# WHAT IS BIONAT AND ALL THAT YOU NEVER WANTED TO KNOW

By definition

A layer of bacteria and other organic matter that forms in the soil around a septic system's drainfield. Also known as a clogmat.

TO TRULÝ UNDERSTAND BIOMAT WE MUST DISCUSS & HEALTHÝ BIOMAT AND AN UNHEALTHÝ BIOMAT

#### **REVIEW of some basics**

<u>Septic Tank</u> Separates solids and liquids

<u>Outlet Baffle</u> Prevents FOG from leaving tank

**Distribution box** 

Equally distributes effluent to the entire leachfield

#### Leach fields

Secondary treatment, delivers effluent to soil for reintroduction to ground water table - yuk!



#### Septic Tanks provide "Primary Treatment"

It is a separation device, Removals are time-based - within limits May remove 50% or more of Suspended Solids & BOD<sub>5</sub>

> The Septic Tank is sometimes referred to as a 'Primary Anaerobic Treatment Tank'



#### Traditional Septic Systems Rely On



discharge to the soil treatment area.

# Types of Soil Absorption Systems

# ANTIQUATED

## Cesspools

## Leach pits





# MODERN

#### Pipe & Stone Bed



#### **Pressure Distribution Bed**



#### **Plastic Chambers**



#### Drip Dispersal



### Let's start with HEALTHY BIOMAT

Under aerobic conditions a healthy biomat is formed with favorable aerobic bacteria that help consume and breakdown human waste (organics)

## Mostly healthy biomat from a leachfield





#### Healthy biomat from aerobic treatment media

Healthy biomat from an ATU

#### Note the tan color NOT black



BIOMAT is a vital part of wastewater treatment

The biomat's bacteria feed on organic matter, bacteria, and viruses

The biomat slows the flow of wastewater into the soil allowing the favorable bacteria more time to treat the wastewater A healthy biomat acts as a "Recycling Center" where the waste constituents are processed before return to the environment



## Goal of Onsite Wastewate Treatment Properly Treat Wastewater



#### Questions?



## Food Chain Carbon Cycle



# <u>Microorganisms</u> are the effective workforce of the system..

#### Specifically <u>AEROBIC</u> Bacteria!



A scanning electron micrograph of a pin showing surface bacteria.





#### ... IT IS <u>MICROORGANISMS</u> THAT PROVIDE THE BULK OF TREATMENT, SPECIFICALLY <u>AEROBIC</u> BACTERIA!









# Surprisingly enough aerobic bacteria have many beneficial affects on human lives







## UNHEALTHY BIOMAT IS PRIMARILY BIOMAT THAT IS DEAD

- Bacteria from human digestive track has an exoskeleton and slime coating to protect from being digested, but this contributes to the unhealthy biomat
- Excess organic matter that is not consumed by living favorable aerobic bacteria also clog the biomat

### Note BLACK color and shiny appearance





Gelatine like consistency due to waste bacteria passed through human digestive track







What can we do to help keep our aerobic bacteria workforce happy & healthy?

#### Maintain aerobic conditions in the soil

- Vents help airflow
- Keep soil loose
- Don't locate leach fields under pavement or pools
- Aerobic bacteria require oxygen to breath and convert organic matter to minerals, CO2, and water

# The soil must then provide the proper conditions for the aerobic biological processes to occur.



TYPICAL TRENCH SYSTEM

Oxygen and Nitrogen



Rainwater pulls O2 into the soil

1 Diffusion

As rainwater falls it absorbs oxygen

- When rainwater infiltrates the soil, it displaces the air already present in the soil pores
- The dissolved oxygen in the rainwater then diffuses into the soil

## 2 Infiltration

- As rainwater infiltrates the soil is displaces the air already present in the soil
- The rainwater then percolates into the soil, pulling fresh air with higher oxygen levels into the soil

# Organic matter is food for the aerobic bacteria

- Don't overfeed
- Feed them food that is easy for them to eat.
  - Food that passes through humans is predigested
  - Food from a garbage grinder is 12 14 X more complex for bacteria to breakdown
- Feed them smaller meals more frequently with time equalized dosing pump chambers
- Feed as many bacteria as you can by dosing to the entire field with pressure distribution

# Organic loading can be almost eliminated with ATUs, thus eliminated overfeeding

-Singulair, FAST, Advantex, and other ATU's used in environmentally sensitive areas such as: wells, ponds, rivers, high ground water areas



# Effluent Filter reduces the food going to the leachfield



#### **PROPER SYSTEM MAINTENANCE**



- Pumping of solids
- Effluent filters
- Laundry lint filters
- Access risers
- Inspections
- Remove garbage disposal
- Keep vehicles off septic system
- Prevent trees and shrubs from growing over system.

## LET'S HAVE A PARTY

- While lowering the amount of food we feed our bacteria helps, we could also increase the number of bacteria
- Process is called biological augmentation
- Common practice in municipal plants
- For on-site systems MA DEP approved additives can be used
- Very short-term effects due to lack of O2

## LET'S REVISIT UNHE&LTHY BIOMATS

What are the
results of
unhealthy biomat

The anaerobic bacteria (consumer) form a fixed biological film on the soil particles. The slimes they produce capture and retain organic constituents forming a "Clog Mat". As the biofilm thickens pore space becomes increasingly restricted reducing hydraulic function that in turn results in system failure.



#### Black biomat indicates it is dead and has become a clog mat



#### <u>Clog mat prevents water from draining</u>



Progressive Clog mat formation seals bottom and results in system ponding



#### Clog mat forms on the side walls of the system.



# Ultimately sealing off the absorption system & causing breakout



## BREAKOUT



# WHAT CONTRIBUTES TO UNHE&LTHY BIOM&T



## PROPER SYSTEM MAINTENANCE ELIMNATES UNNECESSARY WATER INTO THE SEPTIC SYSTEM

- Remove Water Softener Back Wash
- Identify and Fix Leaking Fixtures
- Identify and Fix Surface Water Infiltration



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#### **Proper Maintenance** Leaking toilet adds unnecessary water and stresses the septic system



#### **Proper Maintenance**

Remove Water Softener Back Wash from Septic

#### What has salt been used for since the early ages?

- Food Preservative
- Inhibits Microbial Activity

#### What does salt do to water?

- Increases its Density
- Effecting Settling

#### What effect does sodium have on clays?

- If a grain of sand were the size of a basketball, then a piece of silt would be the size of a marble and a particle of clay would be a pinpoint. Clay particles are so small, less than one 12,500th of an inch, that electron microscopes must be used to see them. These tiny specks are "surface active" with contaminants found in waste water, but the problem is that they are shaped like plates or flakes. When the cationic influence of sodium is present, these flakes tend to stick together like a peanut butter sandwich.



#### **Proper Maintenance** Storm Water Infiltration Identified



## How Do I Maintain My System?

# Washing Machine Filter?



# Medications

#### Antibiotics, kills bacteria

## Chemotherapy, kills bacteria

Acne Medication, lowers pH killing bacteria

# **CHEMICALS**

## ANTIBACTERIAL SOAPS AND CLEANERS CREATE TOXIC ENVIRONMENT

## BLEACH

# WHEN DOES A HEALTHY BIOMAT BECOME UNHEALTHY



HOW DOES HIGH STRENGTH WASTEWATER AFFECT BIOMAT

IN SHORT, HIGH STRENGTH WASTEWATER RESULTS IN OVERFEEDING, THUS CREATING CLOGGING OF SOIL MUCH QUICKER

#### Comparing hydraulic and organic mass loadings for a restaurant wastewater

Infiltration surface sizing traditionally has been based on the daily hydraulic load determined through experience to be acceptable for the soil characteristics. This approach to sizing fails to account for changes in applied wastewater strength. Since soil clogging has been shown to be dependent on applied wastewater strength, it might be more appropriate to size infiltration surfaces based on organic mass loadings.

To illustrate the impact of the different sizing methods, sizing computations for a restaurant are compared. A septic tank is used for pretreatment prior to application to the SWIS. The SWIS is to be constructed in a sandy loam with a moderate, subangular blocky structure. The suggested hydraulic loading rate for domestic septic tank effluent on this soil is 0.6 gpd/ft<sup>2</sup> (table 4-3). The restaurant septic tank effluent has the following characteristics:

BOD<sub>5</sub> 800 mg/L

TSS 200 mg/L

Average daily flow 600 gpd

Infiltration area based on hydraulic loading:

Area =  $600 \text{ gpd}/0.6 \text{ gpd}/\text{ft}^2 = 1,000 \text{ ft}^2$ 

#### Infiltration area based on organic loading:

At the design infiltration rate of 0.6 gpd/ft<sup>2</sup> recommended for domestic septic tank effluent, the equivalent organic loading is (assuming a septic tank BOD<sub>5</sub> effluent concentration of 150 mg/L)

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Organic Loading = 150 \text{ mg/L x } 0.6 \text{ gpd/ft}^2 \text{ x } (8.34 \text{ lb/mg/L x } 10^{-6} \text{ gal})
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= 7.5 \times 10^{-4} \text{ lb BOD}_{5}/\text{ft}^{2}-\text{d}
```

Assuming 7.5 x  $10^{-4}$  lb BOD<sub>5</sub>/ft<sup>2</sup>-d as the design organic loading rate,

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Area = (800 \text{ mg-BOD}_{5}/\text{L x } 600 \text{ gpd x } 8.34 \text{ lbs/mg/L x } 10^{-6} \text{ gal})
```

(7.5 x 10<sup>-4</sup> lb BOD<sub>5</sub>/ft<sup>2</sup>-d)

=  $4.0 \text{ lb } BOD_{5}/d$  = 5337 ft<sup>2</sup> (a 540% increase)

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(7.5 x 10<sup>-4</sup> lb BOD<sub>5</sub>/ft<sup>2</sup>-d)
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Impact of a 40% water use reduction on infiltration area sizing

Based on hydraulic loading,

Area =  $(1 - 0.4) \times 600 \text{ gpd}$  = 600 ft<sup>2</sup>

0.6 gpd/ft<sup>2</sup>

Based on organic loading (note the concentration of  $BOD_s$  increases with water conservation but the mass of  $BOD_s$  discharged does not change),

Area = (800 mg-BOD,/L x 600 gpd) x (8.34 lb/mg/L x 10<sup>-g</sup> gal)

[(1 - 0.4) x 600 gpd] x (7.5 x 10<sup>-4</sup> lb BOD<sub>2</sub>/ft<sup>2</sup>-d)

=  $4.0 \text{ lb BOD}_{5}/\text{d}$  = 5337 ft<sup>2</sup> (an 890% increase)

(7.5 x 10<sup>-4</sup> lb BOD<sub>s</sub>/ft<sup>2</sup>-d)

# QUESTIONS & DISCUSSION