ABSTRACT

Bitumen is a binder material used in the construction of flexible pavements. Besides its numerous applications in different agencies which include agriculture, medicine and in building construction, it is used as a binder in road paving. It is obtained as a waste product from fractional distillation of petroleum crude. It is a very complex material and exhibits visco elastic behavior & possesses water proofing qualities. Generally, in flexible pavements, soft grade bitumen is used in colder climates and hard grade in hot regions. Since it is practically not possible to satisfy the requirements of paving specifications for different temperature and environmental conditions, modifications for binders are suggested by researchers namely, polymer, acid and mineral to use the binder to cater to the requirements of wider climatic conditions.

The acid modification is gaining its attention in the recent past and much interest is shown in the construction of pavements with acid modified bitumen in United States, China, Italy, Iran, Spain, Sweden, Turkey and other parts of the globe. Out of different verities of acids, researchers are exploring the benefits of modification with Polyphosphoric Acid (PPA) as PPA can enhance the high and low temperature performance due to the improvement in binder stiffness and fragility respectively. This modification was found to replace the air blowing technique which was used earlier to get hard grade bitumen from the softer ones obtained as the residue of fractional distillation of crude oil. Despite the great deal of interest shown in different parts of the globe in PPA modification, very limited works were reported in our country and therefore there is great potential for research in this area.

The current research will focus on the effects of PPA modification on VG 30 grade (Viscosity Grade) bitumen which is being used as a paving grade in India in lieu of old 60/70 grade. The research will explore; the method of arriving at optimum dosage of PPA to be used considering the available guidelines, the effects of the modification on fundamental properties, change in performance grades, the detail of fabrication of indigenous rotational viscometer for measurement of consistency bitumen at standard temperature, the changes in composition due to modification, the effects due to short term ageing simulation of straight run and modified bitumen, the micro structural changes for fractions of bitumen, imaging
techniques related to the study of morphology, changes in the thermal properties of bitumen and its fractions due to modification and finally the influence of this modification on performance of bituminous mixes for identified layers, will be addressed in this research activity.

In this research, it was observed that the VG 30 grade bitumen when modified with 2% PPA found to show enhancement in high temperature performance grade by 12°C. The PPA modification has the effect on bitumen microstructure as revealed from SEM and XRD investigations. VG 30 Binder modified with PPA was observed to be thermally stable as found from TG-DSC studies. The performance of the bituminous mixes modified with PPA was found to be good as revealed from Marshall Stability tests and Resilient Modulus tests.