

SEWER ROOT CONTROL

Category 16

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SEWER LINE ROOT CONTROL

PREFACE

This publication was prepared by specialists in the University of Kentucky Cooperative Extension Service. Material was adapted from the US EPA manual “Sewer Line Chemical Root Control with Emphasis on Foaming Methods Using Metam-Sodium”, originally developed under the direction of R. V. Bielarski and authored by E. Jessen and K. Duke. When used in conjunction with the EPA core manual, “Applying Pesticides Correctly,” this manual will provide information to meet minimum EPA standards for certification of commercial applicators in Category #, Sewer Line Root Control. Additional helpful information for Sewer Line Root Control applicators may be obtained from regulatory agencies, pesticide labeling, pesticide dealers, and pesticide industry representatives.

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INTRODUCTION: ROOT RELATED SEWER PROBLEMS

The intrusion of roots into waste collection pipes is probably the most destructive problem encountered in a sewer system. These roots can block or reduce flow, cause overflows, or reduce hydraulic capacity (leading to a loss of self-scouring velocities). Sewer pipes with blocked or reduced flow often have septic pools that produce hydrogen sulfide and other dangerous or odor causing gases. Roots also can damage pipes and other structural parts of the waste collection system. Because sewer systems are underground and out of sight, sewer stoppages and overflows are the way that most municipalities and homeowners find out about root problems. Structural damage, often more costly than stoppages, usually goes unnoticed until the damage is determined through television probing.

To be successful, any pest control program must be effective and must not cause harm to the public, the environment, or to the sewer system itself. The use of products containing metam-sodium is one of the most common methods of sewer line root control. Metam-sodium has been classified as a “Restricted Use” pesticide because of concerns that improper use of its formulations could adversely affect the health of humans, animals, and the environment. Sewer line root control is a matter of using the right technologies, safely. The purpose of this training manual is to provide the technical basics of sewer line root control, with an emphasis on the safe use of chemicals that contain metam-sodium.

ROOT GROWTH

Roots anchor and hold plants upright. They store food, and absorb water and nutrients. Roots are tenacious and long-lived. Often, a root system will live after the aboveground portions of a plant have been destroyed. Willow-tree root systems can survive for years after the top has been removed. The root systems of some grasses are believed to have been alive for thousands of years. Roots can also grow incredible distances to find water and nutrients: live tree roots have been found penetrating pipes in the Rocky Mountains almost 2 miles from the nearest tree.

Types of Root Systems. Plants may have either a *fibrous* or a *tap* root system. Plants with **fibrous root systems**, like most garden plants and grasses, occupy upper soil layers and are normally not associated with sewer problems. Trees and woody plants have **tap root systems**. The primary roots of tap root systems grow down into the soil, often reaching the water table. Secondary roots grow laterally from the primary root. These branches can grow to be several inches in diameter. If they invade sewer pipes, they can exert enough pressure to spread a pipe joint and break the pipe. The leading tip of a root shoot, the root **meristem**, senses and grows toward minute increases in nutrient and moisture gradients. This allows a root to locate a sewer pipe, which may be covered with coated condensation caused by temperature differences, or may be seeping nutrient-rich

water into surrounding soil from cracks, joints, or even from the porosity of the pipe itself.

Factors affecting root growth. The soil conditions around sewer lines can influence root growth. Backfill used during sewer construction may provide more favorable soil than undisturbed ground. Water table levels fluctuate seasonally. During drier seasons, tree roots will grow deeper in search of moisture. During colder seasons, roots may be drawn to the warmer soil surrounding a sewer pipe. Root growth is generally greatest in fall, winter, and in the spring before the tree leafs out. This is when roots store and distribute nutrients. Root growth is less active in the spring and summer when the aboveground parts of the plant are growing.

Root growth into sewer pipes. In urban areas, tree roots may have a hard time finding good sources of nutrients. Limited green space, the removal of leaves and other organic debris from lawns, and the draining away of surface water by sewer systems cause roots to seek water and nutrition at greater depths. Roots thrive in sewer pipes. The sewage system is a perfect environment: well-ventilated, oxygen-rich, and full with water and nutrients. Microscopic openings in sewer systems can permit hair-like root structures to penetrate pipe joints, cracks, connections, or any other opening. A secondary root may grow alongside a sewer pipe for many feet, exploiting each opportunity to penetrate into the system.

The roots of most trees cannot grow or survive if they are constantly submerged so roots are usually not a problem in sewers that are located below a permanent water table. If the water table fluctuates, or if porous soil profiles allow 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 into the sewer system carry on metabolic activity while the woody, submerged portion of the root systems serve as a pipeline for plant nutrients.

Types of root invasions. The two types of root structures found in sewer lines are known as *veil* and *tail*. A **veil root structure** occurs in lines with steady, constant flows, such as interceptor pipes. The roots penetrate the pipe at the top or sides and hang from the upper surface like a curtain, touching the flow. The roots rake the flow and accumulate solids, debris, grease, and other organic materials. Eventually, the root mass and accumulated material can cause flow blockage, and gasses may develop.

Tail root structures occur in sewers that have very low or intermittent flow, such as in small diameter collector sewers, building sewers, and storm drains. A tail root invasion 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 prevents root growth.

IDENTIFYING ROOT PROBLEMS IN SEWER LINES

Pest identification is usually the first and most important step in a pesticide control program but in sewer line root control, pest identification is not an issue. The species of tree producing nuisance roots does not matter. All roots in sewer lines are considered pests – there are no beneficial species. However, because the sewer system is underground, the cause of a blockage is not always apparent and may not always be due to root infiltration. Control with metam-sodium, for instance, is not warranted if the cause of a stoppage is not due to roots.

Ways to determine root problems in sewer collection lines:

Maintenance histories will indicate sewer lines that have experienced a stoppage and the cause of stoppage.

Sewer line television reports provide accurate evidence of a root problem.

Root prone areas. Sewer lines in the same area that were installed at the same time with similar nearby tree-planting patterns may experience similar root problems.

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

- Sewers located near other sewers with known root problems.
- Pipes located near the surface, closer to tree roots.
- Lines located off-road in wooded easements, in tree-lined streets, or at the curb line near trees and roots. In general, sewer lines in residential areas are more susceptible to root problems than lines in industrial areas.
- Lines with many lateral connections per lineal foot, affording greater opportunity for root intrusion.
- Sewer lines 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. Pipe with air-tight gaskets and seamless pipe are less susceptible.

A map (scattergram) of the local sewer system with known root problem lines highlighted is a useful tool for planning root control programs. As new problems arise and are highlighted on the map, patterns emerge which indicate that an area is root prone.

ROOT CONTROL METHODS

There are several chemical and non-chemical sewer line root control methods. In some cases, chemical treatments cannot be used, especially when near sewage treatment plants or because of some other environmental or safety consideration. In these cases, mechanical methods must be used. Some cultural control methods are also important preventative root control measures.

Non-Chemical Root Control Methods

Cultural control of roots in sewers are routine management practices that can prevent roots from invading lines. Cultural controls must be implemented before roots become a problem. The two most important cultural control methods are: 1) careful installation and inspection of sewer lines during construction, and 2) control over the selection of tree species and planting sites near sewer lines. Municipalities should carefully inspect connections where plumbers join building laterals to main sewer lines. 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 in particular have quick-growing, long-reaching roots. When a sewer root problem is detected, it is usually too late for cultural control.

Physical control. Physical control measures for sewer lines involve isolating the sewer pipe from the roots around or near the sewer pipe. Three examples of physical control are *tree removal*, *pipe replacement*, and *pipe re-lining*.

Tree removal works best when the roots of a single troublesome tree have invaded pipes. It is often difficult to convince homeowners to let their trees be removed. Removal is risky because it does not guarantee the death of the roots. For tree removal to be effective, the stump should be pulled or chemically treated with a basal application herbicide.

Pipe replacement involves removing old, defective sewer lines and laying down new pipes. The new sewers should have airtight joints and properly installed connections in order to prevent roots from becoming a problem. Pipe replacement, however, is costly, often disrupts traffic, and damages property and trees near the sewer line. Also, roots can still enter through non-replaceable building sewers. If a pipe is in danger of collapsing or starting to fail, replacement may be the best control method.

Sewer line can also be rehabilitated by **pipe re-lining**. One method, “slip-lining,” involves pulling a seamless pipe through the existing sewer and digging only where building laterals require connecting. Another method, “cured-in-place” lining, involves inflating and curing a sock or plastic tube that conforms to the shape of the pipe. Then, robotic devices are used to cut building connections into the liner. Pipe re-lining can address root infiltration problems and correct some structural defects and is less disruptive than pipe replacement. It also can provide long-term control against root re-growth through joints. However, re-lining often is more costly than replacement, and roots can still enter through building laterals. Even after re-lining sewer main-lines, chemical control may be required to prevent roots from entering through service connections.

Mechanical control is the most important and common method of control. It involves the use of tools or other devices that cut and remove roots from sewers. Its main advantage is

that it is the only method for 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. Root masses grow back heavier each time they are cut. Tap roots continue to grow in diameter and, in time, place stress on sewer pipe. 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 and physical control (for example, to prepare sewer lines for pipe re-lining).

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

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

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 ½” to 1” sewer cleaning hose. Water shooting through orifices in the rear of the nozzle propels the hose through the sewer, blasting it through obstructions. As the hose and nozzle are retrieved, debris is hydraulically flushed back to the insertion manhole for removal. Jetters can also be equipped with water-propelled spinning root cutters. Root cutters often get snagged however, and 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. Winches are most often used in large diameter sewers that cannot be cleaned efficiently with jetters. Winches are useful for heavy cleaning to remove large volumes of solids.

Chemical Root Controls

Root control products, like all chemicals used to kill plants, are herbicides. Herbicides kill plants by *contact* or *systemic* action. **Contact herbicides**, like metam-sodium, have a localized effect and cause quick dieback only of the parts of the plant that they touch. **Systemic herbicides** are absorbed by roots or foliage and are carried throughout the plant. They take time, two weeks or more, to provide desired results.

Herbicide activity is either *selective* or *non-selective*. **Selective herbicides** kill only certain types of plants, and are used to reduce unwanted weeds without harming desirable plants. Some herbicides, for instance, affect only broadleaf plants, while others affect only grasses. **Non-selective herbicides** kill all plants contacted if applied at an adequate

rate. They are used when no plant growth is wanted. Metam-sodium is a non-selective herbicide.

METAM-SODIUM AND DICHLOBENIL

Metam-sodium and dichlobenil have been used together to control roots in sewers in Kentucky for approximately 30 years. Metam-sodium kills the plant roots, while dichlobenil is an effective growth inhibitor. They are applied together as a dry foam.

Metam-sodium

Metam-sodium (sodium-N-methyldithiocarbamate) is also known as metam, metham-sodium, SMDC, and Vapam®. Metam-sodium is a fumigant. It breaks down into a gas, methylisothiocyanate (MITC), which kills the plant roots.

Formulation. Metam-sodium products are currently available as 18% - 42% aqueous solutions (AS). At present, metam-sodium products for sewer usage may only be applied as a foam similar to that of an aerosol shaving cream. The dryer phase of this foam is used to treat smaller pipe (less than 12" – 14" diameter). 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.

Foam is used to deliver root control chemicals because it:

- effectively fills the pipe void above the flow line, contacting the pipe walls and root masses
- does not break down for a period of time after application, maintaining the required contact time
- prevents metam vapor from drifting through pipes into manholes and house vents
- contains surfactants and emulsifiers which increase the effectiveness of the treatment by assisting the herbicides in penetrating through the grease and organic deposits on root masses

Status. Metam-sodium is a Restricted Use pesticide. Products intended for sewer root control that contain it can only be purchased and/or applied by or under the direct supervision of an applicator certified in this category. Labels of products containing metam-sodium display the signal word **DANGER**. This indicates that metam-sodium is a highly toxic pesticide that is very likely to cause acute illness from oral, dermal, or inhalation exposure, or to cause severe eye or skin irritation.

Reactivity. Metam-sodium is stable under normal conditions and very stable at a pH of 8.8 or greater. Metam-sodium is unstable below pH 7. Under this condition, it breaks down into other products. Prolonged exposure to air results in gradual decomposition to form MITC, a poisonous gas. 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 metam-sodium and may reach unsafe levels in poorly ventilated or

confined spaces. **The use of air-supplied respirators is required under such conditions.**

During normal conditions, metam-sodium is diluted with water and air is added to form a foam. Dilution causes rapid breakdown of the metam-sodium.

Toxicology. Metam sodium is acutely toxic and is considered a possible carcinogen by the U.S. EPA. Its breakdown product and the actual pesticidal compound, MITC, is a potent mucus membrane irritant. Studies with laboratory animals fed the active ingredient for several days can cause pregnant females to lose weight, early pregnancy loss, and fetuses and offspring to have skeletal irregularities and brain defects. Metam sodium is a mutagen. In cultures of human cells it has caused increased chromosomal aberrations.

Metam sodium is a Category I for skin irritation, Category II for acute dermal toxicity and Category III/IV for eye irritation. Skin exposure tests demonstrated significant adverse effects to the immune system of laboratory animals. Metam sodium breaks down into several other toxic chemicals. These include two highly flammable and toxic compounds, monomethylamine and carbon disulfide. Carbon disulfide is listed as a female and male reproductive toxicant, and as a developmental toxicant. It can be inhaled or absorbed through the skin, and rapidly enters the bloodstream through the lungs. It interferes with alcohol metabolism, which can result in alcohol poisoning if an exposed person ingests alcohol. Carbon disulfide causes direct injury to the cells lining the blood vessels and changes the body's metabolism of fats. Hydrogen sulfide is another highly toxic decomposition product of metam-sodium.

Inhalation exposure. The risk of exposure to metam-sodium itself by inhalation is assumed to be slight. However, metam-sodium decomposes to MITC, CS₂, H₂S, and other gases. MITC is extremely irritating to respiratory mucous membranes, eyes, and 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 as a result of inhaling MITC, the victim should be transported promptly to a medical facility.

Dermal exposure. Exposure to metam-sodium through the skin is expected to be slight if adequate personal protection equipment (PPE) is worn. These include chemical resistant gloves, a long-sleeved shirt, goggles and/or any other equipment (as stated on product label or labeling). Since the surface of the skin is acidic (pH 4.5 – 6) metam-sodium will decompose to MITC upon contact. It is extremely irritating to the skin and eyes. Exposed areas should be treated immediately with copious amounts of water to avoid burns and corneal injury. Medical attention should be sought if pain or irritation persists.

Environmental Hazards

Some environmental statements appear on nearly every pesticide label. They are reminders of common sense ways to avoid contaminating the environment. Metam-sodium root control labels follow these general statements with specific toxicity statements and steps to take to avoid harming the environment. For example, the metam sodium label contains:

- The statement “toxic to fish and wildlife,” and “equipment washwaters and wastes resulting from the use of this product may be disposed of on-site according to label directions for use,” by flushing the wastes into the sewer line just treated, “or at an approved waste disposal facility.”
- Precautions not to use the product “in storm, field, or other drains unless the effluent is treated in a sanitary sewer system.” And, “keep of lawns and plants as they may be severely injured.”
- Instructions on how to clean spill areas: “foam should be shoveled off planted areas immediately rather than washing of with water.”

Flammability

The metam-sodium root control label reads, “**Do not use or store near heat or open flames.**”

Other Precautions

Metam-sodium root control product labels contain two special USE PRECAUTION sections, “**Use precaution around buildings**” and “**Use precaution around wastewater treatment plants.**” These concerns are discussed in detail in sections to follow.

Dichlobenil

Dichlobenil is a residual-type pesticide formulated as a 50% or 85% wettable powder for sewer use. Dichlobenil kills weeds by impairing metabolic processes that are unique to plant life. Toxicity to mammals is considered low. However, care should be exercised when handling this and any pesticide, especially when used in combination with other pesticides such as metam-sodium. Consult the product’s labeling for precautionary instructions.

APPLICATION OF METAM-SODIUM FOR ROOT CONTROL

Using proper application methods and correctly calibrating equipment can assure the most effective use of root control chemicals. Proper use of chemicals and equipment minimizes the operation costs for the applicator and protects the health and safety of the applicator, the public, the environment, and the wastewater collection system.

Application Equipment

The design and components of foam generating equipment vary but the basic steps of operation are the same:

- 1) The chemicals and wetting/foaming agents are diluted with water according to the manufacturer's label instructions. One type of equipment uses a trailer mounted mix tank (30 – 300 gallons) in which the chemical ingredients are diluted with water. The trailer is then used to transport the chemical to various application sites. 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 – 6 gallon chemical tank in which the chemical ingredients are mixed, but water is not added. This unit has a positive displacement roller pump or 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 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 concentration of active ingredients in the product, as indicated on the product label.

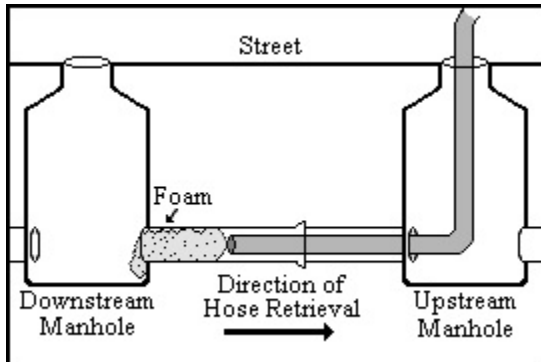
- 2) 10 to 15 CFM (80 – 140 psi) of air from a compressor is combined with the water/chemical solution in the foam production chamber producing the desired foam.
- 3) Foam is delivered to the interior of the pipe through hoses varying in size from ¾" – 1¼".

Foaming Techniques for Applying Metam-Sodium Products

Hose Insertion Method

This is the most common and lowest risk method of foam application. A foam delivery hose is inserted through the section of pipe to be treated. Foam is pumped from a foam generator through the hose as it is retracted at a predetermined rate. The foam delivery hose may require an external mechanism such as a hydrojetter or rodding-machine to move the hose through the pipe prior to the foaming process. This procedure utilizes a two-stage nozzle with foam generation equipment adapted to a standard high-pressure hydrojetter. The two-stage nozzle allows the hydrojetter to "jet" through the pipe to be

treated. When the pressure drops, the large portion of the nozzle opens to allow the unrestricted flow of foam to be pumped through. The insertion manhole may be upstream or downstream. Whenever possible, however, the upstream manhole is the best for insertion, as this avoids drift toward the applicator. The pumping equipment is started once the hose reaches the other manhole. When foam begins to appear, the discharge hose is retracted at a specific rate. With jetters it is recommended that moderate pressures be used when inserting the hose into the pipe. High pressures and excessive cleaning may result in excessive root damage, which can hinder the efficiency of the root control chemicals.



Hose Insertion Method

Hose Insertion Method – Split Treatments

Sometimes 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 these cases, it may be necessary to use two set-ups to treat a section. With this technique, treat the downstream portion first, as this reduces drift toward the applicator.

Hose Insertion Method – Pushing a Slug

Foam will penetrate a distance beyond the discharge nozzle. If masses of roots or other 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” of foam meet and overlap. **EXTREME CAUTION:** Foam may travel further than desired up service laterals when this method is used. Foam will always take the path of least resistance, which may be up a cellar floor drain or through outside building clean-outs.

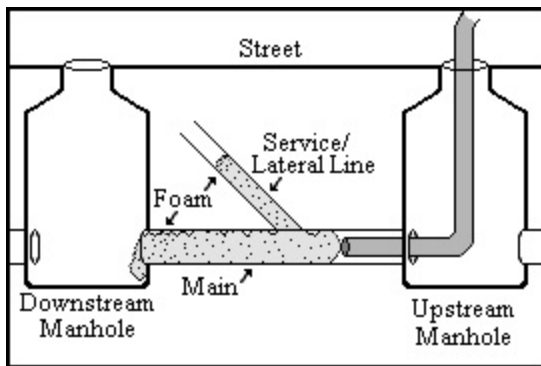
Hose Insertion Method – “Pulling the Water Out”

In some cases sewer pipe may have inadequate slope, 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 Service Lateral Connections from the Main

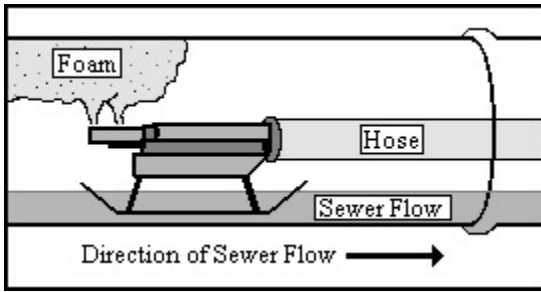
Often it is desirable to treat service connections from the main. This provides an important side benefit to homeowners. Generally treating service connections from the main is only feasible in small diameter (6" – 10") pipe. In large diameter pipe it is not possible to build up the pressures needed to penetrate service connections. Additional foam in the amount needed for the given number and size of building laterals is required to use this method. **EXTREME CAUTION** is required to prevent foam from reaching building floor drains or outside sewer cleanouts.



Treating Service Lateral Connections from the Main

Surface Coating Large Diameter Pipes

When treating large diameter pipe it is often impossible or too costly to completely fill the sewer line with foam. Remember, though, that only the chemical that contacts roots is useful. Excess chemical is wasted and could affect the downstream treatment plant. To coat the pipe surface in large diameter pipes, an elevated nozzle is pulled through the sewer. Foam is ejected through the nozzle above the wastewater 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. The chemical supplier will provide help on calculating the volume of foam needed to coat the upper surface in these situations. Surface coating often does not yield the results obtained by filling the pipe. The foam is not under pressure and will not penetrate root masses as effectively. Repeat treatments may be necessary as layers of root tissue are killed off. Also, surface coating will not allow for foam penetration into service connections. Surface coating is also sometimes used on small diameter pipe when heavy flow rates preclude filling the pipe with foam.



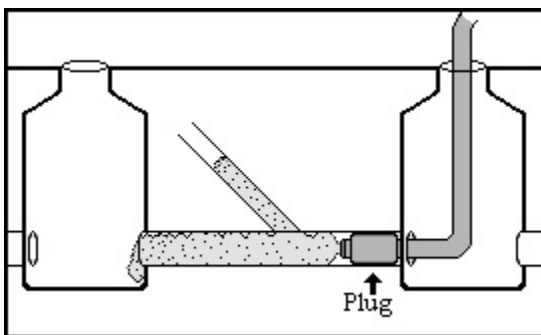
Surface Coating Large Diameter Pipes

Spot Treatments

Spot treatments may be used with either foam filling or surface coating techniques to isolate treatment to specific places where roots exist. The advantage of spot treatments is that less material is usually required. It is necessary, however, to know exactly where roots are in the pipe. This requires up-to-date TV inspection. More roots may have penetrated if TV inspection footage is out of date. Additionally, initial root penetrations are frequently missed or unnoticed by TV inspection. Spot treatments are most useful in large diameter lines where the increased cost of material offsets the cost of TV inspection. The amount of chemicals that can be saved in small diameter pipe is usually negligible compared to the cost of TV inspection. For best results in spot treatments, approximately 10 feet to each side of a root intrusion is also treated.

Pushing Foam Through Inflatable Plugs

In some cases it may be desirable to “push” foam through inflatable, hose-through plugs. These plugs are available through plug vendors in the sewer industry. The hose is inserted at one end of the line with the hose running through it. The plug is inflated and foam injected in a volume required to fill the pipe, or until foam appears at the opposite manhole. **CAUTION:** This is a high-risk method. Because foam always follows the path of least resistance, there is a significant hazard of foam backing into buildings when this method is used. 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.



Pushing Foam Through Inflatable Plug

Treating Building Sewers

Treating house lines also involves the use of hose-through plugs. Some equipment manufacturers have developed specialized portable equipment for treating building sewers. The hose-through plug is inserted in a cleanout that is downstream from all other cleanouts and fixtures. If there are any cleanouts or fixtures downstream from the insertion cleanout, they must be plugged. The calculated volume of foam necessary to treat the given distance of building sewer is then pumped.

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. **CAUTION:** Improper application may result in foam being discharged into houses. ***Building occupants must be alerted that treatment is taking place, and should be advised to exit the building if the rotten egg or sulfur-like odor of metam-sodium is detected.***

Mixing the Chemical

Due to differences in packaged products, specific mixing instructions must be obtained from the label of the metam-sodium root control product being applied. Mixing instructions must also be obtained from the equipment manufacturer for the specific 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 product label instructions. 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 alone in a small chemical tank to be automatically mixed 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. Mild agitation is necessary to keep dichlobenil in suspension.

The chemical mixture should be used promptly after mixing. The applicator should not mix more solution than will be used in one day. To determine the amount of solution needed, the applicator must 1) determine the method of treatment, 2) determine the total footage of pipe and diameters of all lines to be treated, and 3) calculate the chemical mix ratio and the amount of chemical/water solution to prepare.

Calibrating Foam/Solution Expansion Ratio

The applicator must know how to calibrate application equipment to get proper consistency and volume. Below are general guidelines for equipment and foam calibration. The equipment manufacturer should be consulted for more specific details.

To generate a foam application, air is introduced into the metam-sodium root control chemical mixture by an air-compressor. Proper foam quality (chemical/water to foam expansion ratio) is an important factor in achieving successful root control. The industry standard for dry foam is to generate 20 gallons of foam from 1 gallon of chemical-water

solution; a 1:20 ratio. For the proper expansion ratio, 1 part, or 1 gallon, of chemical/water solution will expand to 20 parts, or gallons, of chemical/foam solution. Proper foam will be dense and have small bubbles. It will cling to pipe surfaces, maintain its shape for a specified period of time, and contain the proper concentration of active ingredient per cubic foot of foam. A foam with an expansion ratio of less than 1:20 will be a “wetter” foam. A wet foam will be “runny” and will not stick to pipe surfaces. It will also be “heavy” and will collapse quickly, not holding its shape in the pipe. Additionally, wet foams will not fill pipe volumes at normal retrieval rates or penetrate wye connections. A “dryer” foam will have an expansion ratio greater than 1:20. Dryer foam will have large bubbles and will not carry a sufficient concentration of active ingredient per cubic foot to be active on root chemicals.

NOTE: *Some manufacturers also provide formulations that produce a wetter foam used for treating large diameter pipe. Instructions for these formulations generally specify an expansion ratio of 14 gallons of foam from 1 gallon of chemical/water solution.*

Variations in foam quality can be made by adjusting the water/chemical solution volume (gallons per minute) versus the air volume (cubic feet/minute). Equipment manufacturer’s guidelines should be followed to make these adjustments. Water quality (hardness) may affect foam quality. If this is a problem, the chemical manufacturer or supplier should be consulted for adjustments. A simple test of foam quality is for the applicator to observe the foam discharging unobstructed from the hose into a manhole. If the foam is good, the stream will break into light balls and flakes of foam about 2 – 3 feet from the point of discharge. Tests for foam quality can be performed at a treatment site prior to application by using the appropriate amount of wetting/foaming agents without adding the active ingredients. This reduces the risk of exposure for the operators performing the test. The wetting/foaming agents can be readily obtained from the product manufacturer. To measure the foam more accurately, fill a 2000 ml graduated cylinder to the top and place the cylinder in a wind-free location. When the foam has settled, the remaining liquid should measure 100 ml (i.e., 1/20th of the foam volume) for a 1:20 chemical/water solution: foam volume ratio.

Each piece of equipment should be calibrated separately to determine its proper flow rate. A malfunctioning piece of equipment may show wide variances in foam consistency and should be replaced or serviced according to manufacturer’s recommendations.

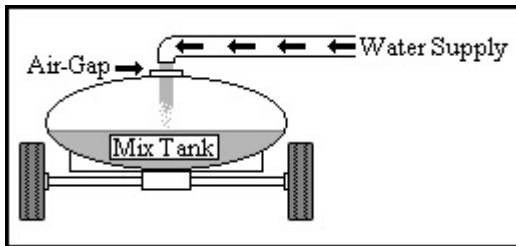
Filling Chemical Mix Tanks

Precautions must be taken when using chemical mix tanks. When mixing metam-sodium with water, it is important to remember that metam-sodium quickly decomposes to the more volatile and toxic MITC. The solution should be used soon after mixing. Also, applicators often make the mistake of filling 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 back-siphon into the fresh-water system, contaminating the entire water distribution system. This could happen when drawing water from other

water sources, such as a farm pond. Whenever a tank is being filled with water it should never be left unattended. Back siphoning can be prevented with an air gap, a back flow prevention device, or an intermediate water source.

Air Gap

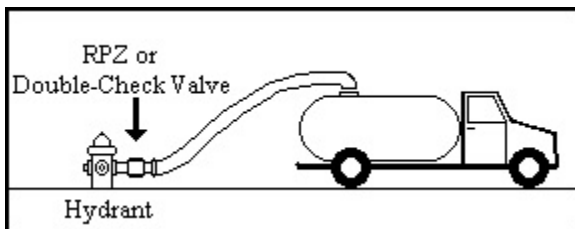
For an air gap to be effective, the distance between the inlet line and the tank must be at least twice the diameter of the inlet line. In the event of a reversal of pressure, air will rush through the air gap, preventing siphoning. It is difficult to use an air gap with foaming root control chemicals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



Air-Gap

Back Flow Preventer

A back flow preventer can be connected between the water source and the filling hose. If the pressure on the outlet side of a reduced pressure zone (RPZ) device ever exceeds the pressure on the inlet side, relief valves discharge onto the ground, preventing back siphoning. (For a more complete technical description of how a RPZ device works, consult a manufacturer). **Double check valves** are examples of back flow preventers.



Back Flow Preventer

Filling from an Intermediate Source

It is often useful to fill mix tanks from an intermediate source such as a sewer jetter. In these cases, the sewer jetter must itself be filled using an air gap or a double check valve. In the event of back siphoning from the mix tank into the intermediary source, there is no danger of contaminating fresh water supplies. Obtaining water from a jet truck will also prevent back siphoning because these trucks have built-in siphoning brakes.

Calculating the Amount of Chemical Required

You can use the charts below to calculate the amount of chemical required for a specific job. The first chart is calculation information for the *foam fill* method. The second chart presents calculation information for the foam spray method that, as mentioned before, is often used on large diameter pipe. When using these charts, you must add to the calculation: 1) the number of feet of each pipe size that will be treated, and 2) 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 instructs to “mix 25 parts water to 1 part chemical,” then “26” (26 total parts chemical + water) is inserted in the “dilution ratio required” column of the chart to complete the calculation. Note that these charts are for illustrative purposes only. The product label and labeling should be consulted to determine manufacturer’s recommendations for actual amount of product required and for specific mixing and application instructions.

Foam Fill Application

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

Example:

8"	2.5	×1000'	2500	500	3000	÷ 20	150	÷ 26	5.8	6
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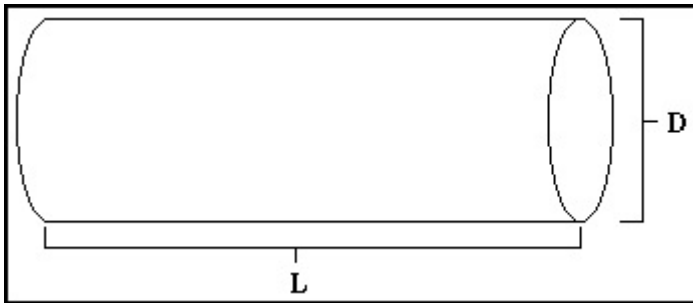
Note: These calculations are based on treating the entire inner surface area of a pipe and any root masses with a layer of foam 3-5" thick. The applicator may need to make adjustments either up or down due to variations in surface area caused by sewer flow, unusual root mass size, etc.

Foam Spray Application

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

Calculating Pipe Volume

If pipe volume is overestimated, too much foam could be pumped into the line and forced up through building laterals. And underestimation could result in a bad application. A pipe is a cylinder open on both ends. Pipe volume is the area of the cross-section of the pipe multiplied by the length of the pipe. The area of the cross-section of the pipe is the radius of the pipe (½ the diameter of the pipe) squared multiplied by π (3.14).



$$\text{radius (r)} = D \div 2$$

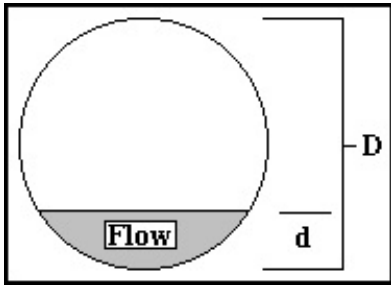
$$r^2 = r \times r$$

$$\text{Volume} = 3.14 \times r^2 \times L$$

The following conversion table may be useful for calculating pipe volumes.

<u>multiply</u>	<u>by</u>	<u>to obtain</u>
# of cubic feet	1728	# of cubic inches
# of cubic feet	7.481	# of gallons
# of gallons	0.1337	# of cubic feet
# of gallons	231	# of cubic inches

Wastewater in a partially filled pipe takes up volume as well. The applicator should be able to compensate for the reduced volume. Roots do not grow below the water level and chemicals are not effective when diluted in sewer flows. Proper application requires that the foam be discharged above the flow line. Under certain conditions where a pipe has slow moving flow the applicator should compensate for the volume displaced by the water in order to avoid overcharging the pipe.



In the figure above, “D” is the diameter of the pipe and “d” is the depth of the flow. The applicator needs to know the relationship between d and D to estimate the percentage of the pipe volume that is submerged. To do this, the length d is divided by the length D. The chart below shows the resulting amount of pipe volume that is submerged.

<u>d/D</u>	<u>% pipe volume submerged</u>
0.1	20%
0.2	30%
0.3	37%
0.4	44%
0.5	50%
0.6	56%
0.7	63%
0.8	70%
0.9	80%
1.0	100%

Calibrating Hose Retrieval Rate

To determine the correct hose retrieval rate, the operator must know: 1) the amount of foam required per foot of sewer pipe, and 2) the rate (gallons per minute) at which the application equipment is producing foam. The amount of foam produced per minute is divided by the amount of foam required per foot to determine the hose retrieval rate in feet per minute.

The chart below shows some example hose retrieval rates.

<u>Pipe Size</u>	<u>Foam Fill (gal/ft)</u>	<u>Retrieval rate (ft/minute)</u>
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 when using surface coating techniques. For example: to surface coat a 24" diameter pipe with a 7" deep wastewater flow with 3" of foam for 300 feet, 2,221 gallons of foam is required, which equals 7.4 gallons of foam per foot. If the equipment is generating 90 gallons of foam per minute, the proper hose retrieval rate is 12.16 feet/minute ($90 \div 7.4$).

Communication with Wastewater Treatment Plant Personnel

Notification prior to treatment is a definite priority, especially with personnel involved with the pre-treatment process, which may require issuance of a discharge permit. Treatment plant personnel should also be made aware of the side effects of metam-sodium treatment, such as the release of H₂S. The applicator should obtain as much information about the treatment area as possible. Important details include: the time of high flows, the size of sewer lines being treated, and the distance of the treated sewer line from the nearest lift station and sewage treatment plant.

Dosage of Product to a Particular System

In order to minimize the possible upsetting effects of root control chemicals on a sewer system it may be necessary for the applicator to apply a reduced volume of material. 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, such as the beginning of biological upset or the detection of the sulfurous odor of metam-sodium, the application process should be discontinued immediately. When applications are re-started, the applicator should use reduced application rates, namely, fewer total gallons of concentrate per hour (or day). The treatment plant operators should continue to monitor the plant to insure against a reoccurrence of adverse effects.

APPLICATION CONCERNS

The qualities and quantities of raw wastewater are always changing, from sewer line to sewer line, and from hour to hour. Efficiencies of treatment plants also vary. An understanding of the operation of sewer collection systems and treatment process can minimize the potential risks associated with the application of root control chemicals. Facilities for handling wastewater usually have three major components: *collection*, *treatment*, and *disposal*. Metam-sodium is a general biocide. Its potential for affecting the treatment process is directly related to the concentration reaching the treatment plant and the efficiency of the treatment process in that particular plant.

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 line coming into the 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**, which normally discharges directly to a water course without treatment. In some areas, a single **combined sewer** picks up both sanitary and storm wastewater.

The collection system consists of a series of interconnecting pipes of varying sizes (from 4" pipe to tunnels in which maintenance personnel can enter in boats). The majority of 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 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. Slope, pipe size, and head pressure determine the velocity of wastewater. The gravity is broken up into sections by manholes, which allow maintenance personnel access to the collection system. Manholes are usually spaced between 150 to 1,000 feet apart, or an average of 250 feet. Most treatment plants with flows of less than 0.5 millions of gallons per day 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.

Slope and Grade

There are several variables in a wastewater collection system that influence root control applications. Pipe **slope** 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 detention time of metam-sodium with respect to impacting treatment plants. The design standard for slope is a minimum flow velocity of 2.0' per second with the preferred velocity of 2.5' per second. As the pipes are designed for more slope, the velocity increases. The presence of roots causes the velocities to decrease. **Grade** is a measure of relative elevation: a building sewer is termed "below grade" if the elevation of floor drains

are below the invert elevation of the upstream manhole. If a building is “below grade,” this can affect root control applications.

Flow

Flow characteristics can affect root growth patterns. Flow may dictate the appropriate treatment method, the rate of root decay following 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 can vary during peak periods of residential or industrial use. Flow can be a detriment by diluting chemicals too much, reducing their effectiveness. Flow can also help by diluting chemicals before they reach the treatment plant. The greater the velocity of sewer flows, 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 problematic with respect to protecting the treatment plant, and should vary 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 them downstream towards the treatment plant.

Large water users (such as industries) that contribute waste to the collection system may affect the efficiency of the treatment plant, especially if there are periods during the day or during the year when their waste flows are a major load on the plant. For example, some industries operate seasonally, making it possible to predict large flows. 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 required for wastes to reach a plant can also affect the efficiency of a treatment plant. Hydrogen sulfide gas may be released by anaerobic bacteria feeding on the wastes if the flow time is quite long and the weather is hot. This can cause odor problems, damage concrete in the plant, and make wastes more difficult to treat. Wastes from isolated subdivisions located far away from the main collection network often have these problems.

Pump stations are normally installed in sewer systems in low areas or where pipe is considerably 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 periodically sending large volumes of flow to the plant one minute and virtually nothing the next.

Dilution. The size of a wastewater treatment plant determines the amount of dilution of root control chemicals that occurs with wastewater. Concentrations of pesticides are measured in terms of parts per million (ppm) of active ingredient (A.I.) to water. One gallon of 100% A.I. mixed with 999,999 gallons of water represents one part per million.

The following is an example of determining the amount of active ingredient, in parts per million, used in a particular situation:

Label instructions indicate to mix 10 gallons of product (25% A.I.) 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 determining the relative amount of A.I. used.)

1. 10 gallons of product is applied over 2 hours, so 5 gallons per hour is applied in 1 hour. Product has 25% A.I.
2.
$$\frac{5 \text{ hours} \times 0.25}{380,000 \text{ gallons water}} = \frac{\text{Parts product (x)}}{1,000,000}$$
3. $(1.25 \times 1,000,000) \div 380,000 (x)$
4. $(x) = 3.289$
5. 3.29 parts of A.I. per million (ppm) of water

Laboratory tests indicate that the “no observable effect limit” (NOEL) for foaming root control products containing metam-sodium and dichlobenil is a concentration of 10 ppm A.I. metam. Seven ppm A.I. metam is used in order to provide a minimal safety margin.

The following is an example of how to estimate the amount of active ingredient necessary to achieve a given concentration.

An applicator learns from the treatment plant operator that average daytime flow is 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 ppm?

1. $(5 \text{ million gallons} \times 7\text{ppm}) \div 0.25 (\% \text{ A.I.})$
2. $(3,500,000) \div 0.25 = 140 \text{ gallons of product}$
3. $140 \text{ gallons} \div 8 \text{ hrs.} = 17.5 \text{ gallons per hour of product with 25\% A.I.}$

Treatment Plants

Size of treatment plant. The size of a treatment plant can be the most important factor in determining the possible negative effects of chemical root control. Chemical root control applicators must be aware of the size of the treatment plant downstream from any applications. The size of the plant is measured in terms of how many gallons of wastewater it treats per day. A typical home with 3.5 people uses around 80 – 85 gallons of water per person day. So, not including industrial and commercial uses, the daily flow for a community of 20,000 would be an estimated 1,600,000 gallons of water per day. Industrial and commercial use, as well as excess groundwater infiltration, could add many more gallons per day. A treatment plant treating around 2 million gallons of water per day (MGD) is referred to as a 2 MGD plant. It is important to distinguish between *design flows* and *actual flows*. **Design flow** is the amount of wastewater that the treatment plant is designed to handle daily. **Actual flow** is the actual volume of water that enters the treatment plant on a given day. If the capacity of a treatment plant is exceeded, excess flows are by-passed around the plant and dumped directly into receiving waters, or stored temporarily in large basins.

Most flows in a sanitary sewer system occur during daytime hours. One-half or more of the daily flow typically occurs between 6:30 – 8:30 a.m. and 4:00 – 9:00 p.m., although this estimate could vary depending on industrial use and groundwater infiltration. For low volume plants it is best not to estimate hourly flows based on typical usage. The treatment plant operator should be consulted for hourly flow rates.

Processes. Wastewater in a treatment plant flows through a series of treatment processes that remove waste. The number of treatment processes and the degree of treatment usually depends on the uses of the receiving waters. Although not all treatment plants are alike, there are certain typical flow patterns that are similar from one plant to another.

When wastewater enters a treatment plant, it usually flows through a series of **pretreatment** or **preliminary treatment** processes – screening, shredding, and grit removal. These processes 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. Pre-aeration is used to “freshen” wastewater and to remove oils and greases.

Wastewater generally receives **primary treatment** next. During this stage, some of the solid matter carried by the wastewater settles out or floats to the surface where it can be separated from the wastewater. **Secondary treatment** commonly consists of biological processes. Organisms are used to partially stabilize (oxidize) organic matter not removed by previous treatment and convert it to a form easier to remove from the wastewater. Current design parameters for secondary treatment plants provide 3 – 30 hours retention time in the aeration portion of the treatment process. Retention time design is a function of plant size and plant type. A small extended aeration plant would probably require a 24-hr retention time. A 5 – 10 MGD plant might require 6 – 8 hours of detention. Waste

treatment ponds, or lagoons, may be used to treat wastes remaining in wastewater after pretreatment, primary treatment, or secondary treatment. Before wastewater is discharged into receiving waters, it is usually disinfected with chlorine.

Effects of Chemical Root Control on Treatment Plant Processes. The sewer line root control applicator is responsible for insuring that an application does not adversely affect the performance of a treatment plant. Applications should not be made when there is a likelihood of a problem. Wastewater plants are biological systems. These systems depend on the growth and reproduction of microorganisms. Root control chemicals are toxic to tree roots and they can also be toxic to the microorganisms in a treatment plant. An upset in the biological process must be avoided. Treatment plant operators do not consider risking upset as an option. Municipal treatment facilities can be fined \$25,000 per day for National Pollutant Discharge Elimination System (NPDES) permit violations for “upset conditions.”

No two treatment plants are alike. Always consult the wastewater treatment plant operator before applying any chemical to a wastewater collection system. Consultations need to be careful and complete. Maintenance and pre-treatment personnel must be notified of treatments as well. Two plants with the same flow may react very differently to the same concentration of pesticides in wastewater flow. The biological process of one plant may be under relatively more stress (e.g. lack of oxygen, chemical pollutants, excessive organic loading, operator error) than another. In a stressed treatment plant, a very small concentration of metam-sodium could cause an adverse change in the biological decomposition process. This upset condition could last for days. The same plant under no such stress could tolerate several ppm of metam-sodium without effect. A well-run plant is more tolerant and resilient to pesticides. Manufacturer’s recommendations for the use of sewer root chemicals should only be used as a guideline. The best source of information about a given treatment plant and how it might respond to root control treatments is the treatment plant operator.

Checklist of variables that may affect the impact of a metam-sodium application on a specific treatment plant:

- type of pesticide and application method
- length, diameter, and slope of pipe
- distance and slope to treatment plant from application site
- size of treatment plant
- estimated flow (gallons per hour) at time of application
- existing problems at treatment plant , such as with the biological filtration process
- the rate of breakdown of metam-sodium in the wastewater

Disposing of Excess Chemicals. Dichlobenil and metam-sodium tend to degrade in the pipe section being treated. The foaming method of application retains the chemical in the pipe section being treated long enough to allow decomposition to take place, reducing risk to the receiving treatment plant. Excess concentrate or mixed solution should not be

dumped into the sewer lines. It may not have time to properly degrade before reaching the plant, and could lead to plant upset. If the applicator has any unwanted concentrate or solution, the safest way to dispose of it is by applying it according to label instructions.

Foam application of root control chemicals to building service laterals. Extreme caution should be taken when treating building service lines. These pipes are connected directly to buildings and there is a chance of accidentally forcing a foam chemical application through the pipe and into the building. Service lines usually connect the building to a sewer main located in the street in front of the building or in an alley behind the building. These service lines usually have a 4" – 6" diameter and were installed as buildings were erected. Records of where these lines go, which buildings are connected to a specific main, and pipe conditions are usually non-existent.

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

Sewer main to building. When treating a main line, a common practice is to apply more foam in order to force the excess into service lines. The applicator reduces the rate of hose retraction during the application process. Foam will take the path of least resistance and travel into service lines. This practice involves risk of accidentally forcing the foam into buildings. No more than 10' – 20' of service lateral should be treated using this method. Normal treatment of the main pipe is sufficient to kill roots at the service connection.

Risk factors in buildings include:

- basements with below grade plumbing
- floor drains
- dry traps
- reduced sewer 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 lateral line treatment, although still risky, is generally less risky than treating from main lines. In principal, a plug is inserted in the service lateral between the point of treatment and the building. This blocks the foam from entering the building. Usually, a specially designed air plug is inserted through a clean out. The plug is a 1" hose with an air bladder molded around the outside. The hose is inserted through the clean out into the downstream sewer pipe. The bladder is then inflated. Foam is pumped through the hose and forced down the service lateral to the main. The inflated bladder blocks the foam from exiting the clean out or from being forced back toward the building.

Risk factors include:

- unknown connections to the service lateral being treated
- inserting hose into upstream pipe instead of downstream
- accidental spills of the chemical on private property (on landscape or in buildings)
- when treating from within buildings, the 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 which are inaccessible at the time of treatment. A spotter should be placed in all buildings when service lines are being treated to monitor for signs that treatment chemicals are being forced into the building.

Factors to consider when treating any service lines with foam:

- Foam will follow the path of least resistance
- Service laterals are usually small diameter (4") and a small amount of foam will go a long way (8" pipe = 2.6 gallons per foot, 4" pipe = 0.65 gallons per foot)
- Root masses reduce the volume of foam needed to treat a given section of pipe, and 4" pipe is more easily blocked than 8" pipe. Calculations of the volume of foam needed to treat a section of pipe are based on clean, unblocked pipe, and need to be adjusted if significant blockage exists.
- A service lateral from a building to a main line may have other building laterals connected to it. Buildings and homes in an area are constructed at different times by different people. The applicator cannot be sure that all of these buildings have underground utilities that fit today's designs and materials.
- The applicator should not rely on anyone's memory as to how a service lateral was constructed and connected to a main line. If possible, the line should be televised prior to treatment to determine any areas that could cause concern during application.
- Many times, the condition of a particular service line is unknown. The applicator should proceed with caution and not treat if there is doubt.

APPLICATION CHECKLIST

This checklist should be reviewed before applying root control chemicals containing metam-sodium.

- Read the chemical product label thoroughly.
- Clear treatment sites and dates with wastewater treatment personnel.
- Know distances between buildings and sewer.
- Know the depth of sewer compared to the drains in any buildings.
- Be aware of any obstructions in the line.
- Note any broken or empty traps.
- Note building drains without traps that would allow easy emergence of foam. Building drains can be plugged to protect against back up and flooding.
- Keep product labels and Material Safety Data Sheets available at treatment site for quick reference.
- Provide job sites with all necessary equipment for proper traffic control (barricades, cones, etc.)
- Provide job sites with proper equipment for safely opening manholes.
- Provide job sites with proper equipment for conforming with OSHA standards for confined space entry (including, but not to, air monitor, harness, and retrieval systems).
- Have 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 equipment
 - long pants and long-sleeved shirt
 - hard hat

DETERMINING EFFECTIVENESS OF ROOT CONTROL TREATMENTS

The results of chemical root control are sometimes difficult to assess because they cannot be seen readily. Tracking results can help applicators and public works officials by pointing out deficiencies in application methods.

Conditions which may influence effectiveness include:

- improper application techniques, in particular, poor contact and exposure time
- high sewer flows or surcharging conditions following application
- severe hydraulic sewer cleaning before or after treatment
- heavy grease deposits which interfere with chemical contact
- old, ineffective, or improperly mixed chemical

Proper treatment with chemicals kills roots, but treatments do not make the roots disappear. A complex of microorganisms is constantly present in the sewer. These organisms feed on dead roots. In addition, the build-up of solids and constant pressure

from wastewater flow breaks off dead roots and sends them to the treatment plant. This process may take weeks, months, or years.

It is important to remember that if a sewer line is experiencing frequent blockages, chemical root treatment will not immediately eliminate the problems. The blockages need to be attacked with a 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. It is also important to remember that roots killed by metam-soidum are not gone forever. Regrowth will begin in a couple of years following treatment. Retreatments at 3 – 5 year intervals are often necessary.

The most difficult part of a successful chemical root treatment is determining with any degree of accuracy the percent kill of a specific root mass or root masses in a specific section of pipe. Live and dead root masses tend to look very similar on TV inspection footage. With time, however, an effectively treated root mass will appear smaller, and pieces will break easily as an inspection camera passes.

Removing a root mass for a detailed visual inspection will also reveal if treatment has been effective. When a root is killed, the normally light-colored tissue located just beneath the bark turns brown. By stripping the bark layer from individual roots in a mass, the effectiveness of a specific chemical treatment can be determined. When performing these visual tests, it is important to remember that there are perhaps hundreds more root masses in a treated sewer line. Due to varying conditions within the sewer, the state of one root mass may not be representative of the root masses in the rest of the system.

Perhaps the most reliable method of judging the success of a chemical root control program is to determine the rate of reduction in root-related sewer problems. If a municipality experiences a 90% decrease in these kinds of problems in the year following the implementation of a root control program, the program has shown positive results. To be ultimately successful, the cost of a root control program must outweigh the cost of root control problems.

ENVIRONMENTAL CONCERNS

Groundwater Advisories

The potential for contamination of groundwater is an important consideration when choosing pesticides. Several products have groundwater advisory statements on their label. Such statements advise not to apply these products where the water table (groundwater) is close to the surface and where soils are very permeable (well-drained soils, such as loamy sands). Refer to these statements and observe all precautions on the label when using these products.

Endangered Species Act

The Endangered Species Act (ESA) is intended to protect and promote recovery of animals and plants that are in danger of becoming extinct due to the activities of people.

Under the Act, the Environmental Protection Agency (EPA) must ensure that the use of the pesticides it registers will not result in harm to the species listed by the U.S. Fish and Wildlife Service as endangered or threatened, or to habitat critical to those species' survival. To accomplish this, the EPA has implemented "Interim Measures," including county bulletins showing the area(s) within the county where pesticide use should be limited to protect listed species. Pesticide active ingredients for which there are limitations are listed in table form in the bulletins. The limitations on pesticide use are not law at this time, but are being provided for use in voluntarily protecting endangered and threatened species from harm due to pesticide use.

GLOSSARY

Absorption: Uptake of a pesticide by micro-organisms, soil, plants, animals, or humans.

Active Ingredient (A.I.): The chemical or chemicals in a product responsible for pesticidal activity.

Agitation: Process of stirring a pesticide solution to keep formulations 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."

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

Bypass pumping: The process of temporarily re-routing wastewater 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.

CHEMTREC: The Chemical Transportation Emergency Center. This organization operates a 24-hour information hot-line (1-800-424-9300) for pesticide spills, fires, and accidents.

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 which is designed to carry both sanitary flows and storm water.

Combined Sewer Overflow: see “Overflow.”

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

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.

Dermal Exposure: The absorption of a pesticide through the skin.

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

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

Effluent: Water that is leaving a structure - e.g. 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 municipalities 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

Foaming Agent: An adjuvant used to convert a pesticide solution into a thick foam. Used in sewer 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 form in which the pesticide is purchased.

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

Fumigants: Pesticides that form a toxic vapor or gas, usually in a confined space or enclosed area.

GPM: Gallons per minute.

Groundwater: Water beneath the earth's surface that is the source of well water.

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.

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

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

Infiltration/Inflow Control (I/I): In general, the process of abating or controlling the introduction of extraneous water in a sewer system. Examples: grouting, pipe re-lining, 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.

Influent: Water that is entering a structure. Example: sanitary sewer flows entering a wastewater treatment plant.

Inspector: A representative of the agency that maintains sewers who supervises the quality of workmanship and materials on the job site.

Interceptor Sewer: Typically a large diameter sewer without service connections that receives flows from collector sewers and transports it to a wastewater treatment plant.

Invert: The lowest point of a pipeline or conduit. Also, the bottom part of a manhole that is rounded to conform to the shape of the sewer line.

Joints: The connections between contiguous pieces of sewer pipe.

Lateral Sewer: see “Building Sewer.”

Leaching: The movement of a pesticide through soil by the movement of water.

Lineal Feet: A measurement of distance in a straight line, such as between two contiguous manholes in a sewer system.

Manhole Section: see “Sewer Section.”

MGD: Millions of gallons per day. Used to express design flow capacity or actual flow of a wastewater treatment facility.

Non-systemic: A pesticide that has a localized pesticidal effect only on that part of the plant or animal actually contacted by the chemical. These pesticides are not transported through the plant or animal system in concentrations high enough to be pesticidal.

Nonelective: A pesticide that is toxic to a wide range of organisms.

Oral Toxicity: The ability of a pesticide to cause injury to a human or animal when taken by mouth.

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

Owner: 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. For example, one gallon of the active ingredient of a pesticide in 1 million gallons of water would represent 1 ppm of pesticide active ingredient. Also used as a measurement to express pesticide residue levels.

Pesticide: Any chemical that can kill, repel, or otherwise control unwanted organisms.

Phytotoxic: The ability of a chemical to cause injury to plants or plant tissue.

Receiving Waters: The body of water into which water from a treatment plant or storm sewer flows.

Restricted Use Pesticide: A pesticide that can only be purchased by a certified pesticide applicator.

Run-off: The movement of pesticides in water over the soil surface.

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

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

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

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

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

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

Surcharge: The condition that exists when the volume of wastewater 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.

Systemic Pesticide: A chemical that is absorbed and translocated within an organism. Some systemic pesticides are designed to protect the plant or animals against pests, others are designed to cause injury to the organism.

Target: The organism to which the actions of pesticides are directed.

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

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

Upset: An adverse change in the biological decomposition process of a wastewater treatment plant.

Water Table: The upper level of below ground water.

Weed: Any plant deemed undesirable by humans.

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

Educational programs of the Kentucky Cooperative Extension Service serve all people regardless of race, color, age, sex, religion, disability, or national origin.