

The Effects of the Waste Plastic Modification of the Asphalt Mixture on the Permanent Deformation

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Abstract : The application of plastic waste for asphalt modification is a sustainable strategy to deal with the enormous plastic waste generated each year and enhance the properties of asphalt. The modification is either practiced 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, the effects of plastic inclusion in asphalt mixture, through the dry process, on the permanent deformation of the asphalt are investigated. The main waste plastics that are usually used in asphalt modification are taken into account, which is linear, low-density polyethylene, low-density polyethylene, high-density polyethylene, and polypropylene. Also, to simulate a plastic waste stream, different grades of each virgin plastic are mixed and used. For instance, four different grades of polypropylene are mixed and used as representative of polypropylene. A precisely designed mixing condition is considered to dry-mix the plastics into the mixture such that the polymer was melted and modified by the later introduced binder. In this mixing process, plastics are first added to the hot aggregates and mixed three times in different time intervals, then bitumen is introduced, and the whole mixture is mixed three times in fifteen minutes intervals. Marshall specimens were manufactured, and dynamic creep tests were conducted to evaluate the effects of modification on the permanent deformation of the asphalt mixture. Dynamic creep is a common 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. The results of this study showed that the dry inclusion of the waste plastics is very effective in enhancing the resistance against permanent deformation of the mixture. However, the mixing process must be precisely engineered to melt the plastics, and a homogenous mixture is achieved.

Keywords : permanent deformation, waste plastics, low-density polyethene, high-density polyethene, polypropylene, linear low-density polyethene, dry process

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