

A Molecular-Level Study of Combining the Waste Polymer and High-Concentration Waste Cooking Oil as an Additive on Reclamation of Aged Asphalt Pavement

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Abstract : In the United States, over 90% of the roads are paved with asphalt. The aging of asphalt is the most serious problem that causes the deterioration of asphalt pavement. Waste cooking oils (WCOs) have been found they can restore the properties of aged asphalt and promote the reuse of aged asphalt pavement. In our previous study, it was found the optimal WCO concentration to restore the aged asphalt sample should be in the range of 10~15 wt% of the aged asphalt sample. After the WCO concentration exceeds 15 wt%, as the WCO concentration increases, some important properties of the asphalt sample can be weakened by the addition of WCO, such as cohesion energy density, surface free energy density, bulk modulus, shear modulus, etc. However, maximizing the utilization of WCO can create environmental and economic benefits. Therefore, in this study, a new idea about using the waste polymer is another additive to restore the WCO modified asphalt that contains a high concentration of WCO (15-25 wt%) is proposed, which has never been reported before. In this way, both waste polymer and WCO can be utilized. The molecular dynamics simulation is used to study the effect of waste polymer on properties of WCO modified asphalt and understand the corresponding mechanism at the molecular level. The radial distribution function, self-diffusion, cohesion energy density, surface free energy density, bulk modulus, shear modulus, adhesion energy between asphalt and aggregate are analyzed to validate the feasibility of combining the waste polymer and WCO to restore the aged asphalt. Finally, the optimal concentration of waste polymer and WCO are determined.

Keywords : reclaim aged asphalt pavement, waste cooking oil, waste polymer, molecular dynamics simulation

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