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Indiana Soils and Septic Systems

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EXPERT REVIEWED

About a third of all Indiana homes use septic systems to treat household wastewater. Most of these systems consist of a septic tank and soil absorption field. These systems rely on the soil to remove all contaminants — including pathogens such as *Shigella*, *Giardia*, and *Escherichia coli* (*E. coli*) — from wastewater before the contaminants reach our drinking water aquifers. This publication is a brief description of soil characteristics that are necessary to provide wastewater treatment.

Soil Treatment of Septic Tank Effluent

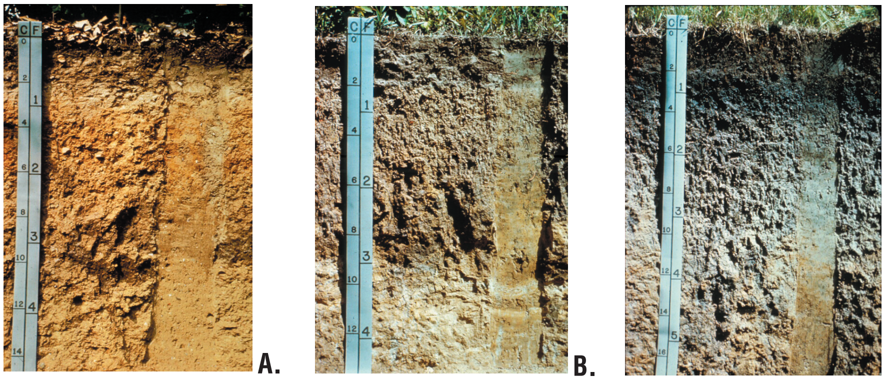
Soils effectively treat effluent through chemical, physical and biological processes. Chemical treatment in the soil involves the interactions of contaminants with soil mineral surfaces. For example, phosphate, a common constituent of household wastewater, is readily adsorbed to the surfaces of soil minerals and does not migrate to groundwater easily. Physical treatment of wastewater in the soil relies on the soil fabric, the relation of minerals to pore space. Contaminants and solids in the effluent are trapped in the pore space between soil particles much like a filter. The smaller the pore area, the more effective the treatment, but the slower the effluent will pass through the soil. Biological treatment is arguably the most important process. Naturally occurring microorganisms in the soil feed on organic contaminants in the effluent, effectively breaking them down and removing them from wastewater.

Soil and Site Characteristics

The ideal location for a soil absorption field is a large area within the lot that contains deep, well-drained soils. Unfortunately, such soils are hard to find in some areas of Indiana. Many of our soils have high water tables, shallow water-impermeable soil horizons, gravel layers, or compacted zones. Indiana law requires a soil inspection before a septic system permit can be issued. This inspection must be done by a health officer or registered professional soil scientist.

Soil Aeration

Septic tanks rely on anaerobic processes (or processes that lack oxygen) to treat effluent, while soil absorption fields rely on aerobic processes (with oxygen) to treat effluent. Oxygenated soil is necessary for waste degradation. If the soil is saturated with water for any length of time, it will become anaerobic, or oxygen-



A. B. C.

Figure 1. *Soil A is well drained (oxygen rich) and suitable for a conventional trench septic system. Soil C is poorly drained (oxygen deprived) and saturated with water most of the time. Soil B is saturated briefly during the year. Soils B and C would be unsuitable for conventional trench septic systems.*

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deprived, like the septic tank. Anaerobic soils are not suitable for pathogen treatment and groundwater contamination may occur (see Figure 1).

Limiting Layers

The professional soil scientist is responsible for determining the depth to the seasonally high water table or limiting layer. Seasonally high water tables are identified by concentrations and depletions of iron oxides. Iron oxides are a major pigmenting agent in soils, and if present, soils are brown to red. When soils are saturated with water for a significant period of time, iron oxide minerals dissolve, leaving grayish areas in the subsoil. Soil horizons that are saturated much of the time, are almost gray (see Soil C in Figure 1 at a depth of about 2-4 feet), while horizons that alternate between saturation and aeration leave a mixture of brownish and grayish colors, called mottling (see Soil B in Figure 1). The extent of this mottling pattern determines the maximum height of the seasonal water table.

Soil scientists are also concerned about dense or impermeable subsoil. Water moves through these layers more slowly than it is applied to the soil surface as precipitation, so the restricting layer and layers above it become saturated with water. For example, many soils contain water-restricting soil horizons of dense till (a compacted zone formed during glaciation periods, common in the northern two-thirds of Indiana) and fragipans (cemented dense layers, common in the southern third of Indiana). Another water-restricting zone is bedrock. Such water-restricting zones result in saturated soils below the absorption field, and often cause inadequate wastewater treatment. These layers cannot transmit natural rainfall let alone the added effluent applied at rates of two to seven times the normal precipitation rate.

Likewise, there can be layers within the soil that transmit wastewater faster than the soil can treat it. This can also place groundwater supplies at risk. Such layers include coarse sand and gravelly layers commonly found near large rivers.

Soil Texture and Structure

The speed that water moves through a soil is dependent on soil texture and soil structure. Soil texture refers to the percentage of mineral size classes within a soil. Soil minerals can be grouped into three size categories, from largest to smallest:

Sand — 0.05 to 2 mm
Silt — 0.002 to 0.05 mm
Clay — < 0.002 mm

The relative percentage of each of these size fractions in a soil determines the soil texture (see Figure 2). These size classes can be compared to each other by the following example: If a sand-sized particle were the size of a basketball, then a silt grain would be the size of a marble and a clay particle would fit on the tip of a sharpened pencil. As one might expect, water moves more quickly through coarse textured soils with a high sand content than through soils with a high clay content. Also, some clay minerals expand when wet, further reducing soil pore space.

Soil structure describes the overall arrangement of soil particles into aggregates. Natural Indiana soil structures include granular, platy, prismlike, and blocklike (see Figure 3). Soil structure affects soil water movement when a soil is saturated with water. Water can move quickly between granular and blocky aggregates and moves much slower through soils with a platy structure.

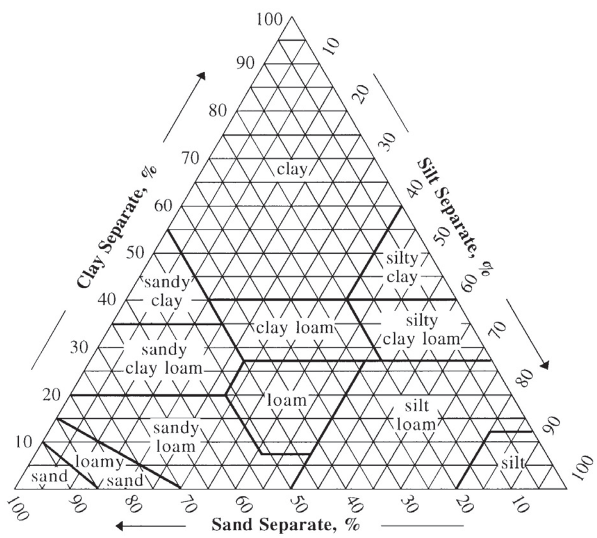

Figure 2. *The relative percentages of different sized soil minerals make up the soil texture (from USDA-NRCS Field book for describing and sampling soils, 2002).*

Soil Report Users

From the information provided by a soil scientist, a system designer or county health department officer can determine the type of system needed within a lot. Designers focus on the thickness of the aerobic zone immediately below the soil surface. The deeper the aerobic zone below the bottom of the system, the more soil available for treatment, and the less costly your septic system will be. In addition, sandy textured soils with subangular blocky structures, for example, will require smaller systems and will be less expensive than systems installed in clayey textured soils with platy structures. Ideally, there are at least two feet of aerobic soil between the bottom of the soil absorption field trench and, either a limiting layer (e.g., bedrock or fragipan), or a seasonally high water table identified by a soil layer with mixed gray and brown coloration.

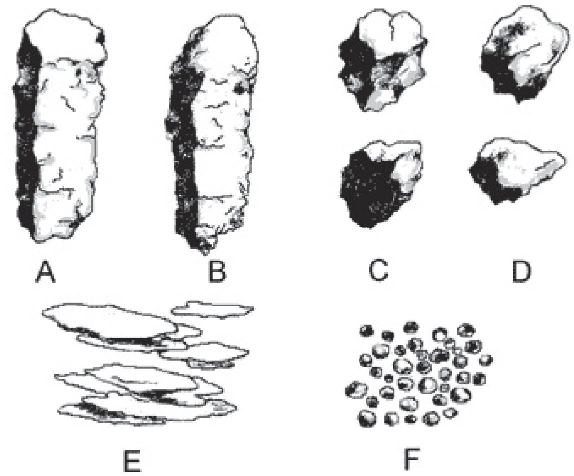

Figure 3. *The common types of soil structure: A-prismatic; B-columnar; C-angular blocky; D-subangular blocky; E-platy; and F-granular (from USDA Soil survey manual, 1951).*

Identifying a Professional Soil Scientist

A list of Indiana Registered Soil Scientists (IRSS) and instructions on how to obtain their services are available online at http://www.isco.purdue.edu/irss/obtaining_services.htm. For a nominal fee, you can also get a printed IRSS list from the Office of Indiana State Chemist by calling (765) 494-1492. Also, contact your county health department for a list of professionals who work in your county.

For more information regarding soils and how they are evaluated, see Purdue Extension publication AY-323, *Indiana Soil and Landscape Evaluation Manual*, version 1.0 (available online from the Education Store: http://www.ces.purdue.edu/new).

References

Schoeneberger, P.J., Wysocki, D.A., Benham, E.C., and Broderson, W.D. (editors) 2002. Field book for describing and sampling soils, Version 2.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE.

Soil Survey Staff. 1951. Soil survey manual. US Department of Agriculture Handbook No. 18. US Gov. Printing Office, Washington, DC.

Other Extension bulletins in this series:

HENV-1-W, *Septic System Failure*, http://www.ces.purdue.edu/extmedia/HENV/HENV-1-W.pdf.

HENV-2-W, *Increasing the Longevity of Your Septic System*, http://www.ces.purdue.edu/extmedia/HENV/HENV-2-W.pdf.

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