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Soil quality — Screening method for water content — Determination by refractometry

Qualité du sol — Méthode de diagnostic applicable à la teneur en eau — Détermination par réfractométrie

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Foreword

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Introduction

On-site determination of water contents in soil helps geological and geotechnical research as well as commercial work in a variety of fields, especially in geotechnical engineering and agriculture. In the civil engineering field, water content tests have been required for the investigation or treatment of contaminated soils. At a disaster site, water contents specifying soil physical properties need to be rapidly determined in a reliable manner on-site, to enable the design of suitable civil engineering structures to relieve the damage caused or prepare appropriate remediation measures. Another potential example is for commercially grown vegetables in greenhouses or in the field. The most important need is to control the water content in the soil. In this type of scenario, quick, robust and simple methods are needed. The rapid screening method described in this document is a simple robust on-site test method for water contents of soils and has been developed to meet such a demand. It is based upon refractive index measurement of a sucrose solution after mixing with a soil sample.

In laboratories, water contents are normally determined by weighing soil samples before and after drying at a specified temperature (e.g. 105 °C). It is not practical, however, to apply this type of method to outdoor sites, since the method requires a time-consuming drying process. Furthermore, soil samples are conveyed from the sites to the laboratory with the need that the water content in a soil sample be maintained during sample transport to the laboratory. The proposed on-site method can be readily employed directly in the field and can be used to rapidly determine water contents at given sites.

One of the recent applications of water content tests is related to global environmental protection work, e.g. on the reduction of greenhouse gas emissions from soil. Management of water in soil to control greenhouse gas emission can help minimizing climate change issues, which depend on the conditions of microbial properties in soil. CO_2, CH_4 and N_2O are emitted from soil as a result of microbial activities that are activated by water at ambient temperatures.

The largest supply source of carbon dioxide is not necessarily from human activities, including industrial facilities and transportation services, but vital natural activities in soil. Increases in atmospheric temperature cause the frozen or cold ground to melt or warm up to change environmental conditions for the soil microbes. These are stimulated and activated at relatively low soil temperatures that will initiate their metabolisation systems. If there is moisture and biomass that can be digested by microbes in their environment, the microbes will immediately start metabolizing labile organic carbon, in biomass resulting in carbon dioxide that will be emitted into the air. This mechanism directly contributes to climate change since carbon dioxide is the most common greenhouse gas.

Investigations have been carried out to try and map land across the world for such risks. Two techniques can be used to monitor the target parameters. The first one is observation of the parameters with panoramic viewing using satellites and planes equipped with infrared or near-infrared spectroscopic detection devices and the second one is a screening method such as that described in this document. Data obtained using the two techniques can be compared to correct, improve and/or complement data from the less accurate panoramic view technique. This will allow more accurate and detailed mapping results of the potential risk from carbon dioxide emissions.

In this context, a rapid check screening method for determination of water contents of soil has become an international social demand in an effort to assist investigation of climate change issues. As the scale for investigation is very large, the refractive index measurement method with simple solvent extraction of water from soil is considered suitable for such situations.