GAS TRANSPORT PARAMETERS FOR ROADBED MATERIALS UTILIZING CONSTRUCTION DEMOLITION WASTE AND INDUSTRIAL WASTE

*Mohd Saufi Mohd Redzuan[1], Ken Kawamoto[1]

1. Saitama university

Gas diffusion coefficient (D_p) and air permeability (k_a) are factors that are controlling gas exchange in variably saturated soil and the surface of pavement. Instead of the conventional subbase materials, utilizing construction and demolition waste (CDW) and industrial waste as subbase for permeable pavement system (PPS) to improved gas movement in subbase is hoped to be achieved in this research. Urbanization, construction maintenance, and population growth leads to increasing solid waste materials which then might contribute to scarcity of dumping and landfill area over time. Utilizing these waste materials for construction purposes is one of the method to reduce construction cost but also ensure minimal negative impact to the environment in the future as well. Among road pavement systems, in especial PPS is capable of reducing water runoff volume and water outflow rate and expected to prevent flood disaster and to reduce urban heat island (UHI) effect. By providing better gas exchange rate in the near surface of PPS and better thermal transfer spread throughout subbase layer, reduction on UHI can be expected. In this study, we investigated gas transport parameters for recycled materials from CDW and industrial waste with different mixing proportions under variable saturated conditions. Graded recycled concrete and steel slag were used as graded aggregate base materials while granulated municipal solid waste (MSW) slag and autoclaved lightweight concrete (ALC) were used as fine grains. The gas diffusion coefficient (D_p) and air permeability (k_a) with their dependence on air-filled porosity (ε) were obtained in this study.

The results showed increased in D_p with increasing ε for all single material samples. However, for k_a, almost all materials increased with increasing ε except for ALC that indicates non-connected large pores and higher tortuosity of ALC. Better D_p/ε and k_a/ε were obtained with the MSW slag mixture indicating lesser tortuosity and improved pore-network connectivity, while there is no significant difference for ALC mixture. Water-induced linear reduction (WLR) model (Wikramarachchi, et al. 2011) and pore diameter gas flow equation (Ball et al., 1981) were used to determine the effect of tortuosity and pore diameter on gas movement in soil. Higher tortuosity exponent, X_{dry} and lower pore diameter of ALC compared to MSW Slag were obtained which agrees with the obtained low gas transport parameters of ALC mixture. Gas transport parameters for compacted concrete and steel slag samples, and their mixtures with granulated MSW slag and ALC grains at air-dried condition were also measured in this study. It was found that the mixing of MSW slag was effective to increase gas diffusion and air permeability for both concrete and steel slag samples. On the other hand, the mixing of ALC grains did not contribute to the increase in gas diffusion and air permeability.

Keywords: Construction Demolition Waste, Permeable Pavement System, Gas Transport