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SEWER LINE ROOT CONTROL

With Emphasis on Foaming Methods using Metam Sodium and Dichlobenil

Edited by Sherman K. Takatori

Preface

Sewer line root control is a matter of using the right technologies and management practices. To be successful, the technology must be effective and must not adversely affect people or the environment. Effective sewer system management practices will enhance existing technologies for effective root control and reduce environmental harm.

The purpose of this training manual is to provide a sound foundation for studying the technical aspects of sewer line root control with emphasis on the safe use and application of chemical products. Specifically, the manual will study the recommended practices for metam-sodium root control pesticides.

On March 1, 1996, the U.S. Environmental Protection Agency (EPA) reclassified metam-sodium for sewer root control as a restricted-use pesticide. The EPA, which is responsible for registration of pesticide products, made this decision because of concerns that metam-sodium products could adversely affect the health of humans, domestic animals and the environment. Because metam-sodium is a Restricted Use Pesticide (RUP), only certified pesticide applicators or persons under their direct supervision may purchase and apply this product. Idaho requires that any pesticide, applied professionally (commercially) or through the use of power equipment, requires a pesticide license. People desiring certification status must apply to the Idaho State Department of Agriculture (ISDA).

In order to obtain a license to treat roots in sewer lines or apply any aquatic pesticide, individuals must first pass the Law & Safety examination and the Aquatic Pest examination. This manual is the study material for the latter examination. A separate study manual for the Law & Safety examination is available through the Idaho State Department of Agriculture (ISDA) and is recommended for all pesticide applicators. Contact the ISDA's Pesticide Applicator Licensing and Training Section at (208) 332-8600 and request the manual, *Idaho Pesticide Laws and Safety*. (Miscellaneous Series No. 148).

This manual is a valuable source of information for people preparing for certification and as a reference manual for the certified applicator. Each chapter covers material considered essential to the proper understanding and implementation of root control involving chemicals such as metam-sodium. Also included is basic information and guidelines to assist the applicator in solving practical problems involving root control.

ISDA adopted this manual from a federal manual with revisions from Washington State. Please communicate any suggestions for revision to:

Idaho State Department of Agriculture
Division of Agricultural Resources
Applicator Licensing and Training Section
2270 Old Penitentiary Road
Boise, Idaho 83701

Send all comments/suggestions to the attention of *Manual Revision*.

Trade names have been used to simplify information. No endorsement of any product is intended or implied.

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* - Kevin Duke is associated with Duke's Sales & Services, Inc. of Syracuse, New York. Eric Jessen is associated with Coness Co. of Paonia, Colorado.

TABLE OF CONTENTS

CHAPTER 1 - PESTS, PESTICIDES AND REGULATIONS

Learning Objectives

- Define the words listed in *italics*.
- Describe what a pest is and name the different types of pests.
- Describe what a pesticide is and why a chemical or product may be called a pesticide.
- Know the agencies that register pesticides for Idaho.

Pest Management

This chapter is intended to provide the applicator with a general background in the safe use of pesticides. This manual focuses on the use of root control products that contain metam-sodium as an active ingredient. However, all pesticide applicators and collection system applicators must know basic pesticide information and how to handle pesticides safely. For example, a product that is a degreaser may, in its marketing material, claim to kill or control roots. Because of that claim, the product is classified as a *pesticide* and is subject to the regulations governing pesticides. All pesticides offered for sale or use in the United States and its territories must be registered with the U.S. Environmental Protection Agency (EPA) and additionally registered for use in Idaho.

Pests

A *pest* is anything that:

- Competes with humans, domestic animals, or desirable plants for food, feed or water
- Injures humans, animals, desirable plants, structures or possessions
- Spreads disease to humans, domestic animals, wildlife or desirable plants
- Annoys humans or domestic animals

Types of pests include:

- Insects
- Insect-like organisms, such as ticks, spiders and scorpions
- Aquatic invertebrates (mollusks) such as snails, slugs, oysters, clams and shipworms
- Aquatic vertebrates (fish)
- *Weeds*, which are any plants growing where they are not wanted, such as mosses, algae, dandelions and any plant part such as root intrusions into wastewater collection systems
- Plant disease pathogens, such as fungi, bacteria and viruses
- Vertebrate pests, such as rats, mice, other rodents, birds and reptiles

Chemical Controls

Chemical controls involve the use of naturally derived or synthetic chemicals called *PESTICIDES* that kill, attract, repel or otherwise control the growth of pest plants, animals and microorganisms. Pesticides include a wide assortment of chemicals with specialized names and functions:

- *AVICIDES* - to control pest birds
- *BACTERICIDES* - to control bacteria
- *FUNGICIDES* - to control fungi
- *HERBICIDES* - to kill weeds and other undesirable plants
- *INSECTICIDES* - to destroy insects and related arthropods
- *MITICIDES (ACARICIDES)* - to kill mites
- *MOLLUSCICIDES* - to kill snails and slugs
- *NEMATICIDES* - to kill nematodes
- *PREDACIDES* - to control vertebrate pests
- *PISCICIDES* - to control pest fish
- *RODENTICIDES* - to destroy rodents

Although not considered pesticides by definition, the following three classes of chemicals are regulated and classified as pesticides under both federal and state pesticide law:

- *DEFOLIANTS* - chemicals that cause leaves or foliage to drop from a plant
- *DESICCANTS* - chemicals that promote drying or loss of moisture in plant tissues
- *GROWTH REGULATORS* - substances (other than fertilizers or food) that alter the growth or development of a plant or animal

In addition, Idaho expands the federal definition of pesticides to include adjuvants. This results in adjuvants being regulated as pesticides in Idaho State.

- *ADJUVANTS* - substances added to pesticide formulations and tank mixtures to increase safety or effectiveness

Pesticide Law

Several federal agencies administer pesticide laws. Individual states must adopt the federal laws and may create their own as well. Therefore, all laws mentioned in this manual are requirements in Idaho, regardless of their origin.

In explaining regulations and rules, we only paraphrase the actual wording found in the laws and rules. Also, this manual is revised once every 5 years, and the laws may be changed (or new laws enacted) in that time. Consult the current laws and rules to determine what you must do to comply with them.

Keep in mind that we do not mention all regulations affecting pesticide use in this chapter. Other chapters include additional legal requirements that are specific to those discussions (e.g. disposal, employee right-to-know, and spills).

FIFRA

Both the United States Congress and the Idaho Legislature have enacted legislation that regulates the production, transportation, sale, use and disposal of all pesticides. The most prominent pesticide law is the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA), which is overseen by the *United States Environmental Protection Agency* (US EPA).

Idaho Pesticide Regulations

The Idaho Pesticide Act of 1976, as amended, is the major state regulatory law and is administered by the Idaho Department of Agriculture (ISDA). Rules and regulations relating to pesticide use and chemigation for Idaho originate from this act.

For a more detailed discussion of pesticides and the regulations governing them, refer to *Idaho Pesticide Applicator Training* manual. This is the study manual for the required Laws & Safety exam.

Practice Test - Chapter 1

Read and complete the questions below. Correct questions are found on page 47.

Q. When may tree roots be considered a pest?

Q. Name several different types of pests.

Q. What is a pesticide?

Q. What is the most significant regulation governing the use of pesticides?

Q. What are the major state regulatory laws in Idaho and who administers them?

CHAPTER 2 - ROOTS IN SEWERS

Learning Objectives:

After you complete your study of this unit you should be able to:

- Define the words listed in *italics.*
- Determine the two different types of root systems which are associated with sewer problems.
- Be familiar with factors around sewer pipes that influence root growth.
- Identify the two types of root structures in sewer lines.
- Describe at least three non-chemical methods of root control.
- Name at least four different chemical control methods other than metam-sodium
- Explain the differences between contact and systemic herbicides and between selective and non-selective herbicides.
- Describe three methods used to identify which sewer lines have root problems.

Root Related Sewer Problems

The intrusion of roots into sewers is probably the most destructive problem encountered in a wastewater collection system.

Root related sewer problems include:

- Sewer stoppages and overflows
- Structural damage caused by growing roots
- Formation of septic pools behind root masses which generate hydrogen sulfide, other gases and odors
- Reduction in hydraulic capacity, and loss of self-scouring velocities
- Infiltration where the pipe is seasonally under the water table

Sewer stoppages and overflows are the way that most municipalities and homeowners find out about their root problems. Structural damage, on the other hand, usually goes unnoticed until the damage is determined through television probing or secondary signs (sewer stoppages, overflows, leaking, etc.). In the long run, structural damage is probably more costly than sewer stoppages.

Sewers are underground, so root problems are not noticed until backups or overflows occur. Effective use of early, preventive root control can avoid costly and permanent structural damage. However, many municipalities are unlikely to find a preventive root control program until a known problem alerts officials to the need for control.

Root Growth

Roots have three basic functions:

- They anchor the plant and hold it upright

- They store food for the plant
- They absorb and conduct water and nutrients

Roots are tenacious and long-lived. The top of a plant is more dependent on the root system for survival than vice versa. A plant can regenerate after it has been topped but cannot survive the loss of its root system. A willow tree root system can survive for many years after the top has been removed and will continually try sending up new shoots through the stump or exposed roots. The root systems of some grasses of the American Great Plains are thought to have remained alive for thousands of years. Just how far roots will grow in search of moisture and nutrients is uncertain. In the Rocky Mountains in Colorado, live tree roots have been found penetrating a pipe in the Moffet tunnel, 2500 feet from the nearest tree.

Types of Root Systems

Root Systems. Plants may have either a *fibrous root system* or *taproot system*. Plants with fibrous root systems, such as garden plants and grasses, occupy the upper layers of soil and their roots extend outward. They are not normally associated with sewer problems.

Taproot systems. Examples of plants with taproot systems are the trees and woody plants. The primary root of the plant grows directly downward into the soil. Taproot systems are well adapted to deep soils and soils where the water table is relatively low. Branches, or secondary roots, grow laterally from the primary root. Secondary root structures can grow several inches in diameter, and if they invade sewer pipes can exert enough pressure to spread pipe joints and break pipe.

Feeder roots are fine, hairlike roots that may develop into secondary roots. The surfaces of feeder roots contain microscopic structures called root hairs. Root hairs greatly increase the total surface area available to absorb nutrients and water.

The leading tip of a root shoot, the meristem, senses minute differences in nutrient and moisture levels and grows toward them. The ability to detect these differences enables the root to locate a sewer pipe. Temperature variances between wastewater flow within a pipe and surrounding soil may cause condensation to form on the pipe. Also, loose pipe joints, cracks, and pipe porosity allow high nutrient content water to seep from the pipe into the surrounding soil. This type of environment attracts and encourages root growth.

Factors Affecting Root Growth

A number of different soil conditions around sewer lines influence root growth. Backfill used during sewer construction may provide more favorable soil than the existing, undisturbed soil. Water table levels will fluctuate with seasonal changes. During drier seasons, the water table drops, and tree roots will grow deeper in search of moisture. The tendency of roots to grow towards moisture is called *hydrotrophism*. Sewer lines above the water table will draw roots in that direction. During colder seasons, especially where ground frost occurs, the warmer soil temperatures surrounding the sewer pipe may also cause the roots to grow in that direction. Moisture and warm temperatures surrounding a sewer pipe create an excellent environment for root growth. If the moisture level drops below a certain point, roots will begin to wilt.

Microscopic openings permit hair-like structures to penetrate pipe joints, cracks, connections, or other openings. Heavy secondary root structures may follow a sewer pipe for many feet, exploiting each opportunity to penetrate pipe joints.

Roots thrive in sewer pipes, a perfect hydroponic environment. Roots are suspended in a well ventilated, oxygen rich environment with a plentiful supply of water and nutrients.

Generally, root growth is greatest in fall, winter, and spring before leafing. At this time roots are either storing or distributing nutrients. Root growth is less active in the late spring and summer when the above ground portion of the tree is growing. Little is known about the growth rate of tree roots.

Roots of most trees cannot grow or survive if constantly submerged in water. Therefore, roots generally do not cause problems in sewers that are located below a permanent water table. With adequate water, available roots need not expend energy trying to penetrate the water table and sewer pipes. However, if the water table fluctuates, or if porous soil profiles permit rapid downward movement of rainwater, roots can be found in saturated soil and can be a major cause of sewer infiltration. In this case, tree roots suspended in the atmosphere of the sewer can carry on metabolic activity while the woody, submerged portion of the root system serves as a pipeline for plant nutrients.

Roots must always grow because parts of the root system are constantly dying. If a root system stopped growing, the plant would die. When the nutrients or moisture in an area of soil is depleted, feeder roots die. Secondary roots elongate or stop growing, depending on the availability of additional nutrients. In time, bacteria in the soil break down the dead root tissue, helping to replenish the depleted nutrients.

Roots in the Sewer Environment

In urban environments, finding good sources of nutrients for tree roots may be difficult. Expanses of concrete and asphalt, removal of leaves and other organic debris from lawns and storm sewers and draining away surface water all cause roots to seek nutrition at greater depths. Some roots may follow building sewers well beyond the tree's drip line to the main line sewer.

Types of Sewer Roots

Two types of root structures found in sewer lines are known as *veil* and *tail*. The *veil root structure* occurs in lines with steady flows, such as interceptor pipe and other lines with constant flow. The roots will penetrate pipes at the top or sides and hang from the upper surface, like a curtain, touching the flow. Live roots are seldom found below the water line. The roots will rake the flow accumulating solids and debris. Grease and other organic materials will also accumulate. Eventually the root mass and accumulated material will cause a stoppage of flow and gases may develop.

The *tail root structure* occurs in sewers that have very low or intermittent flow, such as in small diameter collector sewers, building sewers, and storm drains. The tail root structure looks like a horse's tail. The roots will grow into the pipe from the top, bottom, or sides, and continue to grow downstream filling the pipe. Tail root structures over 20 feet long have been removed from sewers. Such root structures may appear as solid tubes of tree root, possibly with a slightly flattened area along the bottom where submergence in sewer flows prevent root growth.

Roots that enter the sewers or are visible during a television inspection represent only a small percentage of total root structures in the vicinity of the sewer. Roots girdling the pipe on the outside are responsible for pipe damage as they swell inside joints and cracks.

Non-Chemical Methods of Root Control

Non-chemical methods of sewer line root control are available to the root control expert and the public works officials. Although non-chemical methods generally do not provide the same level of results as chemical methods, they have an important place in sewer maintenance. For example, mechanical methods are best for opening plugged sewers and for removing roots from sewers that are at imminent risk of plugging. In some cases, chemical control methods should not be used, especially when near treatment plants or due to other environmental or safety considerations. Pipe re-lining, grouting and sealing may also deter intrusion by roots. Municipal planners may discourage future root problems by discriminate selection and planting of trees in the proximity of proposed sewer lines. A successful line root control program will integrate cultural, physical, mechanical, and chemical root control methods.

Cultural Control

Cultural control of roots in sewers includes routine management practices that can prevent tree roots from invading sewer lines. Cultural control must be implemented before roots have a chance to become a problem. Two major cultural methods are:

1. Careful installation and inspection of sewer lines during construction
2. Control of the selection of tree species and planting sites.

Sewer connections with airtight joints and seams will make it difficult for roots to penetrate. Municipalities should carefully inspect connections where plumbers join building laterals to the main-line sewer. Also, homeowners should be advised of the potential for future root problems and should be discouraged from planting deep-rooted or fast-growing trees near sewer lines. Willow trees are particularly problematic because their aggressive root systems tend to seek out moist areas in general and sewer lines in particular. Unfortunately, when a sewer root problem is detected, it is too late for cultural control.

Physical Control

Physical pest control relies on devices or procedures that physically separate the pest from the target areas. A mosquito net is an example of a type of physical pest control. Physical control of sewer line roots involves isolating the environment of the sewer pipe from the roots around or near the sewer pipe. Three examples of physical control are:

1. Tree removal
2. Pipe replacement
3. Pipe re-lining

Tree Removal. This method works best when removing a single troublesome tree such as a willow whose roots have invaded pipes. It is sometimes difficult to convince homeowners that the municipality's public works department should remove their trees in the vicinity of sewer lines to prevent future problems. This procedure is not only expensive but does not guarantee removal of the root problems. Roots may survive long after the death of the above ground part of the tree, necessitating the use of mechanical or chemical controls for some time afterward. For tree removal to be most effective, the stump should be pulled or chemically treated with a basal application herbicide. This ensures that no future root growth from the stump will be produced that may affect the sewer lines.

Pipe replacement involves removing old, defective sewers and replacing them with new sewers. As discussed above, the new sewers must have airtight joints and properly installed connections to prevent the roots from becoming a problem. Pipe replacement corrects structural defects as well as root problems. There are four major disadvantages to pipe replacement:

1. Cost
2. Disruption of traffic and property
3. Does not guarantee roots will not present a future problem
4. Destruction of trees planted in the vicinity of the trench line

If the pipe is in danger of collapsing, or is in a state of structural failure, pipe replacement may be the best method of control. Pipe replacement is not needed when the pipe is in sound structural condition.

Pipe lining includes various technologies for rehabilitating sewer pipe. Roots must be chemically or mechanically removed prior to installation. *Slip-lining* involves pulling a seamless pipe through the existing sewer and digging only where building laterals require connecting. *Cured-In-Place lining* involves inflating and curing a sock or plastic tube that conforms to the shape of the pipe. Robotic devices are then used to cut building connections into the liner.

Advantages of pipe lining are:

- Addresses infiltration problems and some structural defects
- Less disruptive than pipe replacement
- Promises long-term control against root regrowth through joints

Disadvantages of pipe lining are:

- Often more costly than replacement
- Does not guarantee roots will not present a future problem (roots can still reenter the main-line sewer through building laterals).

Even after relining the main-line sewer, chemical control may be required to prevent roots from penetrating the main-line sewer through service connections.

Mechanical Control

Mechanical control is the most common method of root control and the most important non-chemical method for applicators to understand. Mechanical control involves the use of tools or other devices that cut and remove roots from sewers.

Drill machines, also called coil rodders, are either hand or power-driven, spring-like, flexible steel cables which turn augers or blades within the sewer They are most often used by plumbers to relieve blockages in household lines or other small diameter sewers. They are seldom used in main-line sewers.

Rodding machines are flexible steel rods with attached rotating blade cutters, augers, or corkscrews. Rodding machines are most effective in small diameter sewers up to 12 inches in diameter.

Jetters are also known as flushers, flush trucks, jet rodders, jet trucks, and hydraulic sewer cleaners. Jetters consist of a high-pressure water pump, water tank, hose reel, and 1/2" to 1" sewer cleaning hose. Orifices in the rear of the nozzle propel the hose through the sewer. The nozzle is designed to use water pressure to blast through obstructions within sewer lines. As the hose and nozzle is retrieved, debris is hydraulically flushed back to the insertion manhole for removal. Jetters can also be equipped with root cutters that use the force of water to spin blades. Unfortunately, root cutters can easily get stuck in the sewer, especially where there are protruding taps or other structural defects. Bound cutters can only be removed by digging them out.

Winches, also called drag machines or bucket machines, are large, engine-driven winches that pull buckets, brushes, or porcupine-like scrapers through the sewer. Special tools are designed to cut roots. Winches are most often used on large diameter sewers that cannot be cleaned efficiently with jetters. Winches are used in heavy cleaning to remove large volumes of solids.

The main advantage of mechanical control is that it is the only method of relieving a root blockage. Chemicals are ineffective and dangerous when used in plugged or surcharging sewers. Sewer stoppage is an emergency situation, and the municipality should have some type of mechanical control device for correcting such problems.

The main disadvantage of mechanical control is that it provides no residual control or long-term effectiveness. Roots respond to injury by producing a hormone, abscisic acid, which hastens and thickens regrowth tissue. Because of this natural reaction to mechanical control, root masses grow back heavier each time they are cut. Taproots continue to grow m diameter and, in time, place additional stress on sewer pipes. Good results are obtained if the roots are cut flush with the joints; however, offset joints and cut-in laterals can prevent the use of full-gauge cleaning tools.

Mechanical control is often used in conjunction with chemical control. One example of this is when sewer lines are being prepared for rehabilitation with pipe-lining and grouting.

Chemical Root Control

Pesticides are the fastest way to control pests. The pesticides that control root growth in sewer lines are herbicides. Choosing the best chemical for the job is important. A *contact herbicide* will affect those areas of the plant that the herbicide is applied. *Systemic herbicides* are absorbed by roots or foliage and carried throughout the plant through the plant vascular system. Because contact herbicides act on plants by severely disrupting cellular function, they normally result in a quicker kill and die-back of the affected plant parts. Systemic herbicides take longer, sometimes two weeks or more, to provide the desired results. Metam-sodium is a contact herbicide.

Herbicide activity is either *selective* or *non-selective*. *Selective herbicides* affect certain types of plants and have minimal effect on others at specific rates of application. They are used to reduce unwanted weeds without harming desirable plants. *Non-selective* herbicides kill all plants present if applied at an adequate rate. They are used where no plant growth is wanted. Metam-sodium is a non-selective herbicide.

Many chemicals have been tried for root control. The more common ones used today are discussed below.

Common Chemicals

***Trifluralin*. Brand Names: Treflan, BioBarrier.**

Fabric or rubber impregnated with trifluralin pellets is a relatively new concept in sewer line root control. Trifluralin impregnated fabric is placed between the sewer pipe and trees at the time of sewer installation. The porous fabric allows water to pass through. Trifluralin pellets are time-released and formulated so that the active ingredient leaches only a few inches before being trapped by soil particles. Impregnated rubber is used for joint gaskets. Three advantages of this method are:

1. Root control is long-lasting without a need for re-treatments
2. Pesticides are not directly introduced into the sewer collection system
3. Environmental risk is minimized

The main disadvantage of this method is that it cannot be employed economically after a problem occurs. In addition, it is an unnecessary economic expense if the pipeline is adequately installed in the first place. Modern pipeline installation in addition to the prudent use of preventive root control herbicides can adequately deter root penetration.

Copper Products. Synonyms: Copper Sulfate, Bluestone. Numerous brand names

Although plants require small amounts of copper for normal growth, excessive amounts of copper will cause leaf damage and could result in the death of the tree. Copper is a heavy metal that may not be removed by the normal sewage treatment process. It can be toxic to the treatment plant's microbes and exits the treatment plant as a pollutant in both the effluent and the biomass (sludge), thus becoming a potential environmental contaminate.

Copper Sulfate has been used for many years for root control in sewers and as an algaecide. Some studies have shown that high concentrations of copper sulfate cause systemic injury without completely killing the roots. Nevertheless, copper sulfate products are still in widespread use by many plumbers and homeowners as a "pour down" application for controlling roots in building sewers. Copper sulfate is believed to be a relatively safe material to handle, posing little health risk to the applicator.

The use of copper products may not be permitted in some states. Check with local authorities before using.

Metam-Sodium and Dichlobenil

Metam-sodium and Dichlobenil have been used together as a root control product in sewers for approximately 25 years. Metam-sodium is a fumigant. It breaks down into a gas, *methylisothiocyanate (MITC)*, which kills the plant roots. It is a contact, non-systemic pesticide. Metam-sodium is used in combination with Dichlobenil, an effective plant growth inhibitor.

These two pesticides were originally applied together by a spray or soak method. *Soaking* consists of plugging the pipe, filling it with the chemical for a period of time. This soaking action allows the chemicals to penetrate any blockages as well as soaking out cracks and joints to kill further up the root system. *Spraying* involved spraying the interior of the pipe with the chemical solution. Because of the large doses of chemicals used and their apparent threat to treatment facilities, the soak and spray methods are no longer recommended.

Current methodology uses metam-sodium products as dry foam (similar to shaving cream).

Specialized foam generating equipment is used to produce the foam that is then applied to the interior of the pipe. Application is made through a hose which is inserted the length of the pipe to be treated. While the hose is being retracted, the foam is pumped through the hose and fills the pipe as the hose is retracted. As the foam collapses (over a period of 1 hour or more) it tends to adhere to the pipe and root surfaces.

Any product that does not adhere to the roots and pipe walls enters the wastewater in the pipe and is carried to the treatment facility. The dilution of the product in the wastewater and the rapid breakdown of the metam-sodium provide a safety margin for the treatment plant.

Once the roots have been killed (within hours of application), bacteria and other microbes in the sewer begin to breakdown the dead tissue. Total decomposition of the roots may take several months to a year or more, depending upon the size of the root mass. The decomposed organic matter enters the wastewater stream and is carried to the treatment plant for disposal. Root regrowth will start again over time, which may necessitate re-treatment at 3-to-5-year intervals.

Identifying Which Lines Have Root Problems

Pest identification is essential in pest control and is usually the first and most important step in determining and planning a pest control strategy. For chemical root control in sewer lines, pest identification is not a factor. All trees are capable of producing nuisance roots. All roots in sewers are pests: there are no beneficial species.

For root control in sewer lines it is more important for the pesticide applicator to determine which sewer lines are obstructed by root growth. Several indicators are available for determining which collection lines have root penetration:

- Maintenance history. Maintenance records will indicate sewer lines that have experienced a stoppage and the cause of the stoppage.
- Sewer line television reports. These provide accurate evidence of a root problem.
- Commonalties in root prone areas. Generally, sewer lines in the same area that were installed at the same time with similar tree-planting patterns near sewers will generally experience similar root problems.

Conditions that increase the likelihood of root problems in a particular sewer section are:

- Sewers located near other sewers with known root problems.
- Sewer pipes located near the surface and closer to tree roots.
- Sewer lines located off-road in wooded easements, or at a curb line, near trees and roots.
- Sewer-lines with many lateral connections per lineal foot, affording greater opportunity for root intrusion.
- Sewer-lines located in tree-lined streets and easements.
- Residential areas are more susceptible than industrial areas.
- Sewer pipes constructed with loose-fitting joints or out-dated joint packing material. (Asbestos cement pipe, orangeburg pipe, and clay tile sewers with oakum joints are very susceptible to root penetration whereas pipe with airtight rubber gaskets and seamless pipe are less susceptible).

A useful tool for planning root control programs is the *scattergram*. This is a map of the sewer collection system with known root problem lines highlighted. As a root-related stoppage occurs, or if other evidence of a root problem is detected, the line is highlighted on the map. Over time, patterns will emerge for areas that are root prone.

Practice Test - Chapter 2

Read and complete the questions below. Correct questions are found on pages 47-48.

Q. Name the two types of root systems associated with sewer problems.

Q. Name at least three factors around sewer pipes that influence root growth.

Q. Describe the two types of root structures found in sewer lines.

Q. Name three different non-chemical root control methods.

Q. Explain differences between contact and systemic herbicides and between selective and non-selective herbicides.

Q. Name three methods used to identify which lines have root problems.

CHAPTER 3 - METAM-SODIUM

Learning Objectives

After you complete your study of this unit you should be able to:

- Define the words in *italics*.
- Explain what a pesticide formulation is and common formulations used in root control.
- Describe the formulations used with metam-sodium root control products.
- Describe what happens to metam-sodium in the presence of water.
- Explain why dichlobenil is used in combination with metam-sodium.

Formulations

Pesticide products contain active and inert ingredients. *The active ingredients* are the chemicals that control the target pest. Carriers, solvents and additives are *inert ingredients* (inerts), and may include wetting and/or foaming agents, spreaders, stickers, extenders, or diluents. These inert ingredients are added to the pesticide formulation to make the product safer, easier to apply, more convenient to use, and more accurate to measure. This mixture of active and inert ingredients is called a pesticide formulation. Some formulations are ready for use. Others must be diluted with water, a petroleum solvent, or air, before they are applied.

Types of Formulations

A single active ingredient is often sold in several different kinds of formulations. In other pest control programs, applicators must consider factors such as pests, application equipment, hazards, safety and the environment in deciding which formulation to use. In the wastewater industry, these are simplified since the target pest, tree roots, is confined to the interior of a pipe or structure.

Liquid Formulations

Foams. Except for sewer line root control, use of foam has been limited in the pesticide industry. For sewer-line root control, foams are an important method for delivering pesticides to the site of the pest (root intrusion). At present, metam-sodium products for sewer usage may only be applied as foam. Foam quality may vary and is difficult to define. For instance, foam may have the consistency of an aerosol shaving cream (dense, small dry bubbles) or those of dish washing soap suds (fluffy, large watery bubbles). For sewer use, the desired foam is similar to aerosol shaving cream. The dryer phase of this foam is used to treat smaller pipes (1ess than 12" - 14" diameter) and a wetter foam is used to treat larger pipe (14"+ diameter).

Specially designed foam generating equipment is required to produce and deliver the foam to the interior of the pipe. The industry standard (dry foam) is to generate 20 gallons of foam from l gallon of chemical-water solution, and for the wetter foam, to generate 14 gallons of foam from 1 gallon of chemical-water solution.

Foam is used to deliver root control chemicals because:

- Fills the pipe void above the flow line, contacting the pipe walls and root masses.
- Does not break down immediately after application, maintaining the required contact time for metam-sodium.
- Prevents metam-sodium vapor from drifting through the pipe into manholes and house vents.

- Contains surfactants and emulsifiers that assist the herbicides in penetrating through the grease and organic deposits on the root masses increasing the effectiveness of metam-sodium.
- Allows treatment while pipes remain in service.

Dry Formulations

Wettable Powders (WP). Wettable powders are dry, finely ground formulations which look like dusts. They must be mixed with water for application. Dichlobenil, as used in sewer line root control, falls into this classification.

Metam-Sodium

Metam-sodium is a fumigant pesticide with end use products formulated as 18% to 42% aqueous solutions. Metam-sodium, registered as a fumigant in 1954, continues to be used extensively as a preplant fumigant for production agriculture. It is primarily used to control weeds, nematodes, fungi, bacteria and insects in soils. There are approximately 35 registered metam-sodium products. Additional uses include wood preservation, tree root control and aquatic weed control. Metam-sodium has been used commercially in combination with dichlobenil for sewer root control since the early 1970's.

Reactivity

Metam-sodium is stable under normal conditions and very stable at a pH higher than 8.8. The commercial metam-sodium formulation is stable at a buffered pH of about 10. Metam-sodium is unstable at a pH below 7 at which point it hydrolyzes (breaks-down into other products). Prolonged exposure to air results in a gradual decomposition to form MITC, which is a poisonous gas responsible for its pesticidal action. When metam-sodium is mixed with water it rapidly hydrolyzes to MITC. The MITC gas penetrates the root mass to kill the roots. MITC is much more toxic than its precursor metam-sodium and may reach unsafe levels in poorly ventilated or confined spaces. Use of air-supplied respirators would be required under such conditions.

During normal conditions of use, metam-sodium is diluted with water with air added to form foam. Dilution with water decreases the solution's pH causing rapid hydrolysis of the metam-sodium. In addition to MITC, hydrolysis also yields carbon disulfide (CS_2), hydrogen sulfide (H_2S) and minor products, elemental sulfur and 1,3-dimethylthiourea. In confined space these byproducts could exacerbate hydrogen sulfide problems in collection systems or compromise pre-treatment discharge limitations.

Inhalation Exposure

Exposure to metam-sodium by inhalation is assumed to be slight. However, since metam-sodium decomposes to MITC, CS_2, H_2S and other products, extreme caution is important. MITC is a gas that is extremely irritating to respiratory mucous membranes, to the eyes, and to the lungs. Inhalation of MITC may cause pulmonary edema (severe respiratory distress, coughing of bloody, frothy sputum). For this reason, metam-sodium must be used outdoors only, and precautions must be taken to avoid inhalation of evolved gas by wearing an approved canister respirator or air supplied respirator. If pulmonary irritation or edema occurs because of inhaling MITC, transport the victim promptly to a medical facility.

Safety Note: *When working with metam-sodium outdoors, it is extremely important to wear proper respiratory protection. Even if you are working in outdoor conditions with plenty of ventilation, an approved respirator (canister type) should be worn to protect the nose, throat, and lungs. Goggles should be worn to protect the eyes if a half-face respirator is worn. If applying in a confined area or inspecting manhole areas after an application, an SCBA respirator should be worn.*

Dermal Exposure

Exposure to metam-sodium through the skin is expected to be minimal if adequate *Personal Protection Equipment (PPE)* is worn, namely chemical resistant gloves, long sleeved shirt and goggles. Since the surface of the skin is acidic, pH 4.5 - 6, metam-sodium will decompose upon contact with the skin. MITC is extremely irritating to the skin and eyes. Contamination of the skin should be treated immediately with copious amounts of water to avoid burns and corneal injury.

Safety Note: *Proper protective clothing must be worn when working with metam-sodium due to its irritating effects to the skin and eyes. When metam-sodium breaks down into MITC, it will cause serious damage to any exposed areas of the skin. If you spill metam-sodium on your skin, make sure that you flush the area with large amounts of water and seek medical attention.*

Developmental Effects

Studies with laboratory animals indicate that metam-sodium ingested over a period of several days can cause pregnant females to lose weight and fetuses and offspring to exhibit skeletal irregularities.

Dichlobenil

Dichlobenil is a residual-type pesticide formulated as a wettable powder, soluble concentrated liquid, and granules. The chemical has been registered since 1964 as a soil sterilant to control broadleaf weeds, grasses and aquatic weeds. Dichlobenil is also applied as a foam, spray or additive to chemical grouts for the control of tree roots in sewer lines. In sewer line application, dichlobenil provides for residual root control after the metam-sodium has provided the necessary root kill (metam-sodium is a contact, non-residual pesticide). For sewer use, it is formulated as a 50% or 85% wettable powder and is frequently used in combination with metam-sodium.

Dichlobenil kills weeds by impairing metabolic processes that are unique to plant life. For this reason, its mammalian toxicity is low. Nonetheless care should be exercised when handling this and any pesticide especially when used in combination with other pesticides such a metam-sodium. Consult the product's label and Material Safety Data Sheet (MSDS) for precautionary instructions.

Practice Test - Chapter 3

Read and complete the questions below. Correct questions are found on page 49.

Q. What is a pesticide formulation?

Q. Describe the formulations used with metam-sodium root control products.

Q. Describe what happens to metam-sodium in the presence of water.

Q. How can hydrolysis of metam-sodium affect an applicator?

Q. Why is dichlobenil added to metam-sodium as a root control pesticide?

CHAPTER 4 - APPLICATION CONCERNS WITH WASTEWATER TREATEMENT PLANTS, LATERAL LINES & BUILDINGS

Learning Objectives

After you complete your study of this unit you should be able to:

- Know the three major components for handling wastewater.
- Know the difference between a sanitary and storm sewer.
- Be aware of the variables in a wastewater collection system that influence root control operations.
- Describe the series of treatment processes that remove waste products from the water.
- Understand the purpose of wastewater treatment ponds (lagoons).
- Explain the difference between design flow and actual flow.
- Understand how metam-sodium can affect a treatment plant and the processes involved.
- Understand the treatment principles in service lines.

Wastewater Treatment Facilities

Raw wastewater and the efficiency of treatment processes vary from plant to plant. This chapter will provide you with an understanding of the basic operation of a treatment plant. As a sewer line pesticide applicator, you must determine the potential risks associated with the application of root control chemicals in general, and metam-sodium in particular. It is important that you not only understand the operation of sewer collection systems, but you must also have a basic understanding of the treatment process.

Facilities for handling wastewater usually have three major components:

- Collection
- Treatment
- Disposal

An understanding of the treatment process is very important for the applicator, especially when introducing foreign materials, such as root control chemicals or grease eating bacteria, into the collection system. For example, the root control chemical metam-sodium is a general biocide so its potential for affecting the treatment process is directly related to the concentration reaching the treatment plant and the efficiency of that plant's treatment process.

Collection Systems

Collection and transport of wastewater from the source to the treatment plant is accomplished through a complex network of pipes and pumps, of many sizes. Typically, the sewer coming into the treatment plant carries municipal wastes from households and commercial establishments and possibly some industrial wastes. This is called a *sanitary sewer*. All storm runoff is collected separately in a *storm sewer* that normally discharges to a water course without treatment. In some areas, only one network of sewers has been laid out beneath the municipality to pick up both sanitary wastes and storm water in a combined sewer.

The collection system consists of a series of interconnecting pipes of varying sizes (from 4" pipe to tunnels in which maintenance personnel can float in boats). The majority of the pipe footage in areas serving buildings is 8" - 12" in diameter. The system is designed to provide gravity flow from the point of collection to the treatment plant. Sanitary sewers are normally placed at a slope sufficient to produce a water velocity (speed) of approximately two feet per second, or more, when flowing full. Usually, this velocity will prevent the deposition of solids that may clog the pipe or cause odors. The gravity system is broken up into sections by manholes that allow maintenance personnel access to the collection system. Design criteria usually place manholes at pipe junctions, or changes of pipe grade or direction. Therefore, manholes can be spaced between 150 to 1,000 feet. Generally, manholes are spaced on an average of 250 feet.

Most treatment plants with flows of less than 0.5 Million Gallons per Day (MGD) have pipe sizes 4"- 8" and occasionally 10"- 12". As the plant capacities increase, the pipe sizes increase as lateral flows are collected and approach the treatment plant.

Variables in the Wastewater Collection System

Pipe slope is a major design criterion of the collection system. The slope of a sewer is the change in elevation between two manholes divided by the distance between the manholes. Pipe slope and flow velocity can affect the application and retention time of metam-sodium with respect to impacting treatment plants. The design standard for slope is a minimum flow velocity of 2.0 feet per second with the preferred velocity of 2.5 feet per second. As pipe slope increases, flow velocities increase. The presence of roots within the pipes will cause the velocities to decrease.

Grade is an important consideration when applying root control chemicals in terms of the effect treatment may have on buildings "below grade". The term grade, although used at times in place of slope, is also used to indicate relative elevation: e.g., a building sewer is termed "below grade" if the elevation of floor drains are below the invert elevation of the upstream manhole. Slope, pipe size and head pressure determine the velocity of the wastewater.

Flow characteristics can affect root growth patterns. Flow may dictate the appropriate treatment method, the rate of root decay after treatment, the rate at which chemicals drift toward the treatment plant, and the rate of dilution of chemicals in the wastewater stream. Flows can be influenced by groundwater infiltration and during peak periods of residential or industrial use.

The greater the velocity of sewer flow, the greater the rate at which root control chemicals drift downstream. Foam should be injected above the flow surface to reduce the amount of chemical carried downstream. Pipes with particularly heavy or swift flows should be treated at night or during periods of low flow to improve the efficacy of treatment.

The root control applicator should be aware that heavy or swift flows are more problematic with respect to protecting the treatment plant, and should vary the application rates accordingly. The applicator should also be mindful of force mains upstream from the treatment area. Force mains above treated sections which "kick in" after treatment can wash chemicals out of treated lines and move chemicals downstream towards the treatment plant.

Characteristics of the collection system can affect the efficiency of a wastewater treatment plant and allow the root control chemical to have an unusual influence on the plant. Large water users, such as industries that contribute waste to the collection system, may affect the efficiency of the treatment plant. This is particularly true if there are periods during the day or during the year when their waste flows are a major load on the plant. For example, canneries are highly seasonal, making it possible to predict large flows from them. Even in areas where the sanitary and storm sewers are separate, infiltration of groundwater or storm water into sanitary sewers through breaks or open joints can cause high flow problems at the treatment plant.

The time for wastes to reach a plant could affect the treatment plants efficiency. Anaerobic bacteria feeding on the wastes release hydrogen sulfide gas (rotten egg gas). This is particularly true when the flow time is long, and the temperature is hot. Hydrogen sulfide gas causes odor problems, damage concrete in the plant, and make the wastes more difficult to treat (solids do not settle easily). Wastes from isolated subdivisions located far away from the main collection network often have such problems.

Pump stations are normally installed in sewer systems in low areas or where pipes are deep under the ground surface. These pump stations lift the wastewater to a higher point from which it may again flow by gravity, or the wastewater may be pumped under pressure directly to the treatment plant. A large pump station located just ahead of the treatment plant can create problems by sending irregular volumes or sewage to the treatment plant (high during peak times, virtually nothing during low times). Using variable speed pumps or short pumping cycles can reduce these fluctuating flows.

Dilution

The size of a wastewater treatment plant determines the amount of dilution of root control chemicals that occurs with waste. Concentrations of pesticides are measured in terms of percent of active ingredient (AI) per unit of measure. One gallon of 100% Al. mixed with 999,999 gallons of water represents one part per million (1 + 999,999 = 1,000,000). The following is an example of determining the amount of active ingredient needed in a particular system.

Estimate the maximum concentration of the active ingredient of a product, in parts per million, in wastewater as it enters the wastewater treatment plant.

Label instructions say to mix 10 gallons of Product (25% Al.) with 200 gallons of water. This solution is converted into foam at a ratio of 20:1, foam to solution. This material is applied over the course of two hours to a sewer system with flows of 380,000 gallons per hour.

Note: The 200 gallons of water used in the mix and the foam expansion ratio is irrelevant to the answer.

1. If 10 gallons of product is applied over two hours, then 5 gallons of 25% Al. product is applied in one hour. Therefore:

2. $$\frac{5X0.25}{380,000} = \frac{\text{Parts Product (x)}}{1,000,000}$$

3. 1.25 X 1,000,000 ÷ 380,000(x)
   (1,250,000 ÷380,000(x))

4. (x) = 3.289 or the yield is:

5. 3.29 parts of Al. per million gallons (ppm) of water.

Laboratory tests indicate that the "no observable adverse effect level" (NOAEL) for foaming root control products containing metam-sodium and dichlobenil is a concentration of 10 ppm A.I. metam-sodium. Seven (7) ppm A.I. metam-sodium is used in order to provide a minimal safety margin. By using what we have learned about sewer line flows, we can estimate the amount of active ingredient, or product, necessary to achieve a given concentration.

Example: An applicator learns from the treatment plant operator that average day-time flows are 5 million gallons, and that this is spread evenly over the 8 hour day in which the applicator intends to work. What amount of product can the applicator apply over the 8-hour day to stay under 7 parts per million?

Answer: 5 million gallons X 7 ppm ÷ .25(%)AI
(3,500,000) ÷ .25 = 140 gallons of product
140 gallons ÷ 8 Hrs. = 17.5 gallons per hour of 25% AI

Treatment Plant Upset

No treatment plants are exactly alike. Two plants with the same flow may react very differently to the same concentration of pesticide in wastewater flow. The biological process of one plant may be under more stress such as lack of oxygen, chemical pollutants, excessive organic 1oading, operator error, etc., than a second plant. A treatment plant operating under one or more of these stresses may react to a very small concentration of a pesticide such as metam-sodium and become *upset* (adverse change in the biological decomposition process that can last from hours to days). The same plant, operating well and unstressed, may be able to tolerate several ppm of metam-sodium without effect. Treatment plants become upset for a number of reasons, only one of which may be traced to root control chemicals. A well-run plant is usually more tolerant and resilient to the effects of pesticides.

The best source of information about a given plant and how it is responding to root control treatments is the wastewater treatment plant operator. All root control activities need to be cleared and coordinated not only with treatment plant operators but line maintenance and pretreatment personnel as well.

Disposing of Excess Chemicals

Dichlobenil and metam-sodium have certain physical properties that lend them to either absorption or degradation in the pipe section being treated. The foaming method of application retains the metam-sodium in the pipe section being treated for a period of time. This allows decomposition of the product to take place, thus reducing the risk to the receiving treatment plant. Excess concentrate or mixed solution should not be dumped into the sewer lines as it may not have time to degrade before it reaches the plant. The material may hit the plant as a "slug", and temporarily upset the plant. If the applicator has any unwanted concentrate or solution the safest way to dispose of it is by applying it according to label instructions. Never dump concentrated product or chemical/water solution into the sewer system

NOTE: To determine the daily recommended dosage of metam-sodium root control chemicals to a particular system see calculation procedures in Chapter 5, "Application of Metam-Sodium Root Control Products".

Treatment Plants

When wastewater reaches a wastewater treatment plant, it flows through a series of treatment processes (Figure 1) which remove the wastes from the water. This reduces a potential public health threat before it is discharged from the plant. The number of treatment processes and the degree of treatment usually depend on the uses of the receiving waters.

The following provides an introduction to the names of the treatment processes, the kinds of wastes the processes treat or remove, and the location of the processes in the flow path. Although not all treatment plants are alike, there are certain typical flow patterns that are similar from one plant to another. Figures 2, and 3 show possible flow patterns through treatment plants - pond treatment plant and trickling filter plant. The activated sludge plant (not shown) is also a type of treatment plant that contains more tanks, clarifiers, screens/racks and grit removal processes. Activated sludge plants are more complex in their structure, but the principles of treatment are basically the same. The differences in treatment process, daily flows and treatment plant operating efficiency all affect the treatment plant's ability to tolerate pesticides such as metam-sodium.

Preliminary Treatment

When wastewater enters a treatment plant, it usually flows through a series of *pretreatment* or *preliminary treatment* processes. These processes include *screening, shredding, and grit removal*. They remove the coarse material from the wastewater. *Flow-measuring devices* are usually installed after pretreatment processes to record the flow rates and volumes of wastewater treated by the plant. *Preaeration* is used to "freshen" the wastewater and to help remove oils and greases.

Primary Treatment

Next the wastewater generally will receive primary treatment. During primary treatment, some of the solid matter carried by the wastewater will settle out or float to the surface where it can be separated from the wastewater being treated.

Secondary Treatment

Secondary treatment processes usually follow primary treatment and commonly consist of biological processes. This means that organisms living in the controlled environment of the process are used to partially stabilize (oxidize) organic matter not removed by previous treatment and to convert it into a form which is easier to remove from the wastewater. The current design parameters for secondary treatment 'plants is to provide 3 - 30 hours detention time in the aeration portion of the treatment process. Retention time design is a function of plant size and plant type. For example, a small extended aeration plant would probably require a 24-hour detention time while a 5-10 MGD plant would require 6-8 hours of detention time. Waste material removed by the treatment process goes to a solid handling facility and then to ultimate disposal.

Figure 1

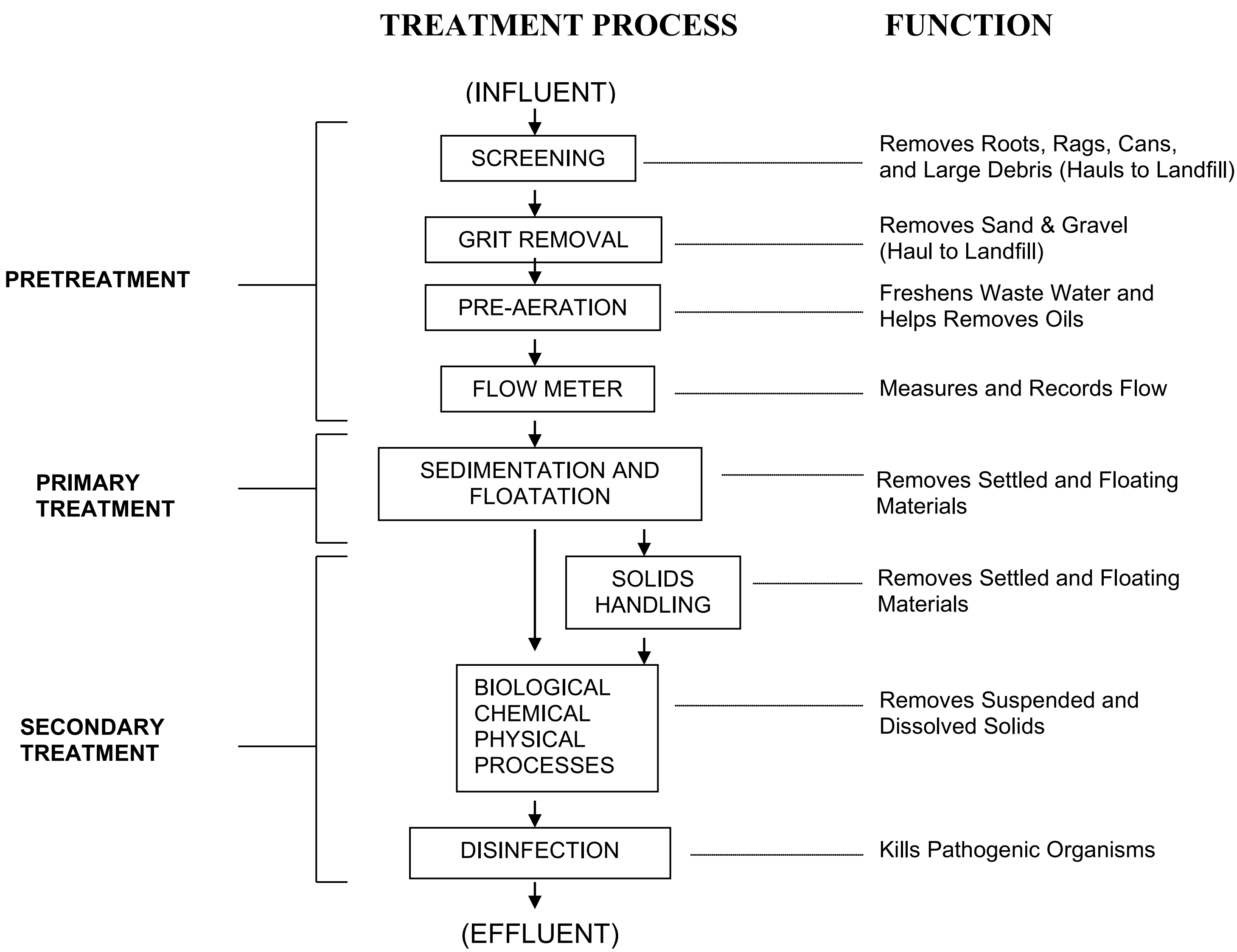

TREATMENT PROCESS
FUNCTION
(INFLUENT)
PRETREATMENT
SCREENING
Removes Roots, Rags, Cans, and Large Debris (Hauls to Landfill)
GRIT REMOVAL
Removes Sand & Gravel (Haul to Landfill)
PRE-AERATION
Freshens Waste Water and Helps Removes Oils
FLOW METER
Measures and Records Flow
PRIMARY TREATMENT
SEDIMENTATION AND FLOATATION
Removes Settled and Floating Materials
SECONDARY TREATMENT
SOLIDS HANDLING
Removes Settled and Floating Materials
BIOLOGICAL CHEMICAL PHYSICAL PROCESSES
Removes Suspended and Dissolved Solids
DISINFECTION
Kills Pathogenic Organisms
(EFFLUENT)

Figure 2

Flow Pattern Through a Pond Treatment System

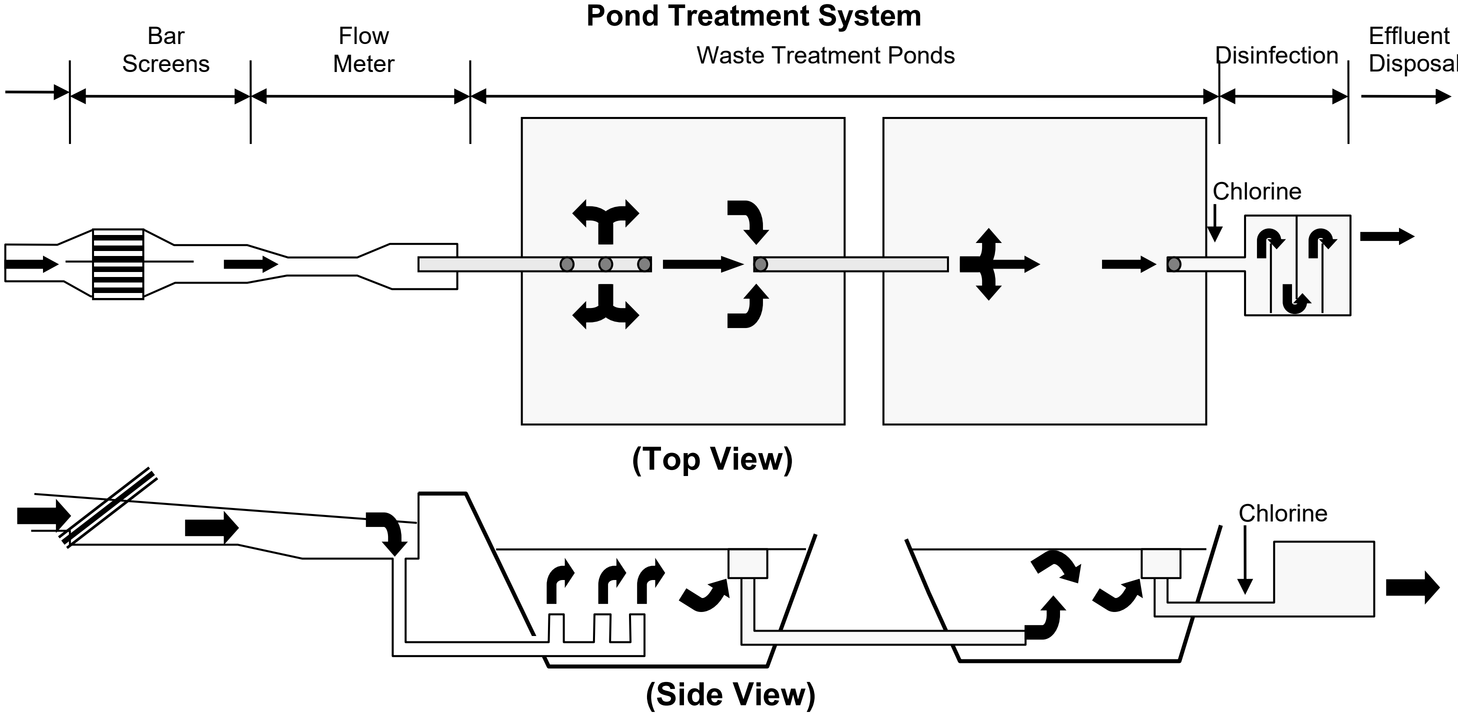
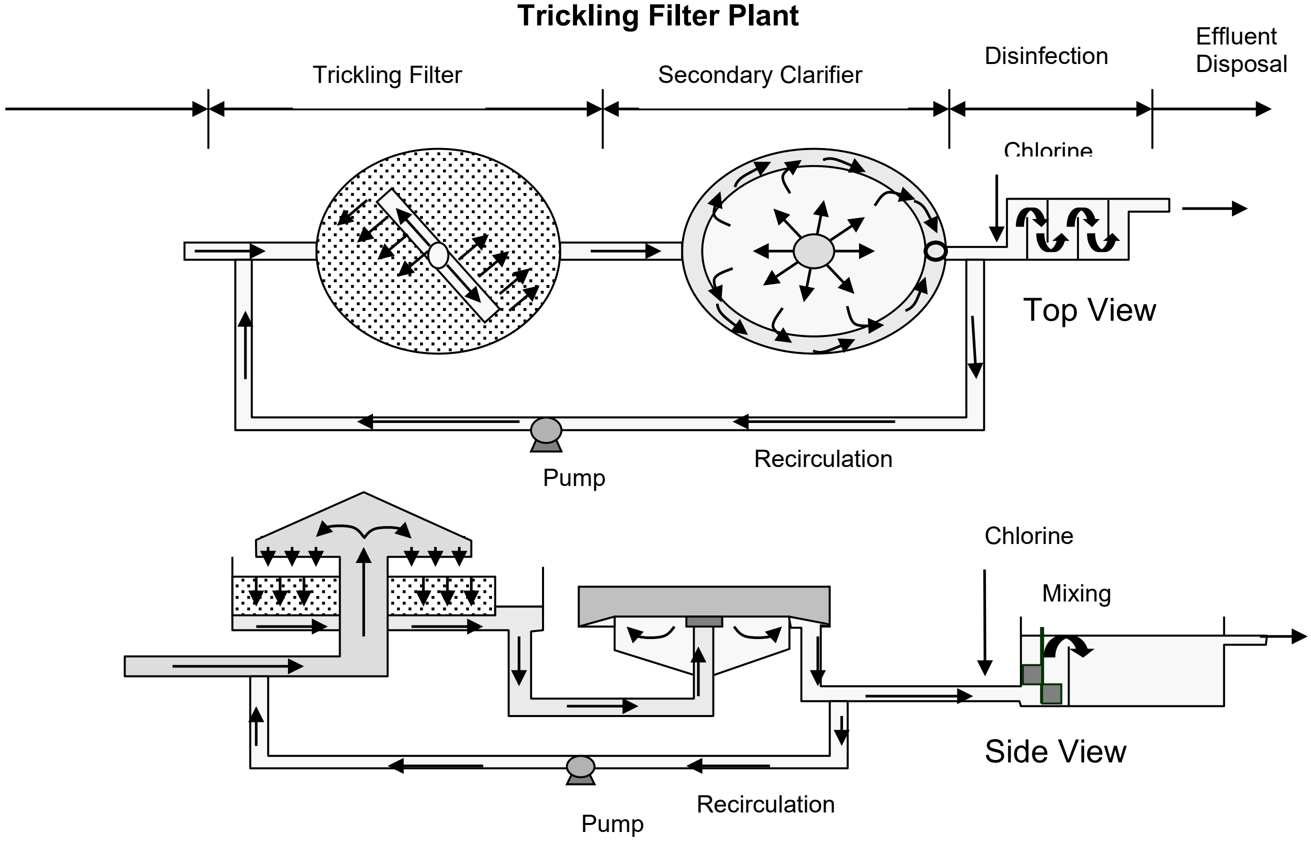


Figure 3

Flow Pattern Through a Trickling Filter Plant



Waste Treatment Ponds

<u>Waste treatment ponds</u>, sometimes called *sewage lagoons*, may be used to treat waste remaining in wastewater after pretreatment, primary treatment, or secondary treatment. Lagoons are frequently constructed in rural areas where sufficient land is available. Flow-through time for lagoons is 4 to 60 days depending on the design.

Advanced methods of waste treatment have been developed for general cleanup of wastewater or removal of substances not removed by conventional treatment processes. These methods may follow the treatment processes previously described, or they may replace them.

Before treated wastewater is discharged to the receiving waters, it should be disinfected to prevent the spread of disease. Chlorine is usually added for disinfecting purposes. Sulfur dioxide (SO_2) may then be added to the effluent to neutralize the chlorine.

The Size of the Wastewater Treatment Plant

The physical size of the wastewater treatment plant is often the most important factor in determining the effects of chemical root control treatments. It is very important for chemical root control applicators to know the size of the wastewater treatment plant downstream from their, applications.

The size of a wastewater treatment plant is measured in terms of the amount of wastewater it is capable of treating. When discussing flows into wastewater treatment plants, it is important to distinguish between <u>design</u> flows and <u>actual</u> flows. *Design flow* is the amount of wastewater that the treatment plant is designed to handle daily. *Actual flows* are just that - the actual volume of water that enters the treatment plant on a given day. If the capacity of a wastewater treatment plant is exceeded, excess flows are bypassed around the treatment plant and dumped directly into the recycling waters. Some treatment plants have large basins to temporarily store untreated flows.

Generally, most flows in a sanitary sewer system occur during the daytime hours. A general estimate is that one-half or more of the daily flow of a wastewater treatment plant occurs between 6:30 - 8:30 a.m. and 4:00 - 9:00 p.m.. This estimate could vary depending on local industries and inflow/infiltration rates.

A typical residence, with 3.5 persons, uses 80 - 85 gallons of water per person per day. This figure does not include industrial use. Using this figure, we could estimate the daily flow for a community of 20,000 people to be approximately 1,600,000 gallons of water per day, excluding industrial discharges. Daily flows are referred to as "million gallons per day" (MGD) so this treatment plant would be a 1.6 MGD plant. If industrial flows are added to that of a residential community, then a combined water flow of 100 gallons per person would result. Excessive groundwater infiltration would also impact the daily flow rate.

The wastewater treatment plant operator can provide information about the amount of flow entering a wastewater treatment plant at any given time. This information is especially important when dealing with low volume plants. To determine the probable impact of a metam-sodium application on a specific treatment plant, one must consider the following:

- The type of application
- Length of pipe
- Size of pipe
- Slope of pipe

- Distance from the treatment plant
- Slope to treatment plant
- Type of treatment
- Size of treatment plant
- Method of operation
- Existing biological stability

Finally, one must consider the rate of breakdown of metam-sodium in an aqueous solution and more specifically, the breakdown in high organic environments, such as sewers.

Variables in the Wastewater Treatment Facility that Influence Root Control Applications

A large number of variables exist when assessing the probability of adverse impact on wastewater treatment plants due to the use of metam-sodium for sewer root control. The following summary of events in the sewer system provides reference calculations to assist metam-sodium applicators.

Biological Upset

The phrase "…wipeout or blowout treatment plant" suggests a vision of a wall of rushing water destroying the treatment plant. A more appropriate term is a "biological upset". Upsets can be caused by:

- Changes in loading (biodegradable solids)
- Hydraulics
- pH
- Toxic chemicals (metam-sodium, gasoline, paints, solvents, etc.)
- Operator errors
- Mechanical breakdowns

The intensity and duration of these upsets last for a few hours to several days. All treatment plants experience biological upsets from time to time, while some may have several upsets a year. Smaller treatment plants are more susceptible to upsets because one event probably represents a larger percent of the plant's flow than would be experienced by a larger plant.

Effect of Metam-Sodium on Treatment Plants

When treatment plants are upset following treatment with products containing metam-sodium and dichlobenil, metam-sodium is usually the culprit. Dichlobenil has a relatively low toxicity and little or no effect on microorganisms at the wastewater treatment plant. Metam-sodium itself will not cause a treatment plant problem, but its breakdown products, MITC, CS_2 and H_2S, can cause serious problems. Previously, you learned that metam-sodium in the presence of water decomposes to form and other products. These products begin to breakdown in the sewer line before reaching the plant. Foaming methods of application enhance degradation of metam by:

- Reducing the pH
- Injecting large quantities of air
- Diluting the material with water
- Slow breakdown of foam which extends the release of metam into the sewer flow, increasing time and dilution

The time required for the wastewater containing metam-sodium to travel from the point of application to the treatment plant, combined with its dilution in wastewater, are the key factors affecting treatment plant upset.

Treatment plant features that may be affected by metam-sodium decomposition products are:

- Bacteria population
- Species diversity
- Age of population
- Dissolved oxygen
- Amount of flow
- Sludge inventory

Flow conditions and proximity to the plant are important considerations in determining the safe application of metam-sodium.

Effects of Chemical Root Control on Wastewater Treatment Plant Processes

NOTE: ***Always consult the wastewater treatment plant operator before applying chemical to a wastewater collection system.***

The sewer line root control applicator is responsible for ensuring that an application does not adversely affect the performance of the wastewater treatment plant. Root control applications should not be made where there is likelihood of adverse effects on a treatment plant.

Wastewater treatment plants are biological systems and depend on the growth and reproduction of microorganisms. Root control chemicals are effective because they are toxic to tree roots. These same chemicals can be toxic to the microorganisms at the wastewater treatment plant. In fact, most substances are toxic in large enough quantities, but pesticides are active at parts per million levels.

Plant upset violations must be avoided. Treatment plant operators do not consider risking upset as an option. Municipal treatment facilities are faced with substantial penalties per day for *National Pollutant Discharge Elimination System* (NPDES) permit violations resulting from "upset conditions".

All consultations need to be careful and complete. Notice of treatment should be made to pretreatment and line maintenance personnel. The wastewater treatment plant operator can monitor the performance of the plant and alert the applicator to any adverse effects before the plant goes into upset or violates its NPDES permit.

Several factors influence the way in which pesticides impact a sewage treatment plant. The most important are:

- Type of pesticide and physical properties of the pesticide
- Flow conditions, in the pipe being treated and application method
- Size of the wastewater treatment plant and dilution factors
- Size of the lines being treated and distance from the plant
- Total rate at which pesticides are applied to the system
- Individual characteristics of the plant and the extent to which the microbe population at the plant is acclimated to synthetic organics

Foam Application of Root Killing Chemicals to Building Service Laterals

Extreme caution should be taken when treating building service lines. As the name implies these pipes are connected directly to buildings and the chance of accidentally forcing foam type root killers through the pipe and into the building is always present.

Building service lines connect the building to the sewer main that is usually in the street in front of the building or in an alley (back lot line easement) behind the building. The service lines are usually 4" to 6" in diameter and have been installed at various times and by different people. Records of where these lines go, which buildings are connected to a specific line, and conditions of the pipe are usually non-existent

Building service lines are normally treated in one of two ways:

- When treating the main line with a sufficient amount of foam to fill the main pipe as well as force foam into service laterals
- Installing a foam through plug at the building end of the service line and forcing foam through the service lateral to the main line

Factors to Consider When Treating Service Lines with Foam

The service applicator must always remember that each application poses its own unique situations and circumstances. The following are some factors to consider before treating any service line with a foam type root herbicide.

- Foam will follow the path of least resistance.
- Service laterals are normally small diameter pipe (4"), and a small amount of foam will go a long way: For example:
  8" pipe =2.6 gallons of foam treatment per foot
  4" pipe =0.65 gallons per foot (a fourfold difference)
- It is much easier for a root mass to entirely block a 4" pipe than an 8" pipe. Calculations of the volume of foam to treat a specific pipe are based on clean empty pipe. Root masses reduce that volume. Root masses affect the volume of a 4" pipe much more than a larger pipe such as 8".
- What may look like a simple service lateral from a building to a main line may have other building laterals connected to it. As sewer technicians know, building areas often began as smaller groupings of homes and commercial buildings built by different developers or individuals. After several growth years, these have grown together into one developed community. The applicator cannot be assured that all of these smaller building areas have underground utilities that fit today's designs and materials. There may be some surprise connections.'
- The applicator should not rely on anyone’s (even his own) memory as to how a service lateral was constructed. If possible, the line should be televised prior to treatment to determine any areas that could cause concern in the foaming operation.
- The condition of a particular service line is almost always "unknown". The applicator should proceed with caution and not treat if there is any doubt.

Sewer Main to Building

When treating the main line, a common practice is to increase the amount of foam applied to force the excess into service lines thus providing root control. Essentially, the applicator reduces the rate of hose retraction during the foam application process, since foam taking the path of least resistance will travel through the service lines. On the surface, this practice appears to be an excellent idea. However, this practice involves significant risk of accidentally forcing chemical foam into buildings.

Do not ever attempt to treat more than the lower 10' - 20' of service lateral by this method. Normal treatment of the main pipe is sufficient to kill roots at the service connection. If you attempt to treat a greater amount of service lateral length (more than the lower 10' - 20') by forcing foam from the main line, you will have a much greater risk of accidentally forcing foam into buildings.

Risk factors in buildings are:

- Basements with below grade plumbing
- Floordrains
- Drytraps
- Reduced sewer pipe volumes due to flow, low spots or root masses
- Unknown connections to the service lateral being treated

Building to Sewer Main (Pump through plug)

This method of application, although less risky than attempting to treat service laterals from the main line, is not without risk. In principle, a plug is inserted in the service lateral between the point of treatment and the building thus blocking the foam from entering the building.

The most common procedure is to use a specially designed air plug that can be inserted through a clean out. The plug is simply a 1" hose with an air bladder molded around the outside. The hose is inserted through a clean out into the downstream sewer pipe and the bladder is inflated. Foam is pumped through the hose and is forced down the service lateral to the main. The inflated bladder blocks the foam from exiting the clean out or being forced back toward the building. Although not recommended, this process can be used from a clean out on the interior of the building.

Although the risks are lower with this type of application method the service applicator must consider the following factors:

- Unknown connections to the service lateral being treated
- Inserting hose into upstream pipe instead of down stream
- Handling chemical on private property - accidental spills on landscaping or in buildings
- When treating from within buildings: the location and configuration of the building plumbing may not have pipe branch connections between the hose plug (treatment location) and the main line.

Treating service laterals is high risk. If there is any question as to the exact configuration of service laterals do not treat. Do not treat service laterals from buildings to which you do not have access at the time of treatment. Have a spotter in all buildings when service laterals are being treated.

Practice Test - Chapter 4

Read and complete the questions below. Correct questions are found on pages 48-49.

Q. What are the three components of handling wastewater?

Q. What is the difference between a sanitary sewer and storm sewer?

Q. Name several variables in a wastewater collection system that will influence root control operations.

Q. Describe the series of treatment process removing waste from water.

Q. What is the purpose of waste treatment ponds (lagoons)?

Q. What is the difference between design flow and actual flow?

Q. How can metam-sodium seriously affect the operation of a treatment plant.

Q. What is the applicator's main concern when treating building service lateral line?

Chapter 5 - Application of Metam-Sodium Root Control Products

After you complete your study of this unit you should be able to:

- Define the words in *italics.*
- Have a general understanding of foam application equipment.
- Explain the basic foaming techniques.
- Understand the precautions to follow when filling chemical mix tanks.
- Understand the basic concepts of calculating the amount of chemical required for treatment.
- Understand the importance of communicating with treatment plant personnel.
- Calibrate hose retrieval rate
- Determine the effectiveness of a root control treatment.

General Concepts

Using the proper application methods and correctly calibrating application equipment will ensure the most effective use of a chemical. This will minimize the chemical and operational costs of the root control application while protecting the health and safety of the applicator, the environment, the public, and the sewer collection system.

When assessing the various methods of application, the applicator must understand the principals of applying chemicals as well as the conditions that exist in the pipe being treated.

General concepts about pipe conditions:

- Under normal conditions sewer pipes are not filled with water.
- Pipe sections with sags or depressions may contain more water than other sections. These sections may even be completely filled with water.
- Solids may build up and fill a portion of the pipe.

General concepts about roots in sewers:

- Roots enter sanitary sewers through cracked joints, other pipe imperfections from the top and sides and not from below the flow line.
- Roots do not grow into the liquid flow of the pipe. They only sweep the surface.
- Root growth is most common in the moist atmosphere of the void above the sewer flow line.
- With a few exceptions, roots cannot grow without oxygen.

General concepts about root control chemicals in sewers:

- Root masses are excellent collectors of grease and other solids. Such buildups can inhibit the effectiveness of root control chemicals because they cannot contact the root.
- Chemicals placed in the void area of the pipe with no surface to attach to, such as a root mass or pipe wall, enter the sewer flow and are transported to the treatment plant.

- Chemical root treatments kill roots, but they do not eliminate blockages. When a root mass is treated, the roots may die quickly but may take weeks, months, or even years to decay and leave the system.

General concepts about chemical root control results:

- It can be very difficult to determine if a root mass is dead with a visual inspection via TV camera.
- The effectiveness of chemical root control is only as good as the application.
- Do not expect a treated pipe to look completely clean following a chemical treatment.

The term root control used in this manual refers to "root management". The entire concept of sewer line root control is to reduce the frequency and size of root intrusions into sewer pipes thus reducing the frequency of sewer stoppages and overflows.

Application Equipment

Equipment design and specific components of foam generating, and application equipment may vary but the basic principles of operation are the same, namely:

- The chemical and wetting/foaming agent is diluted with water as per chemical manufacturer's label instructions.

One type of equipment utilizes a mix tank (30 to 300 gallons) in which the chemical ingredients are diluted with water. This mix tank is usually trailer mounted. The trailer is then used to transport the chemical to the various applications sites throughout the municipality. One 200-gallon tank mix is sufficient to treat approximately 1600 feet of 8" pipe. The chemical-water solution is delivered under pressure (100 - 150 psi) to a foam production chamber. A positive displacement pump is then used to pump the chemical-water solution.

A second type of equipment utilizes a small (3 to 6 gallon) chemical tank in which the chemical ingredients are mixed, but water is not added. This unit utilizes a positive displacement roller pump or the pump on a *hydrojetter* unit to deliver water (without chemical) under pressure (100-150 psi) to a venturi at which point the chemical is introduced into the water stream and mixed just ahead of the foam production chamber. The chemical is then diluted with water during the application process. The chemical/water dilution ratio is based on the product's concentration of active ingredients (identified on the product label).

- Ten to fifteen CFM (80 - 140 psi) of air from a compressor is combined with the water/chemical solution in the foam production chamber to produce the desired foam.

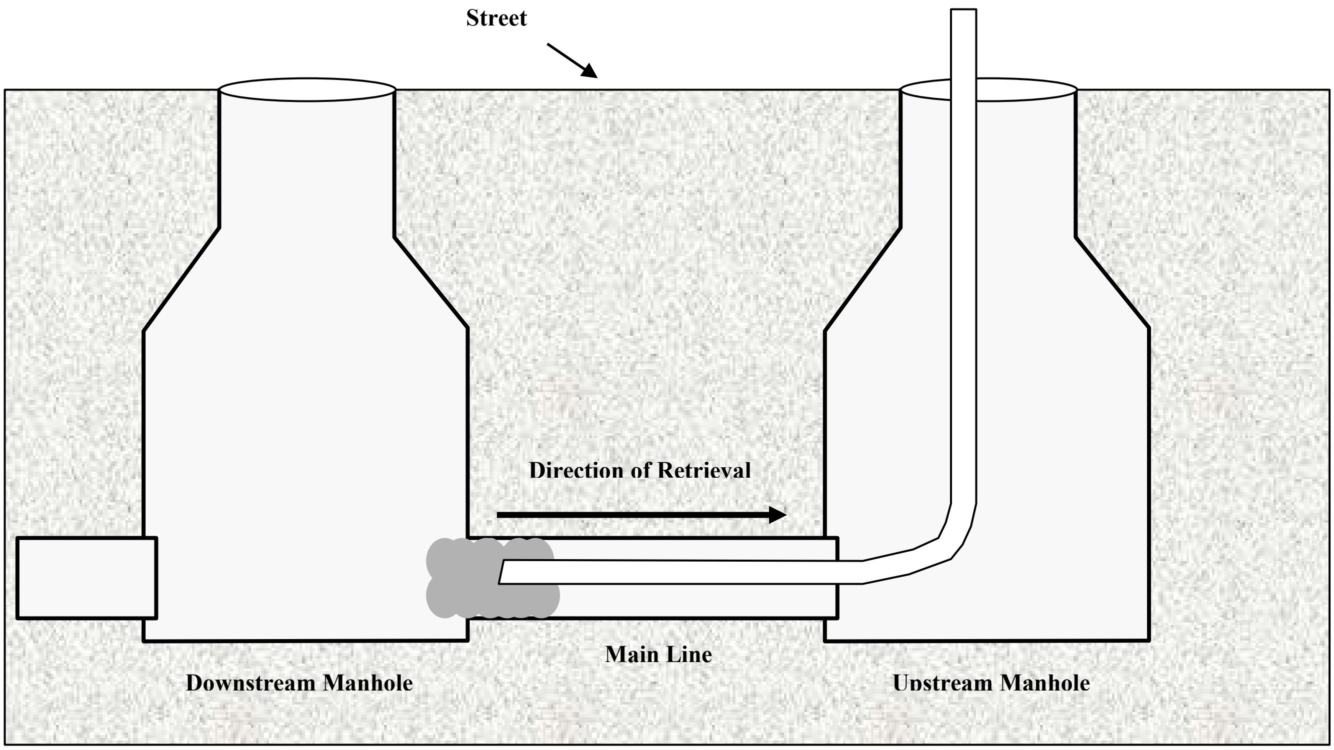
- Foam is delivered to the interior of the pipe being treated through hoses of varying sizes.

Foaming Techniques for Applying Metam-Sodium Root Control Chemicals

Hose Insertion Method

The hose insertion method is the most common and lowest risk method of foam application. A foam delivery hose is inserted through a section of pipe to be treated. Foam is then pumped from a foam generator through the hose as it is being retrieved at a predetermined rate. The foam delivery hose may require an external mechanism such as a hydrojetter or rodding machine to convey the hose through the pipe prior to the foaming process. This procedure utilizes a two-stage nozzle and foam generation equipment adapted to a standard high-pressure hydrojetter. During the first stage, the nozzle is "jetted" through the pipe to be treated. The second stage occurs when the pressure drops, and the large portion of the nozzle opens to allow the foam to be pumped out (see Figure 4).

Figure 4



Although the insertion manhole may be upstream or downstream, it is best to use the upstream manhole for insertion as this avoids drift of the chemical towards the applicator. Once the hose reaches the other manhole, start the equipment and wait for foam to appear. Retrieve the discharge hose at the desired rate. With jetters, it is recommended that moderate pressure be used when inserting the hose into the pipe. High pressures and excessive cleaning may result in extensive root damage that can affect the effectiveness of the root control application.

Hose Insertion Method, Split Treatments

In some cases, the sewer stretch may be longer than the amount of discharge hose or it may not be possible to get the discharge hose completely through the sewer. In this case, it may be necessary to use two set-ups to treat a section. With this technique, it is best to treat the downstream portion first to reduce possible exposure of the applicator to chemical drift.

Hose Insertion Method: "Pushing a Slug"

Foam will penetrate a distance beyond the discharge nozzle. This is known as "pushing a slug". If masses of roots or physical obstructions do not permit the hose to be conveyed completely through the sewer, the equipment may be "allowed to pump" at a fixed location until the foam works its way through the obstruction. The equipment is then set up at the opposite manhole and the procedure is repeated until the two "slugs" overlap.

- **EXTREME CAUTION**: Extreme caution should be employed when using this method as foam may travel farther than desired up service laterals. Foam will always take the path of least resistance; this may be up a cellar floor drain or through outside building clean-outs.

Hose Insertion Method: "Pulling the Water Out"

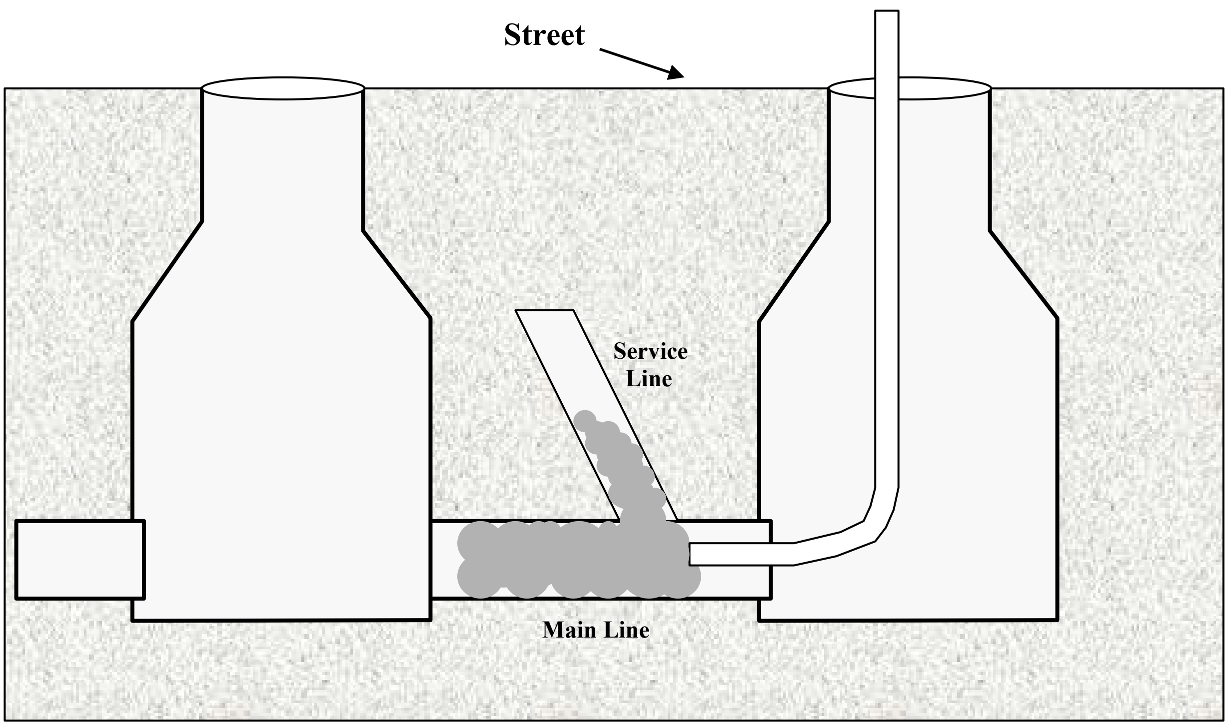
In some cases, sewer pipes may have inadequate slopes or *swales* in which water collects. As the foam is injected it displaces the water in the pipe. Under these conditions it is often advisable to treat using the downstream manhole as the insertion manhole. As the hose is retrieved, excess water is pulled toward the insertion manhole. If the upstream manhole is used as the insertion manhole, then water may pond in the upstream manhole. If this happens, equipment must be shut down until water recedes.

Hose Insertion Method: Treating "Wye" Connections from the Main

Often it is desirable to treat service connections from the main. This provides an important side benefit to homeowners. Generally, treating service connections from the main is only feasible in small diameter (6" through 10") pipe. In large diameter pipe, it is not possible to build up the pressures needed to penetrate service connections (see Figure 5).

Additional foam is required per foot to use this method. Calculate the amount of additional foam required for the given number and pipe size of building laterals and vary retrieval rates accordingly. USE EXTREME CAUTION to prevent foam from reaching building drains or outside sewer cleanouts.

Figure 5

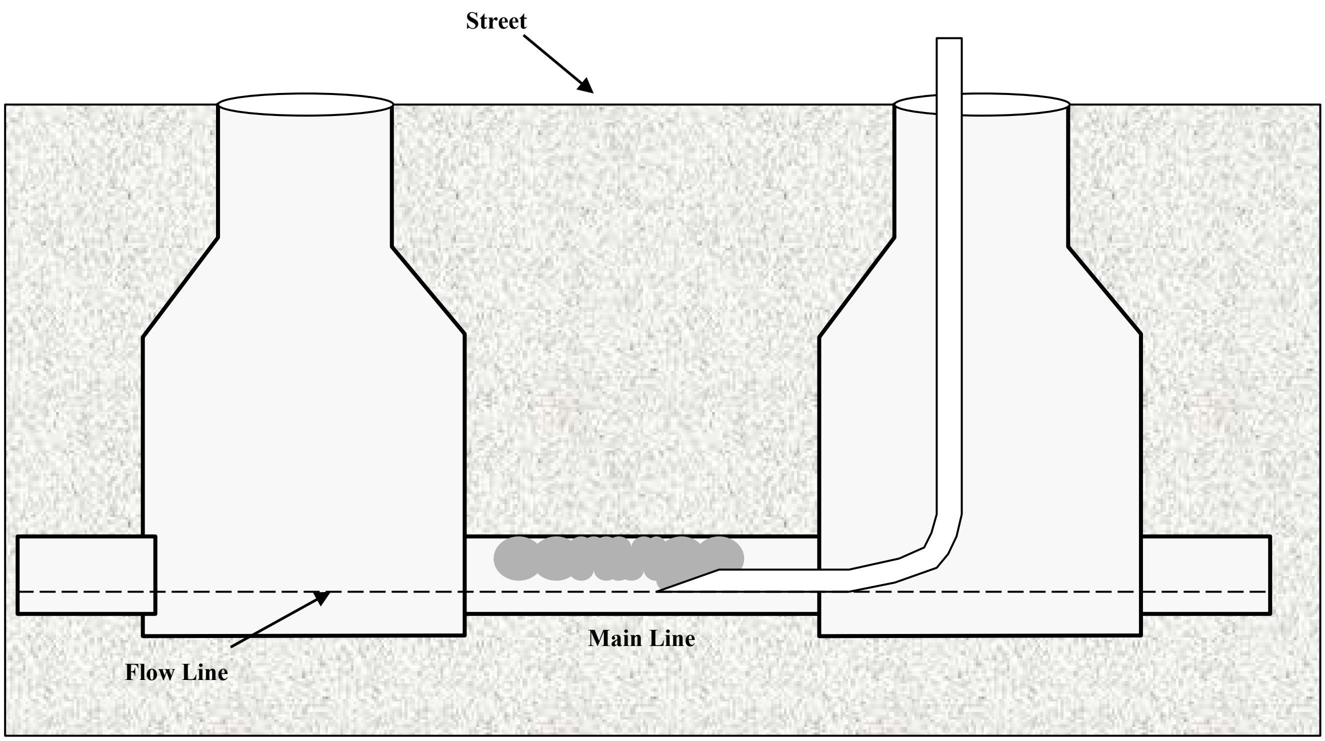


Foam takes path of least resistance

Surface Coating Large Diameter Pipe

When treating large diameter pipes, it is often impossible or expensive to completely fill the sewer with foam. Excess chemical that drifts downstream is wasted and could affect the wastewater treatment plant. To coat the pipe surface, an elevated nozzle (see Figure 6) is pulled through the sewer. Foam is ejected through the nozzle above the flow where it contacts and sticks to pipe surfaces. It is very important that the nozzle be elevated above the flow. If the foam is ejected into the flow, it will not contact pipe surfaces. To calculate the volume of foam required to coat the surface, contact your chemical supplier for instructions.

Figure 6



Surface coating often does not yield the results obtained by filling the pipe, since the foam is not under pressure and will not penetrate root masses as effectively as it would when filling the pipe. Repeat treatments may be necessary as succeeding "layers" of root tissue are killed. Also, surface coating will not result in foam penetrating service connections. Surface coating is also used on small diameter pipes with heavy flow where the flow rates preclude filling the pipe with foam.

Spot Treatments

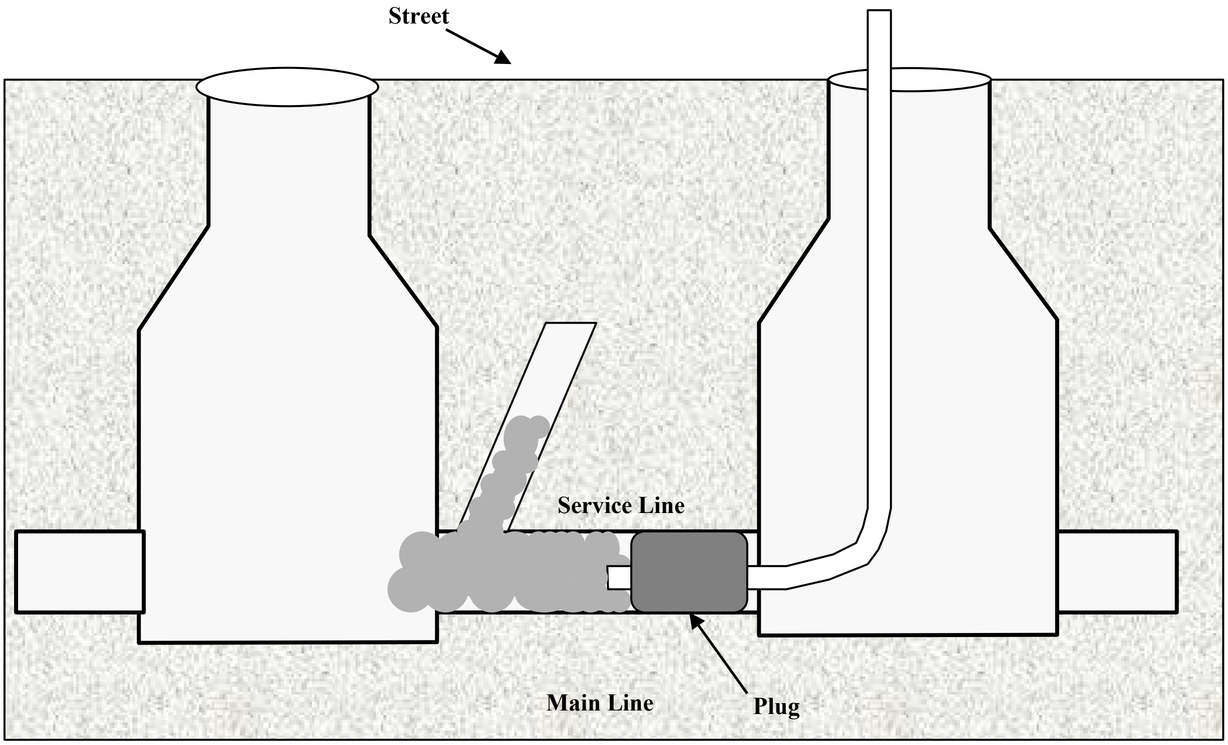
Spot treatments may be used with either foam filling or surface coating techniques. Spot treatments involve treating only where the roots are present. The advantage of spot treatments is that less material is required to treat a given length of sewer pipe. The disadvantage is that television inspection is necessary to know exactly where the roots are located. If the TV inspection is outdated, additional root penetration may have occurred. Initial root penetrations are frequently missed by TV inspections because these penetrations are very small and hard to detect. Spot treatments are most useful in large diameter lines where the increased cost of material offsets the cost of TV inspection. The amount of chemical which can be saved on a small diameter pipe is usually negligible and not worth the cost of TV inspection.

When using spot treatment techniques, allow a certain amount of overlap, approximately 10 feet, on each side of the root masses.

"Pushing" Foam Through Inflatable Plugs

In some cases, it may be desirable to "push" the foam through inflatable, hose-through plugs (see Figure 7). These plugs are available through plug vendors in the sewer industry. Insert the plug at one end of the line with the hose running through it. Inflate the plug and inject foam in a volume required to fill the pipe or until foam appears at the opposite manhole.

Figure 7



CAUTION: This is a high-risk method. When using this method there is a significant hazard of foam backing into buildings because foam will always follow the path of least resistance. This method should only be used where there are no service connections on the main line sewer or where buildings are set far back from the main.

Treating Building Sewers

Treating house lines also involves the use of hose-through inflatable plugs. Some equipment manufacturers have developed specialized, portable equipment for treating building sewers.

Safety Note: Metam-sodium is extremely irritating to skin, lungs, eyes, throat and nose. Wear the proper PPE!

Insert the hose-through plug in a cleanout which is downstream from all other cleanouts and fixtures. If there are cleanouts or fixtures downstream from the insertion cleanout, they must be plugged. It is very important to ca1culate the volume of foam necessary to treat the know distance of building sewer prior to application. This will minimize forcing excessive amounts of foam into the building sewer.

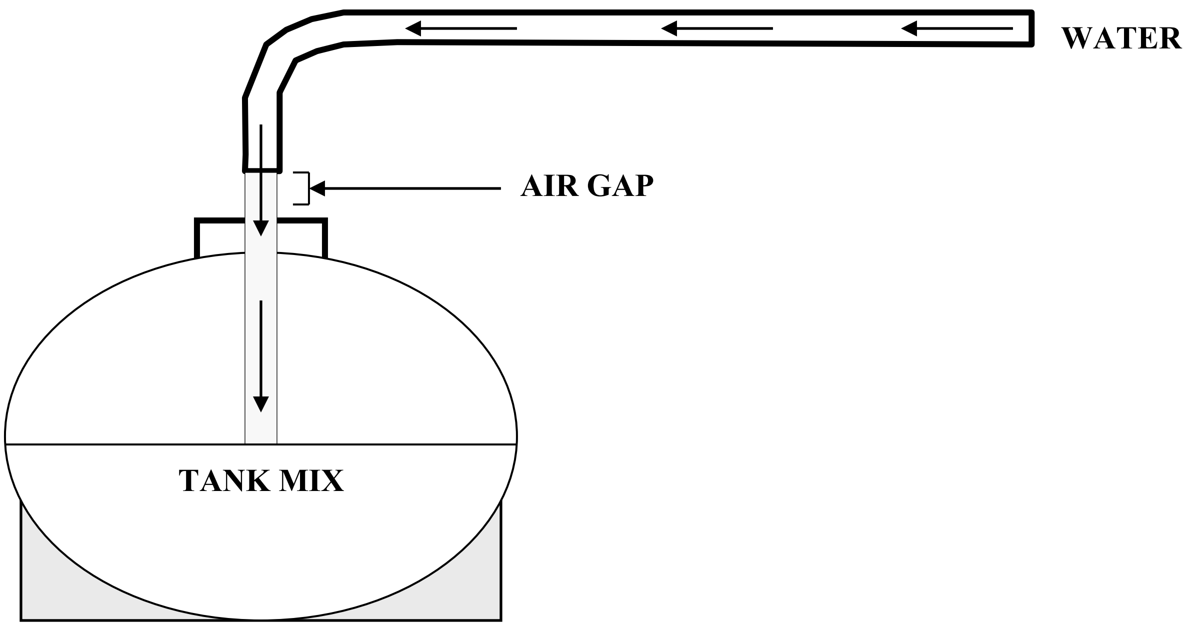
Treating house lines should only be attempted by applicators familiar with the design of building sewer systems or under the supervision of a licensed plumber. Improper application may result in foam being discharged into houses. If a rotten egg or sulfur-like odor of metam-sodium is detected, building occupants should be advised to exit a structure until the building is ventilated.

Filling Chemical Mix Tanks

When using chemical mix tanks, certain precautions must be followed. Applicators often fill mix tanks from fire hydrants, garden hoses, or other fresh water sources. If there is a pressure drop in the water distribution system, the solution in the mix tank could backsiphon into the freshwater system. *Backsiphoning* of the tankmix into the freshwater system could potentially contaminate the entire water distribution system and be very costly to cleanup. This situation could also occur when drawing water from any other source, such as a farm pond, lake or river. Whenever a tank is being filled with water, it should never be left unattended. Backsiphoning can be prevented with one of the following measures:

- Use of an air-gap
- Use of a back flow prevention device such as a double check valve
- Use of an intermediate water source, such as a separate fill tank

Figure 8



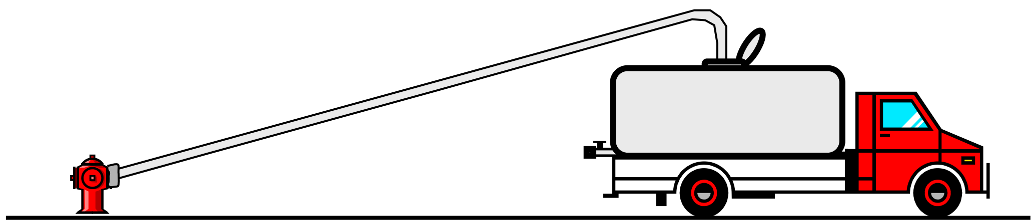
For an air-gap to be effective, the distance between the inlet line and the tank must be at least twice the diameter of the inlet line (See Figure 8). In the event of a reversal of pressure, air will rush through the air-gap, preventing backsiphoning. It is difficult to use an air gap with foaming root control chemicals as the residual material in the tank will foam and prevent the tank from being filled.

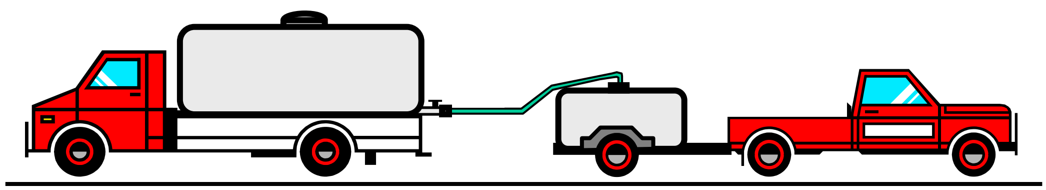
Backflow Preventer

This is a device that is connected between the water source and filling hose. If the pressure on the outlet side of a reduced pressure zone (RPZ) ever exceeds the pressure on the inlet side, relief valves discharge onto the ground, preventing backsiphoning. For a more complete technical description of how a RPZ device works, consult the Idaho State Department of Agriculture Chemigation Manual or a manufacturer.

Filling from an intermediate source. It is often usefill to fill mix tanks from an intermediate source, such as a sewerjetter. In these cases, of course, the sewerjetter must itself be filled using an air-gap or double check valve. The advantage is that in the event of backsiphoning from the mix tank into the intermediary source there is no danger of contaminating fresh water supplies (see Figure 9).

Figure 9





Obtaining water from a jet truck will also prevent back siphoning because the truck has built-in siphoning brakes.

When mixing metam-sodium with water, remember that metam-sodium decomposes to the more volatile and toxic MITC. This process starts immediately and proceeds rather rapidly. Therefore, plan to use the solution soon after mixing, otherwise the material will be ineffective.

Cleanup of Pesticide Spills

When minor pesticide spills occur, you must take action to ensure that the pesticide is not allowed to contaminate water, the surrounding area, or pose a problem for humans and animals. If you spill pesticides or observe a pesticide spill, remember to follow the *three C's* in handling the spilled materials.

Minor Spills

Control the Spill. Stop the materials from leaking or spilling. Keep people away from spilled chemicals. Rope off the area and flag it to warn people. Do not leave unless someone is there to confine the spill and warn of the danger. If the pesticide was spilled on anyone, follow appropriate cleanup procedures.

Confine the spill. Prevent the spill from spreading by building a dike of soil or sand around the spill. Make sure that any spilled materials does not go into storm drains or be allowed to contaminate any water source.

Clean up the spill. Use absorbent material such as soil, kitty litter, sawdust, or an absorbent clay to soak up the spill. Shovel all contaminated material into a leak proof container or chemical resistant bag for disposal. The disposal container must bear a label indicating contents. Dispose of material as you would excess pesticides. Do not hose down the area as this spreads the chemical and could create worse problems. Always work carefully and methodically: do not hurry. Do not let anyone enter the area until the spill is completely cleaned up.

Regardless of the spilled pesticide or material, it is important that the person(s) attending to the spills always wear the appropriate personal protective equipment (PPE). PPE will protect people cleaning up any spills from exposure to the pesticide.

Special Procedures for Foam Spills

Foam spills act very similar to liquid and if left unattended they break down to the liquid form. Although the cleanup procedures are very similar, extra measures may be required.

Outdoors. Try to pick up the foam as quickly as possible before it liquefies. Scoop foam up with a shovel and transfer it to a manhole or place it in large, chemical resistant plastic bags. Empty the foam into a manhole. Triple-rinse the bags before disposing of them in a landfill. For spills on the pavement, dispose of the foam in a manhole and then rinse the area into the manhole. If the spill occurs on soil, remove all contaminated soil and place it in sealed containers and dispose of it in accordance with local regulations.

Indoors. Spills will usually occur in bathrooms, basements or laundry rooms. Evacuate the building if the pungent, rotten egg or sulfur-like odor of metam-sodium is detected. Open exterior doors and windows and ventilate with fans. Seal all heating and air conditioning vents to prevent contaminating the system. Scoop up foam with a shovel or dustpan and place it in a plastic bag. Seal the plastic bag and remove if from the building, then dispose of the foam in the nearest manhole. Triple-rinse the plastic bags and dispose of them in a landfill. On hard floors, wipe up remaining liquid with rags or other absorbent material and dispose of as directed by local regulations. Wash the floor at least three times with detergent, flushing each down a drain. On rugs and cloth, take them outside, if possible, and dry them before laundering separately. On carpeting, use a wet vacuum and flush foam down the drain. Shampoo with detergent at least three times, then ventilate the area and allow the carpet to dry completely. If the odor persists, remove all affected materials and replace.

Major Spills

The cleanup of a major spill may be too difficult for the sewer applicator to handle, or the applicator may not be certain what to do. In either case, keep people away, give first aid if needed, and confine the spill. Call the local emergency response agency in your area or the police if you do not know if your area has an emergency response capability. Another available resource for emergency information on spills, leaks, or fires is the Chemical Transportation Emergency Center (CHEMTEC) in Washington D.C. CHEMTEC can be reached at (800) 424-9300. For further information on pesticide spills, refer to the manual, Idaho Pesticide Laws and Safety.

Calculating Amount of Chemical Required

The applicator can use the worksheets in Figures 10 and 11 to calculate the amount of chemical required for a specific job. Figure 10 is the calculation for the foam fill method. In larger pipes the foam/chemical is directed toward the pipe walls rather than filling the whole pipe. The foam spray method (figure 11) requires less chemical and protects the system from injecting too much chemical at one time. When using these figures, the applicator needs to add to the formula:

- The number of feet of each pipe size that will be treated
- The dilution ratio

To determine the dilution ratios, the applicator should refer to the label of the product being used. For example, if the product label states, "mix 25 parts water to 1 part of chemical" then insert "26" (26 parts of chemical/water solution) in the "dilution ratio required" column of either figure 12 or 13 and complete the calculation.

Figure 10

Foam Fill Applications

Pipe Size	Gallons per Foot	Length of Pipe	Gallons of Foam	Service Laterals 15-25%	Total Foam Needed	Expansion Ratio - 1:20 Minimum	Chem/ Water Solution	Dilution Ratio Required	Total CMG	Round up
4"	0.7	X	=	+	=	÷ 20	+	÷	=	
6"	1.5	X	=	+	=	÷ 20	+	÷	=	
8"	2.5	X	=	+	=	÷ 20	+	÷	=	
10"	4.0	X	=	+	=	÷ 20	+	÷	=	
12"	6.0	X	=	+	=	÷ 20	+	÷	=	

Figure 11

Foam Spray Applications

Pipe Size	Gallons per Foot	Length of Pipe	Gallons of Foam	Service Laterals 15-25%	Total Foam Needed	Expansion Ratio - 1:15 Minimum	Chem/ Water Solution	Dilution Ratio Required	Total CMG	Round up
12-14"	3.0	X	=	+	=	÷ 15	+	÷	=	
15-16"	3.5	X	=	+	=	÷ 15	+	÷	=	
18"	4.3	X	=	+	=	÷ 15	+	÷	=	
20"	4.5	X	=	+	=	÷ 15	+	÷	=	
21"	4.75	X	=	+	=	÷ 15	+	÷	=	
22"	5.0	X	=	+	=	÷ 15	+	÷	=	
24"	5.5	X	=	+	=	÷ 15	+	÷	=	
26"	6.0	X	=	+	=	÷ 15	+	÷	=	
27"	6.75	X	=	+	=	÷ 15	+	÷	=	

Application Checklist

This checklist should be reviewed before applying root control chemicals containing metam-sodium to a sewer section. ALWAYS READ THE PRODUCT LABEL COMPLETELY PRIOR TO APPLICATION.

1. Read the chemical product label thoroughly.
2. Notify the wastewater treatment plant operator and workers of treatment site and date.
3. Know the distances between buildings and the sewer.
4. Know the depth of the sewer compared to the drains in the buildings.
5. Are there any obstructions in the line?
6. Are there broken or empty traps?

7. Are there drains without traps that would allow easy emergence of foam? (Building drains may be plugged to protect against back-up and flooding.)
8. Product labels and Material Safety Data Sheets should be available at the job site for quick reference.
9. Provide the job site with all necessary equipment for proper traffic control (i.e., barricades and cones).
10. Provide the job site with proper equipment for safely opening manholes.
11. Provide the job site with proper equipment for conforming to OSHA standards, for confined space entry (including but not limited to air monitor, harness, and retrieval systems).
12. Have the proper PPE available:
    - Gauntlet type chemical resistant gloves
    - Rubber boots
    - Chemical resistant, full length plastic or rubber apron
    - Respirator and goggles or a full-face respirator with cartridges approved for pesticide use, and if required air supplied respirator or SCBA.
    - Long pants and long-sleeved shirts.
    - Hard hat and/or chemical hat.
13. Have spill clean-up material available.

Communication With the Wastewater Treatment Plant Personnel

Coordination and cooperation with plant operations is very important. Notification prior to treatment is a definite priority, especially with the pre-treatment program which may require issuance of a discharge permit. Treatment plant personnel should be made aware of any unusual side effects of metam-sodium.

The applicator should obtain as much information about the treatment area as possible. For example, the times of high flows, the size of the sewer lines being chemically treated and the distance of the sewer line from the nearest lift station and sewage treatment plant. These are important determinants of the effects of chemical root control on a wastewater treatment plant's processes. Sewer line size is an important consideration to determine the amount of chemical needed to treat. Depending on the application method used, it can take up to nine times as much chemicals per foot to treat a 24" sewer as an 8" sewer.

Dosage of Product to a Particular System

To minimize the effects of root control chemicals on a sewer system, it may be necessary for the applicator to reduce the volume of material applied. Knowing the volume and hourly flows for the system and the manufacturer's recommended maximum concentrations, the applicator can determine the maximum amount of product that can be injected into the system for any given day or hour.

If adverse effects are indicated at the treatment plant (i.e. the rotten-egg odor of metam-sodium is detected or the beginning of biological upset is determined) the application process should be immediately discontinued. When applications are restarted, the applicator should use reduced application. The treatment plant operators should continue to monitor the plant to ensure against a reoccurrence of adverse effects.

Metam-Sodium Root Control Application

The three phases of applying the metam-sodium root control chemicals are:

1. Mixing the chemicals or the chemical/water solution
2. Calibrating a 1-part chemical/water solution to 20 parts foam
3. Calibrating the hose retrieval rate

Mixing the Chemical

Due to the differences in packaged products, specific mixing instructions must be obtained from the label of the metam-sodium root control products being applied. Mixing instructions must also be obtained from the equipment manufacturer for the specific application equipment being used.

The active ingredients, metam-sodium and dichlobenil, can only be used in combination with each other and with a foaming agent as per the product label. Depending on the equipment being used, the ingredients may be mixed with the proper amount of water in a mixing tank or may be mixed together separately in a small chemical tank prior to automatically mixing with water at the moment of application.

Dichlobenil should be mixed with the other root control ingredients vigorously before mixing with water. The mixed solution should not be allowed to stand as mild agitation is necessary to keep the dichlobenil in suspension.

The chemical mixture should be used promptly after mixing and the applicator should not mix more solution than can be used in one day. To mix the proper amount of needed solution, the applicator must:

1. Determine the method of treatment
2. Determine the total footage of pipe by using the pipe diameter and method of treatment
3. Calculate the chemical mix ratio and the amount of chemical/water solution to prepare depending on the pipe diameter and method of application

Methods of treatment include foam fill and foam spray. Pipe diameters l2" - 14" or less require filling the entire pipe void with foam (foam fill). Pipe diameters 12" - 14" or larger are more economically treated by surface coating on the root masses and pipe surface (foam spray). Other factors may dictate the method of application e.g., wastewater level, velocity of flow and root density.

Calibrating Foam/Solution Expansion Ratio

The applicator should know how to calibrate the application equipment to get the proper consistency and volume. This section provides general guidelines for equipment and foam calibration. Consult with the equipment manufacturer for more specific calibration details of their equipment.

Metam-sodium root control products require a foam application. The ingredients are mixed with water, according to the package instructions, and then air is introduced with an air compressor. The proper chemical/water to foam expansion ratio is an important factor in achieving a successful root control application. The proper expansion ratio is that 1-part, or 1-gallon, chemical/water solution will expand to 20 parts, or gallons, of chemical/foam solution.

The proper foam will be dense, have small bubbles, "cling" to the pipe surfaces, maintain its shape for a specified period of time, and contain the proper concentration of active ingredient per cubic foot of foam.

An expansion ratio less than 1:20 produces a wetter foam. Wet foam will have a runny consistency and not stick to pipe surfaces. It will also be heavier and quickly collapse, not holding its shape in the pipe. Wet foams do not properly fill pipes at normal retrieval rates or penetrate wye connections.

An expansion ratio greater than 1:20 produces a dryer foam with large bubbles that will not carry a sufficient concentration of active ingredient per cubic foot to be effective at killing tree roots.

Variations in foam quality can be made by adjusting the water/chemical solution volume (gallons per minute (gpm)) versus the air volume (cubic feet/minute (CFM)). Follow the equipment manufacturer's guidelines to make these adjustments.

The water quality (i.e., hardness) may affect foam quality. If this is a problem, check with the chemical representative or supplier for technical assistance.

The applicator can test the foam quality by observing it as it discharges from the hose into a manhole. A good foam consistency is achieved when the stream breaks into light balls and flakes of foam about 2-3 feet from the point of discharge.

These tests for foam quality or equipment calibrations can be performed at a testing site by using the appropriate amount of wetting/foaming agent only (without adding the product's active ingredients) This reduces the risk of exposure for the operators performing the test. The wetting/foaming agents can readily be obtained from the product manufacturer. Contact the equipment manufacturer for detailed calibration procedures specific to their respective equipment.

To measure the foam more accurately from the mound of foam created, fill a 2000 ml graduated cylinder to the top with foam. Place the filled cylinder in a location free of wind (wind causes unnecessary breakdown of the foam). When the foam has settled, measure the remaining liquid. The desired result is to have the liquid measure 100 ml or 1/20th of the foam volume.

Each piece of equipment should be calibrated separately to determine its proper flow rate. If a piece of equipment shows wide variances in foam consistency, there may be a problem with the equipment. Service the equipment per the equipment manufacturer's recommendations.

Calibrating the Hose Retrieval Rate

To determine the hose retrieval rate, the operator must know:

1. The gallons of foam required per foot of sewer pipe
2. The amount of gallons per minute that the application equipment is producing

Divide the amount of foam produced per minute by the amount of foam required per foot to determine the hose retrieval rate in feet per minute.

Figure 12 provides a quick method of determining retrieval rates.

Figure 12

Pipe Size	Foam Fill gal/ft	Feet per Minute
4"	0.7	143
6"	1.5	67
8"	2.5	40
10"	4.0	25
12"	6.0	17

This same procedure can be used for determining the hose retrieval rate for surface coating applications. For example:

Example Calculations

> To surface coat a 24" pipe carrying 7" of flow, with 3" of foam for 300 feet in length it requires 2,221 gallons of foam. This breaks down to 7.4 gallons of foam per foot. If the equipment is generating 90 gallons of foam per minute, then the proper hose retrieval rate would be 12.16 feet per minute (90÷7.4).

Determining Effectiveness of Root Control Treatments

Determining the effectiveness of chemical root control treatments is an important issue for contractors and public works officials. The results of chemical root control are sometimes difficult to assess because they cannot be seen by the naked eye. Tracking results can also be a learning tool for the applicator by pointing out deficiencies in application methods.

- Improper application techniques, in particular, poor contact and exposure time
- High sewer flows or surcharging conditions soon after application
- Severe hydraulic sewer cleaning before or after treatment
- Heavy grease deposits on roots that interfere with chemical contact
- Old, ineffective or improperly mixed chemical

Due to the remoteness of root masses in sewer pipes, it is extremely difficult to accurately assess the percentage of the root kill. An important fact to remember is that chemical root treatments kill the roots but do not make the roots disappear. A complex of decaying organisms that are constantly present in the sewer feed on the dead roots. The build-up of solids and the constant pressure caused by wastewater flows dislodge the dead roots sending them to the treatment plant. This process may take weeks, months, or even years.

NOTE: If a sewer line is experiencing frequent blockage problems, chemically treating roots will not immediately eliminate these blockages. You need to address these blockages with good cleaning, preferably with a high-pressure jetter. Once the blockage problem is resolved, the long-term solution of chemically treating roots can be addressed.

As discussed previously in the section on how roots grow, root masses are made up of a central trunk dividing into a series of smaller and smaller branches and ending as microscopic hair roots. A specific root mass in a pipe may be the result of single rootlets entering the pipe through a faulty pipe joint. These rootlets then grow and divide into more rootlets which in turn divide and grow forming a "root mass". As the root mass grows, the supporting branch (the original root hair entering the pipe) grows in size and is frequently protected by the surrounding root mass.

TV Inspections

The most difficult part of a successful chemical root treatment is accurately determining the percent kill of a root mass or root masses in a specific section of pipe. When viewing the root masses with the use of closed-circuit TV, a root mass looks brown and dirty. Usually, root masses tend to reflect light causing glare and "hot spots". Dead root masses look very similar to live root masses, particularly if the roots are inspected quickly after an application. The inspection then becomes a case of judgment on the part of the inspector.

With time, the treated root mass becomes smaller due to decay and breakage. The contents of a dead root mass become soft and brittle, breaking off easily as the camera passes. These are all factors in assessing the success of a chemical root control treatment. Removing a root mass from the pipe for a detailed visual inspection can significantly increase the confidence level of these judgment calls.

Examining Root Masses

Like the trees above ground, roots grow in diameter by adding cells between the dead tissue in the root center and the dead bark (skin) on the outside. These healthy living cells create a light colored almost white layer under the bark. When a root is killed, this layer turns brown. By stripping the bark layer off the individual roots in a root mass, the effectiveness of a specific chemical treatment can be determined. When performing this visual test, you need to remember that you are examining only one of perhaps hundreds of root masses from the specific section(s) of the treated line. Due to non-standardized conditions in a sewer system, what you find in one root mass may not be what you find in the next.

Perhaps the most reliable method of judging the success of a chemical root control program is to determine the rate of reduction in sewer stoppages, overflows, emergency calls, and other root-related sewer problems. For example, a municipality experiences 100 stoppages (average) per year with no chemical root control program. After initiating a root control program, the municipality experiences two stoppages in the two years immediately after the start of the program. Obviously, the program has shown positive results, and the chemical root control program is effective. The program could be justified by weighing the cost of the root control program against the cost of relieving stoppages and the damage caused by stoppages.

The ultimate goal of a root control program is to totally eliminate all root masses within a sewer line or sewer system. In reality, a successful program is one in which the roots are managed at a level where the cost and risk of application is less than the cost and risk of unwanted sewer blockages and damaged pipes.

Practice Test - Chapter 5

Read and complete the questions below. Correct questions are found on pages 49-50.

Q. Briefly describe two types of foaming equipment.

Q. Name the foaming techniques used for applying metam-sodium root control chemicals.

Q. When filling a mix tank, how can you prevent backsiphoning?

Q. What are the major steps for handling a pesticide spill?

Q. How can an applicator calculate the amount of chemical required for a specific job?

Q. Why is it necessary for the certified applicator to communicate with treatment plant personnel?

Q. How do you calculate the hose retrieval rate?

Q. How can the applicator determine the effectiveness of root control treatments?

Practice Test Answers

The following are answers to the practical tests at the end of each chapter. Although answering these questions correctly will not guarantee a passing score on the Aquatic Pest Examination, a good score (above 90%) on all of these tests will significantly help you choose the correct answers on the certification test.

Chapter 1 Answers

Q. When may tree roots be considered a pest?
A. When they become pests, when they affect humans property and well-being especially when they invade and damage sewer pipes in search of food and water.

Q. Name several different types of pests.
A. Certain insects, other invertebrate organisms such as spiders and ticks, plant diseases, weeds, and vertebrates such as mice and rats.

Q. What is a pesticide?
A. A pesticide is any substance or mixture of substances intended to prevent, destroy, repel or mitigate any pest, or for use as a plant regulator defoliant or desiccant.

Q. What is the most significant regulation governing the use of pesticides?
A. The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

Q. What is the major state regulatory laws in Idaho and who administers them?
A. The Idaho Pesticide Act of 1976 (as amended) is administered by the Idaho State Department of Agriculture.

Chapter 2 Answers

Q. Name the two types of root systems associated with sewer problems.
A. Fibrous root systems and taproot systems.

Q. Name at least three factors around sewer pipes that influence root growth.
A. Factors include:
1. Backfill soil around the pipe is more favorable than compacted soil.
2. Roots are hydrotropic and seek moisture.
3. A dropping water table will encourage roots to grow deeper in search of moisture.
4. Warmer temperatures around pipes are more attractive than colder surface temperatures.

Q. Describe the two types of root structures found in sewer lines.
A. Veil root structures hang from pipes with steady flows and sweep the tops of the flow or nutrient. Tail root structures grow into pipes with low or intermittent flow and look like a horse's tail growing downstream.

Q. Name three different non-chemical root control methods.
A Cultural control, physical control and mechanical control.

Q. Explain differences between contact and systemic herbicides and between selective and non-selective herbicides.

A. Contact herbicides quickly kill only that part of the plant they contact while systemic herbicides kill a plant more slowly as they are transported throughout the plant. Selective herbicides will affect one type of plant such as broadleaf or grasses whereas non-selective herbicides affect all plants.

Q. Name three methods used to identify which lines have root problems.
A. Maintenance histories (scattergram), sewer line television reports and commonalties in root prone areas.

Chapter 3 Answers

Q. What is a pesticide formulation?
A. A formulation is a mixture if active ingredients (pesticidal agent) and inert ingredients (carriers and other agents such as foam).

Q. Describe the formulations used with metam-sodium root control products.
A. Metam-sodium is a liquid formulation that includes a foaming agent or requires a foaming agent to be added prior to dispersal. Dichlobenil is a wettable powder that may be added to the metam-sodium foam mixture.

Q. Describe what happens to metam-sodium in the presence of water.
A. Metam-sodium mixed with water will hydrolyze to form MITC, H_2S, CS_2 and other minor products.

Q. How can hydrolysis of metam-sodium affect an applicator?
A. MITC, a product of hydrolysis, is a highly toxic gas. Irritation of mucus membranes, eyes, ears, nose, throat and lungs.

Q. Why is dichlobenil added to metam-sodium as a root control pesticide?
A. Metam-sodium is a contact herbicide, killing only the root parts it contacts. Dichlobenil is a residual type herbicide that continues to control root growth for a period after application.

Chapter 4 Answers

Q. What are the three components of handling wastewater?
A. The three components are collection, treatment and disposal.

Q. What is the difference between a sanitary sewer and storm sewer?
A. A sanitary sewer collects wastes from buildings and transports it to a treatment plant before emptying into a watercourse. A storm sewer collects surface runoff water and transports it directly to a watercourse.

Q. Name several variables in a wastewater collection system that will influence root control operations.
A. Root control operations may be affected by the pipe slope/grade, the flow, characteristics of the collection system, aging of the wastewater and generation of gasses.

Q. Describe the series of treatment process removing waste from water.
A. Pretreatment/preliminary treatment processes remove coarse material from the wastewater. Primary process involves settling out or floating solid matter for removal. Secondary treatment consists of biological processes converting missed solids into more easily removed material.

Q. What is the purpose of waste treatment ponds (lagoons)?
A. To treat wastes remaining after the other processes. Flow through time is 4-60 days, depending upon design.

Q. What is the difference between design flow and actual flow?
A. Design flow is the amount of flow a system is designed to handle daily. The actual flow is the amount of flow actually passed through a system daily.

Q. How can metam-sodium seriously affect the operation of a treatment plant?
A. If a treatment plant is under stress, the addition of even a small amount of metam-sodium could upset the biological processes and last from hours to days.

Q. What is the applicator's main concern when treating building service lateral line?
A. Forcing foam root control pesticide through lateral lines into buildings.

Chapter 5 Answers

Q. Briefly describe two types of foaming equipment.
A. The following are the two types of foaming equipment generally used to treat sewer lines.

1. Utilizes a 30 - 300-gallon mix tank in which chemical and water are mixed. The solution is delivered under pressure to a foam production chamber then pumped out as chemical foam.
2. Utilizes a small (3-6 gallon) tank into which only chemical is mixed. The chemical is pumped under pressure to a venturi where it is introduced into the water stream and into a foam chamber. Foam is then pumped out for application.

Q. Name the foaming techniques used for applying metam-sodium root control chemicals.
A. The following are the types of foaming techniques used for applying metam sodium in sewer lines.

- Hose insertion method, split hose insertion method, hose insertion
- "Pushing a slug", hose insertion
- "Pulling the water out", hose insertion
- "Treating Wye connections"
- Surface coating large diameter pipe
- Spot treatments
- Pushing foam through inflatable plugs

Q. When filling a mix tank, how can you prevent backsiphoning?
A. By using an air gap between hose and tank; by using a backflow preventer or by using an intermediate water source, such as a jetter or separate fill tank.

Q. What are the major steps for handling a pesticide spill?
A. Control the spill to prevent spilling more pesticide. Confine the spill to keep it from spreading. Clean up the spill by placing it in labeled containers and disposing of the material in an approved manner.

Q. How can an applicator calculate the amount of chemical required for a specific job?
A. Determine if the foam fill or foam spray method will be used. Select the appropriate chart for that method. Then refer to the product's label to determine the amount of water to mix with 1 part of chemical. This total will be used in the "dilution ration required "column to complete the calculation.

Q. Why is it necessary for the certified applicator to communicate with treatment plant personnel?

A. Informing treatment plant personnel is very important for a number of reasons.

1. To alert personnel that a chemical will be introduced into their system so they may monitor for signs of upset and any unusual side effects from the chemical.
2. To obtain the necessary permits to treat sewer lines (if required)
3. To obtain information about times of high flow, sizes of pipe to be treated, and distances between different sewer structures such as lift stations and treatment plant

Q. How do you calculate the hose retrieval rate?

A. Determine the gallons of foam required per foot of sewer pipe. Next, determine the gallons per minute that the application equipment produces. Then divide the amount of foam produced per minute by the foam required per foot to determine the hose retrieval rate in feet per minute. A chart is also available to assist the applicator.

Q. How can the applicator determine the effectiveness of root control treatments?

A. This is not easy. A combination of:

- Television inspection
- Pulling treated root masses and inspecting them for live tissue
- Comparing the rate of sewer stoppages before and after treatment

GLOSSARY

Activated Charcoal: Finely ground or granulated charcoal that adsorbs chemicals.

Active Ingredient: The chemical or chemicals in a product responsible for pesticidal activity.

Acute Toxicity: The capacity of a chemical to cause injury from a single exposure.

Adherence: The ability of a pesticide or substance to stick to a surface.

Adjuvant: A substance added to a pesticide to improve its effectiveness or safety. Examples: penetrants, spreader-stickers and wetting agents.

Adsorption: The process where chemicals are held or bound to a surface by physical or chemical attraction. Clay, charcoal, and high organic soils adsorb pesticides.

Agitation: Process of stirring a pesticide solution so as to keep wettable powders, etc. in suspension.

Anti-Siphoning Device: A mechanism used to prevent the flow of a pesticide solution from a mix tank to a water source.

Back-Flow Preventer: see "Anti-Siphoning Device".

Backsiphoning: The action of water siphoning from the fill tank back to its original source; opposite the direction of fill.

Bactericide: A pesticide that destroys or prevents the growth of bacteria.

Basal Application: Application of a pesticide to plant stems or tree trunks just above the ground line.

Building Sewer: That portion of a sewer system that lies between the building foundation and the collector sewer. Also called lateral sewer.

Bypass Pumping: The process of temporary re-routing sewer flows around a given section of sewer.

Calibration: The process of adjusting application equipment so that pesticides are applied at the proper rate. Also, the process of determining the rate at which a given piece of application equipment discharges pesticides.

Carrier: An inert ingredient used to dilute a mixture of pesticides, or to transport a pesticide to target.

Chemical Name: The scientific name for a chemical substance. Example: Sodium Methyldithiocarbamate is the chemical name for metam sodium.

CHEMTREC: The Chemical Transportation Emergency Center. This organization operates a 24-hour information hot-line for pesticide spills, fires, and accidents. 1-800424-9300.

Chronic Toxicity: The long-term effects of exposure to a pesticide.

Collector Sewer: A sewer, typically small diameter, which collects wastewater flows from buildings and transports those flows to an interceptor sewer.

Combined Sewer: A sewer that is designed to carry both sanitary flows and. storm water, either all or part of the time.

Combined Sewer Overflow: see Overflow.

Commercial Applicator: One who engages in the business of applying pesticides to the property of another. Idaho State requires commercial applicators to be licensed through the Idaho State Department of Agriculture. (See Professional Applicator)

Common Name: A generic name given to an active ingredient that is generally accepted in pesticide nomenclature. Distinguished from chemical name or brand name. Examples: Metam, dichlobenil, Copper Sulfate.

Compatibility: The ability of two pesticides or substances to mix without reducing the effectiveness or usefulness of either substance.

Contact Herbicide: A chemical that kills primarily by contact with plant tissue, with little or no translocation.

Copper Sulfate: Chemical that was used extensively for root control in sewer lines and other aquatic weed control purposes. Is not used extensively in current sewer root control or weed control due to its toxic effects to aquatic invertebrates and possible accumulation in sludge.

Cure-In-Place Lining: Lining that is inserted into an existing sewer line, inflated to conform to the shape of the pipe, then cured to provide a resilient protective liner.

Decomposition/Degradation: The process by which a chemical substance is broken down into simpler substances. This process can take place through chemical, biological, or physical means.

Deposit: The amount of pesticide left on a treated surface (noun). Also, the process of leaving a pesticide on a treated surface (verb).

Dermal Exposure: The absorption of a pesticide through the skin, eyes, or mucous membranes.

Dermal Toxicity: The ability of a pesticide to cause injury to a human or animal when absorbed through the skin.

Desiccant: A chemical that promotes drying or loss of moisture from plants and animals such as insects.

Detoxify: The ability of a substance or process to render a pesticide harmless.

Dichlobenil: A residual type pesticide that is frequently added to metam-sodium for root control to provide additional long-term root control.

Drill Machine: Also called Coil Rodders. Hand or power-driven flexible steel cables that turn augers or blades within the sewer. Are used to relieve blockages in sewer lines.

Dust: A dry mixture containing pesticide(s) and inert ingredients.

Easement: In sewer work, the location of a sewer line in back-yards, parks, public lands, off-road, or other areas which are typically more difficult to access than sewers located beneath street surfaces. Also, the right of government to access manholes and sewer lines which are located on private property.

Effluent: Water that is leaving a structure. Example: the discharge from a water treatment plant.

Engineer: In sewer work, the designated official of a municipality who represents and is authorized to act on behalf of a municipality with respect to the municipality's dealings with a contractor.

Exfiltration: The leakage of water or other substances from a sewer pipe into the ground through joints, cracks, or defects.

EPA: The Environmental Protection Agency, the federal agency-responsible for regulating and enforcing the registration, sale and use of pesticides.

EPA Registration Number: The number assigned to a pesticide by the EPA. This number must appear on all pesticide labels.

FIFFA: The Federal insecticide, Fungicide, and Rodenticide Act. Most important legislation concerning pesticide usage.

Foaming Agent: An adjuvant used to convert a pesticide solution into thick foam. Used in agriculture to prevent drift; in sewer line root control as a carrier and to prevent drift.

Foam Retardant: An adjuvant used to prevent foaming of a pesticide mixture.

Formulation: A mixture of pesticide(s) and inert ingredients. The pesticide product as purchased.

French Drain: A perforated or porous conduit used to remove groundwater from an area and convey it downstream.

Fumigants: Pesticides which form a vapor or gas, usually in a confined space or enclosed area, that are toxic when absorbed or inhaled.

Fungicide: A pesticide that kills or controls fungi.

General Use Pesticide: A pesticide that can be purchased and used by an applicator without special training or state certification.

Germicide: A pesticide that kills or controls pathogenic (disease carrying) bacteria.

GPM: Gallons per minute.

Groundwater: Water beneath the earth's surface such as aquifers.

Grouting: The process of sealing pipe joints or other open sewer defects against groundwater infiltration.

Herbicide: A pesticide used to control or kill undesirable plants.

Hydrojetter: Also known as flushers, flush trucks, jet rodders, jet trucks, and hydraulic sewer cleaners. Hydrojetters consist of a high-pressure water pump, water tank, hose reel, and 1/2" to 1" sewer cleaning hose. Orifices in the rear of the nozzle propel the hose through the sewer. The nozzle is designed to use water pressure to blasts through obstructions within sewer lines.

Idaho State Department of Agriculture: (ISDA) The responsible Idaho State Agency for the administration and enforcement of pesticide laws and rules. Also administers to the certification of state pesticide applicators.

Incompatible: Two pesticides or substances that cannot be mixed together without adversely effecting their usefulness.

Inert Ingredients: A material that has no pesticidal effect, but which is contained in a pesticide formulation.

Infiltration: Ground water that enters sewer systems through joints or other defects.

Infiltration Inflow Control (IIC): In general, the process of abating or controlling the introduction of extraneous water in a sewer system. Examples: grouting, re4ining, manhole rehabilitation, etc.

Inflow: Distinguished from infiltration, extraneous water other than groundwater that enters a sewer system. Examples: surface water that enters through manhole covers, water coming from roof leaders and foundation drains.

Inhalation: Exposure to a pesticide by breathing it in through the mouth or nose into the lungs.

Influent:	Water that is entering a structure. Example: sanitary sewer flows entering a wastewater treatment plant.
Inspector:	A representative of the Owner or municipality who is actually on the job site supervising the quality of workmanship and materials.
Interceptor Sewer:	Typically a large diameter sewer without service connections, which receives flows from collector sewers and transports the flows to a wastewater treatment plant.
Invert:	The lowest point of a pipeline or conduit. The bottom part of a manhole that is rounded to conform to the shape of the sewer line.
Joints:	The connection between two contiguous pieces of sewer pipe.
Jetters:	Also known as flushers, flush trucks, jet rodders, jet trucks, and hydraulic sewer cleaners. Consist of a high-pressure water pump, water tank, hose reel, and the cleaning hose. Uses hydraulic pressure to clear obstructions within sewer lines. Usually used in conjunction with other mechanical means.
Lateral Sewer:	Same as building sewer.
Leaching:	The downward movement of a pesticide through soil by the movement of water.
Lineal Feet:	A measurement of distance, in a straight line, between two contiguous manholes in a sewer system.
LD_{50}:	The average lethal dose of a given pesticide for a given species. The amount that will theoretically kill 50% of a test group. Usually expressed in parts per million
Manhole Section:	Same as Sewer Section.
Mechanical Control:	The most common method of root control. Utilizes tools or other devices that cut and remove roots from sewers.
Metam-Sodium:	Fumigant pesticide used for sewer line root control. Metam-sodium breaks down into a gas (methylisothiocyanate, MITC) which kills plant roots.
MGD:	Millions of gallons per day. Used to express the design flow capacity, or actual flow, of a wastewater treatment facility.
Nematicide:	A pesticide used to kill or control nematodes.
Nematode:	Microscopic, colorless, worm-like animals that live as saprophytes or parasites. Many cause diseases or plants and animals.

Non-Systemic: A pesticide, usually a contact pesticide, which has a localized pesticidal effect only on the part of the plant or animal actually not transported through the plant or animal system in pesticidal concentrations.

Nonselective: A pesticide which kills or controls any living thing, or which is toxic to a wide range of organisms.

Oral toxicity: The occurrence of injury when a pesticide is ingested through the mouth.

Overflow: An undesirable discharge of sanitary or combine4 sewer flow into a river, stream, or other surface waters.

Owner: In sewer work, the municipality or public agency that maintains public sewers.

Parts per million (ppm): A typical measure of the concentration of a pesticide in another substance, or pesticide residues. One gallon of active ingredient in 1,000,000 gallons of water which represent 1 part per million.

Persistence: The ability of a pesticide to resist chemical or biological degradation, and therefore remains in the environment for an extended period of time.

Personal Protective Equipment (PPE): Protective equipment that maintains a physical barrier between the wearer and the chemical being applied. Equipment that protects the pesticide applicator from exposure.

Pesticide: Any chemical that will kill, repel, or otherwise control an unwanted plant, animal, fish, bird, insect, or microorganism.

Pipe Lining: Materials that are placed inside existing pipes during a relining process that enhances the longevity of existing sewer lines.

Phytotoxic: Toxic to plant life. Can be desired or undesired.

Professional Applicator: Applicator that applies chemicals (Pesticides) to property that is not owned, leased or rented by him/her for compensation.

Receiving Waters: The body of water to which wastewater treatments plants or storm sewers discharge.

Restricted Entry Interval: The period between the application of a pesticide and the time when people can reenter the treated area without having to wear PPE.

Residual Pesticide: A pesticide that remains active for an extended period of time.

Residues: The amount of pesticide that remains on the target or other surfaces following treatment.

Restricted Use Pesticide: (RUP) A pesticide which can only purchased by a certified pesticide applicator and used only by certified applicators or persons directly under their supervision. RUPs are not available to the general public because of high toxicity and/or environmental hazards.

Rodding Machine: Flexible steel rods with attached rotating blade cutters, augers, or corkscrew devices used to clear obstructions in sewer lines up to 12 inches in diameter.

Rodenticide: A pesticide used to kill or control rats, mice or other rodents.

Sanitary Sewer: A sewer designed to carry only residential or commercial waste.

Scattergram: A map of the sewer collection system with known root problem lines highlighted. Useful in determining problem or root prone areas.

Selective Pesticide: A pesticide that is toxic to some species, but not to others at selected rates.

Sewer Section: The length of sewer pipe connecting two manholes.

Slip Lining: A type of sewer pipe relining. A lining that is slipped into existing sewer pipes that extend the longevity of the existing pipe.

Soaking: A method of sewer line root control that is seldom used today due to the amount of chemical needed. Sewer lines are plugged at one end and filled with a pesticide solution, allowing the pesticide to soak into existing plant roots and pipe walls.

Soil Fumigant: A pesticide that forms a vapor or gas in soil, used to control pests in soil such as weed seeds, nematodes, bacteria, viruses, fungi, etc.

Soil Sterilant: A chemical, usually a herbicide, that renders the soil unfit for growing plants.

Solution: A mixture of one or more pesticides with another substance, usually water, in which all materials are dissolved or in suspension.

Spot Treatment: A local application of a pesticide to only a small area.

Spraying: A method of sewer line root control that is seldom used today. Involves spraying the walls of the sewer pipes with root control products and allowing them to remain for a determined amount of time for effective root control.

Storm Sewer: A sewer designed to carry only rain water, ground water or surface water.

Surcharge: The condition that exists when the volume of water exceeds the hydraulic capacity of a sewer.

Surfactant: A type of adjuvant that improves the spreading and/or wetting qualities of a pesticide.

Suspension: A pesticide mixture in which fine particles, usually a solid, float or mix evenly in water or oil.

Swale: A dip or sag in a sewer pipe, in which water and debris often collects.

Synergism: The action of two or more pesticides or substances that yields a result greater than that which any one of the substances is capable of achieving individually.

Systemic Pesticide: A chemical that is absorbed and translocated within a animal or plant. Some systemic pesticides are designed to protect the plant or animal against pests or else they are designed to cause injury to the organism.

Target: The organism to which pesticides are applied.

Three C's: Pertaining to pesticide spills. Means Control, Contain and Clean up.

Translocation: The movement of a pesticide through vascular plant tissue.

Trade Name: A brand name of a pesticide. The same active ingredient may be sold under different trade names. Example: "Vapam" is a trade name for metam.

Trifluralin: Known by the brand name of "Treflan". A pesticide that is applied to the exteriors of sewer pipes to enhance root control.

Volatility: The tendency for a substance to turn from a solid or a liquid to a gas.

Water Table: The upper level of water saturated ground.

Weed: Any plant, that because it is in the wrong place at the wrong time, is determinied undesirable by man.

Wettable Powder: A pesticide formulation made by impregnating a powder with an active ingredient and wetting agent.

Winches: Also called drag machines or bucket machines. Large, engine-driven winches that pull or drag buckets, brushes or scrapers through sewers for mechanical root control. Generally used on large diameter pipes or pipes requiring heavy cleaning.

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This manual produced by the Idaho State Department of Agriculture to promote the education and training of pesticide applicators throughout the state. Idaho State Department of Agriculture provides pesticide applicator certification and training programs, activities and materials without regard to race, color, religion, national origin, sex, age or disability in accordance with state and federal laws.

Idaho State Department of Agriculture
Patrick A. Takasugi, Director