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CONTAMINANT DIFFUSION PREDICTIONS IN THE SOIL BASED ON THE LAT-PIV MEASUREMENT RESULT

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Recently, continuous time random walk (CTRW) model by Hatano [1] and Berkowitz [2] has been widely used for the diffusion prediction of the contaminant in underground water. However, it has been understood that there is a part where actual density distribution cannot be shown. Especially, the forecast of the tail that distribution extends to the low concentration is difficult. It is enumerated that the physics phenomenon in the micro scale has not been clarified. In continuous time random walk, a basic process that the waiting time function has come off from normal distribution is done, and it appears the tail by this assumption. Then, it is necessary to analyze the appearance of the space between sand to clarify the influence that the contaminant in the soil receives with underground water in the micro scale. Therefore, we observe how the behavior of the contaminant changes depending on the speed of the flow of underground water and the root contaminant passes between sand. In this study, we performed the experiments based on LAT-PIV (Laser Aided Tomography and Particle Image Velocimetry) method developed for the research of the ground liquefaction at earthquakes, and we tried to clarify the velocity distribution in the pores.
In a modern technology, it is difficult to make structure in the soil visible. Therefore, we substitute soil by glass beads and silicon oil. In the LAT-PIV measurement, the glass beads of 2mm~5mm is packed into a plastic box (10 cm in length, 10 cm in width, 40 cm in height). In plastic box, silicon oil mixed the tracer particle (tens of microns) is poured with the pump at constant flow velocity. An X-ray laser is irradiated to the plastic box, and visualized the tracer particle is recorded in sequential photographs. The reason to use the glass beads and the silicon oil is that the refractive index of both materials is the same as 1.514 in order to prevent reflex on the edges. It becomes possible to reproduce the flow of underground water by inventing the constant flow with the pump, and we observed the behavior of the tracer particles in the flow.
Using the images obtained by LAT-PIV method, we processed the pore velocity distribution. Based on the result of the velocity distribution between sand, we clarified that the pore velocity distribution follows the generalized Cauchy distribution [3] rather than the power law distribution.

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