Waste cooking oil as a sustainable bio modifier for asphalt modification: a review

ABSTRACT

The rising demand for non-renewable resources such as asphalt binder is a significant issue in the pavement industry. Flexible pavement consumes a significant amount of asphalt binder, which has become a major issue in terms of environmental sustainability and from an economics viewpoint. Hence, researchers strive to find other alternatives to solve these problems, to enhance the performance and lifespan of flexible pavement. Biomass-based bio-oil, such as waste cooking oil (WCO), as a modifier has illustrated favorable effects for asphalt binder and mixture. However, in the pavement industry, its adoption as a modifier is still in an empirical stage. Hence, this paper aimed to give an overview by analyzing literature in-depth to reveal the potential of WCO as a modifier in the pavement industry. The low- and intermediate-temperature performance of the WCO-modified asphalt binder are superior. However, it compromises physical properties and high-temperature performance. Hence, it can be improved by controlling the quality of WCO or by further modification by additives such as ground tire rubber (GTR) and waste plastic. This paper also attempts to review available and potential physical and chemical technologies to minimize the negative effects of free fatty acid (FFA) and water content of WCO on modified asphalt binder properties. For WCO-modified asphalt mixture, the overall performance depends on the dose, quality of WCO, and type of additive added in the WCO-modified binder. Finally, future recommendations are provided to broaden the scope of WCO as a modifier in the forthcoming sustainable pavement industry.

Keyword: Waste cooking oil; Transesterification; Sustainability; Free fatty acid; Asphalt binder; Rheological properties