EVALUATION OF INFILTRATION PROPERTY OF POROUS MEDIA USING DIELECTRIC METHOD

MAN-IL KIM[1], MAKOTO NISHIGAKI[2],
GYO-CHEOL JEONG[3] and CHANG-KUN PARK[4]

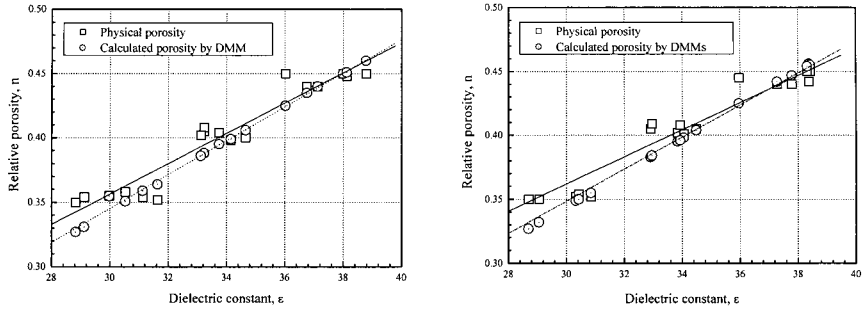
[1] Post Doctoral Researcher, Korea Institute of Water and Environment,
KOWACO, 462-1 Jeonmin-dong, Daejeon 305-730, Korea
(Tel: +82-42-860-0427, Fax: +82-42-860-0592, e-mail: mikim916@hotmail.com)
[2] Professor, Department of Environmental and Civil Design,
Okayama University, Okayama 700-8530, Japan
(Tel: +81-86-251-8164, Fax: +81-86-251-8164, e-mail: n_makoto@cc.okayama-u.ac.jp)
[3] Associate Professor, Department of Earth and Environmental Sciences,
Andong National University, 388 Songchon-dong, Andong 760-749, Korea
(Tel: +82-54-820-5753, Fax: +82-54-823-1627, e-mail: jeong@andong.ac.kr)
[4] Associate Professor, Department of Civil Engineering, Kwandong University,
522 Naegok-dong, Gangneung 210-701, Korea
(Tel: +82-33-670-3320, Fax: +82-33-671-3359, e-mail: ckpark@kwandong.ac.kr)

To estimate these parameters of porous media, numerous investigators have been conducted in-situ experiments as a variety of applied tracer and well tests using excavated boring holes in the field (Singh, 2002). Furthermore, several researchers were carried out laboratory column tests for measuring factor to use a fine grain material such as clay, silt and bentonite (Zheng et al., 2002; Kim et al., 1997). Li et al. (1996) reported the hydrologic properties that govern fluid flow through the sub-surface are porosity, permeability, relative permeability, pore and grain particle size distributions. The aims of these applied experiments can be explained to estimate a velocity of groundwater, coefficient of advection or dispersion, porosity or effective porosity of saturated porous media due to movement velocity of tracer materials in the field or laboratory. However, previous researches are required a lot of experimental periods and costs for estimating these parameters through an applied tracer experiment. Despite of these experiments, quantitative result shows a difficulty to estimate a corrective parameter. Hence, economical and utilizable measuring method is required to know the parameters in the field and laboratory.

In this work, we proposed a measuring method using the permittivity systems such as Frequency domain reflectometry (FDR) and Frequency domain reflectometry with vector network analyzer (FDR-V) systems to estimate porosity and effective porosity of porous media. In order to discuss with an in-situ experiment using permittivity systems, we estimated a soil column injection experiment using the fully saturated Toyoura and River sands by FDR and FDR-V systems in the laboratory.

In the sub-surface environments, detection of the movement of contaminant substances and recharge of groundwater by rainfall are very important factors, which contain the porosity and effective porosity of porous media. In this paper, the applicability of dielectric methods and proposed dielectric mixing models (DDMs) are discussed. This study showed that the ratio of effective porosity to porosity of saturated Toyoura and River sands were 0.856 and 0.843. From the relationships between the relative porosity and

effective porosity, all measured values can be confirmed to outside the range to about 0.800 for saturated Toyoura and River sands under all experiments by FDR and FDR-V systems. Consequently, this dielectric apparatus can be considered to be good enough to measure determining the physical parameters of saturated soils. As well as, it can be contributed to estimate the porosity and effective porosity of saturated porous media.



(a) FDR-V system (b) FDR system

Fig. 1 Relationship between dielectric constant and porosity of saturated sands by FDR-V and FDR systems.

REFERENCES

Li, H., Y. Ohtsuka, N. Mori, T. Inagaki and S. Misawa, 1996, Effective porosity and specific yield of a sedimentary rock determined by a field tracing test using tritium as a tracer, Environmental Geology, Vol 27(3), 170-177.

Singh, S. K., 2002, Estimating dispersion coefficient and porosity from soil-column tests, Environmental Microbiology, Vol 128(11), 1095-1099.

Zheng, Z., P. Aagaard and G. D. Breedveld, 2002, Sorption and anaerobic biodegradation of soluble aromatic compounds during groundwater transport. 1. Laboratory column experiments, Environmental Geology, 41, 922-932.