The Use of Soil Effervescence to Determine Site Suitability for an Onsite Sewage System

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Purpose:

The purpose is to provide guidance on soil profile interpretations for onsite system selection. This document is not intended to dictate how to describe the soil profile. It is to point out the effects of the characteristics of a BC or CB horizon on the performance of an onsite system.

Background:

The classification of soils includes the description of soil characteristics at various depths. To accomplish this, the soil profile is divided into soil horizons. Three kinds of symbols are used in combination to designate soil horizons and layers. These are capital letters, lower case letters, and Arabic numbers. Capital letters are used to designate master horizons and layers; lower case letters are used as suffixes to indicate specific characteristics of the master horizon and layer; Arabic numerals are used both as suffixes to indicate vertical subdivisions within a horizon or layer and as prefixes to indicate discontinuities. The major mineral horizons of a soil are A, B, and C. These well-developed horizons are readily identified in the field.

The A horizon is the upper horizon of a mineral soil. In this horizon, organic material mixes with inorganic products of weathering. The A horizon is typically a darker color due to the presence of organic matter.

B Horizons in mineral soils are commonly referred to as 'subsoil', and may contain concentrations of clay and minerals. In addition, they have a distinctly different structure or consistence to the A horizon above and the horizons below. Soil structure developed in B horizons includes prismatic, columnar, angular and subangular blocky units. Platy structure may exist if the horizon contains compaction. The B horizon is a zone where material (especially fine material and minerals) accumulates by the action of downward moving water. In some soils the B horizon is enriched with calcium carbonate, occurring when carbonate precipitates from downward moving water or from capillary action. This accumulation of calcium carbonates typically occurs at the depth where vertical movement of water stops.

C Horizons are commonly referred to as the 'parent material' or 'substratum'. These horizons are little affected by the soil forming processes operating in A and B horizons, and lack of soil development is one of the defining attributes. The glacial till C horizon is calcareous and dense with low hydraulic conductivity. This calcareous Wisconsin glacial till has very limited amounts of soil structure or soil porosity which are necessary for the downward movement of water.

During soil genesis, weathering of the Wisconsin glacial material changed the original soil material, during which time the soil structure, porosity and mineral content was developed within the A and B horizons. This development sometimes results in the creation of transitional horizons, where the horizon is dominated by properties of one master horizon but has subordinate properties of another. For transitional horizons uppercase letters are used. For example, a BC horizon has the characteristics of the overlying B horizon and the underlying C horizon, but is more like the B than the C.

A common method to determine the level of carbonate accumulation in a B horizon is effervescence. Effervescence (fizzing) when dilute hydrochloric acid (HCl) is dropped on the soil indicates the depth to which carbonates have been leached and constitutes an important horizon separation, commonly occurring in the Master B horizon or at the upper boundary of the C horizon. It is the depth of effervescence within a B, BC or CB horizon that marks the depth where soil permeability has decreased to a point where it will have an adverse effect on any soil absorption field placed in too close proximity to it. Soil scientists use a field test for effervescence to quickly determine the depth where soil genesis has nearly stopped.

Discussion:

The characteristics of the B soil horizons are significant in the performance of soil absorption fields. In most onsite systems, the infiltrative surface of the soil absorption field is placed in, or in close proximity to, the B horizon. As the B horizon looses its shared characteristics with the A horizon and takes on more of the characteristics of the C horizon, it can have dramatic effects on subsurface water movement, and therefore affect the performance of soil absorption fields.

ISDH staff regularly assists local health departments with the evaluation of onsite sewage systems in failure to help identify the causes of failure. These investigations have included failing onsite sewage systems in northern Indiana that were installed in soils developed from Wisconsin age glacial till. A number of these investigations have included soil evaluations using backhoe pits, where the original soil evaluations had been described from either a small push probe hole or a slightly larger soil auger hole. In many of these investigations, the only characteristic that ISDH staff was able to identify as the primary cause of the failure was the vertical separation distance from the BC horizon. The failures seemed to occur more frequently when the separation distance between the BC horizon and the trench bottom was less than 30 inches. Similar problems may also be occurring in sand mound systems when the ground surface is less than 20 inches above the BC horizon. In nearly all of these cases, ISDH staff was able to observe a weak, coarse or very coarse prismatic structure or a weak, platy structure that was parting to a weak, medium or coarse subangular blocky structure. These structural characteristics were observed from the sidewalls of the backhoe pits - these structural characteristics would not have been able to be observed using push probes or soil augers.

ISDH staff discussed this situation several years ago with Mr. Bobby Ward, former State Soil Scientist, USDA-NRCS. Mr. Ward stated that he had serious reservations about the values provided in the soil loading rate tables of Rule 410 IAC 6-8.1 for the BC and CB horizons that developed from Wisconsin glacial till material. He suggested it would be best to state that these horizons have a soil loading rate of less than 0.25 gpd/ft^2 or a value that was unacceptable for use in any onsite system. He strongly suggested that to determine site suitability for onsite sewage systems, all horizons identified as a BC or CB, and having developed from Wisconsin age glacial till, be assigned the same soil load rate as the underlying C horizon.

Decision:

When effervescence is not observed in a B, BC, or CB horizon, or one of their subhorizons, the soil loading rate from the Soil Loading Rate Tables in ISDH Rule 410 IAC 6-8.1 or 8-10, whichever is applicable, will be applied based on the texture and structure of the soil horizons.

In any soil where effervescence is observed in a B, BC, or CB horizon in a soil developed from Wisconsin glacial till, the depth of that effervescence should then become the point at which the soil loading rate drops to below 0.25 gpd/ft^2.