Maine Center for Disease Control and Prevention
An Office of the Department of Health and Human Services

Paul R. LePage, Governor Mary C. Mayhew, Commissioner

Department of Health and Human Services
Maine Center for Disease Control and Prevention
286 Water Street
11 State House Station
Augusta, Maine 04333-0011
Tel. (207) 287-8016
Fax (207) 287-9058; TTY (800) 606-0215

Tel. (207) 287-5672 Subsurface Wastewater Unit Fax (207) 287-4172

September 20, 2011

Geomatrix, LLC
Attn.: David Potts, Environmental Scientist
114 Mill Rock Road East
Old Saybrook, CT 06475

Subject: Reduced Separation Distances, Geomatrix LLC *SoilAir*

Dear Mr. Potts:

The Division of Environmental Health has reviewed your request to reduce the vertical separation distances between disposal areas and ledge and the seasonal high groundwater table in profile 5 and 6 soils to 12 inches each, when a Geomatrix LLC *SoilAir* unit is used in a system. Information in the Division's files demonstrates that the *SoilAir* treatment units routinely achieve BOD^5 and TSS reductions to single digit levels, both in the high 90's percent range of reduction. The units also achieve E. coli reductions in excess of 99 percent.

On the basis of effluent quality, the Division amends the product registration for *SoilAir* systems under the Rules, as follows:

1. A minimum separation distance of 12 inches shall be maintained between the seasonal high groundwater table and the lowest elevation of the system's disposal area soils when a *SoilAir* unit is used in a system, and

2. A minimum separation distance of 12 inches shall be maintained between bedrock and the lowest elevation of the system's disposal area when a *SoilAir* unit is used in a system.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of *SoilAir*. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar or competing products.

If you have any questions, please fee free to contact me.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Project Manager, Webmaster
Division of Environmental Health
Drinking Water Program
Subsurface Wastewater Unit
286 Water Street, Augusta, ME 04333
e-mail: james.jacobsen@maine.gov

xc: File

Jacobsen, James

From: Jacobsen, James
Sent: Tuesday, September 20, 2011 8:33 AM
To: 'Dave Potts'
Subject: RE: SoilAir
Attachments: separation letter.doc

David,

Please see the attached approval. Contact me if you have any questions.

Jim Jacobsen

James A. Jacobsen
Project Manager, Webmaster
Division of Environmental Health
Drinking Water Program
Subsurface Wastewater Unit
286 Water Street, Augusta, ME 04333
Phone: 207-287-5695 Fax: 207-287-3165
http://www.mainepublichealth.gov/septic-systems
http://www.mainepublichealth.gov/cemeteries

From: Dave Potts [mailto:dpotts@geomatrixllc.com]
Sent: Thursday, September 08, 2011 3:38 PM
To: Jacobsen, James
Subject: SoilAir

Jim,
Thank you for taking the time to explain how the separation distance to ledge and high permeability sands and gravel are handled in Maine. As we discussed, some designers have suggested that we request approval from your Department for a 50% reduction in vertical separation distance (24" to 12") to ledge and profile 5 and 6 soils, when a SoilAir™ system is utilized. Based on our conversation, it is my understanding that this would be allowable. If you could confirm this understanding in writing it would be much appreciated.

Thank you for your help with this.

Sincerely,

David Potts
Environmental Scientist

Geomatrix, LLC
114 Mill Rock Road East
Old Saybrook, CT 06475
860-510-0730 - phone
860-510-0735 - fax
860-227-0636 - cell
dpotts@geomatrixllc.com

Jacobsen, James

From: Dave Potts [dpotts@geomatrixllc.com]
Sent: Friday, July 18, 2008 12:13 PM
To: Jacobsen, James
Subject: GeoMat and SoilAir
Follow Up Flag: Follow up
Flag Status: Completed

Jim,

Thank you for your review and approval of the GeoMat leaching system and SoilAir aeration system for use in the State of Maine. Based on our phone conversation of earlier today, we suggest the following:

GeoMat
Our controlled testing, presented in "Wastewater Renovation and Hydraulic Performance of a Low Profile Leaching System", published in the April 2008 NOWRA Proceedings and current field sizing is based on a hydraulic loading rate of 1.8 gallons per day / square foot of "typical" residential septic tank effluent. We request that this loading rate be applied to the GeoMat sizing for use in the State of Maine. Horizontal spacing of the products should be no less than the width of the respective product, i.e. with the 12" wide GeoMat 1200, a minimum of 12" edge to edge should be maintained.

SoilAir
Unlike other treatment systems, SoilAir aerates the leaching/disposal system. By aerating the soil, in a process similar to composting, treatment is not limited by the solubility of oxygen in water; this equates to a 21,000 times increase in oxygen. Through this process anaerobic biomat is eliminated, microbial populations are significantly increased and hydraulic capacity can match that of the soil that the system is installed in. Through studies conducted to date (included in our application information) and hundreds of field installations, it has been proven that wastewater loading rates can be increased 3 to 5 times without any negative effects; in fact, nitrogen remove is significantly improved. Based on this, we request that when SoilAir is utilized that a 50% size reduction be allowed on a leaching/disposal system; as is similarly provided for with other aerobic systems. We believe that this will still provide for a significant safety factor.

Thank you for your help with this matter, and let us know if you have any questions or suggestions.

Sincerely,
David Potts
Geomatrix Systems, LLC

FILE

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Fax: (207) 287-9058; TTY: 1-800-606-0215

August 5, 2008

Geomatrix Systems, LLC
Attn.: David and Elizabeth Potts
385 Roast Meat Hill Road
Killingworth, CT 06419

Subject: Product Registration, GeoMat, Models 600, 1200, and 3900

Dear Mr. and Ms. Potts:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

The GeoMat consists of a one inch thick mat comprised of fused, entangled plastic filaments. Non-woven geotextile fabric is bonded to the bottom of the mat. A one inch diameter pressure distribution pipe is placed on the top of the mat, and both are then covered with one layer of non-woven geotextile fabric. Clean out ports are incorporated into the distal ends of the distribution pipes. The minimal storage capacity of the GeoMat is mitigated through use of flow equalization measures including, but not limited to, timed doses. Biomat formation is minimal after one year of operation according to the report titled "*Wastewater Renovation and Hydraulic Performance of a Low Profile Leaching System*".

GeoMat is available in six inch, 12 inch, and 39 inch widths. (Note: the product cross section drawing dated 07/02/07 shows 12 inch, 39 inch, and 78 inch widths.) GeoMat is designed for use with septic tank effluent treated to secondary levels, as well as untreated septic tank effluent. No sizing modification was proposed for use with treated effluent. A cover of six to 12 inches of fill is recommended. Horizontal spacing between rows of GeoMat are not specified.

Claim

According to the information you provided, and information available on your company web site, the GeoMat provides reductions in BOD_5, nitrogen (total, ammonia, and nitrate), and phosphorus. However, reduction in the strength of disposal area leachate is to be expected from any disposal area.[1] At the risk of stating the obvious, cleansing of the effluent is a broad function of ***any*** onsite sewage disposal system's disposal area.[2, 3]

Determination

On the basis of the information submitted and available on your company web site, the Division has determined that the GeoMat is acceptable for use as a disposal area for wastewater effluent pursuant to the Rules, in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and the following conditions:

1. Sizing of GeoMat disposal areas shall be 1.8 gallons per square foot. This rate is based upon historic data contained in the application and various published studies.

2. Backfill and construction fill used in GeoMat systems shall conform to the backfill specifications of Section 804.2.2 of the Rules, copy enclosed.

3. Vertical separation from the limiting factor shall be measured to the bottom of the GeoMat.

4. Horizontal separation between rows of GeoMat shall be 100 percent of the width of the model in use, measured edge to edge. For example, a 12 inch horizontal separation shall be maintained between rows of the 12 inch wide GeoMat 1200.

In the event that the product fails to perform as claimed by the applicant, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of GeoMat. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar or competing products.

This letter supersedes the letter dated 06/16/08. If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

1. Table 3-18, U.S.E.P.A. *"Onsite Wastewater Treatment Systems Manual"*, 02/2002.
2. Pages 5 & 6, *"Site Evaluation for Subsurface Wastewater Disposal in Maine"*, 04/2001
3. *"In Ground Dispersal of Wastewater Effluent: The Science of Getting Water into the Ground"*, Small Flows Quarterly, Spring 2003, Volume 4, Number 2

Jacobsen, James

From: Dave Potts [dpotts@geomatrixllc.com]
Sent: Friday, July 18, 2008 12:13 PM
To: Jacobsen, James
Subject: GeoMat and SoilAir
Follow Up Flag: Follow up
Flag Status: Completed

Jim,

Thank you for your review and approval of the GeoMat leaching system and SoilAir aeration system for use in the State of Maine. Based on our phone conversation of earlier today, we suggest the following:

GeoMat
Our controlled testing, presented in "Wastewater Renovation and Hydraulic Performance of a Low Profile Leaching System", published in the April 2008 NOWRA Proceedings and current field sizing is based on a hydraulic loading rate of 1.8 gallons per day / square foot of "typical" residential septic tank effluent. We request that this loading rate be applied to the GeoMat sizing for use in the State of Maine. Horizontal spacing of the products should be no less than the width of the respective product, i.e. with the 12" wide GeoMat 1200, a minimum of 12" edge to edge should be maintained.

SoilAir
Unlike other treatment systems, SoilAir aerates the leaching/disposal system. By aerating the soil, in a process similar to composting, treatment is not limited by the solubility of oxygen in water; this equates to a 21,000 times increase in oxygen. Through this process anaerobic biomat is eliminated, microbial populations are significantly increased and hydraulic capacity can match that of the soil that the system is installed in. Through studies conducted to date (included in our application information) and hundreds of field installations, it has been proven that wastewater loading rates can be increased 3 to 5 times without any negative effects; in fact, nitrogen remove is significantly improved. Based on this, we request that when SoilAir is utilized that a 50% size reduction be allowed on a leaching/disposal system; as is similarly provided for with other aerobic systems. We believe that this will still provide for a significant safety factor.

Thank you for your help with this matter, and let us know if you have any questions or suggestions.

Sincerely,
David Potts
Geomatrix Systems, LLC

FILE

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John E. Baldacci, Governor Brenda M. Harvey, Commissioner

Department of Health and Human Services
Maine Center for Disease Control and Prevention
286 Water Street
11 State House Station
Augusta, Maine 04333-0011
Tel: (207) 287-8016
Fax: (207) 287-9058; TTY: 1-800-606-0215

August 5, 2008

Geomatrix Systems, LLC
Attn.: David and Elizabeth Potts
385 Roast Meat Hill Road
Killingworth, CT 06419

Subject: Product Registration, Geomatrix Systems, LLC , *SoilAir*

Dear Mr. and Ms. Potts:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

The *SoilAir* is a system for introducing pressurized air to existing disposal areas, for the purpose of rejuvenation by degradation of restrictive biomats. The *SoilAir* is available for installation in existing septic tanks, and as separate installations in a lift station following a septic tank. The in-tank system consists of a high-pressure air blower and electronic control module in a weather-tight housing, a check valve, an air inlet line, and liquid level sensor. The lift station installation is nearly identical, except that the air line is introduced in a distribution box adjacent to the system's disposal area, and the check valve is installed in-line between the lift station and distribution box.

SoilAir operates by adding pressurized air to the effluent distribution line from a septic tank, e.g., the building sewer. Gravity flow systems require installation of a check valve in the building sewer, and an electronic level sensor in the septic tank to control the check valve and air blower. The check valve serves to prevent pressurized air from flowing "backward" in the system, thus restricting air flow to the disposal area.

Claim

According to the information you provided, and the reports you submitted, *SoilAir* provides reductions in BOD_5, total nitrogen, phosphorus, and fecal coliform bacteria; and rejuvenates disposal areas clogged by a restrictive biomat. The *SoilAir* facilitates reduction of restrictive biomats by converting the environment in the disposal area from anaerobic to aerobic, with an attendant shift to metabolically active biota.

Determination

On the basis of the information submitted, the Division has determined that the *SoilAir* is acceptable for use as a disposal area for wastewater effluent pursuant to the Rules, in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and the following conditions:

1. This approval does not authorize use of the *SoilAir* in an onsite sewage disposal system which has experienced a hydraulic malfunction, i.e., a "break-out" and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

2. *SoilAir* is allowed for use only for onsite sewage disposal systems which conform to provisions of the Rules in effect at the time of the system's installation. Specifically, *SoilAir* may not be used in cesspools, dry wells, and other non-conforming disposal areas.

3. If *SoilAir* is used in an apparently conforming but undocumented system, the applicant first shall document the system. This documentation shall be prepared by a licensed Site Evaluator, Professional Engineer, Certified System Inspector, or other knowledgeable professional retained by the applicant. The documentation may be in the form of a written report, a copy of which shall be provided to the owner and the Local Plumbing Inspector.

4. *SoilAir* installations shall require a permit from the Local Plumbing Inspector for installation as "Miscellaneous Component".

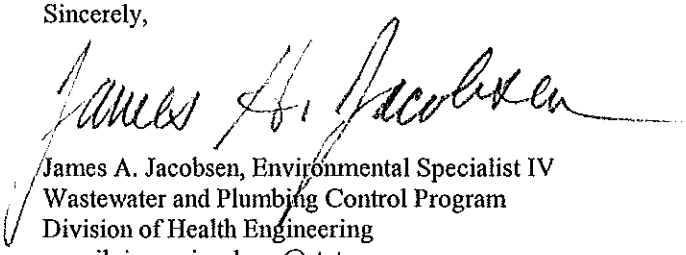
5. If *SoilAir* is used, the disposal area size may be adjusted by as much as 0.5 pursuant to Table 603.1 of the Rules.

In the event that the product fails to perform as claimed by the applicant, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of *SoilAir*. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar or competing products.

This letter supersedes the letter dated 06/18/08. If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,



James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

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June 18, 2008

Geomatrix Systems, LLC
Attn.: David and Elizabeth Potts
385 Roast Meat Hill Road
Killingworth, CT 06419

Subject: Product Registration, Geomatrix Systems, LLC , *SoilAir*

Dear Mr. and Ms. Potts:

The Division of Environmental Health has completed a review of a registration application for your company's product. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

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SoilAir operates by adding pressurized air to the effluent distribution line from a septic tank, e.g., the building sewer. Gravity flow systems require installation of a check valve in the building sewer, and an electronic level sensor in the septic tank to control the check valve and air blower. The check valve serves to prevent pressurized air from flowing "backward" in the system, thus restricting air flow to the disposal area.

Claim

According to the information you provided, and the reports you submitted, *SoilAir* provides reductions in BOD_5, total nitrogen, phosphorus, and fecal coliform bacteria; and rejuvenates disposal areas clogged by a restrictive biomat. The *SoilAir* facilitates reduction of restrictive biomats by converting the environment in the disposal area from anaerobic to aerobic, with an attendant shift to metabolically active biota.

Determination

On the basis of the information submitted, the Division has determined that the *SoilAir* is acceptable for use as a disposal area for wastewater effluent pursuant to the Rules, in the State of Maine, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions and the following conditions:

1. This approval does not authorize use of the *SoilAir* in an onsite sewage disposal system which has experienced a hydraulic malfunction, i.e., a "break-out" and overland run off. Such malfunctions are imminent public health hazards and must be replaced in an expeditious manner under provisions of the Rules.

2. *SoilAir* is allowed for use only for onsite sewage disposal systems which conform to provisions of the Rules in effect at the time of the system's installation. Specifically, *SoilAir* may not be used in cesspools, dry wells, and other non-conforming disposal areas.

3. If *SoilAir* is used in an apparently conforming but undocumented system, the applicant first shall document the system. This documentation shall be prepared by a licensed Site Evaluator, Professional Engineer, Certified System Inspector, or other knowledgeable professional retained by the applicant. The documentation may be in the form of a written report, a copy of which shall be provided to the owner and the Local Plumbing Inspector.

4. *SoilAir* installations shall require a permit from the Local Plumbing Inspector for installation as "Miscellaneous Component".

In the event that the product fails to perform as claimed by the applicant, use of the product in Maine, including all installations approved pursuant to Chapter 18 of the Rules, shall cease. Use of the product shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

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If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

Geomatrix

May 27, 2008

James A. Jacobsen, Environmental Specialist IV
Department of Health and Human Services
Division of Environmental Health
Subsurface Wastewater Program
286 Water Street, Augusta, ME 04333

RE: SoilAir System Approval Submittal

Dear Mr. Jacobsen,

I am finally getting around to sending you the documentation for the approval of the SoilAir System. I am sorry for the delay.

Please let me know if there is anything else that would help you or if you have any questions on the documents. I can be reached at 860-663-3993 and would be happy to talk with you.

Thank you.

GEOMATRIX, LLC

Elizabeth Potts

Geomatrix, LLC
385 Roast Meat Hill Road, Killingworth, CT 06419
(860) 663-3993 Fax: (860) 663-0324

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APPLICATION FOR REGISTRATION OF EXPERIMENTAL SYSTEM/INNOVATIVE TECHNOLOGY OR ONSITE SEWAGE DISPOSAL SYSTEM PRODUCT

Please complete the following Sections. Please print or type.

Applicant

Company Name: Geomatrix, LLC
Contact Person: David Potts
Address: 385 Roast Meat Hill Road
Town/City: Killingworth State/Province: CT Zip Code: 06419
Country: USA
Telephone: 860-663-3993 e-mail: dpotts@geomatrixllc.com

Product

Product Name: SoilAir™
Model: _____

Product Classification (choose one)

Primary or Secondary Treatment Unit

[ ] Septic Tank [ ] Extended Aerobic Treatment Unit [ ] Recirculating Aerobic Unit
[ ] Aerobic Fixed Film Unit [X] Other (specify): Soil Aeration System

Effluent Filter

[ ] Septic Tank Outlet Filter [ ] Post-Tank Filter [ ] Other (specify) _____

Disposal Device

[ ] Gravel-less Disposal Pipe [ ] Gravel-less Disposal Bed [ ] Chamber, Plastic
[ ] Chamber, Other [ ] Other (specify) _____

Miscellaneous

[ ] Pipe [ ] Effluent Flow Distribution Device [X] Other (specify): Soil Aeration System

SoilAir™ systems

Restoring and Enhancing
Leachfield Performance

Technical Description

December, 2005

Geomatrix, LLC

Introduction

The SoilAir System is a recently patented process that is quickly gaining the acceptance and respect of the onsite wastewater treatment community. The SoilAir system can rejuvenate subsurface wastewater infiltration systems (SWIS) that have failed due to organic buildup on the soil interface (biomat). Additionally, the SoilAir system can improve the long-term acceptance rate (LTAR) and increase the treatment efficiency for many wastewater constituents.

The SoilAir system consists of applying supra atmospheric air pressure to the SWIS. This results in oxygen flowing through the SWIS and out into the surrounding soil. Through this process, the biomat is transformed from anaerobic to aerobic. The aerobic and facultative microorganisms that flourish in this well aerated environment can then reduce the thickness of the biomat through their metabolic activity. Furthermore, the aerobic biomat is significantly more efficient at treating wastewater than conventional anaerobic biomats (Potts et al., 2004; Amador et al. 2005).

To date, SoilAir systems have been utilized on approximately 100 + sites. Systems are operating on new and existing SWIS including pipe and stone, plastic chambers, concrete galleries and dry wells. The SoilAir system has rejuvenated SWIS serving single family residences, restaurants, community systems, and numerous other commercial establishments; including those with high biochemical oxygen demand (BOD) and grease accumulations; some systems are over fifty years old. This has been accomplished in a wide range of climates and soil conditions.

Oxygen concentrations and the impact on the SWIS

It is commonly thought that oxygen concentrations in the soil adjacent to deep (>6 feet) SWIS are limited, oxygen in soils shallower than this are generally not believed to be limiting. In reality, although oxygen concentrations at depth do generally diminish, oxygen concentrations in the soil surrounding even the shallowest SWIS rarely match what is present in the atmosphere (21%).

Unfortunately, the oxygen transfer rate of the soil rarely meets the BOD of the wastewater, except in the most lightly loaded SWIS. This oxygen deficit results in the gradual buildup of biomat. When the biomat develops, it is typically significantly less permeable than the soil the SWIS is installed in. With the SoilAir system, soil oxygen levels adjacent to even deep, heavily loaded SWIS can be maintained at 21%. This is more oxygen than is typically present in soils just 6 inches below the surface of a golf green during the growing season, as is shown in Figure 1.

Figure 1

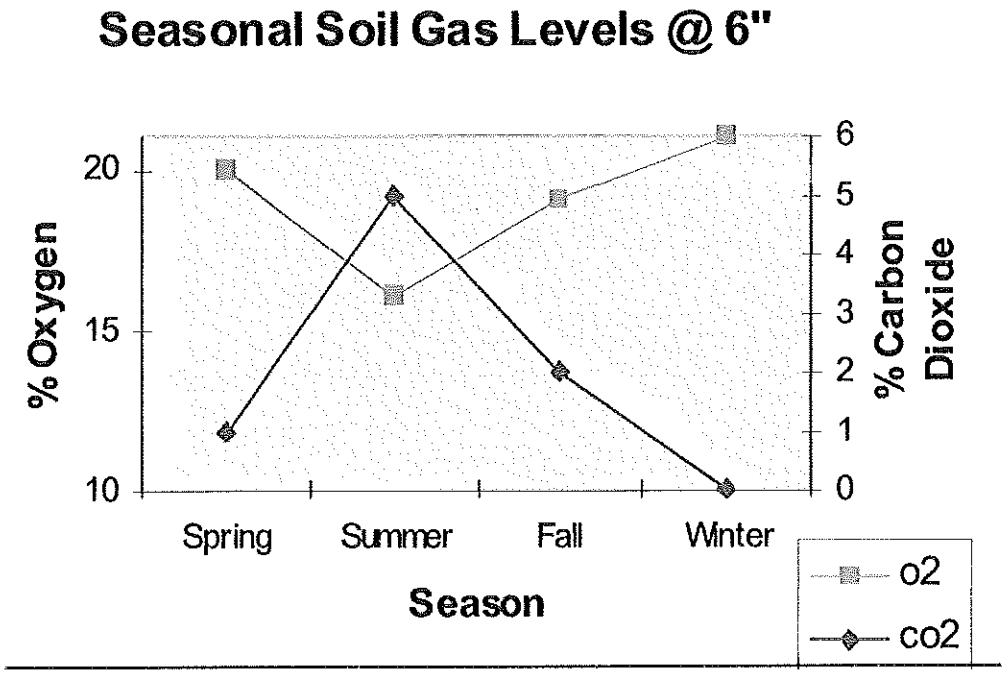

Figure 2

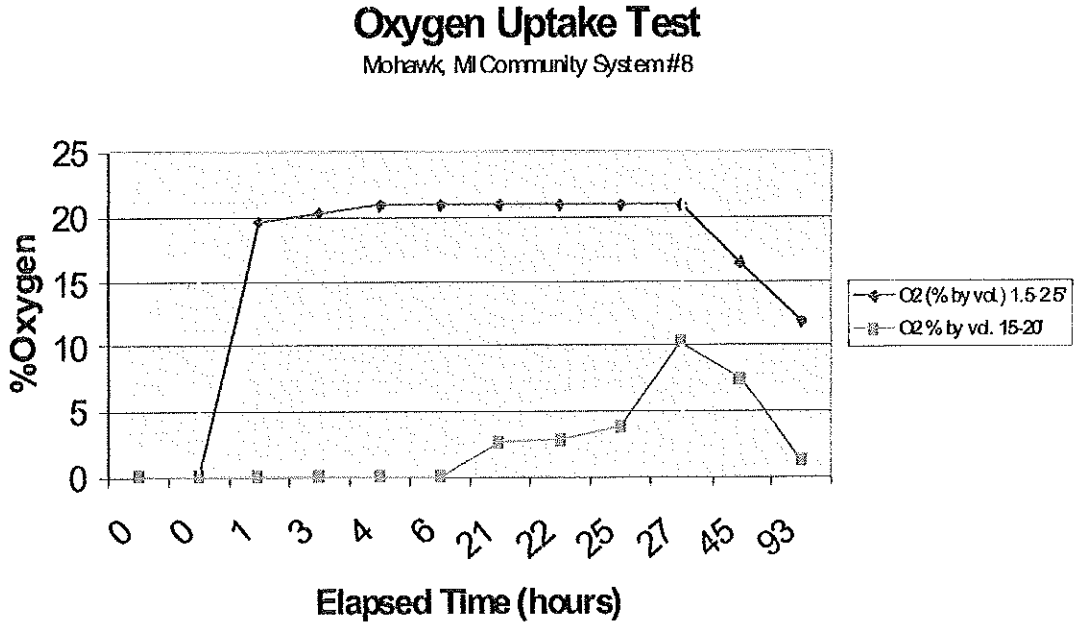

Figure 2 shows the soil oxygen levels at 1.5 to 2.5 feet (MP-1S) and 15 to 20 feet (MP-1D) below a SWIS during a SoilAir pilot study. The initial oxygen levels in both monitoring points are 0.0% by volume (%). Oxygen levels in MP-1S reach 21% within 6 hours of starting the SoilAir pilot unit. Oxygen levels in MP-1D reach a high of 10%, after 27 hours of air injection. Once the SoilAir pilot unit is turned off, oxygen demand immediately exceeds oxygen supply. Within a few days, the oxygen provided by the SoilAir pilot unit is completely consumed.

SWIS designers routinely assume that soils in the vadose zone inherently have high concentrations of oxygen present in the soil pore space. To illustrate how this is an incorrect assumption, groundwater on this site was greater than 25 feet below the SWIS. However, the background oxygen concentration was 0.0% at depths of 1.5 – 2.5 and 15 – 20 feet below the SWIS.

Hydraulic loading rates must not only take into effect the hydraulic capacity of the soils, but the capacity of the soil to transfer oxygen. When oxygen concentrations adjacent to the SWIS are increased to 21%, it results in the oxidation of historic biomat accumulations and the subsequent reestablishment of hydraulic capacity. Furthermore, maintaining 21% oxygen in the soil pore space adjacent to the SWIS allows the LTAR to approximate that of the native soil it is installed in.

The practice of resting SWIS is very similar to the SoilAir process. Resting is the only rejuvenation method endorsed by the U.S. EPA "Resting is an effective method to rejuvenate hydraulic capacity of soil infiltration surfaces" (Sharpe et al., 1984). When SWIS are rested, oxygen supply has an opportunity to catch up with oxygen demand, resulting in the reduction of biomat and the restoration of the infiltration capacity. "Extended periods of resting at regular intervals is effective in preventing excessive soil clogging and restoring clogged infiltration surfaces of SWIS" (U.S. EPA, 2002). The SoilAir system simply accelerates this natural resting process, without the need for temporarily diverting the wastewater. Wastewater and air flow are simply alternated to the SWIS to mimic a rest interval on a daily basis.

Comparison of other SWIS rejuvenation technologies

SWIS have historically been outfitted with various aerobic treatment units (ATU) in an attempt to meet the BOD and unclog the excess biomat. This approach has met with some limited success. When wastewater is aerated, even in the most efficient, modern publicly owned wastewater treatment plant (WWTP), sludge/biosolids are generated, not eliminated. Most ATU do not operate at anywhere near these efficiencies. Even the WWTP must remove this sludge and landfill, incinerate, land apply or compost it. Land application and composting exposes this sludge to 21% oxygen, and in this environment the sludge can be further broken down. This is the same condition that the SoilAir system creates under ground.

However, when the sludge is saturated with water oxygen concentrations are limited to the solubility of oxygen in water. In a conservative estimate at 55°F, this is a maximum of 10 parts per million (ppm) or 0.001%. When the sludge is exposed to air, 21% oxygen, this is approximately 21,000 times more oxygen than can be supplied under water. 21,000 times more oxygen in air than water is the primary reason why the SoilAir system is effective at reducing the thickness of biomat; and why ATU produce sludge. The SoilAir process is effectively insitu composting of biomat.

The SoilAir system is often confused with the Terralift® process. The Terralift process consists of injecting plastic pellets entrained in a blast of air into the soil adjacent to the SWIS to create fractures and fissures though the soil, through the biomat and into the SWIS. These newly formed pathways allow the wastewater to rapidly drain out of the SWIS. However, in most situations, these pathways provide but a fraction of the original infiltrative surface area that has already been shown to provide insufficient hydraulic capacity. This technology rarely provides a long term solution.

Another SWIS rejuvenation strategy is to inject hydrogen peroxide and other strong oxidizers such as acids into the SWIS. When this is done, the biomat is chemically oxidized. However, as this reaction is occurring, the biomat and soil interface "boil"; causing the coarser grained particles to sink and the finer grained particles to rise. Although this can allow the wastewater to infiltrate the soil for a period of time, the beneficial results are often short lived. This uniform layer of fine grained soil particles will also develop a biomat and the combination of the two is even less permeable than the original condition.

Soil pore space oxygen concentrations and the effect on treatment

Soils are a highly effective media for wastewater treatment, providing filtration, buffering capacity, large surface areas for microorganisms, temperature stability, moisture retention, and aerobic and anaerobic regions in close proximity to one another. No other wastewater treatment system can consistently match this combination and consistent performance. The only deficiency of heavily loaded soils is the limited oxygen supply.

When the SoilAir system is operating, air travels out of the SWIS and into the surrounding soil through the capillary tubes and macropores. This air movement displaces gases such carbon dioxide, methane and hydrogen sulfide that have built up in the soil pore space and replaces them with air. The air contains oxygen for utilization by the aerobic and facultative microorganisms and for biochemical reactions. An additional benefit is the air movement also helps to more uniformly distribute both free water and water vapor in the soils adjacent to the SWIS, significantly diminishing the potential for saturated flow conditions to exist.

High oxygen concentrations in the soils surrounding the SWIS allow for a higher level of wastewater treatment; specifically, increased removal of ammonium, nitrite, nitrate, total nitrogen, phosphorus, BOD and pathogens such as fecal coliform.

The introduction of air into the soil adjacent to the SWIS results in significantly greater oxidation of ammonium to nitrate than occurs in the absence of SoilAir. Once nitrified, the denitrification process can proceed and the net result is additional total nitrogen removal over what occurs in the absence of SoilAir. (Potts et al., 2003; Amador et al., 2005).

Enhanced total phosphorus removal will result when iron is present in well-aerated soil (Robertson, 2003; Zanini et al., 1998). Increased total phosphorus removal has been observed in aerated test lysimeters containing native soil with iron in the parent material, as compared to nonaerated lysimeters in the Westbrook, Connecticut test facility. For instance, in four replicate test lysimeters operating for approximately eight months, the mean influent concentration of total phosphorus was 8.7 ppm. The mean total phosphorus value for the aerated and non-aerated lysimeter was 1.5 and 2.5 ppm respectively.

The high soil oxygen levels resulting from the SoilAir process dramatically improves the BOD removal efficiency of the soil adjacent to the SWIS. After 1 foot of aerated soil, 100% of the BOD was consistently removed. As a comparison, 1 foot of nonaerated soil removed between approximately 15 and 82% of the BOD (Potts et al., 2004; Amador et al., 2005)

Soils adjacent to SWIS with SoilAir provide for significantly greater removal efficiencies of fecal coliform, ranging from one to four orders of magnitude greater than those without SoilAir (Potts et al., 2004; Amador et al., 2005). Increased removal is largely attributed to less saturated flow conditions/increased straining, intermicrobial predadation and antagonistic micro flora.

SoilAir system field application and components

The SoilAir system installation necessitates that the septic tank cleanout is uncovered to allow for cleaning and inspection of the septic tank and related components. On gravity systems, the effluent line between the septic tank and the leach field is exposed directly downstream from the septic tank. A portion of this line is removed to facilitate vacuum dewatering of the SWIS and the installation of subsurface SoilAir components. These subsurface components include an air backflow prevention device to pneumatically isolate the SWIS and a float switch to monitor septic tank levels and control blower operation. When the SWIS is outfitted with a pump station, a check valve is installed on the pump discharge line, and the SoilAir system is configured to turn off the blower prior to energizing the pumps.

The aboveground SoilAir components include a blower and controller, both in weatherproof enclosure installed in an unobtrusive location within 200 feet of the septic tank. An air supply line connects the subsurface components described above to the blower. Lastly, power and phone lines are run to the equipment enclosure location.

The SoilAir system is equipped with a microprocessor based controls package. This allows for a wide range of operational schemes to be accommodated. When rejuvenating a failed septic system, the blower is typically programmed to operate continuously, stopping only to allow a dose of wastewater to flow from the septic tank into the SWIS. As the excess biomat is oxidized, the system back pressure will typically decrease. The microprocessor can sense this change and can reduce the duration and/or frequency of blower operation. Furthermore, changes in system back pressure are indicative of the relative hydraulic capacity of the SWIS; effectively a permeability test is conducted whenever the blower is operating.

The microprocessor can also determine the volume of wastewater applied to the SWIS by tracking the number of doses per day. The control logic can be programmed to adjust system operation accordingly. A message can be forwarded to the service provider and property owner via the modem for uncharacteristic flows, such as a running toilet.

Control logic based or manual adjustments to SoilAir system operation can be readily made via the modem or directly through the control panel.

Maintenance

All septic systems need management and routine maintenance. SWIS with SoilAir are no different. Maintenance can include inspection of the septic tank sludge and scum levels and any necessary pumping. Smoke testing, blower efficiency analysis and filter replacement are also typically performed. With automated systems should a component fail during the course of the year, the controller can notify a service provider. Maintenance programs have proven to be the most efficient and cost effective manner of ensuring proper system operation. If the blower becomes inoperable or the air filter clogs, the oxygen supply will once again become limited and the BOD may no longer be met. In time, the SWIS will again develop a restrictive biomat and no longer be able to handle the hydraulic load.

Suitable uses of SoilAir for rejuvenation of failed SWIS

The SoilAir technology is not suitable for all failed SWIS. Soils must be unsaturated and have sufficient hydraulic conductivity for the present hydraulic loading rate. A crude litmus test for the potential use of the SoilAir technology on any given site is the following: assuming a similar historical hydraulic load, did the SWIS function properly for at least one to two years? If the answer to this question is yes, the SWIS exhibits symptoms that are characteristic with biomat buildup. The SoilAir System will likely be effective at restoring hydraulic capacity.

Balance BOD with oxygen supply for reliable performance

Present day design practices and federal and state regulations have addressed many of the historical deficiencies. The one remaining critical omission is providing a means to balance BOD with the oxygen supply. When this demand is met, unprecedented treatment efficiencies and hydraulic performance result. When this demand is not met, SWIS fail prematurely and treatment efficiencies suffer.

This oxygen demand in the SWIS can only be consistently met through intermittent treatment outside of the SWIS, larger systems with uniform wastewater application or with SoilAir Systems.

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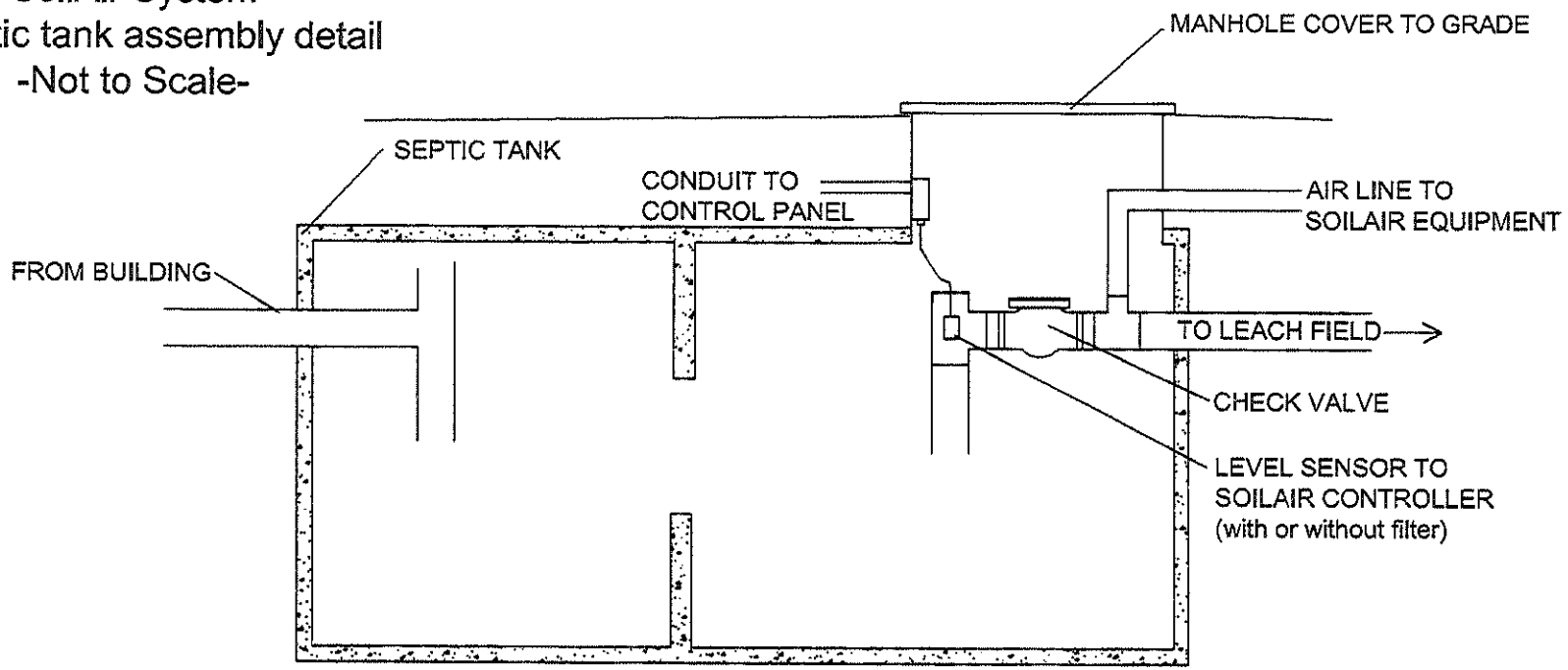
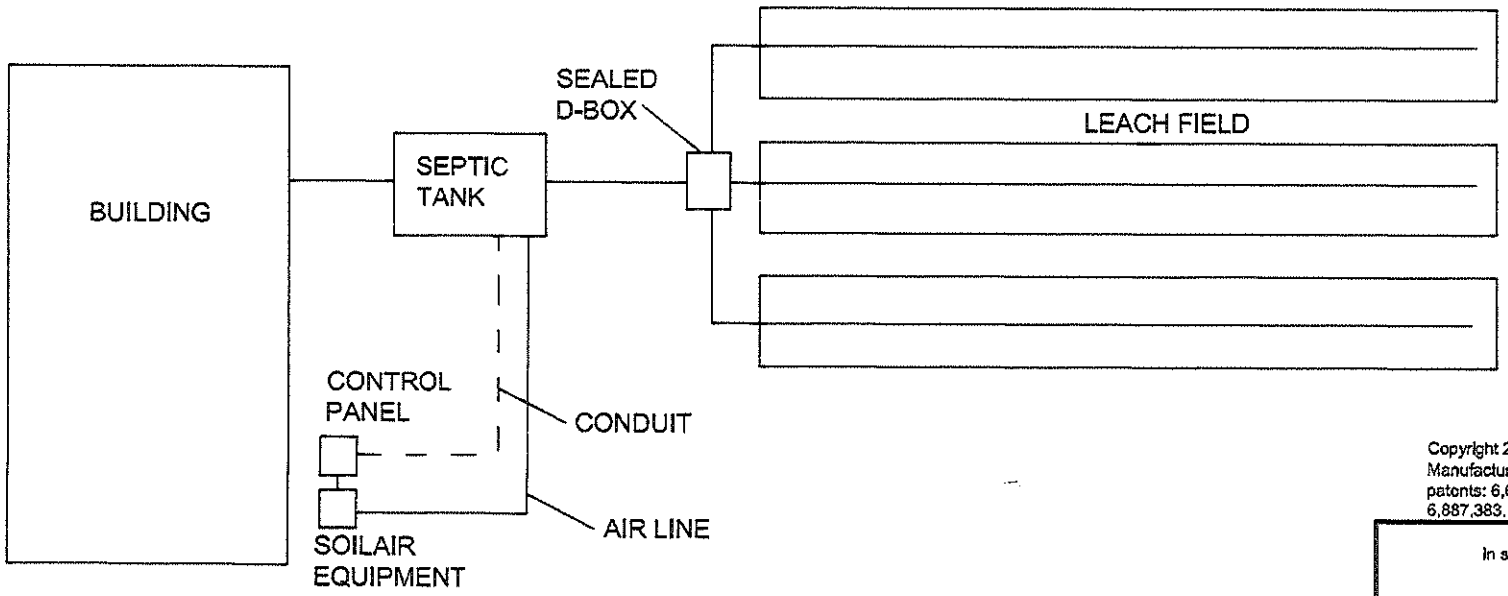
Killingworth, CT 06419
860-663-3993
fax: 860-663-0324

SoilAir System
In septic tank assembly detail
-Not to Scale-





SoilAir System In septic tank assembly detail GEOMATRIX, LLC Killingworth, CT	
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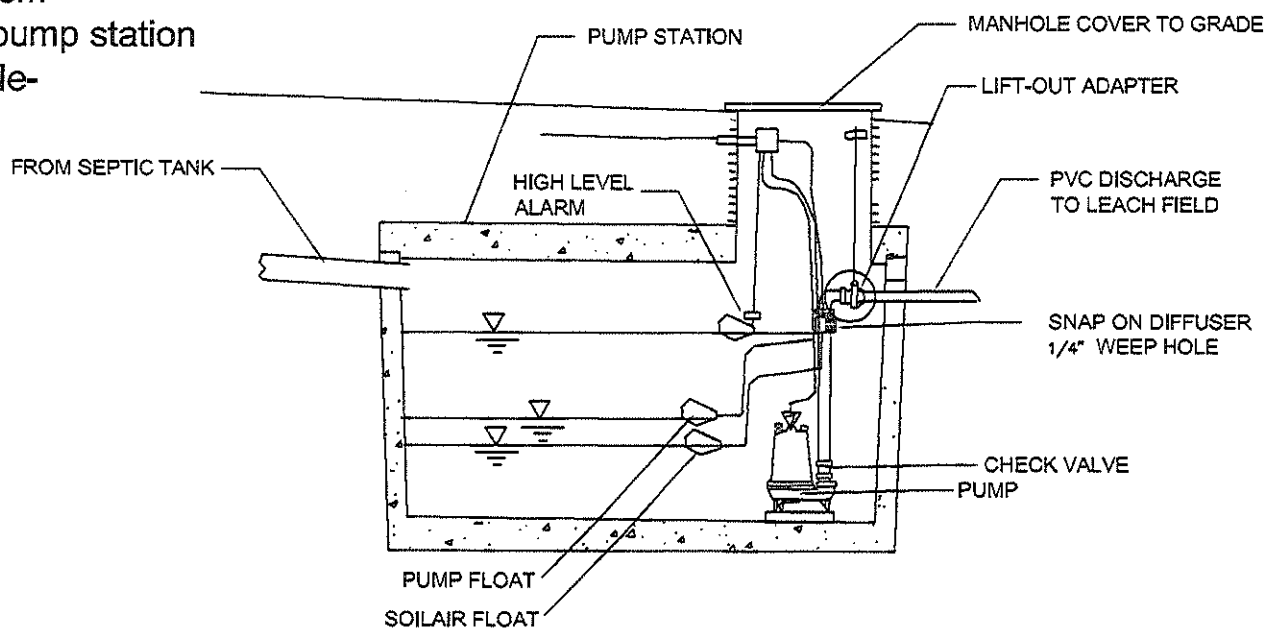
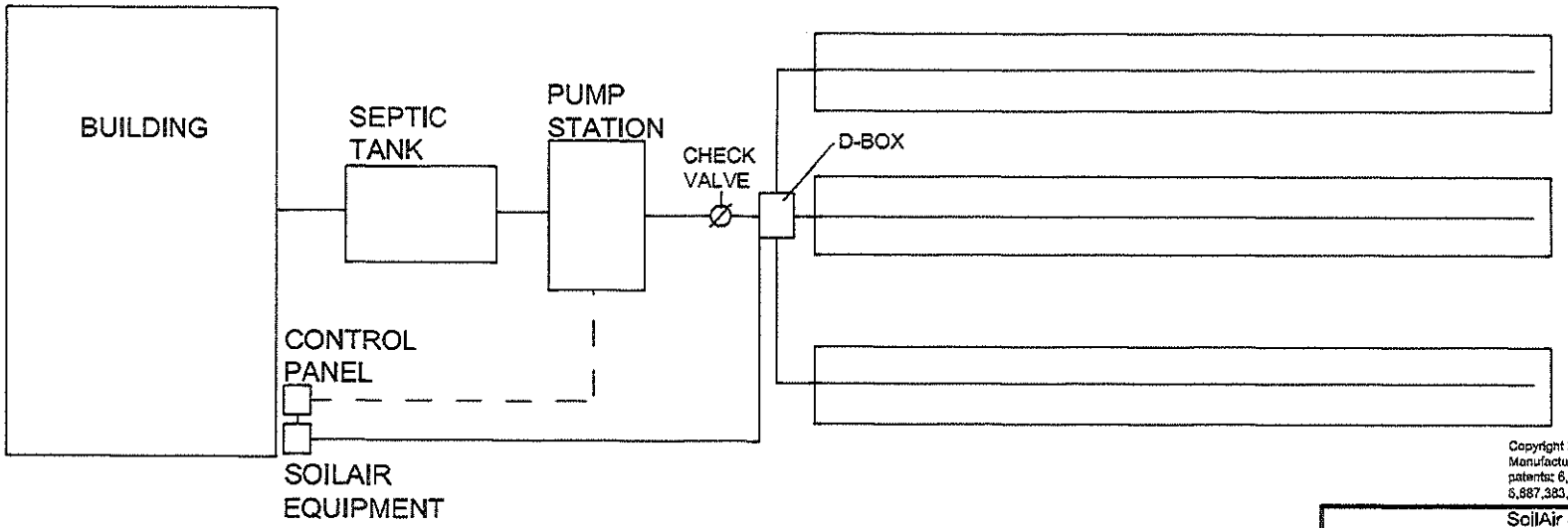
SoilAir System
with demand dosed pump station
-Not to Scale-





SoilAir System with demand dosed pump station GEOMATRIX, LLC Killingworth, CT	
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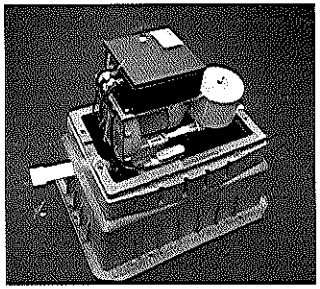
SYSTEM COMPONENTS

SoilAir System components include a high-pressure blower and a microprocessor based controller in a small unobtrusive enclosure. This enclosure is connected to a power supply, phone line and the pipe running from the septic tank to the leach field. Other components are also installed on this pipe to monitor septic system operation and to determine aeration frequency.

Once installed, the SoilAir System can monitor the septic system performance and forward this information via the phone.



EVERYTHING NEEDS MAINTENANCE

All septic systems require routine maintenance, the SoilAir System is no different. In order for your septic system to perform consistently, the microorganisms need a consistent supply of oxygen. When this oxygen supply is limited, the septic system performance will suffer.

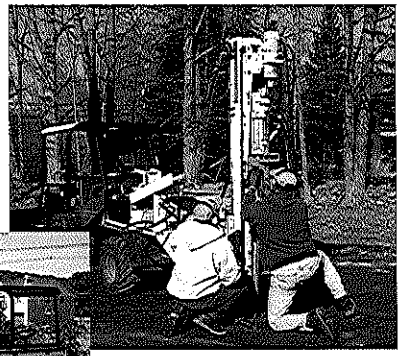
A typical SoilAir System should be tested and serviced once a year. If at any time conditions in the septic system change, a technician can be notified.

THE SOILAIR SYSTEM DOESN'T JUST TREAT A SYMPTOM,

IT SOLVES THE UNDERLYING PROBLEM

THERE IS NO SUBSTITUTE FOR EXPERIENCE

Since 1987, the SoilAir staff has engineered a wide variety of systems for soil and water treatment to help protect the environment.



With a multi-disciplined team of Engineers and Scientists, specializing in soils, wastewater treatment, microbiology, hydrogeology and construction management, SoilAir is uniquely qualified to analyze and solve your challenging wastewater treatment problems.

The SoilAir solution is provided through local leaders in the septic industry who are uniquely qualified to install, service and maintain both your SoilAir and septic system.

Talk to your local Health Department about the SoilAir System as an alternative to replacing your failed leach field.

SoilAir™ systems
Restoring and Enhancing Leachfield Performance

888-SoilAir - www.soilair.com

Available locally from:

GEOMATRIX, LLC

Phone: 860-663-3993
Fax: 860-663-0324

SoilAir™ systems

Restoring** and **Enhancing
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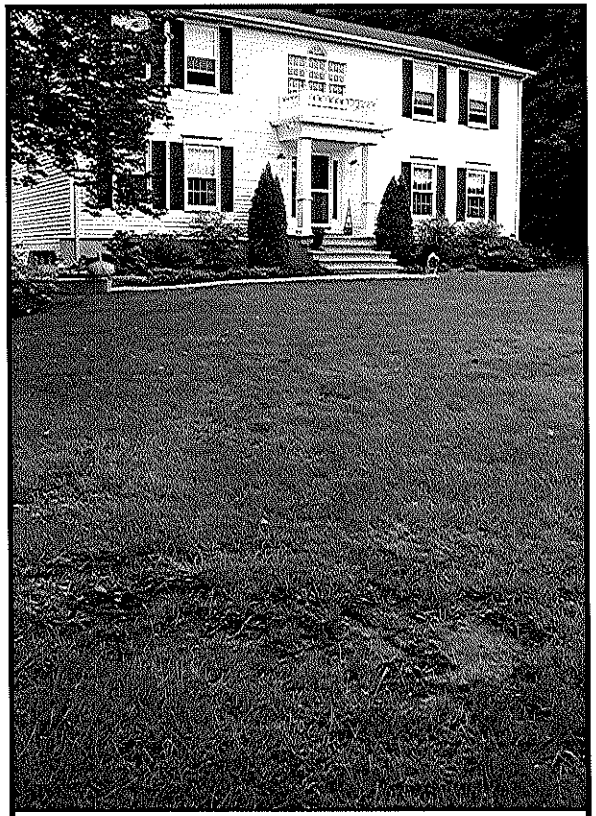


The Solution for Failing Septic Systems

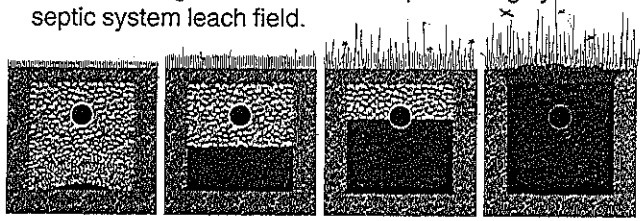
Long-term Performance with the SoilAir System

WE'RE DIFFERENT... HERE'S WHY.

Why put the same septic system in again and expect a different result?

Until now the only option for fixing a failed septic system was reconstructing it with the same basic system and hoping for the best, even though this has already failed to work on your property.

Believe it or not, wastewater surfacing on your lawn and plumbing backups are not the REAL problem, but rather symptoms of a larger, more persistent issue. Over time, organic matter builds-up and clogs your septic system leach field.



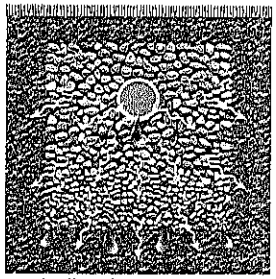
Progressive build up of organic matter in leach field and subsequent hydraulic failure

Definition of Insanity: Doing the same thing over and over again, yet expecting a different result.

HOW THE SOILAIR SYSTEM WORKS

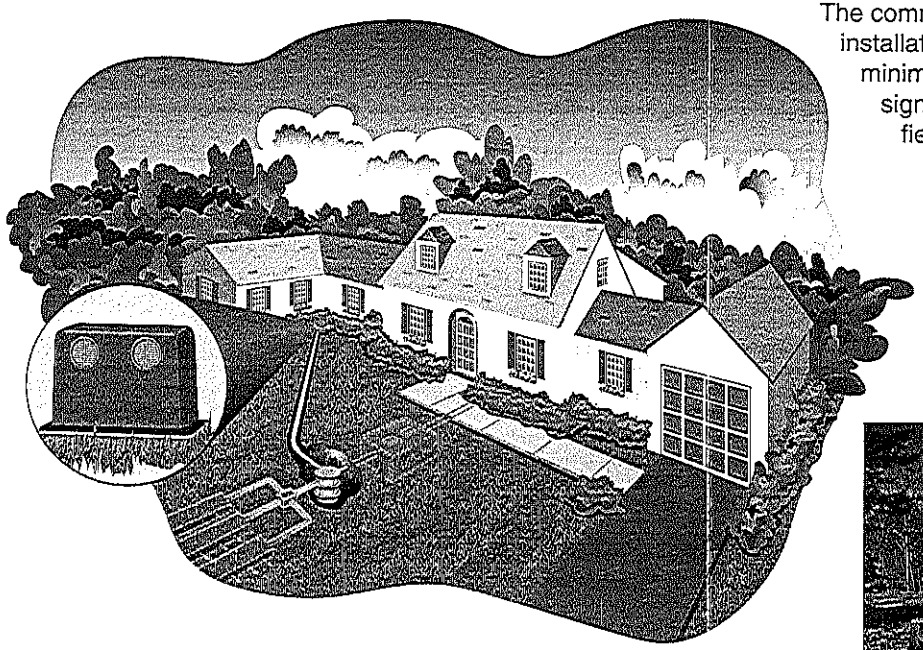
The patented SoilAir System fundamentally changes the leach field environment with the introduction of oxygen.

Air is injected into the leach field and travels into the surrounding soil. The oxygen in the air allows the soil microorganisms to thrive and reach unprecedented population levels. In a process similar to composting, this oxygen allows the microorganisms to reduce (eat) the accumulated organic matter, unclogging the leach field and allowing the wastewater to infiltrate into the soil. Within a few weeks, the leach field is back to its original hydraulic capacity.



"The SoilAir System has been a miracle for us with astronomical savings. We put in at least three new septic systems in the past 25 years, and recently we were spending thousands to pump once or twice a week, and the town was ready to shut us down. The SoilAir System immediately solved our septic problems and let us stay in business."

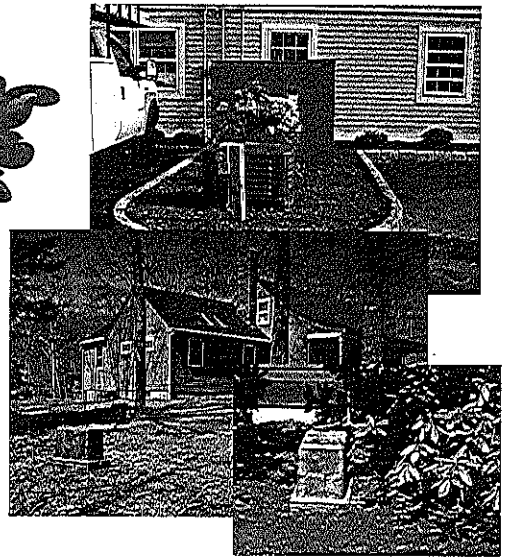
—Maureen Jentoft, Manager, Frankie's Restaurant



THE VERSATILE SOILAIR SYSTEM

SoilAir Systems have been utilized on new and existing leach fields, dry wells and other soil absorption systems. Projects include single-family residences, community systems, commercial facilities and even restaurants with heavy grease deposits. SoilAir Systems are operating on septic systems ranging in age from 2-50+ years old, in a wide range of climates and soil conditions.

The common denominator in these SoilAir installations is... PROBLEM SOLVED, with minimal disruption to landscaping and at a significant cost savings over a new leach field.



BENEFITS OF A SOILAIR SYSTEM

- Long-Term Solution
- Rapidly restores proper septic system function
- Minimal disruption and damage to existing landscaping
- Up to 70% cost savings over a traditional repair/replacement
- High level of treatment, including enhanced nitrogen removal

"After struggling for many years with septic system problems and receiving inadequate suggestions from a variety of contractors, we turned to the SoilAir System. When the intellect, science, and engineering behind the SoilAir System were applied to our faulty septic leach field, it made a crucial problem easy to fix. Anyone with a failing septic system would benefit from the SoilAir System. It's simply a world-class solution."

— Kenneth P. Wolski, M.D., Homeowner

EFFECTS OF SOIL AERATION ON A FAILING COMMUNITY LEACH FIELD

David A. Potts[1], José A. Amador[2] Erika L. Patenaude[2], and Josef H. Görres[2]

Soil-based treatment systems have been effectively treating wastewater since the end of the 19th century. Although highly efficient and cost effective, they can be overloaded resulting in less than satisfactory performance. To work properly, these natural systems should be operated like the bioreactors they are. Bioreactors must be supplied with the necessary reactants in the proper order to operate at maximum efficiency. In most instances, soil-based treatment systems receive significantly more organic carbon than oxygen, and the water in the soil pores further diminishes oxygen transfer. Under these conditions, soils adjacent to a leaching system become depleted of oxygen and enriched in carbon dioxide, methane and hydrogen sulfide, products of anaerobic microbial processes. The SoilAir™ (SA) System is a patented process designed to ensure that oxygen supply to the soils adjacent to the leaching system is sufficient to meet the microorganism's demand for oxygen.

Data will be presented from a community system site in Connecticut, USA, where the SA process has been pilot tested. The treatment system consists of a pump station, septic tanks and concrete 4' × 4' leaching structures that have been in operation since mid 80's. This site receives up to 15,000 gallons of wastewater per day from a small municipal collection system. The soils underlying the site are predominantly fine to medium sand and gravel; the water table is approximately 10' to 15' below grade. Water samples are typically collected on a quarterly basis from monitoring wells located adjacent to and down gradient of the leaching system.

SA pilot study equipment was retrofitted onto the existing treatment system in the fall of 2004. This SA pilot study equipment consisted of a high-pressure blower that was manifolded to the existing concrete leaching structures, which were outfitted with observation ports to monitor ponding levels. A check valve was installed at the outlet of the downstream septic tank to isolate the leaching structures pneumatically from the septic tanks. A septic tank effluent pump (STEP) system was installed in the second compartment of the downstream septic tank to facilitate demand dosing with approximately 1,000 gallons of wastewater per dose. The SA pilot study equipment was configured to introduce air into the leaching structures every two hours for 30 minutes. A float switch in the STEP system prevented the blower from operating just prior to and after the application of a dose of wastewater.

Sequencing the operation of the blower and dosing pump, as described above, optimizes conditions for nitrogen removal. Specifically, it results in atmospheric levels of oxygen in the leaching structures and the macropores of the soil adjacent to the leaching system, promoting nitrification. Once sufficient oxygen has been provided, the blower is turned off allowing for the oxygen to be depleted, with oxygen consumption occurring more rapidly in the soil pores than in the leaching structures. Next, a dose of wastewater of sufficient volume to saturate the soil pores

[1] Geomatrix, LLC, Killingworth, CT, USA

[2]Laboratory of Soil Ecology and Microbiology, University of Rhode Island, Kingston, RI, USA

is applied to the leaching system. This further helps to lower the oxygen level and provides a carbon source for denitrification. In effect, the aerated leaching system operates like a Sequencing Batch Reactor.

For more than ten years prior to conducting the SA pilot study, the leaching structures at this site were surcharged and prone to overflow; this necessitated frequent pumping to prevent effluent from surfacing. Sludge deposits over 18" deep had accumulated in the leaching structures. Groundwater quality was also being impacted from the operation of the leaching system. Water samples collected from the down gradient monitoring wells did not meet the state standards for total phosphorus and total nitrogen. Groundwater was anoxic, which resulted in reduction and dissolution of iron oxides from soil particles, which precipitated where the groundwater seeped out of a hillside and into a brook.

After installing and operating the SA pilot system, 2/3 of the leaching structures were dried out, and 1/3 of the leaching structures were ponded ¾ full. Sludge deposits were oxidized until the underlying soil surface was exposed. The quality of water in samples collected from the surrounding monitoring wells gradually improved over approximately a 10 month period, until the state standards for nitrogen and phosphorus were met for the first time in over ten years. A comparison of chloride values measured directly adjacent to the system and also further down gradient of the system, indicate that nitrogen removal is occurring, as opposed to dilution. As the dissolved oxygen concentration in the groundwater increased, iron precipitation at the groundwater seeps disappeared.

Soil-based treatment systems have massive surface area, indigenous microorganisms that are well suited to metabolizing wastewater constituents, micronutrients, aerobic and anaerobic regions, temperature buffering capacity, etc – all the conditions necessary for effective treatment. However, when wastewater is routinely loaded into subsurface soil-based treatment systems, oxygen becomes limited. When oxygen is limited, organic matter begins to accumulate on the soil-water interface; this leads to ponding of wastewater and anaerobic conditions. The SoilAir system can satisfy the oxygen needs of these systems. This results in the *in situ* decomposition of organic accumulations on the soil surface and increased wastewater treatment efficiencies. Enhanced nitrogen removal can also be accomplished by simply sequencing the aeration and dosing intervals in the leaching system.

Soil-based treatment systems can provide treatment efficiencies on a par with the most advanced bioreactors. Wastewater treatment processes require that oxygen be supplied at a rate sufficient to meet the demand at the appropriate time; soil-based treatment processes are no different.