Field Test for Determining the Kind of Organic Matter

Being able to estimate the amount and describe the kind of organic matter in the soil are essential skills needed by a wetland scientist when making a hydric soil determination. The organic matter content in a soil is expressed as either organic carbon or organic matter (by dry weight). The correction factor for converting organic carbon to organic matter is approximately 1.7.

Soil material is divided into 3 categories depending upon the organic matter content within the soil: organic soil material, mineral soil material, and mucky mineral soil. **Organic soil material** associated with wetland soils and, excluding live roots, has 18 percent or more organic carbon with 60 percent or more clay or 12 percent or more organic carbon with 0 percent clay. Soils with an intermediate amount of clay have an intermediate amount of organic carbon. **Mineral soil material** has a higher mineral content and less organic matter than organic soil material. Mucky mineral soil is a mineral soil material that has an unusually high amount of sapric organic matter. Mucky modified mineral soil material that has 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil material that has 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon. Where the organic component is peat (fibric material) or mucky peat (hemic material), mucky mineral soil material does not occur.

Depending on the degree of decomposition, soil organic matter is classified into four categories: undecomposed litter, fibric, hemic, or sapric material. The **Rubbed fiber content** is used when determining the degree of decomposition of soil organic matter. The rubbed fiber content is estimated in the field by first taking a moist sample (about the size of a marshmallow) and removing the live roots. Live roots do not count as soil organic matter and are not considered when determining the fiber content. The sample is then rubbed in the palm of one's hand using the thumb of the other for about 10 times using firm pressure. The rubbing shreds and breaks up any decomposed organic matter that is still intact. After rubbing, the sample is compressed into a round mass and then pulled apart into two halves. The percent fiber content is estimated by examining the broken face using a hand lens (10 power or more). If there is a question between unrubbed and rubbed fiber content, rubbed content is used.

Undecomposed litter is plant material that has not begun to decompose and has no observable evidence of decomposition. This most often occurs in woodland areas as a surface layer of loose, fluffy leaves and/or needles that can be easily brushed aside with one's hand or blown from one area to another by a strong wind. Undecomposed litter is not considered part of the soil. When present, depth measurements for a profile description start below the undecomposed litter and at the top of the organic material that has observable evidence of decomposition (i.e., fibric, hemic, or sapric). The thickness of the litter layer may be recorded as inches to zero (e.g., +3 inches to 0).
Fibric material is slightly decomposed organic material. Most often the original source of the organic matter (e.g., red maple) can be identified. Fibric material has a rubbed fiber content of 40 percent or more (by volume). Soil horizons composed of fibric material are designated Oi.
Hemic material is partially decomposed (intermediate decomposition) organic material. It often has the look and feel of mature compost. Hemic material has a rubbed fiber content of 17 to 40 percent (by volume). Soil horizons composed of hemic material are designated Oe.
Sapric material is highly decomposed organic material. It most often has a black or a very dark reddish black color with a massive or solid appearance. Sapric material has rubbed fiber content of less than 17 percent (by volume). Soil horizons composed of sapric material are designated Oa.

Peat, Mucky Peat, and Muck

Peat, mucky peat, and muck are terms used to describe fibric, hemic, and sapric materials associated with wetness. Key factors to consider when making this determination are landscape position and presence of indicators of wetland hydrology. These terms should only be considered in areas where there is a high probability of soil saturation, flooding, and/or ponding. Soils with organic horizons comprised of peat, mucky peat, and muck are most often found within depressions, swales, at the base of long slopes (footslope and toeslope), or in low areas adjacent to water bodies. Organic surface horizons (Oi, Oe, and/or Oa horizons) associated with Histosols, histic epipedons, and soils that are gleyed in the upper part of the subsoil are almost always peat, mucky peat, and/or muck. These areas most often have indicators of wetland hydrology (e.g., water-stained leaves, sediment deposits, etc.). There are some situations where the surface organic layers of a hydric soil are comprised of fibric, hemic, and/or sapric material. These typically occur in transitional areas.

Field Tips:
1. Another form of the strength test is to clean the face of a test pit and probe the soil. A finger or trowel will easily penetrate an organic horizon but there is strong resistence when probing a mineral horizon.
2. Never assume that a thick black surface layer is the same soil texture throughout. In many situations, a black surface layer of well decomposed organic matter (Oa horizon) is underlain by a black mineral soil (A horizon). Always check to confirm whether there is a dark mineral horizon (A horizon) directly underlying the surface organic layers (O horizon).
3. Before trying to estimate the kind (sands, silt, and/or clay) or amount of mineral soil in an organic rich surface layer, first determine the soil texture of the mineral horizon (E, B, or C) that directly underlies the organic rich layer. Assuming the mineral component of the soil is similar throughout the upper part of the soil, this makes for a good comparison (gritty feel and/or strength) when estimating the mineral content in an organic rich layer.
4. Laboratory analysis conducted at the University of Rhode Island by Dr. Mark Stolt confirms that the highest amount of organic carbon (OC) one might expect in soil organic matter is about 50 percent, and in most situations it is 40 percent. When estimating the OC in fibric material (Oi horizon), it is most often less than 40 percent. For hemic material (Oe horizon) the maximum OC content is typically 30 percent, and the maximum for sapric material (Oa horizon) is about 25 percent.

For additional guidance on describing, documenting and estimating the amount and kind of organic material in a soil refer to the following documents:
- U.S. Army Corps of Engineers, Regional Supplement to the Corp of Engineers Wetland Delineation Manual: Northcentral and Northeast Region
- Field Indicators for Identifying Hydric Soils in New England, Version 3, April 2004
- National Soil Survey Center, U.S. Department of Agriculture, Field Book for Describing and Sampling Soils, Version 3.0

USE OF THIS CHART: Depending on the site, determining the organic matter content of a soil can be difficult often with significant differences between experienced professionals. No field test alone is reliable enough to conclude with a high degree of confidence that a particular sample has a specified percentage of organic carbon/organic matter. The confidence level increases as additional tests are applied and results compared.

Compiled by Peter C. Fletcher *Draft December 8, 2011*

FIELD TEST	ORGANIC SOIL MATERIAL (OSM)	MUCKY MINERAL SOIL (MMS)	MINERAL SOIL MATERIAL (MSM)
1. Soil Color Moist: Organic matter is a strong coloring agent in the soil and as little as 3 to 5% can turn a mineral soil black. Dark and very dark colors confirm the presence of organic matter in soil. Soil color alone is not a definitive test for OSM or MMS.	Fibric and hemic material, typically have colors with values of 4 or less and chromas of 3 or less. Sapric material has very dark soil colors with values and chromas of 2 or less. Organic soils formed in tidal marshes often have higher values and chromas.	Has a very dark soil color most often with values and chromas of 2 or less.	Has a broad spectrum of soil colors including black. Soils that have colors with values of 3 or higher and chromas of 2 or more are most often MSM.
2. Air-Dry Soil Color: For this test smear a very moist soil sample onto a sheet of white paper and let dry.	The dry soil retains nearly all of its dark color.	The dry soil retains some of its dark color, typically with values of 4 or less and chromas of 2 or less.	The dry soil turns a light color with values of 4 or higher and any chroma, or values and chromas of 3 or higher.
3. Rubbed Fiber Content: The percentage of visible fibers observed with a hand lens after rubbing in one's palm approximately 10 times. Live roots do not count as soil organic matter and should be removed before conducting this test.	Fibric material has a rubbed fiber content of 40% or more by volume. Hemic material has rubbed fiber content of 17 to 40%. For Sapric material it is less than 17%. *Reliable test for fibric and hemic material when used in combination with Test 6.*	Typically lacks fibers or has low fiber content.	Most often lacks fibers or has a very low fiber content.
4. Soil Strength: For this test, remove a clod (undisturbed piece) of soil, about the size of a lemon, from the side of the pit. The sample should be very moist but not saturated. If dripping wet, wrap the sample in a paper towel to remove excess water. When conducting this test, the soil sample should be squeezed but not repeatedly worked within one's hand.	When squeezed firmly, soil material oozes out freely from between one's fingers. *Reliable test for sapric material when used in combination with Tests 1 and 5.* 	When squeezed firmly, soil material has a slight to moderate tendency to ooze between one's fingers. *Reliable test when used in combination with Tests 1, 2, and 5.*	When squeezed firmly, soil material forms a solid mass and no soil material oozes from between one's fingers. *Reliable test when used in combination with Tests 2, 5 and/or 6.*
5. Gritty Feel: For this test rub a saturated sample in one's palm using moderate thumb pressure. This test is unreliable if the mineral fraction of the soil is predominantly very fine sand, silt and/or clay size particles.	After 5 rubs retains its greasy, slippery feel with no grittiness.	Initially has a creamy, smooth feel that after 3 to 5 rubs has an underlying gritty feel. *Reliable test when the mineral soil is a sand, loamy sand, sandy loam or loam.*	Has a gritty feel after 1 or 2 rubs. This test only works well when there are sand size particles present. *Reliable test when the mineral soil is a sand, loamy sand, sandy loam or loam.*
6. Air-dry Weight: For this test form a moist sample of soil into a mass about the size of a lime and let dry for 1-2 days.	Soil sample becomes significantly lighter in weight and retains most of its original color. If sapric, the mass often shrinks in size.	May lose a noticeable amount of its original weight and retains some of its dark color. When held up to the light, one can often see a shiny reflection off the mineral soil particles.	Retains a significant amount of its original weight and turns considerably lighter in color.
7. Squeezed Liquid: For this test, place a saturated sample of soil about the size of a lemon in one's palm and squeeze using firm pressure. The extruded liquid and particulates are then examined. If there is a difference in results (fibric, hemic, or sapric) between this method and the rubbed fiber content, the rubbed fiber content is used. This method was originally developed by L.von Post and is described in more detail in ASTM Standard D 5715-00	The liquid extruded from fibric material is typically clear to brown with no organic solids. The liquid extruded from hemic material is dark and often turbid with as much as 1/3 of the sample squeezed out. For sapric material the liquid is very turbid or it is thick and pasty with most of the sample squeezed out. The test is not used for mineral soils or mucky mineral soils.		