Laboratory Investigation on Performance Properties of Rubber Modified Vacuum Bottom Residuum

N. Tabatabaee[1], M. Z. Alavi[2]
1-Associate Professor, Department of Civil Engineering, Sharif University of Technology, Tehran, Iran
2-Graduate Student, Department of Civil Engineering, Sharif University of Technology, Tehran, Iran

alavi@civil.sharif.edu

Abstract

Crumb rubber modifier (CRM) is known to have a positive effect on the properties of typical paving asphalts. In this paper, the effect of CRM on the performance properties of vacuum bottom, a residuum from the vacuum tower of a crude oil refinery plant, is investigated using the Superpave testing protocol. Initial results show that rubber modification increases viscosity, enhances high service temperature, and expands intermediate service temperature range as defined in performance grade superpave specifications. The effect of this modification on low service temperature is positive, but less pronounced compared to high and intermediate service temperatures.

Keywords: Vacuum Bottom residuum, Crumb rubber modifier, Viscosity, Performance grade

1. INTRODUCTION

Millions of scrap tires are discarded each year, creating a serious environmental dilemma unless effective methods of recycling them can be developed. Using scrap tires in the form of crumb rubber modifier (CRM) to produce rubber modified asphalt binders using the wet process can recycle a significant portion. In the wet process, during the mixing of hot asphalt and crumb rubber, rubber particles swell due to the absorbing aromatics of asphalt and result in a semi-gelatinous substance with better properties than neat asphalt [1,2].

Base asphalt properties can strongly effect CRM binder properties [3,4] and the properties of rubber CRM binders from typical grade asphalt have been widely studied. The current study investigated the effect of crumb rubber on the modification of vacuum bottom residuum (VB). VB is the remnant of crude oil at the bottom of the vacuum tower which is usually air blown to produce paving asphalt. If the desired performance properties can be obtained from rubber modified VB, modification of VB with crumb rubber can be introduced as a novel method of producing modified paving asphalt.

2. OBJECTIVE AND SCOPE

The present study investigated the performance properties of VB before and after modification with CRM using the Superpave testing protocol. Marshall mix specimens made from rubber modified VB were also examined to provide a basis for future research on the effect of modified VB in mixtures.

Rubber modified VBs were prepared in the laboratory using three crumb rubber concentrations (12%, 15%, 18% by weight of VB). The samples were mixed using a simple four-blade mixer at a speed of 350 rpm for 30 min at 165 °C. The VB was mixed under the same conditions as CRM binders to evaluate the effect of mix aging on its properties. Two samples were prepared for each type of binder and their performance properties were evaluated under different aging conditions. Viscosity and high temperature properties were measured for unaged binders, high temperature properties were measured for rolling thin film oven (RTFO) aged binders and intermediate and low temperature properties for RTFO + pressure aging vessel (PAV) aged binders. In addition, the Marshall stability, flow, and indirect tensile strength of the Marshall mixes with rubber modified VB (18% CRM) were measured. Figure 1 shows the flow chart of the test plan.