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Soil quality — Determination of perchlorate in soil using ion chromatography

Qualité du sol — Détermination du perchlorate des sols en utilisant la chromatographie ionique

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Foreword

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This document was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 3, *Chemical and physical characterization*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Although perchlorate occurs naturally, it is mainly a manmade anion (ClO_4^-). Usually, it is combined with NH_4^+, Na^+ and K^+ to form ammonium perchlorate, potassium perchlorate, and sodium perchlorate, respectively. It was reported that more than 90 % of perchlorate is used in military activities. Due to the excellent oxidizing capacity of perchlorate, it is added into propellant of rocket, missile, and satellite. We can presume some routes of manmade perchlorate exposure to soil and groundwater. For example, complete or incomplete explosion of the signal bomb (containing about 2 000 µg of perchlorate) in target or impact area, oversupplying of perchlorate for complete combustion in firing point, grand scale of fireworks could be the route of perchlorate exposure to soil and groundwater. In addition to these, other route could come from waste treatment process. Because perchlorate in missile is naturally deteriorated according to time, it should be recharged with a new one. In the past, incineration was preferred for the treatment of deteriorated perchlorate. When the incineration process was carried out in open space and kept as ash on site without any caution, it could be an important route of soil and groundwater contamination. Perchlorate is very stable in water and is not adsorbed easily on soil particle. From that view, surface water or groundwater could be contaminated more often than soil due to surface runoff or leaching process. However, perchlorate can also contaminate soil and vegetation. This kind of contamination could affect high level organisms in food chain. Perchlorate contamination of drinking water and food chain potentially affect human health because it can interfere with iodide uptake by the thyroid gland. Through this kind of interference, thyroid hormone production is decreased and it cause hyperthyroidism. The permitted level of perchlorate concentration in drinking water is below 15 ppb in Korea. Some states in the USA have an advisory level for perchlorate in drinking water. It is very difficult to find a country to regulate perchlorate level in soil because it seems that perchlorate contamination of soil is very rare in normal areas. However, perchlorate could be one of the major contaminants at a target area or firing point in military field and it is needed to manage the perchlorate concentration of soil to protect the vegetation, surface water, and groundwater. For this purpose, a standard method for perchlorate analysis in soil has been developed.

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Soil quality — Determination of perchlorate in soil using ion chromatography

1 Scope

This document specifies a method for the determination of perchlorate in soil and soil materials.

Under the conditions specified in this document, a concentration as low as 0,1 mg/kg can be determined.

The working range is restricted by the ion-exchange capacity of the separator column. Dilution of the water extracts to the working range can be necessary.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8466-1, *Water quality — Calibration and evaluation of analytical methods and estimation of performance characteristics — Part 1: Statistical evaluation of the linear calibration function*

ISO 8466-2, *Water quality — Calibration and evaluation of analytical methods and estimation of performance characteristics — Part 2: Calibration strategy for non-linear second-order calibration functions*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Principle

A dried and sieved soil sample is used as the test portion. Perchlorate is extracted by distilled or deionised water from the soil sample. Extraction is conducted by mechanical shaking and centrifugation.

After filtering the extract with a 0,45 µm membrane filter (e.g. cellulose acetate, hydrophilic polypropylene or polyethersulphone filter), the filtrate is analysed by ion chromatography to determine perchlorate.

If the adverse effects of anions, cations or organics are not negligible, appropriate pre-treatment for the elimination of these effects should be applied. Selective removal of interfering elements using a cartridge is one of the applicable pre-treatments.

The method requires the application of high-capacity separator columns, which allow the injection of sample volumes up to 1 ml.

Perchlorate is separated by ion chromatography (IC). Detection is conducted by suppressed conductivity (CD).

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