

## Investigation of Physical Properties of Asphalt Binder Modified by Recycled Polyethylene and Ground Tire Rubber

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**Abstract :** Modification of asphalt is a fundamental method around the world mainly on the purpose of providing more durable pavements which lead to diminish repairing cost during the lifetime of highways. Various polymers such as styrene-butadiene-styrene (SBS) and ethylene vinyl acetate (EVA) make up the greater parts of the all-over asphalt modifiers generally providing better physical properties of asphalt by decreasing temperature dependency which eventually diminishes permanent deformation on highways such as rutting. However, some waste and low-cost materials such as recycled plastics and ground rubber tire have been attempted to utilize in asphalt as modifier instead of manufactured polymer modifiers due to decreasing the eventual highway cost. On the other hand, the usage of recycled plastics has become a worldwide requirement and awareness in order to decrease the pollution made by waste plastics. Hence, finding an area in which recycling plastics could be utilized has been targeted by many research teams so as to reduce polymer manufacturing and plastic pollution. To this end, in this paper, thermoplastic dynamic vulcanizate (TDV) obtained from recycled post-consumer polyethylene and ground tire rubber (GTR) were used to provide an efficient modifier for asphalt which decreases the production cost as well and finally might provide an ecological solution by decreasing polymer disposal problems. TDV was synthesized by the chemists in the research group by means of the abovementioned components that are considered as compatible physical characteristic of asphalt materials. TDV modified asphalt samples having different rate of proportions of 3, 4, 5, 6, 7 wt.% TDV modifier were prepared. Conventional tests, such as penetration, softening point and roll thin film oven (RTFO) tests were performed to obtain fundamental physical and aging properties of the base and modified binders. The high temperature performance grade (PG) of binders was determined by Superpave tests conducted on original and aged binders. The multiple stress creep and recovery (MSCR) test which is relatively up-to-date method for classifying asphalts taking account of their elasticity abilities was carried out to evaluate PG plus grades of binders. The results obtained from performance grading, and MSCR tests were also evaluated together so as to make a comparison between the methods both aiming to determine rheological parameters of asphalt. The test results revealed that TDV modification leads to a decrease in penetration, an increase in softening point, which proves an increasing stiffness of asphalt. DSR results indicate an improvement in PG for modified binders compared to base asphalt. On the other hand, MSCR results that are compatible with DSR results also indicate an enhancement on rheological properties of asphalt. However, according to the results, the improvement is not as distinct as observed in DSR results since elastic properties are fundamental in MSCR. At the end of the testing program, it can be concluded that TDV can be used as modifier which provides better rheological properties for asphalt and might diminish plastic waste pollution since the material is 100% recycled.

**Keywords :** asphalt, ground tire rubber, recycled polymer, thermoplastic dynamic vulcanizate

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