

Creep Behaviour of Asphalt Modified by Waste Polystyrene and Its Hybrids with Crumb Rubber and Low-Density Polyethylene

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Abstract : Polystyrene, being made from a monomer called styrene, is a rigid and easy-to mould polymer that is widely used for many applications, from foam packaging to disposable containers. Considering that the degradation of waste polystyrene takes up to 500 years, there is an urgent need for a sustainable application for waste polystyrene. This study evaluates the application of waste polystyrene as an asphalt modifier. The inclusion of waste plastics in asphalt is either practised by the dry process or the wet process. In the dry process, plastics are added straight into the asphalt mixture and in the wet process, they are mixed and digested into bitumen. In this article, polystyrene was used as an asphalt modifier in a dry process. However, the mixing process is precisely designed to make sure that the polymer is melted and modified in the binder. It was expected that, due to the rigidity of polystyrene, it will have positive effects on the permanent deformation of the asphalt mixture. Therefore, different mixtures were manufactured with different contents of polystyrene and Marshall specimens were manufactured, and dynamic creep tests were conducted to evaluate the permanent deformation of the modification. This is a commonly repeated loading test conducted at different stress levels and temperatures. Loading cycles are applied to the AC specimen until failure occurs; with the amount of deformation constantly recorded the cumulative, permanent strain is determined and reported as a function of the number of cycles. Also, to our best knowledge, hybrid mixes of polystyrene with crumb rubber and low-density polyethylene were made and compared with a polystyrene-modified mixture. The test results of this study showed that the hybrid mix of polystyrene and low-density polyethylene has the highest resistance against permanent deformation. However, the polystyrene-modified mixture outperformed the hybrid mix of polystyrene and crumb rubber, and both demonstrated way lower permanent deformation than the unmodified specimen.

Keywords : permanent deformation, waste plastics, polystyrene, hybrid plastics, hybrid mix, hybrid modification, dry process

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