

Study Objectives

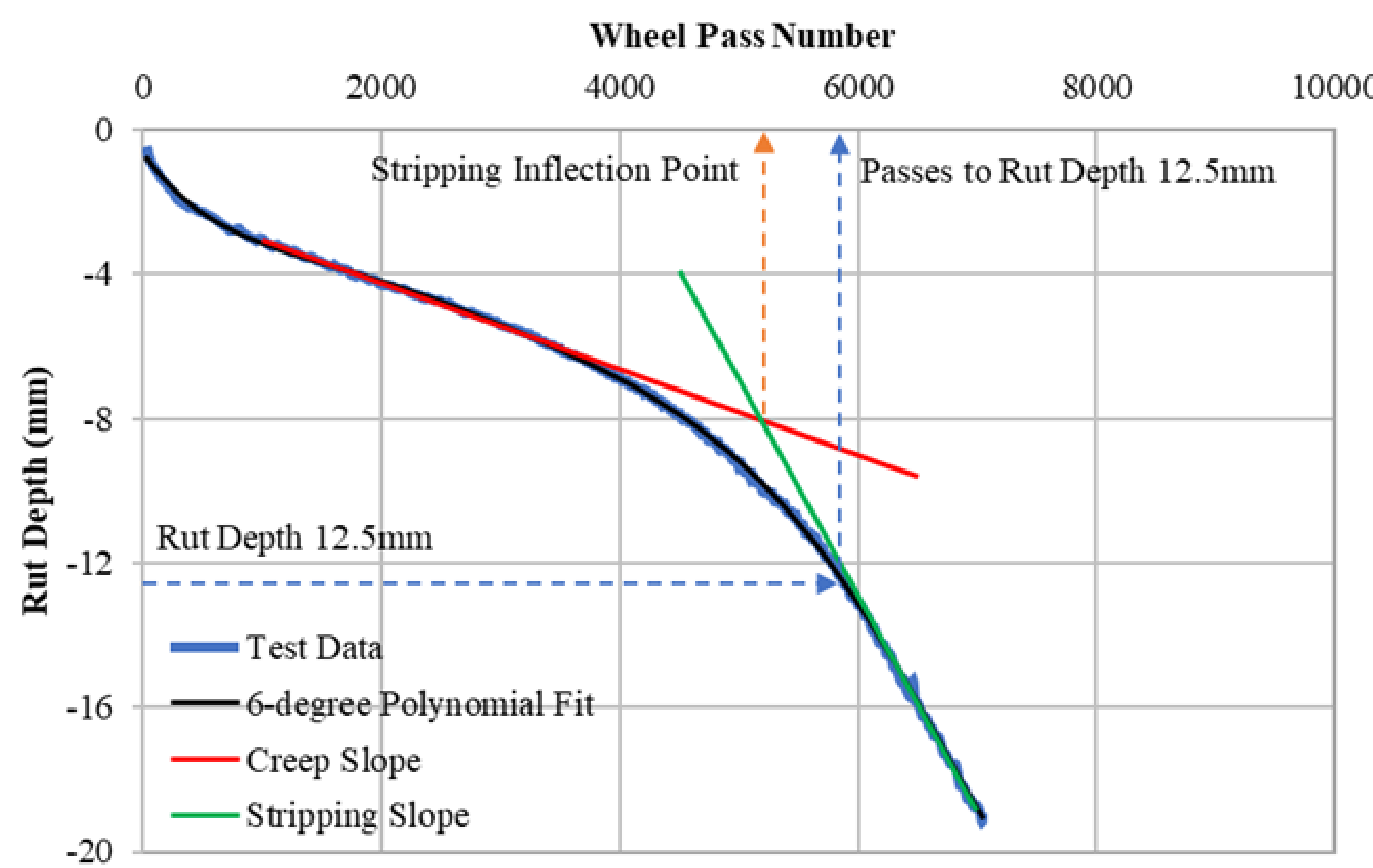
- To investigate the rutting resistance and moisture susceptibility of high RAP/RAS mixtures through analyzing the HWTT results using the Iowa DOT method;
- To introduce the newly developed HWTT analysis method for high RAP/RAS mixtures, in which the deformation due to visco-plastic flow is separated from the deformation induced by moisture in the HWTT at wet condition.

Methods & Materials

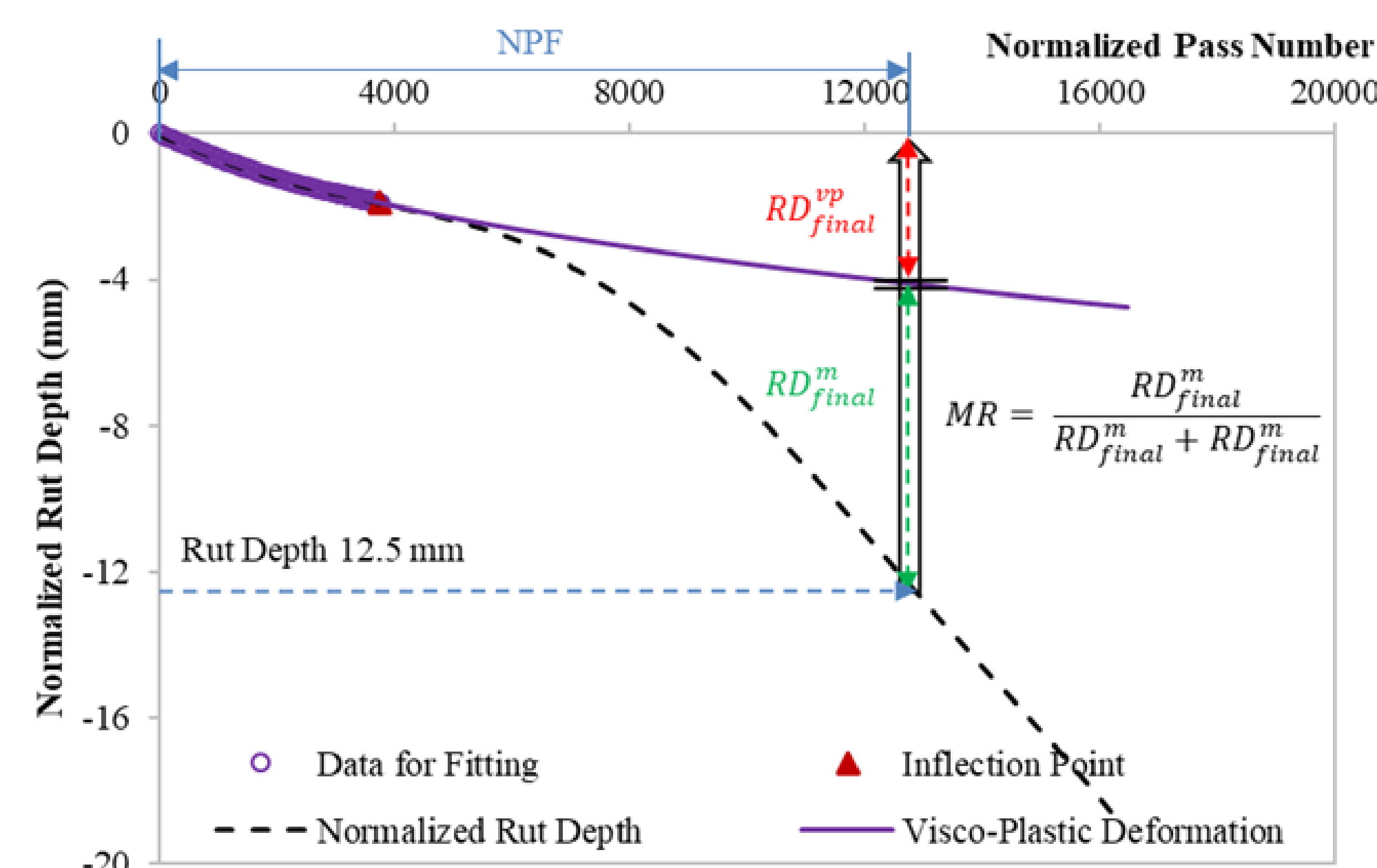
Design of Experiment

Factor	Description			
Mixture type	Virgin Mix	30% JMF RAP Mix	50% JMF RAP Mix	30% RAP+5% RAS JMF Mix
Base binder used	PG 58-28S			
Recycling agent type	NA	REOB; Bio-Oil#1; Bio-Oil#2		
Percent binder replacement	NA	27.0%	45.0%	47.5%
Recycling agent dose	NA	REOB - 5.0%; Bio-Oils - 3.0%	REOB - 10.0%; Bio-Oils - 5.0% (As percentage of total binder blend)	
Aging condition	Short-Term Oven Aging (4 h at 135 °C)			

HWTT Analysis Method – Iowa DOT

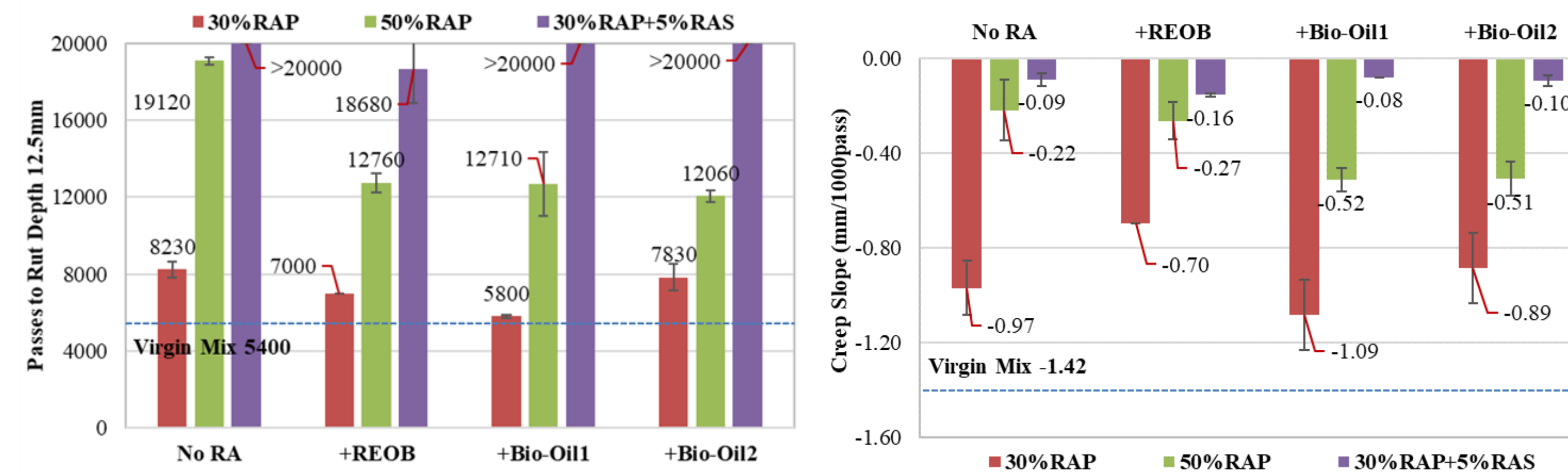


Newly Developed HWTT Analysis Method

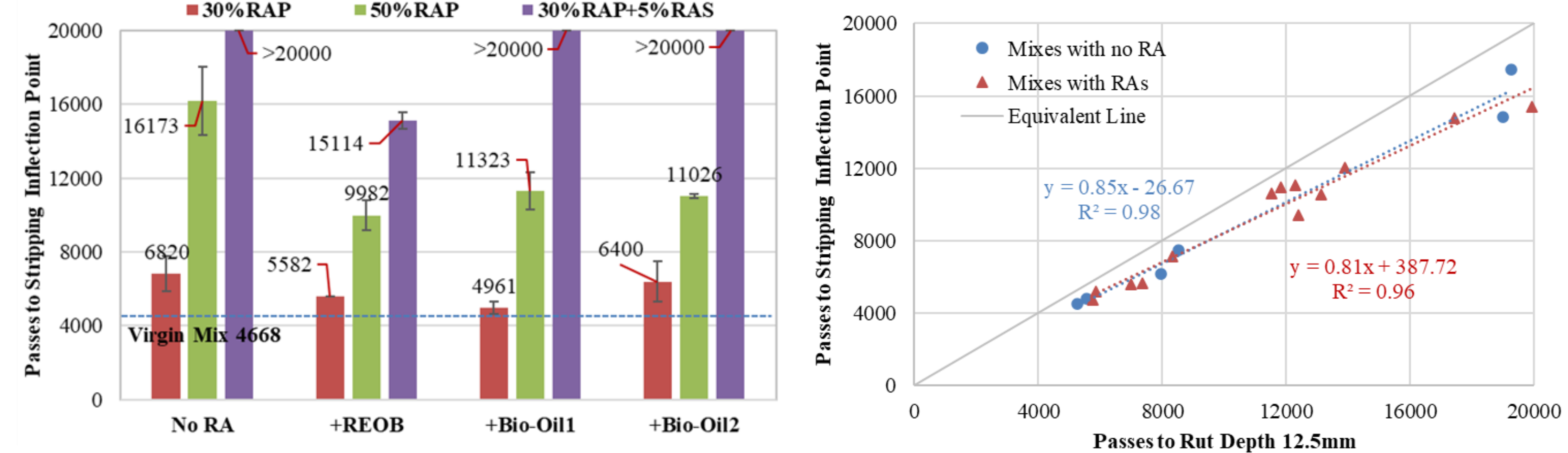


Analyses of HWTT Results

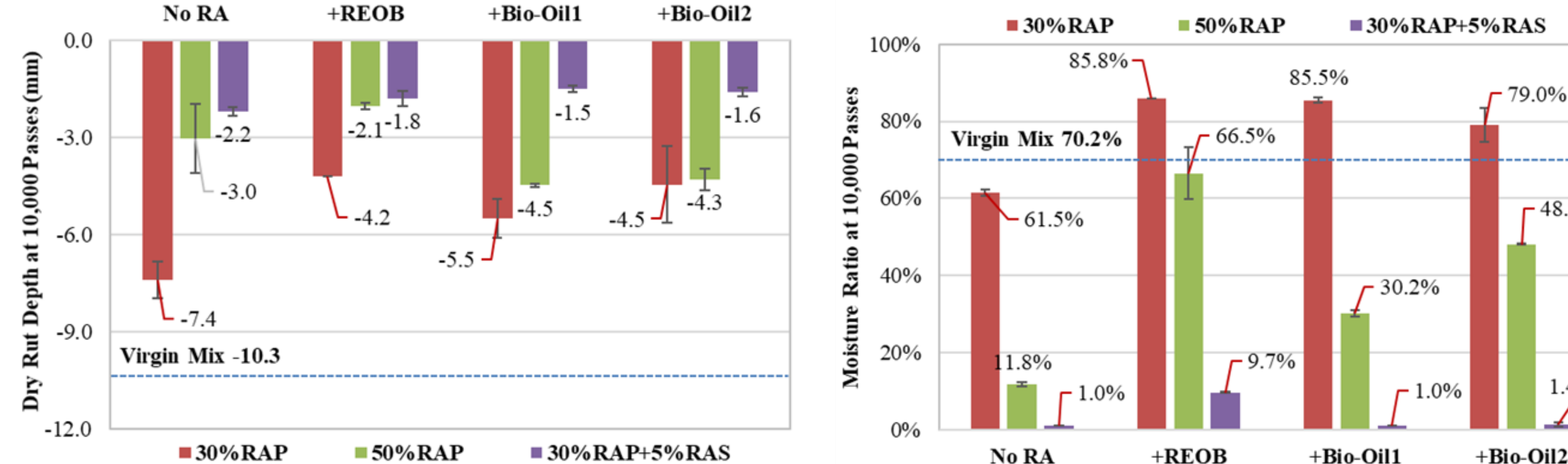
Passes to Rut Depth 12.5 mm and Creep Slope



Passes to Stripping Inflection Point



Dry Rut Depth at 10,000 Passes and Moisture Ratio



Main Findings

- The recycling agents reduced the passes to 12.5 mm, but the values are higher than virgin mixture;
- The recycling agents increased creep slope, but total rut depth remained lower than virgin mixture;
- There is a high correlation between the SIP and passes to 12.5 mm, indicating confounding effects of rutting and moisture damage in the wet HWTT;
- Significant stripping was observed in the mixtures with 10% REOB, while the mixtures with 5% Bio-Oils did not show stripping;
- The moisture ratio parameter confirmed that recycling agents may increase moisture damage and the relative effect is specific to the type of recycling agents.

This study was funded by the Transportation Pooled Fund Project TPF-5(352) and the support of the executive board members of Recycling Material Research Center (RMRC) is gratefully acknowledged.