Alaska
Department of
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and
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Alaska Guide to Description and Classification of Peat and Organic Soil

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Table of Contents

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1. Classification of Peat and Organic Soil

1.1. Introduction

The classification of peat and organic soils requires special attention beyond that needed to classify other soils. There are several existing classification schemes for peat and organic soils, but no single system that allows classification of any soil that contains any amount of organic material.

The many peat classification schemes often rely on overly descriptive means to categorize these soils for engineering purposes. Some of the peat classification systems rely on biologic descriptions of plant constituents. Geologists and engineers are usually not well versed in botany and are unlikely to make much use of classification schemes that require biological knowledge. Instead, engineers and geologists tend to rely on methods that use numerical values as part of the system for nomenclature.

A classification system for peat and organic soils should include a means to readily distinguish organic soil from peat. The system described in this paper (Appendix A) provides a unified classification scheme that covers the whole spectrum of organic soils and peat. The system is based primarily on current ASTM test methods, including a recently developed test method based on an 83-year-old Swedish classification system (See Von Post, L. 1921) that uses a simple field test for classifying peat.

The systems developed thus far generally only cover part of the spectrum of organic soil and do not focus on the soil characteristics engineers need to consider in order to design a project. A classification system that directs its users to critical characteristics of a soil type will help geologists and engineers focus their investigation and design efforts.

There has been research to establish correlations between classifiable characteristics of organic soil and critical soil properties. More such research will be useful in further establishing the correlations. During preparation of this guide, little information was found about classification of coarse-grained soil containing organic material. Additional information and research is needed to address behavior of coarse-grained soil with small, but significant, amounts of organic material that affects handling characteristics.

1.2. Description and Classification of Peat

All operations involving the use of nuclear gauges must be carried out under the direction of a Regional Radiation Safety Officer (RRSO). The Regional Construction Engineer designates RRSOs.

The RRSO is authorized to initiate remedial action or to temporarily halt or immediately terminate the use of a nuclear gauge or licensed activities that are found to be a threat to health, safety, or property or otherwise in violation of federal, state, or local regulations or the requirements of this manual.

Peat (PT) is a naturally occurring, highly organic substance composed primarily of vegetable matter in various stages of decomposition. It is fibrous to amorphous in texture, is usually dark brown to black, and has an organic odor. Ash content will be less than 25 percent when tested under ASTM D2974. Peat does not include the surface organic mat. The organic mat is not peat; it is the living matter that dominates the upper layer of a soil column, consisting primarily of live plants and roots, but may include dead vegetative matter and windblown soil.

The procedure for classifying peat is outlined in Standard Classification of Peat Samples by Laboratory Testing (ASTM D 4427). This method includes use of the following test methods:

Field Tests

- Fiber content by field testing for degree of humification (ASTM D 5715)

The humification test was developed in the early 1920s in Sweden, and is related to the fiber content of the peat. This simple field test consists of taking a sample of peat and squeezing it in the hand. The material that is extruded between the fingers is examined and the soil is identified as one of 10 categories. The categories have been divided between three types of peat as shown in Table 1-1, below.

Laboratory Tests

- Ash content by the ignition test (ASTM D 2974),
- Fiber content determination by wet sieving (ASTM D 1997),
- Acidity (ASTM D 2976),
- Absorbency (ASTM D 2980)

The specific situation will guide whether and which laboratory tests should be used. Use of the laboratory tests methods may be inappropriate in many situations.

Botanical descriptions are included as part of the ASTM D 4427 test method, but as noted above, engineering geologists and engineers are generally not expected to be adept at botany. Classification schemes that rely on biological type or species recognition are not likely to be widely accepted or used.

Further classification of peat may be made by dividing the peat into one of three type categories based on the degree of humification (ASTM D 5715) or the fiber content of the soil (ASTM D 1997):

Name	Fiber Content	Degree of Humification
Fibric Peat	>67%	H_1-H_3
Hemic Peat	33%-67%	H_4-H_6
Sapric Peat	<33%	H_7-H_{10}

Table 1-1
Peat Naming Conventions

Where the classification of the peat is not critical, peat soil may simply be identified as "Peat," with moisture content and ignition test results to provide data for the geotechnical engineer and designer.

Fiber content has been related to numerous soil properties such as permeability, shear strength, compression index, water content, void ratio, density, etc. (See references). These established relationships can be quite useful to geotechnical engineers and designers in determining the behavior and characteristics of peat and highly organic soils. Discussion of the utility of these relationships and how they may be used is beyond the scope of this paper, which focuses on identifying and classifying organic soil and peat.

1.3. Description and Classification of Organic Soil

Organic soil has enough organic content to significantly affect the soil characteristics. For fine-grained organic soil, the question of how much organic soil is "significant" is addressed in ASTM methods, as discussed below. For coarse-grained organic soils, the answer is not readily apparent. In both cases, this paper presents a method to classify the soil.

For laboratory classification of organic soil, the most common current practice is to use the ignition test for determination of organic content (ASTM D 2974). When used in conjunction with Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM D 2487), the ignition test provides a quick and inexpensive means of determining organic content of soils and is, in many cases, the only laboratory test needed for classification of organic soil.

A classification system for organic soil must include few enough classes to be useful, but enough classes to separate differing types of organic soil and peat along important boundaries. The key to differentiating between organic and non-organic soils is the influence that the organic constituents have on the soil properties. This is true for both visual-manual methods and laboratory test methods. (See ASTM D2488 § 14.8 and ASTM D2487 § 11.3.2.)

1.3.1. Fine-Grained Organic Soils

In the field, the engineering geologist can determine whether soil is organic by observation of the soil characteristics and field relationships of the soil horizons, and the use of a few simple visual-manual tests outlined in Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM D 2488). The tests are:

- *color* (soil color lightens upon drying);
- *toughness* (soil thread for toughness test feels spongy); and
- *plasticity* (soil will have low or no plasticity).

In addition, the engineering geologist in the field will note the soil conditions and relationships that may suggest the presence of organics. For example, silt layers below a peat deposit would be expected to have organics; an alluvial sand and gravel deposit downstream from a marsh might be expected to have some organic component; and a silt deposit in the Yukon-Kuskokwim Delta area would be expected to have organic layers or finely disseminated organic particles. The engineering geologist will also describe soil samples and the presence and nature of visible organic particles.

In the laboratory, fine-grained soils are tested following ASTM D2487 classification methods. The Atterberg Limits test determines whether a soil is organic enough to "influence soil properties." Where the liquid limit as determined after oven drying is less than 75 percent of the liquid limit determined before oven drying, the soil is an organic silt or organic clay.

1.3.2. Coarse Grained Organic Soils

As mentioned in the introductory comments, the classification of coarse-grained soils with organics is problematic. Little information is presently available to provide a sound basis for determining whether the presence of organic matter affects the soil characteristics in significant and measurable ways. This is the case both for learning the important engineering characteristics of the soils and for determining what characteristics must be examined in order to develop a sound classification system.

At present, this classification system includes somewhat arbitrary boundaries for coarse-grained organic soil classification, with reference to the 1993 Engineering Geology and Geotechnical Exploration Procedures Manual guidelines that say in part:

"Mineral soils containing less than 50% organics should be described as follows:

1. Highly Organic – A soil, which contains large amounts (15 to 50%) of visible organic material such as sticks, roots, tree trunks, and peaty layers. This organic material may preclude the use of the soil as embankment material.

2. Organic – A soil which contains small (5 to 15%) amounts of organic material, which may significantly affect its handling and compaction characteristics. Usability as embankment material will generally depend on its natural moisture and/or prevailing weather conditions at the project location. The organic material may or may not be visible.

3. Slightly Organic – A soil, which has minor (less than 5%) or traces of organic material that are not visible but may have an effect on handling or compacting characteristics. Laboratory testing is necessary to determine the percent organics."

This classification system modifies the boundaries for two reasons: First, for the boundary between peat and highly organic soil to reflect a value representing the range of values appearing in the literature; second, to establish a lower limit for slightly organic soil of 2 percent to address test method inconsistencies that may result in reporting low levels of organic material in non-organic mineral soil and rock.

1. Highly Organic – 15 to 75 percent
2. Organic – 5 to 15 percent
3. Slightly Organic – 2 to 5 percent

As research and new data are developed concerning the behavior and characteristics of coarse-grained soils with organics, this new classification scheme may be revised to reflect new understanding of the role organic material plays in affecting important characteristics of organic soil and peat.

1.4. References

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Appendix A. Peat and Organic Soil Classification System