

# Physical & Rheological Properties of RAP Binder Rejuvenated with Mustard Oil



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June 2019

## ABSTRACT

Transportation infrastructures play a vital role towards the economic development of a country. Road pavements in general, while the flexible pavements specifically are considered as backbone of any transportation infrastructure. Billions of dollars are spent every year around the world for the development and maintenance of highway infrastructures. One of the main constituents of flexible pavement is bitumen. A major shortcoming of flexible pavement is its continuous deterioration over the service life which causes pavement failure before reaching its desired design life.

Reclaimed Asphalt Pavement (RAP) is generally aged pavement material obtained from milling a de-functioned pavement. Utilization of RAP material reduces cost of pavement construction as well as the environmental degradations. In order to save natural environment, reduce waste and present a cost effective and economical way for construction of highways, RAP material is used in recycling process. High amount of RAP addition to asphalt mix may make it prone to fatigue failure as the RAP binder is stiff because of loss of volatile materials and oxidation with passage of time. “Rejuvenators” are the materials which can be effectively used to restore the chemical & physical properties of the aged asphalt binders. The present research aims to study the feasibility of using Mustard oil as a suitable rejuvenator and to evaluate its effectiveness as rejuvenator by determining how much the chemical and physical properties of aged asphalt binder has restored. The study mainly comprised of rheological characterization studies such as PG grading, frequency sweep and creep-recovery studies of the aged and rejuvenated binder specimens using Dynamic Shear Rheometer (DSR). Low temperature properties of all binders were determined using Bending Beam Rheometer (BBR). Chemical investigations using Fourier Transform Infrared Spectroscopy (FTIR) was also conducted to affirm the use of mustard oil in effectively restoring the chemical properties of aged binder. In addition, for assessment of the long-term performance in terms of thermo-stability of the rejuvenated binders, a thermal analysis was also carried out using Thermo-gravimetric analysis (TGA), which confirmed the adequate thermal stability of the

rejuvenated binders. In order to study the moisture susceptibility of binders, rolling bottle test was performed. Gas Chromatography-Mass Spectrometry (GC-MS) test was also performed to study the chemical composition of mustard oil. Results from all the performed tests revealed that Mustard oil improves the aged asphalt binder properties and can be used as a suitable rejuvenator for aged binder.

**Keywords:** Flexible pavement; Reclaimed asphalt pavement (RAP); rheology; rejuvenator; Mustard oil; FTIR; Bending Beam Rheometer (BBR); moisture susceptibility