-gallon water trailer, or water buffalo. Prior to filling the 400-gallon water trailer with water, it should be inspected for cleanliness and serviceability.



NOTE: Refer to TB MED 577, page 7-3. Section IV. Preventive Medicine Inspection Criteria.

a. **Container appearance.** Perform a visual inspection of the water container prior to using it to store your unit's water. Generally speaking, the interior and exterior of the container should be clean and in a good state of repair.

(1) Interior surfaces of stainless steel and aluminum trailers.



(a) Interior seams should be free of rust. If rust is present, scrub the interior seams with a non-metallic brush and a non-abrasive, non-chlorinated cleanser. Rinse the interior thoroughly after cleaning.

(b) Interiors should not be painted or coated with any material.

(c) Cracks and dents that expose the polyurethane foam insulation are not permitted for use and must be repaired.

b. **Exterior.** POTABLE WATER ONLY must be stenciled on the exterior of the trailer in plain view.

(1) Manhole cover.

(a) Manhole covers should seal effectively to prevent contamination.

(b) Rubber gaskets should be intact, without cracks and missing pieces. Ensure gaskets are free of excessive dry rot, and fit cover properly.

(c) Locking mechanism should be fully functional.

(d) Manhole cover should be free of rust on both the interior and exterior.

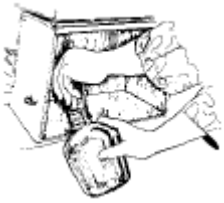
(e) Insulation on the inside cover should not be damaged.

(f) Pressure relief valve should operate effectively.

NOTE: Test the pressure relief valve by blowing into the bottom. If air escapes through the top, then the valve is working correctly.

(2) Dispensing spigots.

(a) The T-handle that dispenses water to the spigots should open and close freely.



(b) Water should flow from the spigots when the T-handle is turned to the 'open' position.

(c) The protective box covering the spigots should be intact.

(d) Locking devices for the spigots should be operational.

(3) Drains.

(a) The drain plug should be easy to remove.

(b) Threads in the plug and drain hole should not be stripped or damaged.

(c) The drain plug should be installed hand tight only.

NOTE: Interior surface cracks around the drain hole indicate that excessive pressure was used remove or install the plug. Remove thread corrosion at least semiannually.

c. **Site conditions.** The chlorine residual must be rechecked when the trailer arrives at the unit's site. This verifies that the driver went to an approved water point, and it verifies that the water point is maintaining the correct chorine residual in the water.

(1) If the residual meets the required standard, the water is safe to drink.

(2) If the residual does not meet the required standard, re-chlorinate the water to the required level.

NOTE: Heat and sunlight will cause chlorine to evaporate and dissipate more rapidly. Therefore, check the chlorine residual periodically and re-chlorinate as necessary.

4-9. CHLORINE RESIDUAL MONITORING

a. Components of the chlorination test kit.

(1) 6 oz. Calcium Hypochlorite bottle.

(2) Half-gram spoon.

(3) HACH® Aquacheck Test Strips for Total and Free Chlorine.

b. Procedure for monitoring the chlorine residual in water.

(1) Wash your hands.

(2) Flush the taps of 400-gallon water trailer for several seconds.

(3) Hold the test strip under water stream for 10 seconds.

(4) Compare the free chlorine pads to the color chart on the bottle. Estimate results if the color of the test pad falls between two color blocks.

4-10. RE-CHLORINATION PROCEDURES

a. **Procedure for re-chlorinating a full water 400-gallon trailer.**

(1) Mix 5 half-gram spoonfuls of calcium hypochlorite from the 6-ounce bottle (For 5 ppm, use 22 half-gram spoonfuls) with one-half canteen cup of water.

(2) Thoroughly mix the slurry and then add it to the water in the trailer.

(3) Mix the solution with a clean stick or other clean device and flush the four taps.

(4) Wait 10 minutes, flush the taps again, and check the chlorine residual.

(a) If the residual is 1 ppm or greater, wait an additional 20 minutes before releasing the water for consumption.

(b) If the residual is not 1 ppm, check the inside of the water buffalo for possible contamination (i.e. large amounts of dirt, leaves, rust or other debris.) If there is no sign of gross contamination, then add additional chlorine, but not a full MRE spoonful. Wait 10 minutes before testing the chlorine residual. Repeat this process until the chlorine residual reaches 1 ppm.

b. **Procedure for re-chlorinating a 5-gallon water can.** 5-gallon containers filled from the 400-gallon water trailer must also maintain a chlorine residual of 1 ppm. This procedure is for a full 5 gallons of water. Using this procedure to re-chlorinate less than 5 gallons of water may result in over chlorination.

(1) Add 1 half-gram spoonful to a ½ canteen cup of water and stir the slurry solution.

(2) Add approximately ½ of the solution to one 5-gallon can of water.

(3) Shake the container and wait 10 minutes. Loosen the can cap, invert the can to let some treated water flow over the threads of the can.

(4) Wait an additional 20 minutes, for a total of 30 minutes of contact time prior to water consumption.

c. **Procedure for re-chlorinating a 1-quart canteen.** In emergency cases, where no treated water is available, canteens of water can be disinfected using iodine tablets, calcium hypochlorite or Chlor-Floc (c).

(1) Re-chlorination procedure using iodine tablets. Two iodine tablets must be used to disinfect a 1-quart canteen of water.

NOTE: Always inspect the iodine tablets prior to use. The tablets should be a uniform gray in color with a smooth even surface. Tablets that are yellowish brown or crumbling should be turned in and replaced with new tablets.

(a) Drop the tablets into the canteen filled with water and wait 5 minutes for tablets to dissolve.

(b) Cover the canteen and shake it.

(c) Wait 5 minutes, loosen the canteen cap and invert the canteen to allow the treated water to flow across the threads of the canteen neck. This will kill any organisms growing there.

(d) Wait an additional 25 minutes for a minimum contact time of 30 minutes to ensure all harmful organisms are killed prior to consumption of the water.

(2) Re-chlorination process using Calcium Hypochlorite.

(a) Dissolve the contents of 1 half-gram spoon in ½ canteen cup of water to make a slurry solution.

(b) Fill an NBC compatible canteen cap or ½ non-NBC compatible canteen cap with the slurry solution. Pour the cap contents into the canteen, cover the canteen and shake it.

(c) Loosen the canteen cap and invert the canteen to allow the treated water to flow across the threads of the canteen neck. This will kill any organisms growing there.

(d) Wait a minimum of 30 minutes to ensure all harmful organisms are killed prior to consuming the water.

NOTE: Sometimes, adding small amounts of chlorine to water can cause the water to taste and smell bad. If this happens, adding a little more chlorine to the water will usually correct this problem.

(3) Re-chlorination process using Chlor-Floc. Re-chlorinating with Chlor-Floc is another method of treating water in a canteen. Follow the directions listed on the Chlor-Floc package.

NOTE: This product requires a settling time. The treated water must also be strained before it can be consumed.

(4) Disinfection process by boiling. In emergency situations without a means of re-chlorination, water can be boiled to destroy harmful disease organisms.

NOTE: There is no chemical residual in boiled water, so the water can be easily re-contaminated if not protected.

(a) Boil water at a rolling boil for 5-10 minutes to kill pathogenic organisms.

NOTE: In tactical situations where an open flame for minutes might mean attack or capture, boiling for as little as 15 seconds will kill most harmful organisms.

(b) After boiling, the water must be stored in a clean, closed container to prevent recontamination.

4-11. BOTTLED WATER OPERATIONS

a. Bottled water is often used in current operations. Bottled water is not chlorinated as is field water, and so can present a special challenge to ensure it is a safe product to the soldiers.

b. Bottled water must only come from approved sources through the normal supply chain. Preventive Medicine and the Veterinary Corps are the authorizing agents for bottled water.

c. Bottled water that is acquired from an approved source can still become contaminated in the field if not properly stored and protected.

d. Bottled water should be stored in a dry, cool environment out of direct sunlight. Sunlight can trigger biologic growth in the water, and exterior contaminants can seep into water bottles that become submerged due to flooding.

e. Bottled water that is opened for personal consumption must still be protected against secondary contamination from humans or the environment.