CHAPTER 3

METAM-SODIUM

Learning Objectives

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

- Explain what a pesticide formulation is.
- 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.

Formulation

The **active ingredients** in a pesticide are the chemicals that control the target pest. The pesticide product the sewer applicator purchases is rarely made up only of active ingredients. Usually the pesticide is dissolved in a carrier, such as water, or in the case of wettable powders, clay is added as a carrier, with other chemicals added before the product is offered for sale. Carriers, solvents and additives inert ingredients (**inerts)**, and may include wetting and/or foaming agents, spreaders, stickers, extenders, or diluents. They usually make the product safer, easier to apply, more convenient to handle, 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, by the user, before they are applied.

Types of Formulations
A single active ingredient often is sold in several different kinds of formulations. Normally for 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 waste water industry these choices have been much simplified since the target pest (tree roots) are 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 the present, metam-sodium products for sewer usage may only be applied as a 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 that of dish washing soap suds (fluffy, large watery bubbles). For sewer use, the desired foam is that of an aerosol shaving cream. The dryer phase of this foam is used to treat smaller pipe (less 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 1 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:

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

Dry Formulation

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 (sodium-N-methyldithiocarbamate), is also known as Vapam® [1] , Metham sodium and SMDC. Metam-sodium is a fumigant pesticide with end use products formulated as 18% to 42% aqueous solutions. This chemical has been registered since 1954 for use as a preplant fumigant to control weeds, nematodes, fungi, bacteria and insects. There are approximately 35 registered metam-sodium products. Additional uses include wood preservation, slimicide, 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 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 its precursor metam-sodium. MITC may reach unsafe levels in poorly ventilated of confined spaces. Use of air-supplied respirators would be required under such conditions.

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1 Vapam is a registered trademark of Zeneca Agricultural Products.

During normal conditions of use metam-sodium is diluted with water with air added to form a 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 local 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. 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 of air supplied respirator. If pulmonary irritation or edema occur as a result of inhaling MITC, transport the victim promptly to a medical facility.

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. If skin or eye irritation persists, 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 concentrate/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. 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 it's 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.

Test Your Knowledge

Q. What is a pesticide formulation?
A. A formulation is a mixture if active ingredients (control material) 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 include a foaming agent or require 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.

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

CHAPTER 4

READING THE METAM-SODIUM ROOT CONTROL PESTICIDE LABEL

Learning Objectives

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

- Interpret the terms of a label.
- Describe how metam-sodium and dichlobenil are packaged and labeled.
- Explain the differences between Brand, chemical and common names.
- Interpret the signal words and symbols on a pesticide label.
- Know the types of hazard precautionary statements on the pesticide label.

The Pesticide Label

The pesticide **label** is the information attached to the pesticide container. **Labeling** includes the label plus all other information you receive from the manufacturer about the product. FIFRA requires that specific information be printed on the container labels of registered pesticides. This provision is made for the protection of humans, animals, plants, and the environment. Some labels are easy to understand. Others are complicated. But all labels will tell you how to use the product correctly. This chapter will explain the items that must be on a label.

Root control products containing metam-sodium are packaged separately. These products are meant to be mixed together in the field as two active ingredients, metam-sodium and dichlobenil. Dichlobenil is formulated separately. In some cases, manufacturers also package the wetting/foaming agent separate from the metam-sodium. Thus the user will find a product label on each of the separately packaged containers that describes the ingredients contained in that container. The overall package label lists all the ingredients contained in the complete package. Note: these labels each contain a statement "Only for use as a combination of metam-sodium, dichlobenil and foaming agent as directed".

Front Panel - Contents and Warnings

FIFRA requires that certain statements appear at specific locations on a pesticide label. Refer to Figure 1 at the end of this chapter for the locations of required statements on a metam-sodium root control product.

1. Classification Statements

A statement "Restricted Use Pesticide" is placed prominently at the top of the front label. It also may include a brief statement why it is classified for restricted use. Metam-sodium root control products have the statement that "These products can only be purchased and/or applied by or under the direct supervision of a certified applicator".

2. **Brand Name**

Each manufacturer has a brand name for its products. It is usually the largest and most conspicuous wording on the label. Different manufacturers may use different brand names for the same pesticide active ingredient. Most companies register each brand name as a trademark and will not allow any other company to use that name. The brand or trade name is the one used in advertising and by company salespersons. Brand names are not used by EPA.

3. Type of Pesticide

The type of pesticide is usually listed on the front panel of the pesticide label. This short statement usually indicates in general terms what the product will control. The sample label reads "***A Nonsystemic Fumigant Solution for pruning roots in wastewater collecting systems".***

4. Ingredient Statement

Each pesticide label must list what is in the product. The percentage of each active ingredient and the total percentage of the inert ingredients are included for each ingredient listed. The ingredient statement must list the official chemical names and/or common names for the active ingredients. Inert ingredients need not be named.

Active Ingredients are those chemical agents in a pesticide mixture that kills or otherwise controls the target pest or pests. **Inert Ingredients** are materials in the formulation that are carriers and have no pesticidal effect.

Chemical and Common Names

Pesticides have complex chemical names which identify the active ingredients. Some pesticides are given another name to make them easier to identify. These are called common names. Although different manufacturers of the same pesticide may use different brand names they can only use one common name. Metam-sodium is the common name for sodium methyldithiocarbamate, the chemical name. Only common names are accepted by EPA.

5. **Front Panel Precautionary Statements**

All front panel precautionary statements must be grouped together and they include:

"KEEP OUT OF THE REACH OF CHILDREN"

This statement must appear on all pesticide products regardless of classification or toxicity.

6. **Signal Word**

The signal word DANGER, WARNING OR CAUTION must appear in large letters on the front panel of the pesticide label immediately following the "Keep Out of Reach of Children". It indicates how acutely toxic the product is to humans. The signal word is based not only on the active ingredient alone, but on the contents of the formulated product. Use the signal word to help you determine the precautionary measures to be used.

The signal words are:

DANGER (with skull and crossbones) - all highly toxic pesticides that are very likely to cause acute illness through oral, dermal, or inhalation exposure will also carry the word POISON printed in red and the skull and crossbones symbol.

DANGER - This word signals a high toxic pesticide that is very likely to cause acute illness from oral, dermal, or inhalation exposure , or to cause severe eye or skin irritation. Metam-sodium labels display the DANGER label

WARNING - This word signals that the product is moderately toxic orally, dermally, or through inhalation or causes moderate eye and skin irritation.

CAUTION - This word signals that the product is slightly toxic orally, dermally, or through inhalation or causes slight eye an skin irritation.

7. **Statement Of Practical Treatment (first aid)**

This statement provides instructions on how to respond to an emergency exposure involving that product. The instructions may include first aid measures and may instruct to seek medical help.

8. **Referral Statement**

If the Statement of Practical Treatment (above) is not located on the front panel of the label, then a statement on the front panel must refer the user to the section of the label or labelling where the Statement of Practical Treatment may be found.

9. **EPA Registration and Establishment Numbers**

An EPA registration number indicates that the pesticide label has been registered by the EPA, and will identify both the registrant and the product. If the product is registered in other states it also may include a state registration number.

The establishment number appears on either the pesticide label or container. It identifies the facility that formulated the product and the location of that establishment by state.

10. **Company Name and Address**

The name and address of the manufacturer, registrant, or person or firm registering the product must appear on the label. If the registrant is other than the manufacturer, the label should indicate both parties.

11. **Net Contents**
The front panel of the pesticide label tells how much is in the container. This can be expressed as pounds or ounces for dry formulations and as gallons, quarts, or pints for liquids. Liquid formulations may also list the pounds of active ingredient per gallon of product.

Note that the separately packaged ingredients of this type of root control product has the weight of just that container's contents on the separate labels. The overall package label will have the combined weight of the total product.

12. **Misuse Statement** (not illustrated on Figure 1)
The misuse statement must appear on all products and state in general terms that, "it is a violation of Federal Law to use the product in a manner inconsistent with the label".

Other Statements which may not be on the Front Panel

Precautionary Statements. These usually include statements about possible hazards such as "HAZARDOUS TO HUMANS AND DOMESTIC ANIMALS". If the EPA considers the product to cause delayed effects the label must warn you of this fact. These statements will tell you whether the product has been known to cause tumors or reproductive problems in laboratory animals. If the pesticide has the potential to cause allergic effects, such as skin irritation or asthma then the label or labeling must state this fact.

Personal Protective Equipment (PPE) Statements
Immediately following the statements about acute, delayed and allergic effects the labeling usually will list personal protective equipment requirements. Metam-sodium root control labels are very specific on the PPE requirements. These statements tell you the minimum PPE that you must wear when using the pesticide. An individual may wear more than required, but not less. Also, some states may include requirements greater than the label statement. Consult the product's Material Safety Data Sheet (MSDS) for additional information on PPE.

Environmental Hazards. Metam-sodium labels contain special statements that product is hazardous to aquatic life if not used correctly. This statement reads "Toxic to fish and aquatic life".

Some environmental statements appear on nearly every pesticide label. They are reminders of common sense actions to follow to avoid contaminating the environment. The metam-sodium root control label follows these general statements with specific

toxicity statements and provides practical steps to take to avoid harm to wildlife. For example, the label gives the user specific directions on the following:

- disposal of equipment washwaters and wastes. "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 off lawns and plants as they may be severely injured".

- how to clean ground areas, "Foam should be shoveled off planted areas immediately rather than washing off with water".

Physical or Chemical Hazards. This section of the label or MSDS warns you of any special fire, explosion, or chemical hazards the product may pose. The metam-sodium root control label reads, "Do not use or store near heat or open flames".

Specific Precautions. The metam-sodium root control products contain two special, **USE PRECAUTION** sections.

Use precautions around buildings. Due to the health risks involved in using metam-sodium products, special precautions are used around people. The metam-sodium root control label has a special warning requiring the applicator to take special consideration of sewer service lines, buildings and basements. The major concern is that the root chemical foam will be inadvertently forced up service lines and into homes, jeopardizing the health and safety of the inhabitants.
Explicit directions for avoiding backups are included in the **USE PRECAUTION** section, "Building drains may be plugged to protect against backup and flooding. Follow the directions for measurement and use carefully to avoid using excess foam that may be forced up lateral lines into building drains.". The label **does not** preclude treating service lines. It states, "Lateral lines may be treated, but do not force excessive foam into service lines which may cause it to be forced up lateral lines to building drains."

Specific directions are given if the situation should arise that the building has been penetrated with the metam-sodium fumes, "Building occupants should exit structures if the pungent, rotten egg odor of metam-sodium is detected. Open windows and ventilate with fans. Flush drains with ample water if the odor comes from them". Also included are specific directions for clean up, "Use squeegee, dust pan, or wet vacuum and garbage bags for spills of backups and dispose of foam and liquid in an open drain or manhole. After removal of foam and liquid, wash area of spill or backup with water and detergent and flush down the drain. If rugs or cloth are contacted, take them outside to dry before laundering them separately".

See Chapter 5 for greater detail of application concerns near buildings/lateral lines.

Use precaution around wastewater treatment plants. Because high concentrations of metam-sodium root control chemicals in the waste water may adversely affect the biological sewage breakdown process in the wastewater treatment plants a special **USE PRECAUTION** statement is on this product label.

Specific preventative application procedures are mentioned, "Large scale applications to sewage collection systems in proximity to a sewage treatment plant should be divided into smaller sectional treatments done at one or two day intervals to minimize effects on the sewage treatment process".

To protect the treatment plant and the plant operators, specific directions are given to communicate with the plant operators. Directions are given for detecting the presence of metam-sodium in the plant, "Inform appropriate wastewater treatment plant officials prior to use so they may check for any unusual, pungent, rotten egg or sulfur-like odor of metam-sodium above that of sewage and monitor the performance of filter beds or digesters. If the odor is detected at the sewage treatment plant or the biological breakdown process is adversely affected, root control applications should stop until normal conditions are established".

See Chapter 5 for greater detail of treatment procedures near wastewater treatment plants.

Statement Concerning Applicator Category, Storage and Disposal, and Directions for Use.

Applicator Category. A statement restricting the use of this product to a certified applicator appears on the metam-sodium root control labels.

Storage and Disposal Statement. All pesticide labels contain general instructions for the appropriate storage and disposal of the pesticide and its container.

Directions for Use. Pesticide labeling must bear directions for the product use and must be adequate for the protection of the user and the public. Label instructions on intended uses must be clearly stated and in such terms that they will be readily understood by the user.

Note: specific directions for use will be covered more completely in this manual in Chapter 7 - Application.

READING THE LABEL SUMMARY

The following statements will give you an idea of the information you will find in the product label. Although this chapter has not dealt with the complete specific details in the metam-sodium label these topics will be dealt with in detail in the following chapters.

Before you buy a pesticide, read the label to determine:
- if it is the pesticide you need for the job,
- if the pesticide can be used safely under the application conditions.

Before you mix the pesticide, read the label to determine:
- what protective equipment you should use,
- what the pesticide can be mixed with (compatibility),
- how much pesticide to use,
- the mixing procedure.

Before you apply the pesticide, read the label to determine:
- what safety measures you should follow,
- where the pesticide can be used,
- how to apply the pesticide,
- whether there are restrictions for use.

Before you store or dispose of the pesticide or pesticide containers, read the label to determine:
- where and how to store the pesticide,
- how to decontaminate and dispose of the pesticide container,
- where to dispose of surplus pesticides.

Labels generally list other precautions to take while handling the product. These are self-explanatory:
- Do not contaminate food or feed.
- Remove and wash contaminated clothing separately from household clothing before reuse.
- Wash thoroughly after handling and before eating or smoking.
- Wear clean clothes daily.
- Not for use or storage in and around the house.
- Do not allow children or domestic animals into the treated area.

Test Your Knowledge

Q. Explain the difference between the terms "label" and "Labeling".

A. The label is information printed on or attached to the pesticide container. Labeling ncludes the label and all other information received from the manufacturer about the product.

Q. Explain the differences between brand, chemical and common names.
A. A brand name is usually a trademark used by manufacturers to identify their product. The chemical name is a complex name that identifies the chemical components and structure of a pesticide. A common name is a shorter name that the EPA recognizes as a substitute for the chemical name.

Q. Name and explain the signal words and symbols you may see on a pesticide label.
A. "Caution" indicates the product is slightly toxic or relatively nontoxic. "Warning" indicates the product is moderately toxic. "Danger" indicates the pesticide is highly toxic and may be a skin and eye irritant. The addition of "Poison" in red and the skull and crossbones indicates the pesticide is highly toxic as a poison.

Q. What types of hazard statements should you look for on the label?
A. Look for precautions about hazards to human (and domestic animals), environmental hazards, and physical/chemical hazards.

Q Describe how a metam-sodium and dichlobenil root control product is packaged and labeled.
A. Each product is packaged and labeled separately. The overall label will list all ingredients in the complete package. The label has a statement "Only for use in combination of metam-sodium, dichlobenil and foaming agent as directed".

RESTRICTED USE PESTICIDE 1.
FOR RETAIL SALE TO AND APPLICATION ONLY BY
CERTIFIED APPLICATORSS OR PERSONS UNDER THEIR
DIRECT SUPERVISION

BRAND NAME 2.

A Nonsystemic Fumigant Solution for pruning roots in wastewater collecting systems 3.

Only for use as a combination of metam-sodium, dichlobenil and foaming agent as directed.

ACTIVE INGREDIENT	% by weight
Metam-sodium (sodium methyldithiocarbamate).	30.%
INERT INGREDIENTS	70%
Total.	100%

Contains 3.18 lbs. active ingredient per gallon. 4.

EPA Reg. No. 64945-3 EPA Est. No. 44616-MO-1 9.

KEEP OUT OF REACH OF CHILDREN 5.

DANGER - PELIGRO 6.

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label find someone to explain it to you in detail).

STATEMENT OF PRACTICAL TREATMENT 7.

FIRST AID: Immediately start the procedures given below and contact a Poison Control Center, a physician, or the nearest hospital. Report the type and extent of exposure, describe the victim's symptoms, and follow the advice given.

IF ON SKIN: Immediately flush skin with large amounts of running water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately.

IF IN EYES: Immediately flush eyes with large amounts of running water for at least 15 minutes. Hold eyelids apart to ensure rinsing of the entire surface of the eye and lids with water. Get medical attention immediately.

IF INHALED: Remove to fresh air. If not breathing, clear the victim's airway and start mouth-to-mouth artificial respiration. If breathing is difficult, give oxygen, preferably with a physician's advice. Get medical attention immediately.

IF SWALLOWED: Immediately give several glasses of water but do not induce vomiting. If vomiting does occur,. give fluids again. Have a physician determine if condition of patient will permit induction of vomiting or evacuation of stomach. Do not give anything by mouth to an unconscious or convulsing person.

FOR ADDITIONAL PRACTICAL TREATMENTS: 8.
See Inside Panel of the Label or Labeling

In case of significant spills call
CHEMTREC 1-800-424-9300

Manufacturer 10.
Address

NET CONTENTS: 2.5 gallon 11.

Figure 1.

CHAPTER 5

APPLICATION CONCERNS- WASTEWATER TREATMENT 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 waste water.
- 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 wastes from the water.
- Understand the purpose of waste water 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 efficiencies of treatment processes vary from plant to plant. This chapter will provide you with an understanding of the basic operation of a treatment plant and will help you determine the potential risks associated with the application of root control chemicals with emphasis on metam-sodium. 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, and 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**, which 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 which allow maintenance personnel access to the collection system. Design criteria usually place manholes at pipe junctions, changes of pipe grade or direction. Therefore manholes can be spaced between 150 to 1,000 feet, or 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 that Influence Root Control Applications

Pipe slope is a major design criteria 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 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 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 and 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 amount of flow can affect root control chemicals by diluting them before reaching the reaching the treatment plant, or the flow can be a detriment by diluting the root control too much thereby decreasing its effectiveness.

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 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 which 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, 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 required for wastes to reach a plant can also affect a treatment plants efficiency. Hydrogen sulfide gas (rotten egg 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 the wastes more difficult to treat (Solids won't settle easily). Wastes from isolated subdivisions located far away from the main collection network often have such "aging" 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 minute. These fluctuating flows can be reduced by using variable speed pumps or short pumping cycles.

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 percent of active ingredient (A.I.) per unit of measure. One gallon of 100% A.I. 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 need 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 headwords.

Label instructions say 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 the answer.

(1) 10 gallons of product is applied over two hours, so 5 gallons per hour is applied of a product containing 25% A.I in one hour. Therefore:

(2) $\frac{5 \text{ X } 0.25}{380{,}000} = \frac{\text{Parts Product (x)}}{1{,}000{,}000}$

(3) $1.25 \text{ X } 1{,}000{,}000 \div 380{,}000(x)$
$(1{,}250{,}000 \div 380{,}000(x))$

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

(5) 3.29 parts of A.I. per million gallons (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 (7) ppm A.I. metam 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 MG x 7 PPM ÷ .25 (%) A.I.
(3,500,000) ÷ .25 = 140 gallons of product
140 gallons ÷ 8 Hrs. = 17.5 gallons per hour of 25% A.I. Product

Note: No two treatment plants are alike. 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 more stress, such as lack of oxygen, chemical pollutants, excessive organic loading, 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 pesticides.

The applicator should keep in mind that manufacturer's recommendations should be used only as a guideline. 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 - Effect on the Plant
Dichlobenil and metam-sodium have certain physical properties which lend them to either absorption or degradation in the pipe section being treated. The foaming method of application retains the metam in the pipe section being treated for a period of time, allowing decomposition 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 enroute to 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 7 - Application of Metam-Sodium Root Control Chemicals.

Treatment Plants

When wastewater reaches a wastewater treatment plant it flows through a series of treatment processes (Figure 2) 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 3, 4 and 5 show possible flow patterns through treatment plants - pond treatment plant, trickling filter plant, and activated sludge. 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.

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" the wastewater and to help remove oils and greases.

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 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 and a 5 - 10 MGD plant 6 - 8 hours detention.

Waste material removed by the treatment processes goes to a solids handling facility and then to ultimate disposal.

Waste treatment ponds, called lagoons, may be used to treat wastes 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 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 method 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.

TREATMENT PROCESS	FUNCTION
PRETREATMENT	
INFLUENT	
SCREENING	REMOVES ROOTS, RAGS, CANS & LARGE DEBRIS (HAUL TO LANDFILL)
GRIT REMOVAL	REMOVES SAND & GRAVEL (HAUL TO LANDFILL)
PRE-AERATION	FRESHENS WASTE WATER & HELPS REMOVE OIL
FLOW METER	MEASURES & RECORDS FLOW
PRIMARY TREATMENT	
SEDIMENTATION AND FLOTATION	REMOVES SETTLED & FLOATING MATERIALS
SECONDARY TREATMENT	
SOLIDS HANDLING	TREATS SOLIDS REMOVED BY OTHER PROCESSES
BIOLOGICAL CHEMICAL PHYSICAL PROCESSES	REMOVES SUSPENDED & DISSOLVED SOLIDS
DISINFECTION	KILLS PATHOGENIC ORGANISMS
EFFLUENT	

Figure 2

Possible flow pattern through a
Pond Treatment Plant

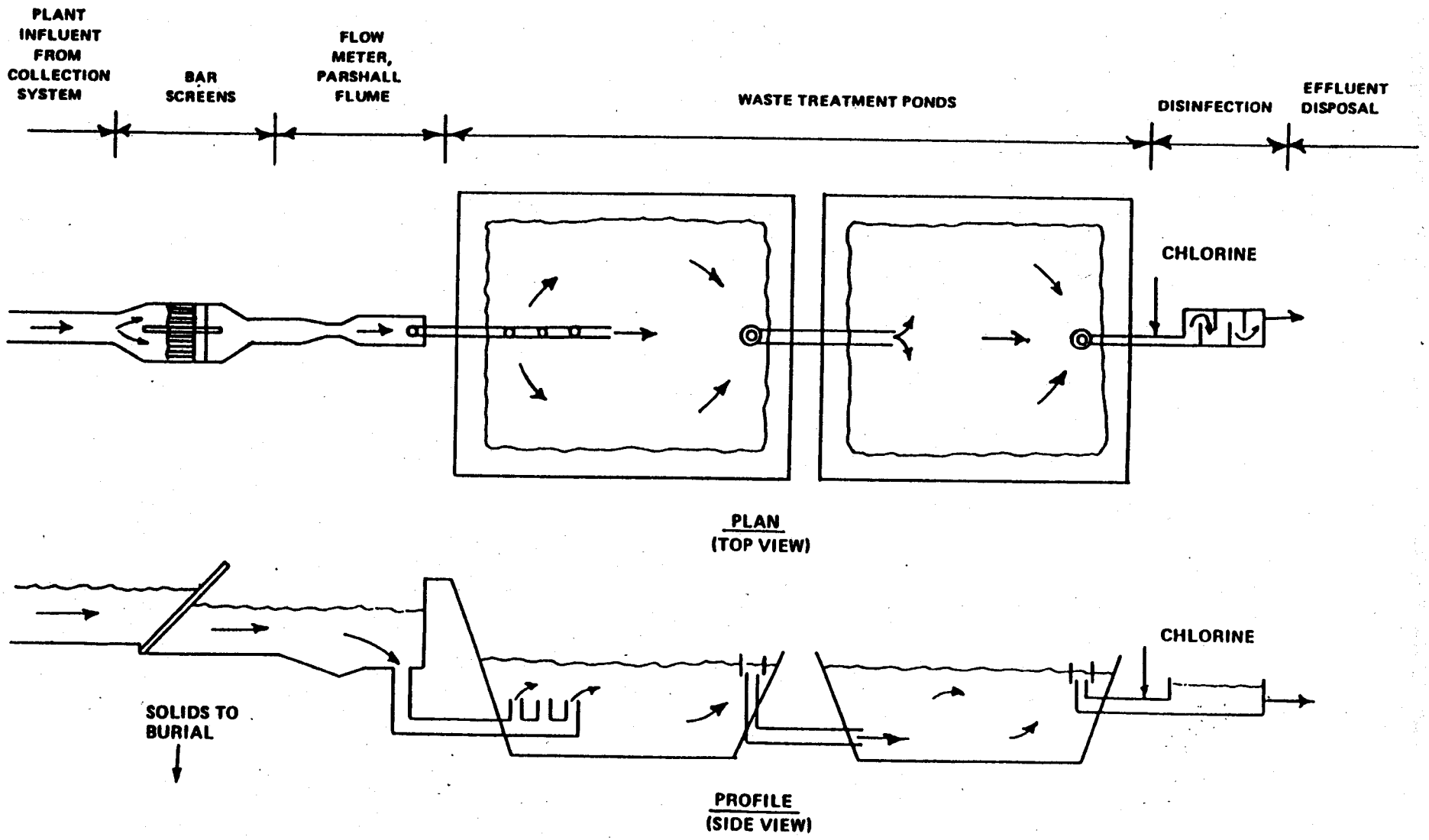

Figure 3

(Con'd) Possible flow pattern through a Trickling Filter Plant

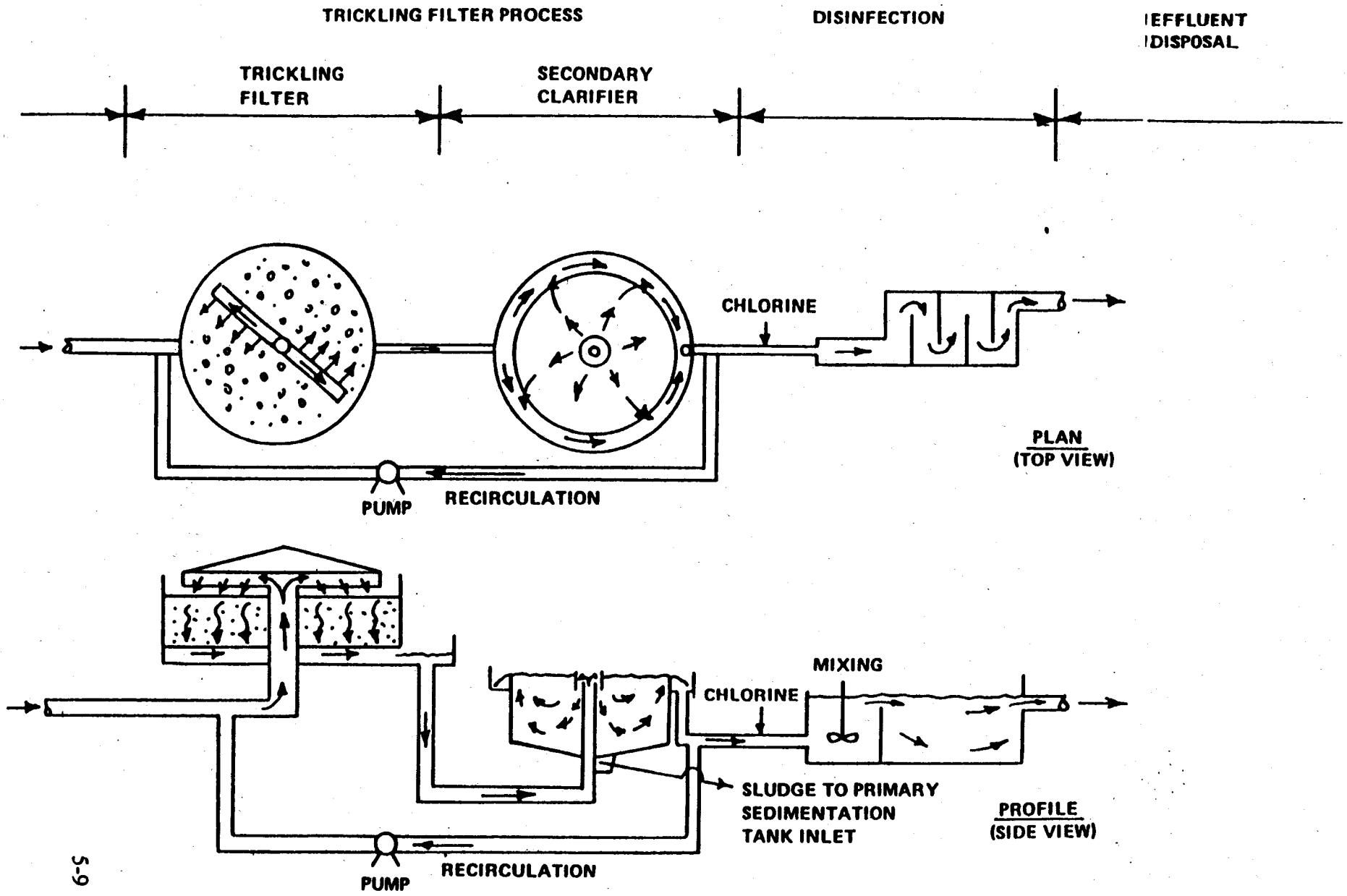

Figure 4

(Con'd) Possible flow pattern through a Trickling Filter Plant

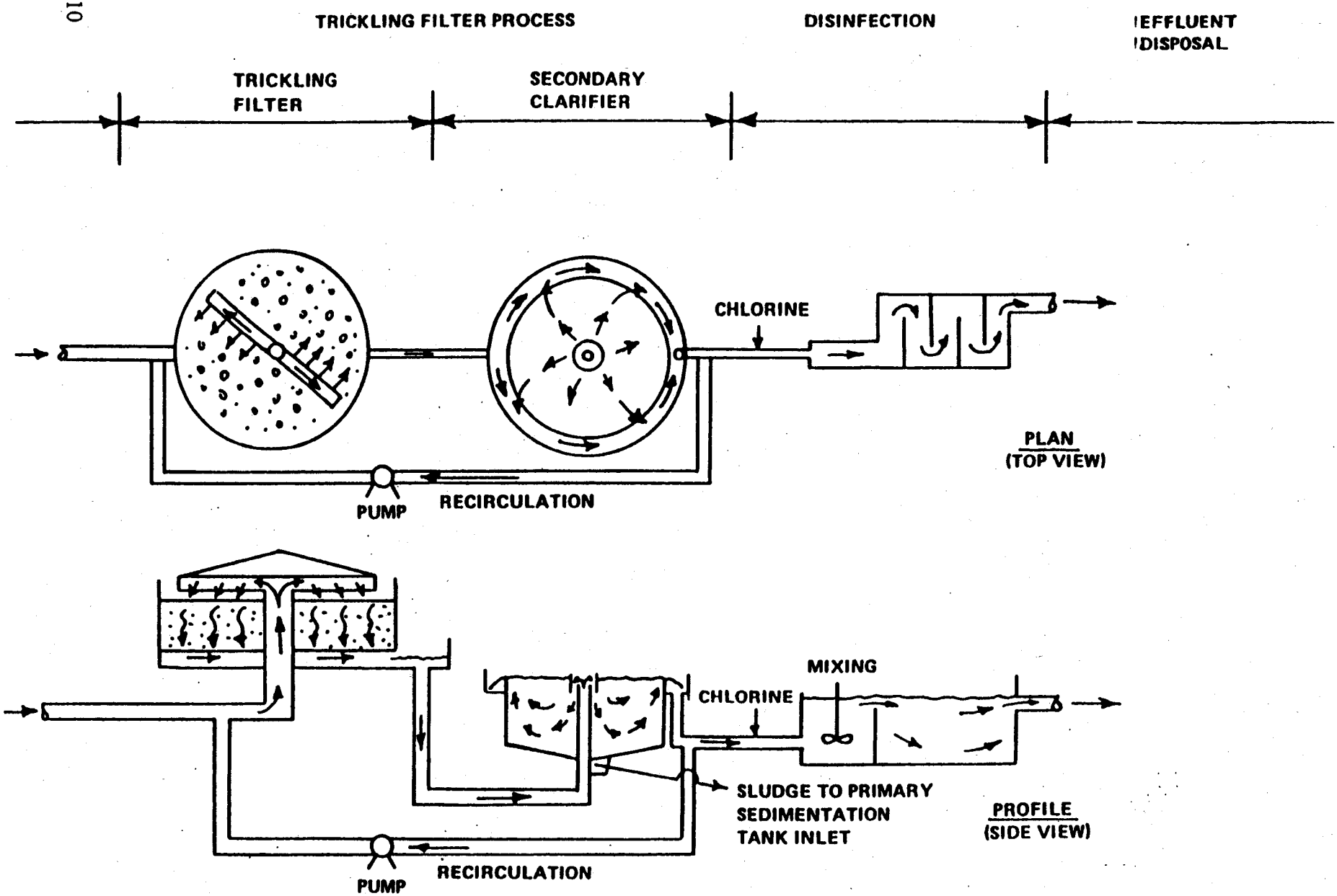

Figure 4 ntinued

Possible flow pattern through an
Activiated Sludge Plant

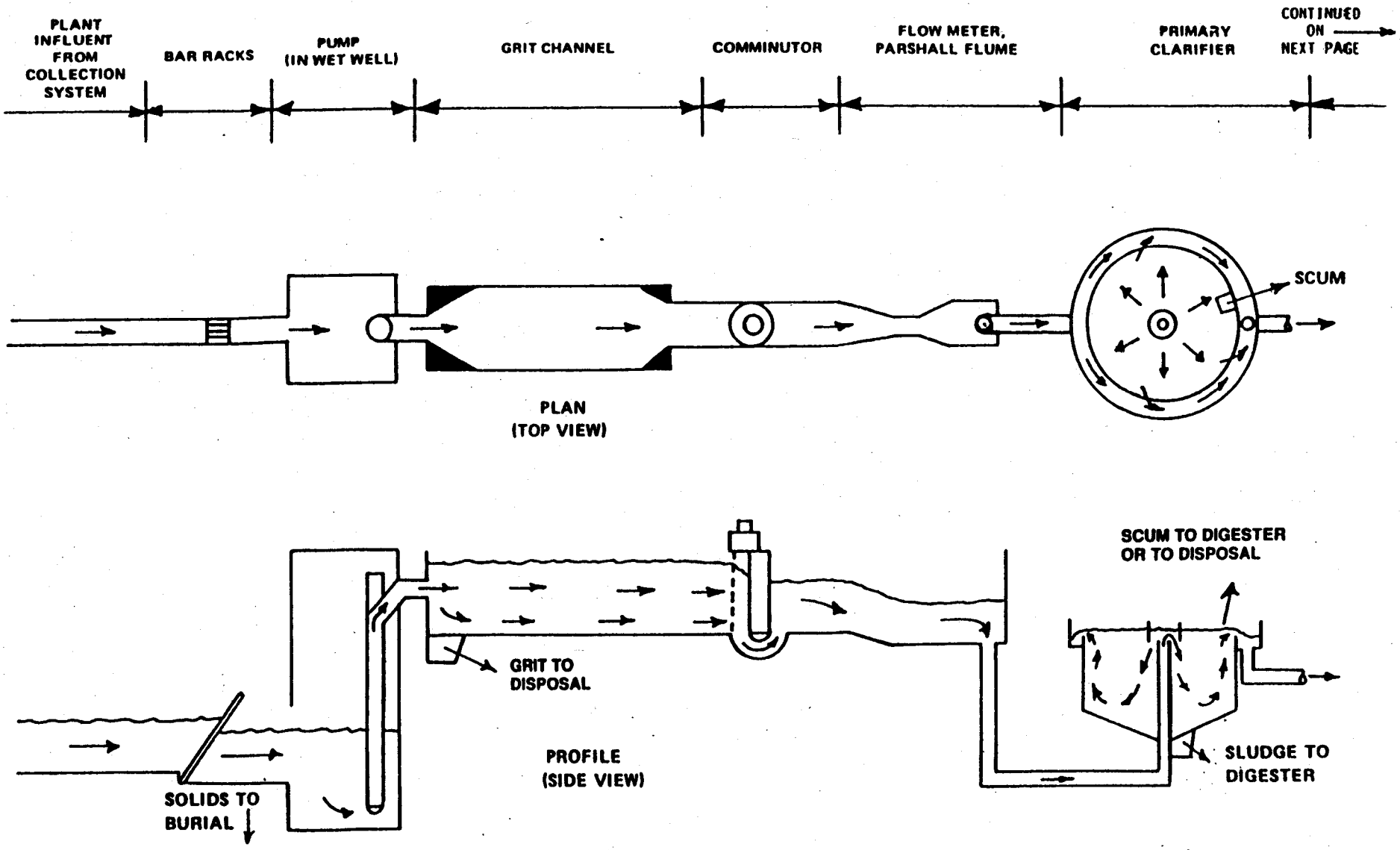

Figure 5

(Con'd) Possible flow pattern through an Activated Sludge Plant

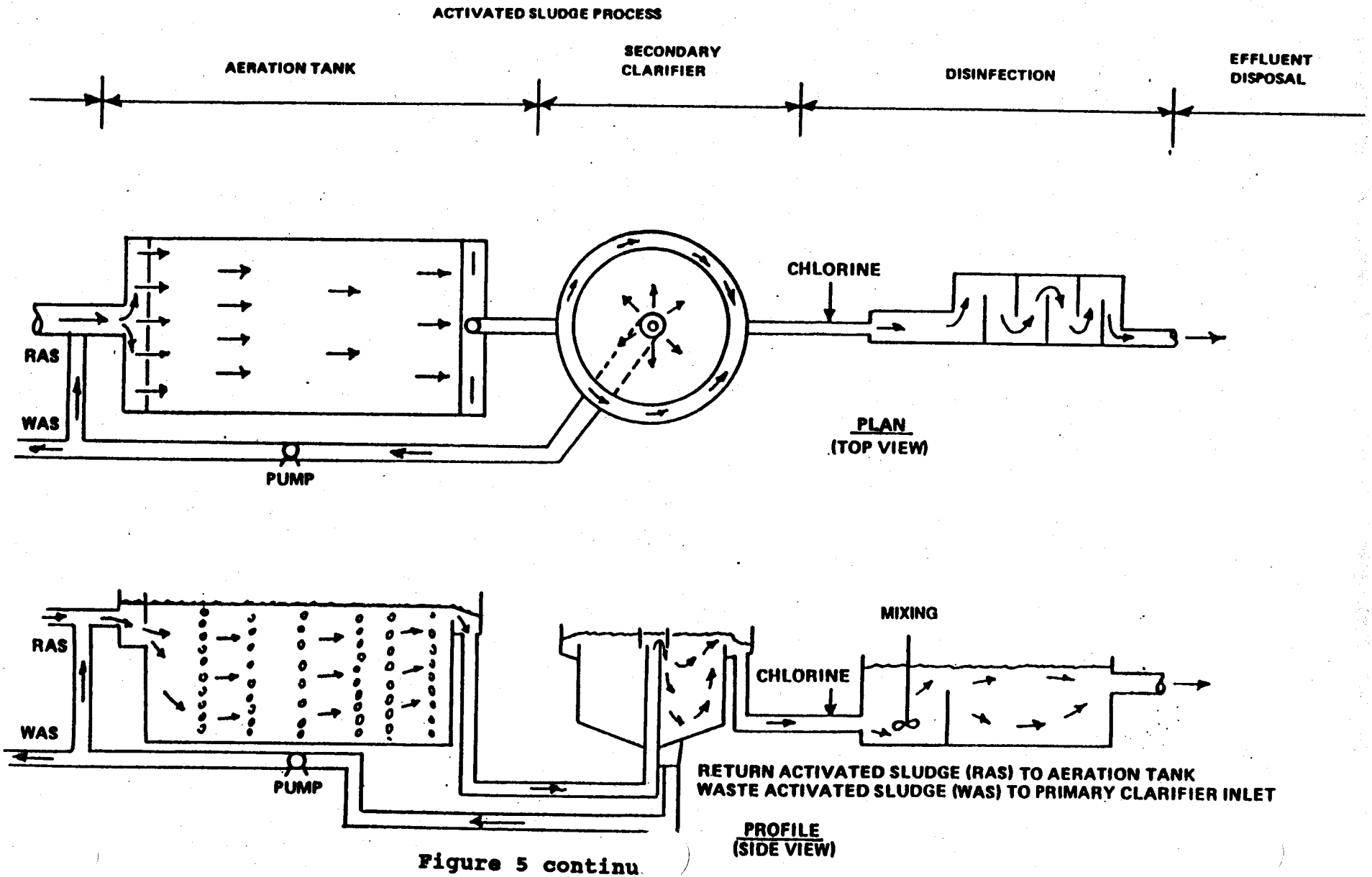

Figure 5 continu

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. Also, if there is excessive groundwater infiltration this would impact the daily flow rate

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 design flows and actual flows. Design flow is the amount of wastewater

that the treatment plant is designed to handle on a daily basis. 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 by-passed around the treatment plant and dumped directly into the receiving waters. Some treatment plants have large basins to temporarily store untreated flows.

Generally, most flows in a sanitary sewer system occurs during the day time hours. A Generally 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.

The wastewater treatment plant operator can provide information about the amount of flow entering a wastewater treatment plant at any given time.

Example: Calculate a reasonable estimate of the day-time (8 a.m. to 5 p.m.) hourly flows for a wastewater treatment plant with a design capacity of 10 MGD, and an actual flow of 7 MGD.

Answer: Note: design flows should not be used when calculating actual flow rates. The figure 7 MGD should be used. We can assume that half the flow occurs during the 8 a.m. to 5 p.m. period, then the hourly flow is:

(1) $7 \div 2 = 3.5$
(2) $3.5 \div 9 = 0.38$ MGD (380,000 gallons per hour)

Note: In practice, do not estimate hourly flows for low volume plants - ask the treatment plant operator for the hourly rate.

In order to determine the probable impact of a metam-sodium application on a specific treatment plant, one must consider: 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; and 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 an adverse impact on a wastewater treatment plant due to the use of metam-sodium for sewer root control. These variables may be combines into: 1) collection system (pipeline) and 2) treatment plant. The following summary of events in the sewer system provides reference calculations to assist metam-sodium applicators.

Root Control Chemicals Containing Metam-Sodium

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; and 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 plants flow than would be experienced by a larger plant.

When treatment plants are upset following treatment with products containing metam-sodium and dichlobenil, metam is usually the culprit. Dichlobenil has a relatively low toxicity, and little or no effect on microorganisms at the wastewater treatment plant. Metam-sodium of itself does not cause a treatment plant problem, but its breakdown products do. Previously you saw that Metam-sodium in the presence of water decomposed to form MITC, CS_2, H_2S, and other products. These products begin to evolve in the sewer line before reaching the plant. Foaming methods of application enhance degradation of metam by: 1) reducing the pH, 2) injecting large quantities of air, and 3) diluting the material with water, and 4) 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

The sewer line root control applicator is responsible for insuring 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 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 $25,000 per day penalties for National Pollutant Discharge Elimination System (NPDES) permit violations resulting from "upset conditions"
NOTE: Always consult the wastewater treatment plant operator before applying any chemical to a wastewater collection system. 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:

1. type of pesticide and physical properties of the pesticide,
2. flow conditions in the pipe being treated and application method,
3. size of the wastewater treatment plant and dilution factors,
4. size of the lines being treated and distance from the plant,
5. total rate at which pesticides are applied to the system, and
6. 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 which 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" diameter and have been installed at various times, as buildings were erected, by a number of different people over the years. 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, and
- 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

- 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 four fold 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 ofa 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 were often smaller groupings of homes and commercial buildings built by different developers or individuals. After several growth years these have finally grown together into one developed community. The applicator can not 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 any one'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.
- Ninety nine times out of a hundred the conditions of the particular service line is an "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 in order to force the excess into service lines thus providing root thus providing root control. On the surface this practice appears to be an excellent idea, however, this practice involves significant risk of accidentally forcing chemical foam into buildings. Essentially the applicator reduces the rate of hose retraction during the foam application process, since foam taking path of least resistance will travel through the service lines.

Don't 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. The higher the percentage of service lateral length you attempt to treat by this method the greater the risk of accidental contamination in a building.

Risk factors in buildings are:

- basements with below grade plumbing,
- floor drains,
- dry traps,
- reduced sewer pipe volumes due to flow, low spots or root masses, and
- unknown connections to the service lateral being treated.

Building to Sewer Main. (Pump through plug)

This method of application is less risky than attempting to treat service laterals from the main line. However, it is not without risk. In principal 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 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 down stream sewer pipe. The bladder is than 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.

Risk factors may be:

- 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 time of treatment. Have a spotter in all buildings when service laterals are being treated.

Test Your Knowledge

Q. What are the three components of handling waste water?
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 waste form 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 variable 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 processes removing waste from water.
A. Pretreatment/preliminary removes 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 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.