

ABSTRACT

Polymers are being increasingly used to modify bitumen to enhance the properties of bituminous mixtures. The polymer modified binders (PMB) are highly suitable for special applications such as, where traffic is extremely heavy, climatic variations are large, at roundabouts etc. The polymers to be used, should be easily, cheaply and abundantly available. From this consideration, reclaimed polyethylene in the form of low density polyethylene carry bags, which are very popular in domestic sectors of India, and which cause serious waste disposal problems, has been used for modification of bitumen in this investigation. To compare the properties of this new material, a virgin Ethylene Vinyl Acetate Copolymer (EVA) was also selected, as EVA has been considered as a promising polymer for bitumen upgradation. Out of the two grades of EVA (depending on vinyl acetate content) recommended for bitumen upgradation by the manufacturers, EVA with 28% vinyl acetate content has been selected in this investigation after carrying out some initial tests using both grades of EVA.

From the review of literature on development of modified binders using polymers and evaluation of such binders, it is seen that, the mixing parameters like speed of stirring, mixing time and mixing temperature play an important role in the preparation of PMB. It is further seen that the PMBs are evaluated in terms of some engineering properties of the binders as well as of the mixes containing these binders. Conventional tests as applicable to bitumen have been used in case of modified binders too.

Initially about 400gms of 80/100 penetration grade bitumen was used with each type of polymer using a laboratory stirrer. Later a mixing device was fabricated to prepare a larger sample (about 3kgs) under similar conditions, at one time. The effect of increase of temperature and time of blending on binder properties, was studied and the variation was found to be insignificant.

Some conventional tests were carried out on the modified binders. The penetration, ductility and specific gravity decreased while

softening point and viscosity increased with increase in polymer content. The temperature susceptibility and hardening of binders decreased. Using non-conventional tests, like storage stability test and penetration test at softening point, the dispersion of polymer in bitumen was found to be uniform.

Marshall specimens were prepared using normal procedure for study of Marshall characteristics, tensile strength and repeated load properties. The Marshall stability increased while flow value and unit weight decreased with increase in polymer content in binder. However, all Marshall criteria, specified by the Indian Roads Congress for bituminous concrete mixes were satisfied at the selected optimum binder contents. At same polymer concentration PE offered maximum stability.

Based on the Marshall properties and tensile strength values of the mixes the concentration of PE and EVA in binder was selected to be 2.5% and 5% respectively for tests under repeated loading conditions. A repeated load indirect tensile test apparatus was fabricated in the laboratory to determine the mix properties like Poisson's ratio, resilient modulus and fatigue lives. At a particular temperature and a stress level the last two properties were found to be maximum in case of mixes containing EVA modified binders followed by those with PE modified binders and bitumen.

The moisture susceptibility characteristics of the mixes improved with use of both PE and EVA modified binders.

KEY WORDS:

Reclaimed Polyethylene, Ethylene vinyl Acetate Copolymer, Polymer Modified Binders, Saybolt-Furol Viscosity, Storage Stability Test, Marshall Properties, Optimum Binder Content, Indirect Tensile Test, Tensile Strength, Poisson's ratio, Resilient Modulus, Fatigue Life, Tensile Stress, Stress Difference, Initial Tensile Strain, Moisture Susceptibility.