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Permeable Reactive Pavement for Controlling the Transport of Benzene, Toluene, Ethyl-Benzene, and Xylene (BTEX) Contaminants

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Abstract : Volatile organic compounds such as benzene, toluene, ethyl-benzene, and xylene (BTEX) are common contaminants in environment, which could come from asphalt concrete or exhaust emissions of vehicles. The BTEX may invade to the subsurface environment via wet and dry atmospheric depositions. If there aren't available ways for controlling contaminants' fate and transport, they would extensively harm natural environment. In the 1st phase of this study, various adsorbents were screened for a suitable one to be an additive in the porous asphalt mixture. In the 2nd phase, addition of the selected adsorbent was incorporated with the design of porous asphalt concrete (PAC) to produce the permeable reactive pavement (PRP), which was subsequently tested for the potential of adsorbing aqueous BTEX as compared to the PAC, in the 3rd phase. The PRP was prepared according to the following steps: firstly, the suitable adsorbent was chosen based on the analytical results of specific surface area analysis, thermal-gravimetric analysis, adsorption kinetics and isotherms, and thermal dynamics analysis; secondly, the materials of coarse aggregate, fine aggregate, filler, asphalt, and fiber were tested in order to meet regulated specifications (e.g., water adsorption, soundness, viscosity etc.) for preparing the PRP; thirdly, the amount of adsorbent additive was determined in the PRP; fourthly, the prepared PAC and PRP were examined for their physical properties (e.g., abrasion loss, drain-down loss, Marshall stability, Marshall flow, dynamic stability etc.). As a result of comparison between PRP and PAC, the PRP showed better physical performance than the traditional PAC. At last, the Marshall Specimen column tests were conducted to explore the adsorption capacities of PAC and PRPs. The BTEX adsorption capacities of PRPs are higher than those obtained from traditional PAC. In summary, PRPs showed superior physical performance and adsorption capacities, which exhibit the potential of PRP to be applied as a replacement of PAC for better controlling the transport of non-point source pollutants.

Keywords : porous asphalt concrete, volatile organic compounds, permeable reactive pavement, non-point source pollution
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