Penn State **Extension**

Geotextile Sand Filter (GSF) On-Lot Systems

Agricultural and Biological Engineering **abe.psu.edu**

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The purpose of this fact sheet is to explain the purpose, components and function of the Geotextile Sand Filter on-lot sewage disposal system known as the GSF System. Pennsylvania Department of Environmental Protection has approved the use of GSF systems as a wastewater disposal method for on-lot sewage. The GSF system was developed and is marketed by Eljen Corporation[1], East Hartford, CT. The GSF system can be designed and installed on sites with restrictive soil conditions, especially sites with limiting zones located between 10 and 48 inches below the soil surface where few cost-effective alternatives exist. Thus, the GSF system may be installed as an alternative to an elevated sand mound or an at-grade system on most sites. The primary advantage of the GSF systems is that no advanced filtration treatment unit, such as a peat or sand filter, is required between the septic tank and the absorption area. The height of the mound is also somewhat reduced.

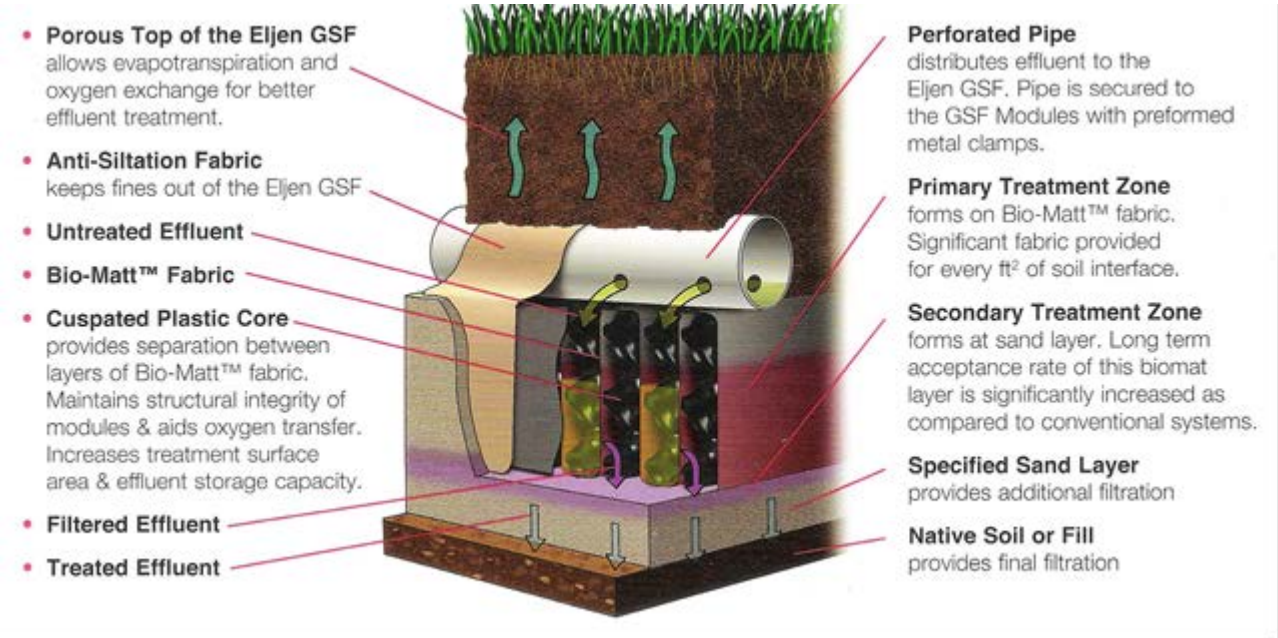


Fig. 1. Cross-section of the GSF system.

Components of the GSF System

The major components of the GSF system include a dual-chamber septic tank and an absorption area. In most practical cases the GFS system (Fig. 1), which requires 12 inches of sand plus the 7-inch thick B43 GFS unit, and 12 inches of cover soil (see Fig. 5 or 6) is seen as an alternative to the more traditional elevated sand mound, which requires up to 28 inches of sand, a foot of gravel and a foot of cover above the soil surface. It is also viewed as a practical alternative to the more recent at-grade system, which requires an expensive advanced treatment unit (usually a peat or sand filter) between the septic tank and adsorption area, which still requires a small mound on the soil surface made up of a foot of gravel and a foot of cover soil. The GSF system replaces the costly advanced treatment unit and the bed of gravel with a bed of sand and a cuspated core of plastic covered with geotextile (Fig. 2) that improves the quality of the effluent before it enters the native soil for final disposal.

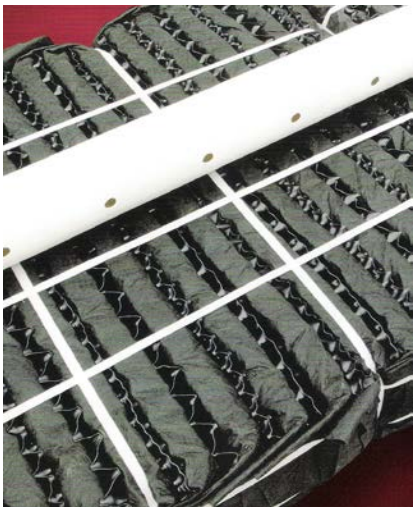
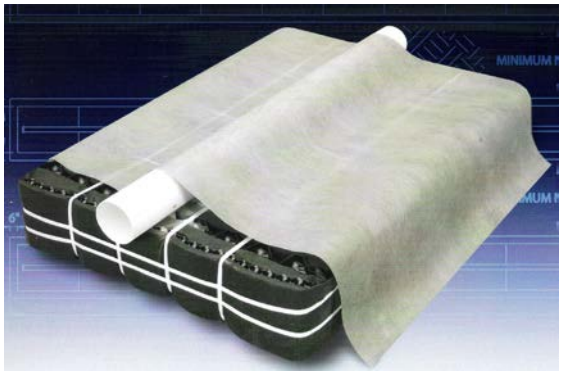


Fig. 2. B43 module showing the cuspated core, geotextile, and distribution pipe.



The cuspated core B43 units come in 48- x 36- x 7-inch (L x W x H) modules (Fig. 3) that are placed end to end on a level, 12-inch deep bed of sand to form a linear application (Fig. 4) that can be configured into either a trench, series of trenches, or a rectangular seepage bed.

Fig. 3. B43 module.

There are many approaches available to designing a GSF system. These design decisions are dictated by several site parameters including the depth to the Limiting Zone, the site's Percolation Rate (Perc Rate), whether gravity or pressure distribution will be used, and whether a seepage bed or trench configuration fits the site better. The design options available based on these site parameters are summarized in Table 1. The parameters in each column will be discussed below.

Fig. 4. GSF system installation before backfilling.

Table 1. GSF System Selection Table

	Absorption Area						
Depth to Limiting Zone	**Sizing Data**	**Configuration**	**Reduction**	**Distribution Required**	**GSF Module Area**	**Sand Perimeter**	**Between Bed Rows**
< 20 in	Soil Texture Soil Structure Soil Structure Grade	Mound (SingleTrench Reqrd)	None	Pressure	HLLR (length)	Min 6 in or HLLR/ILR	NA
≥ 20 in	Perc Rate < 61 mpi	Trench	Up to 40%	Gravity or Pressure	16 ft^2	Min 6 inches	12 inches
≥ 20 in	Perc Rate < 61 mpi	Bed	Up to 40%	Gravity or Pressure	16 ft^2	Min 6 inches	12 inches
≥ 20 in	Perc Rate < 61 mpi	Mound	Up to 40%	Pressure	16 ft^2	Min 6 inches	12 inches
≥ 20 in	Perc Rate > 61 mpi	Trench	None	Pressure	24 ft^2	Min 18 inches	36 inches
≥ 20 in	Perc Rate > 61 mpi	Mound	none	Pressure	24 ft^2	Min 18 inches	36 inches

Depth to Limiting Zone

The primary depth-to-limiting-zone consideration is whether the depth to limiting zone (from the site Probe) is less than or greater than 20 inches. If the limiting zone is less than 20 inches deep, the system sizing criteria is based on the site's soil characteristics, specifically the Hydraulic Linear Loading Rate (HLLR) and the Infiltration Loading Rate (ILR) as defined by a licensed soil scientist's evaluation of the site's soils profile. These soil parameters are used to determine the required length and width of the single absorption area trench.

If the limiting zone is deeper than 20 inches, a traditional Perc Test may be conducted and the results used to determine the absorption area size (see Table 2). The configuration of the absorption area may be either a seepage bed or a series of trenches. In many cases, to maximize the depth of soil available to provide final in-soil treatment of the effluent, the absorption area is placed on the existing soil surface and creates a shallow mound.

Perc Rate ≤ 61 minutes per inch (mpi)
On those sites where the Perc Rate is less than 61 mpi (these are the rapidly permeable sites) the absorption area, obtained from Table 2, may be reduced in size by up to 40%. Effluent may be distributed to beds and trenches by either a gravity or pressure distribution system. If an above land-surface-mound is used, pressure distribution is required. For design purposes, each B43 module provides 16 ft^2 of absorption area and must be installed with 6 inches of sand on both sides of each module (Fig. 5). The sand must meet ASTM C33 sand standards or PADOT Type A. If the modules are placed above grade, the sand tapers away from the module on a 2:1 slope and the cover soil tapers away from the module on a 2:1, 3:1, or 4:1 slope.

Perc Rate > 61 minutes per inch (mpi)
On those sites where the Perc Rate is greater than 61 mpi (these are the slowly permeable sites) the absorption area, obtained from the Table 2 equations may not be reduced in size. Effluent must be distributed to trenches by a pressure distribution system. For design purposes, each B43 module provides 24 ft^2 of absorption area and must be installed with 18 inches of sand on each side of the module (Fig. 6). The sand must meet ASTM C33 sand standards or PADOT Type A. If the modules are placed above grade, the sand tapers away from the module on a 2:1 slope and the cover soil tapers away from the module on a 2:1, 3:1, or 4:1 slope.

Table 2. Absorption area sizing requirements for GSF systems with limiting zones ≥ 20 inches.

Perc Rate (Min/In)	Absorption Area Required (Ft^2/Gpd)
< 3.0	Unsuitable
3 to 30	1.5
31 to 45	(Perc. Rate – 30)(0.026) + 1.50
46 to 60	(Perc. Rate – 45)(0.022) + 1.89
61 to 90	(Perc. Rate – 60)(0.020) + 2.22
91 to 120	(Perc. Rate – 90)(0.017) + 2.82
121 to 150	((Perc. Rate – 120)(0.015) + 3.33)(1.05)
151 to 180	((Perc. Rate – 150)(0.014) + 3.78)(1.10)
> 181	Unsuitable

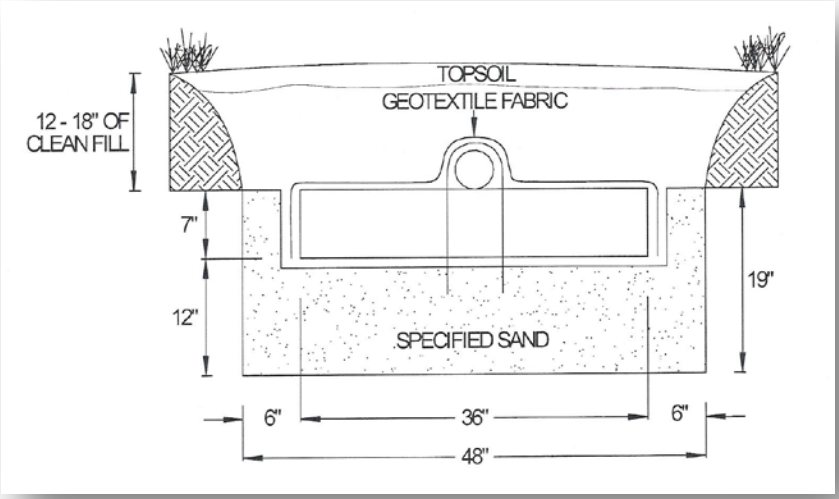


Fig. 5. Minimum dimensions for modules and sand where perc rates are between 3 and 60 min/in.

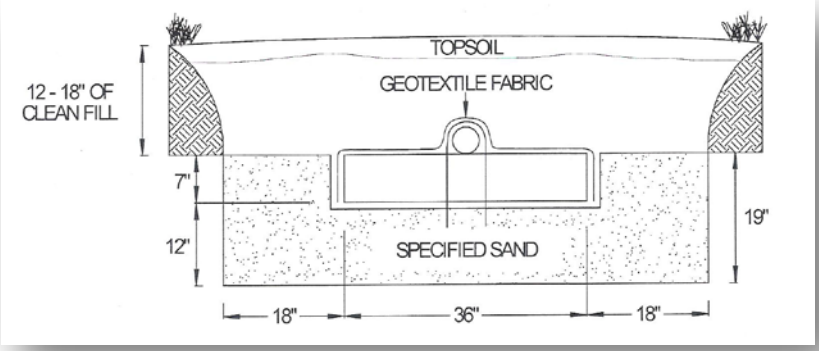


Fig. 6. Minimum dimensions for modules and sand where perc rates are between 61 and 180 min/in.

Distribution of Septic Tank Effluent to the GSF Absorption Area

Gravity Distribution. Septic tank effluent may be gravity distributed to the GSF absorption area if the Perc Rate is less than 61 mpi, the Depth to Limiting Zone is greater than 20 inches, and if there is a downhill grade to make the effluent flow from the septic tank to the absorption area. Standard 4-inch diameter pipe is used to transport the effluent from the septic tank to the distribution box and from the distribution box to and over the GSF B43 modules. In the length were the effluent is to be distributed to the top of the B43 modules, 4-inch perforated SDR-35 PVC pipe must be used with orifices located at the 4 and 8 o'clock positions to produce uniform flow to all GSF units.

Pressure Distribution. In cases where the septic tank effluent must be lifted to an aboveground mounded absorption area or the depth to the Limiting Zone is less than 20 inches, the septic tank effluent is piped to and collected in a small single-chamber tank known as a pump or dose tank. A 2-inch diameter Schedule 40 PVC pipe carries the collected effluent from the dose pump to the center of each linear GSF series of units. At the GSF units 1.5-inch PVC pipes are inserted into the perforated 4-inch distribution pipes, with orifices at the 4 and 8 o'clock positions. These 1.5-inch pressurized pipes have perforations spaced every 3 feet.

Dose Tank. If pressure dosing is selected or required, the septic tank effluent is collected in a dose tank. The GFS system is time dosed. Typically four or more equal doses per day, spaced to provide equal rest periods, are transferred to the GFS system's soil absorption area. Dosing takes place if sufficient liquid is available and the time sequence calls for a dose. The dose volume must be between 4 and 30 gallons per dose for each B43 module in the system.

Summary

To the delight of many homeowners, the GSF system is being widely adopted across Pennsylvania. If you think the GSF system may be applicable on your site, contact your SEO or your County Agent.

Created: November 2013

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An OUTREACH program of the College of Agricultural Sciences

Penn State College of Agricultural Sciences research and extension programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

[1]Where trade names appear, no discrimination is intended, and no endorsement by Penn State Cooperative Extension is implied.

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