[EE] Evening Poster | A (Atmospheric and Hydrospheric Sciences) | A-GE Geological & Soil Environment

[A-GE31]Subsurface Mass Transport, Material Cycle, and Environmental Assessment

convener:Yuki Kojima(Department of Civil Engineering, Gifu University), Shoichiro Hamamoto(Department of Biological and Environmental Engineering, The University of Tokyo), Hirotaka Saito(東京農工大学大学院農学研究院, 共同), Yasushi Mori(Graduate School of Environmental and Life Science, Okayama University)

Mon. May 21, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

This session covers the topics on mass transport, water and energy cycles in geoenvironment. Subjects related to laboratory and field measurements, theoretical analysis, and numerical modeling will be discussed. Presentations on geo-pollution, remediation, geological disposal of hazardous wastes, ground source heat utilization, mass transport in vadose zone, soil-water monitoring, and environmental assessment are encouraged.

[AGE31-P09]Estimation of LNAPL concentration in unsaturated soil using thermo-TDR

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Keywords:LNAPL, thermo-TDR, dielectric constant, volumetric heat capacity, thermal conductivity

Early detection of soil contamination by Light Non-Aqueous Phase Liquid (LNAPL) leaked from underground tanks is important because LNAPL contamination can spread relatively fast. In order to detect the LNAPL soil contamination in situ, thermo-time domain reflectometry (thermo-TDR) method was proposed by Noborio (2006). Thermo-TDR method measures soil electrical properties, i.e., dielectric constant and electrical conductivity, and soil thermal properties, i.e., volumetric heat capacity and thermal conductivity. LNAPL content in unsaturated soil can be estimated by analyzing these properties. However, it was found that the thermo-TDR method to estimate LNAPL content was not enough accurate. In this study, we aimed to improve the accuracy of the thermo-TDR method for LNAPL content determination by developing a new design sensor and examining a several kind of estimating procedures.

A new thermo-TDR sensor which has longer stainless steel probes than those of traditional sensors was developed. The developed sensor showed improvement in accuracy of dielectric constant measurement. However, the accuracy of volumetric heat capacity was degraded. Dielectric constant showed clear correlation with dielectric constant regardless of LNAPL content. Volumetric heat capacity and thermal conductivity were the functions of volumetric liquid content, i.e., sum of volumetric water content and volumetric LNAPL content, although there were minor effects of LNAPL content. Therefore, we examined the estimation of LNAPL content from dielectric constant and volumetric heat capacity, or from dielectric constant and thermal conductivity.

The estimation of LNAPL content from dielectric constant and volumetric heat capacity showed higher accuracy than that from dielectric constant and thermal conductivity. This is because the effect of LNAPL content on the thermal conductivity was bigger than that on the volumetric heat capacity. However, the estimation accuracy of LNAPL content from dielectric constant and volumetric heat capacity was not high again, i.e., at most 12% error was observed. In order to much improve the LNAPL content estimation with thermo-TDR, higher accuracy of dielectric constant, volumetric heat capacity,

and thermal conductivity is necessary. Even the accuracy of dielectric constant measurement improved by the new sensor was not sufficient. In addition, utilizing electrical conductivity may be beneficial to improve the accuracy even though electrical conductivity was not used in this study. Also developing another new sensor might be necessary to improve this method.