Improving the Selection of Virgin Binders for Recycled Hot Mixtures in Ontario

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ABSTRACT
The design of Recycled Hot Mixtures (RHM) in the United States is based on the guidelines provided by the National Cooperative Highway Research Program (NCHRP) Report 452. However, the extreme climatic characteristics in Canada require a validation on the selection of the virgin binders especially for Superpave Surface layer mixtures. This paper shows the results of a laboratory characterization of twelve conventional Superpave 12.5 mm mixtures, four of them with high Reclaimed Asphalt Pavement (RAP) content. Thermal Stress Restrained Specimen Test (TSRST) was conducted on triplicate samples for each mixture, and also the continuous grades for the binders were obtained. The findings were compared with the recent guidelines provided by the NCHRP Report 752. Dynamic modulus was performed and used to determine the critical temperatures of the blended binder without extraction. The analyses suggest that the virgin binder could be selected based on the critical temperature of the climate zone and the RAP content, and that the use of softer binders could not guaranty that the mixtures have the desired performance to low temperature cracking.

1. INTRODUCTION
The Ministry of Transportation Ontario is committed of having the greenest roads in North America [1]. Ontario has one of the maximum allowances in Reclaimed Asphalt Pavement (RAP) content for new Hot Mix Asphalt (HMA) [2]. The current

specification allows the use of up to 40% RAP for binder courses or lower layer mixes, and 20% RAP for surface courses, or top layer mixes. However, a survey among the contractors confirmed that the actual in-place RAP percentages are below those limits [3]. Ontario is divided in three zones, delimited according to the geographic and climatic information, that define the base Performance Grade (PG) of the asphalt cement to be used as shown in Figure 1 [4].

A general concern among contractors is the ability of the Recycled Hot Mixture, to resist thermal cracking. To control the appearance of this distress; the common practice is the use of a softer binder for mixtures containing more than 20% RAP.

The main objective of this research was to validate the recommendations in the recent NCHRP Report 752 [5] for the Ontario conditions. For this purpose, twelve Superpave 12.5 mm mixtures were prepared using four basic binders; PG 58–28, PG 52–34, PG 58–34 and PG 52–40 (polymer modified); and two RAP contents, 20% and 40% respectively, in addition to the control mixtures with 0% RAP. The recommendations in the NCHRP Report 752 represents improvements to the AASHTO M323 [6] and AASHTO R35 [7] standards than include guidelines for the Superpave design of mixtures containing RAP, and are based on the use of blending charts for selecting virgin binders.

The use of blending charts is a regular practice for designing Recycled Hot Mixtures (RHM). The comparison with the critical temperatures of the blended binder measured directly from the extracted binder has drawn interesting conclusions. In the research conducted by Horton et al. [8] on high RAP plant mixtures for the low temperature grade, the measured properties of the blended asphalt binder had a lower grade than

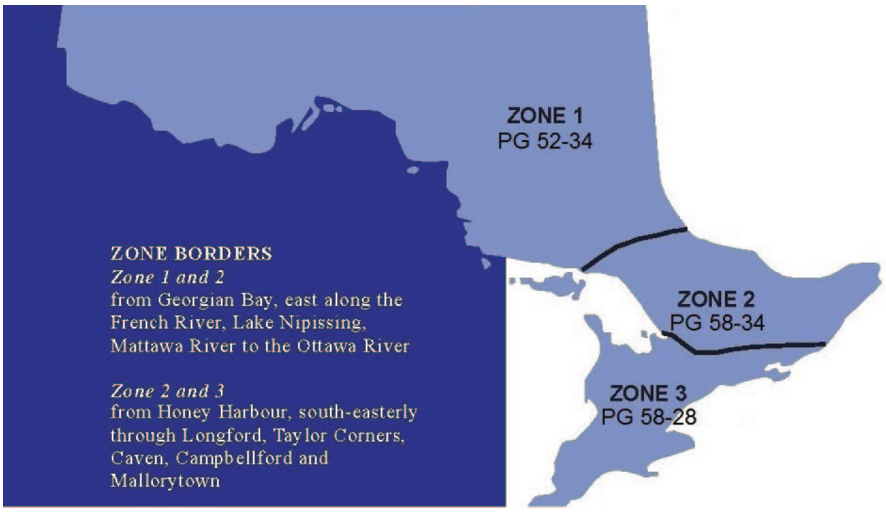

Figure 1. Ontario PG zones [4]