THE PURPOSE OF THE TYPICAL SEPTIC SYSTEM:

The traditional purpose of anaerobic septic systems is to safely recycle the water component of sewage on the site where the sewage is produced. The vast majority of organic matter (solids) entering a septic system is retained in the anaerobic septic tank for periodic removal off site for treatment and disposal (hopefully with a low level of pollution). The requirement for any septic system to have an anaerobic septic tank is the evidence that only the disposal of contaminated water is the purpose.

The soil on the site provides the **final treatment, or** purifies the water, unless mechanical disinfection is allowed. All onsite septic systems are expected to protect humans from disease, water sources from contamination and the eco-systems from environmental damage from human sewage.

Human waste enters a septic tank as organic solids (other than urine). The general septic industry to date has not considered the disposal of organic matter and solids onsite because there was no means or method to dependably recycle organic solids on site whether by anaerobic or aerobic septic systems until the introduction of the Pirana System in 2000. ***

We put our body's wastes in water (sewage) as organic solids to move them away from, and outside of, our homes or buildings using water as the vehicle and most often gravity as the force (unless pumps are required). In an anaerobic conventional septic system, removing the waste from the water in sewage so the water can be safely recycled is a multi-step filtration process.

WHAT IS FINAL TREATMENT:

Final treatment means the complete removal, or reduction to government approved "acceptable levels of concentration", of specific chemical and biological contaminants contained in the contaminated water from the septic tank prior to contact with humans, exposure to the environment or introduction into surface and ground waters. If effluent cannot receive **final treatment** by native soil, some approved method of disinfection must be provided. Native soils act as a filter purifying the contaminated water by capturing and holding biological and organic contaminants in the water for eventual destruction by naturally occurring aerobic soil microbes.

DEFAULT SEPTIC SYSTEM DESIGN:

For the past century, anaerobic septic tanks with disposal fields (hereafter called conventional septic systems), and cesspools have been generally accepted in the USA and worldwide as the default designs for onsite disposal of the water component of sewage.

Conventional septic systems and cesspools are essentially a series of three filters. The first filter is the septic tank that separates solids from the water into settled sludge and floating scum and holding these solids in the tank for eventual removal by pumping and transport off site. The septic tank is a very efficient filter as it removes 80% to 90% of solids entering a septic tank. Removing a portion of a flow of material through an apparatus is technically a filtering process no matter how the removal is accomplished. The contaminated water containing soluble and suspended particulate matter from feces and hazardous bacteria and microbes leaving a septic tank is commonly called effluent.

The second filter is the disposal field construction. Suspended organic particulates in the effluent will settle out and soluble organic matter will partially coagulate out while trapping a portion of the bacteria and microbes in the contaminated water from the septic tank. This settling out is another form of filtration.

The third filter is the aerobic native soils. The native soil is an excellent filter. After the effluent passes through three to five feet of unsaturated and undisturbed native soil, all of the remaining organic and biological contaminates and some of the chemical contaminants are filtered out of the water and held in the soil for digestion and destruction by soil microbes thereby purifying the water so it can safely be recycled.

A cesspool functions as a combined septic tank and disposal field in one construct. The functional life of a typical cesspool is expected to be dramatically shorter than a conventional septic system in comparable soils because the cesspool has a very small soil infiltrative surface compared to a disposal field. The cesspool and conventional septic system both fail from the same biological process.

Soil structure is or should be the determinant factor in cesspool and disposal field designs. The right design is critical in projecting how long either will functions properly. In the USA, Federal EPA guidelines outline that if a disposal field functions properly for +/- ("hoped for") 20 years before a symptom of failure occurs, it is generally considered a properly designed and installed disposal field. What is critical to property owners is this 20-year "hoped for period" before failure makes septic systems affordable. Unfortunately in many areas of the US, being "affordable" is often not considered in modern septic system designs. Regulators allow septic system disposal fields to be installed in soils that anyone with reasonable experience would know cannot function properly for anywhere near that "affordable time period".

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So what ultimately causes failure? The answer is simple. All anaerobic septic systems will eventually fail from biomat clogging of cesspool or disposal field infiltrative soils.

WHAT IS BIOMAT:

Biomat is the accumulation of natural, very viscous polysaccharide slime secreted by obligate anaerobic intestinal bacteria colonizing all of the infiltrative soil surfaces that absorb the contaminated water from cesspools or septic tanks.

Biomat is a slime layer that is bio-chemically resistant to the movement of water through the slime layer. Over time, the accumulation of biomat reduces the permeability of the disposal field design causing contaminated water to pond in the drain field void spaces or within the vertical column of a cesspool. According to the USA EPA, 95+% of conventional septic system failures are from anaerobic biomat slime clogging the surfaces of the infiltrative soil.

HOW BIOMAT CAUSES DISPOSAL FIELD FAILURE:

There are positive and negative aspects of anaerobic septic systems. Both are from how we deal with out bodily waste. First we put our waste in water to take it away from us. Then we temporarily store the water and waste in a cesspool or septic tank that quickly becomes anaerobic as organic waste solubilizes and suspends in the effluent. The organic waste and dissolved oxygen in the water bond together removing the oxygen from the water creating anaerobic conditions (no available oxygen for aerobic respiration).

Obligate anaerobic intestinal bacteria that secrete biomat in the drain field soils do not survive outside of our bodies primarily because they cannot tolerate exposure to oxygen (oxygen is toxic to them). The development of anaerobic conditions of the water in septic tanks allows biomat secreting anaerobic

intestinal bacteria to survive in the septic tank. The anaerobic contaminated water leaving a septic tank or stored within a cesspool eventually creates anaerobic conditions throughout the disposal field construct and in the infiltrative surfaces of the native soil. (including cesspool infiltrative soil surfaces).

Native soils are naturally aerobic. Anaerobic bacteria cannot survive in aerobic soils. As within the anaerobic septic tank, anaerobic conditions in the disposal field and infiltrative soil surfaces allow biomat secreting intestinal bacteria to survive. When they finally colonize all of the infiltrative surfaces of the native soil in a drain field or around a cesspool, failure will occur.

Biomat is bio-chemically resistant to the passage of water through its structure. It will eventually reduce the passage of contaminated water through it so that some of the contaminated water entering the disposal field from the septic tank each 24-hour period, or into a cesspool, cannot pass into the native soil. A tiny volume remains in the disposal field void spaces or within the cesspool eventually creating a vertical liquid depth.

Initially the stored anaerobic effluent in the cesspool or the void spaces of the disposal field rises to a vertical depth that creates hydraulic pressure that forces the anaerobic effluent through the restrictive biomat layer more efficiently. A temporary equilibrium between what enters the drain field or cesspool in our 24-hour living cycle is established. The vertical depth of the stored anaerobic effluent that created the initial hydraulic pressure remains but doesn't increase. The hydraulic pressure however, "pushes" anaerobic effluent further into the soil creating a deeper anaerobic soil environment. The anaerobic soil conditions allows more biomat producing bacteria ever deeper into the soil while supplying nutrients to support their continued survival.

Greater depth penetration creates greater resistance to the passage of anaerobic effluent that eventually requires more hydraulic pressure. The temporary equilibrium is destroyed. Again a small volume of effluent remains each day in the drain field void spaces. The liquid level in the cesspool or disposal field void spaces increases again (and again); incrementally step by incremental step, temporary equilibrium to temporary equilibrium. Each step forces biomat bacteria further into the native soil causing the requirement for more hydraulic pressure to another temporary equilibrium. Eventually the process runs out of vertical height in the disposal field or cesspool to increase hydraulic pressure. An event of failure will then occur.

SYMPTOMS OR DEFINITIONS OF SEPTIC SYSTEM FAILURE:

It is important to understand that "failure" doesn't mean no septic effluent enters the soil for **final treatment**. Biomat isn't an impermeable layer that doesn't allowing any effluent to be absorbed. In nearly all cases of failure, 99+% of the septic effluent will continue to be absorbed into the native soil for **final treatment**. The small amount of effluent that can't enter the soil in our 24-hour living cycle is then "excess" effluent that causes some form of failure. It is this small excess that we see surfacing or is stored in the septic system that eventually backs up toilets and plumbing from rising septic tank liquid levels.

There are classic symptoms of cesspools or conventional septic systems that can presage an event that would be defined as failure: (A) Occasional and increasing frequency of slow draining fixtures and gurgling when toilets are flushed with occasional sewer odors when toilet is flushed (B) Periodic episodes of sewage upwelling into a tub or shower (C) Green stripping from vigorous plant growth over disposal field (D) Plant dead zone over disposal field (E) occasional damp or wet spots over disposal field or around the cesspool and septic tank (F) back flow from the disposal field into the septic tank when the septic tank is pumped.

The five classic descriptions of failure are: (1). Noxious odors with permanent swampy areas or surfacing effluent over a drain field, a cesspool or septic tank are most common. (2). Permanent slow draining or over flowing toilets and plumbing fixtures in the house or building that make using the septic system difficult or impossible (most disturbing to a house or building owner). (3). Polluted surface waters by liquid drainage or "seep" off site that can be proven to originate from a particular cesspool or conventional septic system (rare). (4). Potable water source (well or spring) contaminated with human intestinal bacteria where the source of the contamination is a cesspool or septic system. (5). Change in government codes or ordinances that re-define existing septic systems as failed.

To recap: anaerobic cesspools and conventional septic systems are only designed to recycle the water component of sewage. They do relatively little to dispose and recycle the organic load or pollutants that enter a septic system. Because a conventional septic system or cesspool is essentially a series of filters, and only the first filter can be cleaned, they are essentially designed to fail over time. 95+% of failures are from the same cause: biomat clogging of infiltrative native soils. Failure isn't defined as zero absorption of effluent. Failure is defined as any volume of septic effluent, even a tablespoon of effluent, that isn't purified by the native soil, or approved disinfection method, before contact with human beings, the environment, ground and surface waters, or the plumbing in your home ceases to function properly.

*** For 19 years the septic industry resists recommending or using the superior capabilities of the Pirana System. The general public depends in most cases on the septic industry for information and solutions. By not mentioning the Pirana System the participants in the septic industry simply and easily constrain its use.