Performance Comparison of Polymer-modified Bitumen with Virgin and Recycled Polyethylene Plastics

Implications for road development and durability in Jamaica

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Introduction

Figure 1. Porous Asphalt Paving: A Typical Cross-Section

POROUS ASPHALT COURSE
1/2- to 3/4-IN. AGGREGATE ASPHALTIC MIX (1.27–1.91 CM)

FILTER COURSE
1/2-IN. CRUSHED STONE (1.27 CM) 2 IN. THICK (5.08 CM)

RESERVOIR COURSE
(2.54–5.08 CM)
1- TO 2-IN. CRUSHED STONE VOIDS VOLUME IS DESIGNED FOR RUNOFF DETENTION

THICKNESS IS BASED ON STORAGE REQUIRED AND FROST PENETRATION

EXISTING SOIL
MINIMAL COMPACTION TO RETAIN POROSITY AND PERMEABILITY

Polymer-modified bitumen goes here

Limitations of Asphalt

Oxidation

Reduction in polar molecules

Fractures and permanent deformation

Polarity of Asphalt

Greater affinity to water

Moisture Damage and Stripping

A Solution…

So… how can we improve the asphalt?

We could add plastic….

A Solution….

BUT WHAT ABOUT US?

A Solution…

Two types of polyethylene are used:

High density polyethylene (HDPE)

Low density polyethylene (LDPE)

What characteristics can Polyethylene give to Asphalt?

Disadvantages of Asphalt		Desirable Characteristics of Polyethylene
Susceptibility to oxidation	→	**Chemically resistant**
Susceptibility to water damage	→	**Water resistant and weather-proof**
Permanent deformation and fracture	→	**Durable , flexible and tough**

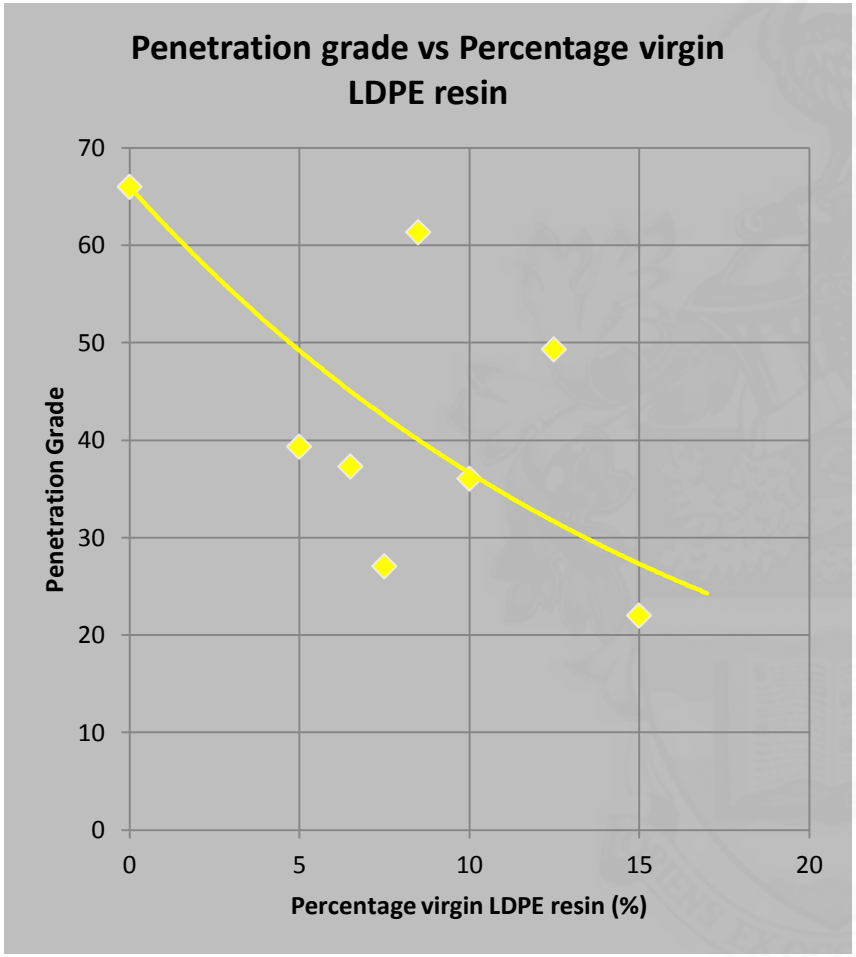
Performance Evaluation of Modified Bitumen

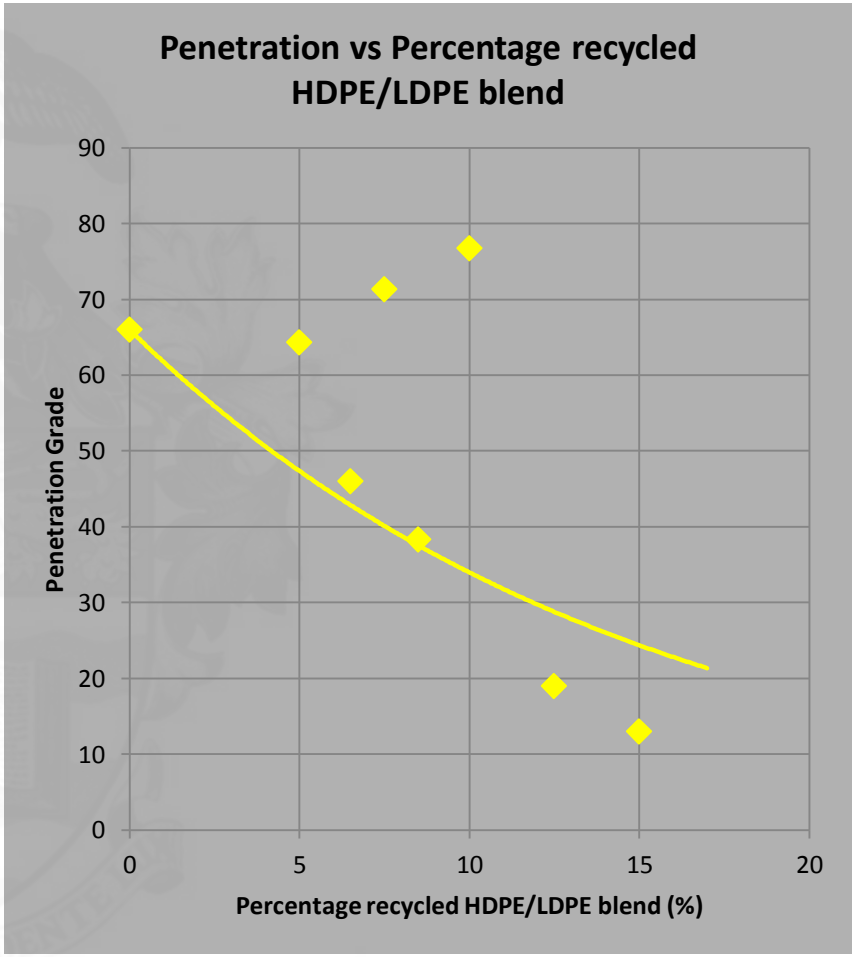
Penetration Grade

The penetration grade is a measure of how adhesive the modified bitumen sample is

Performance Evaluation of Modified Bitumen

Penetration Grade



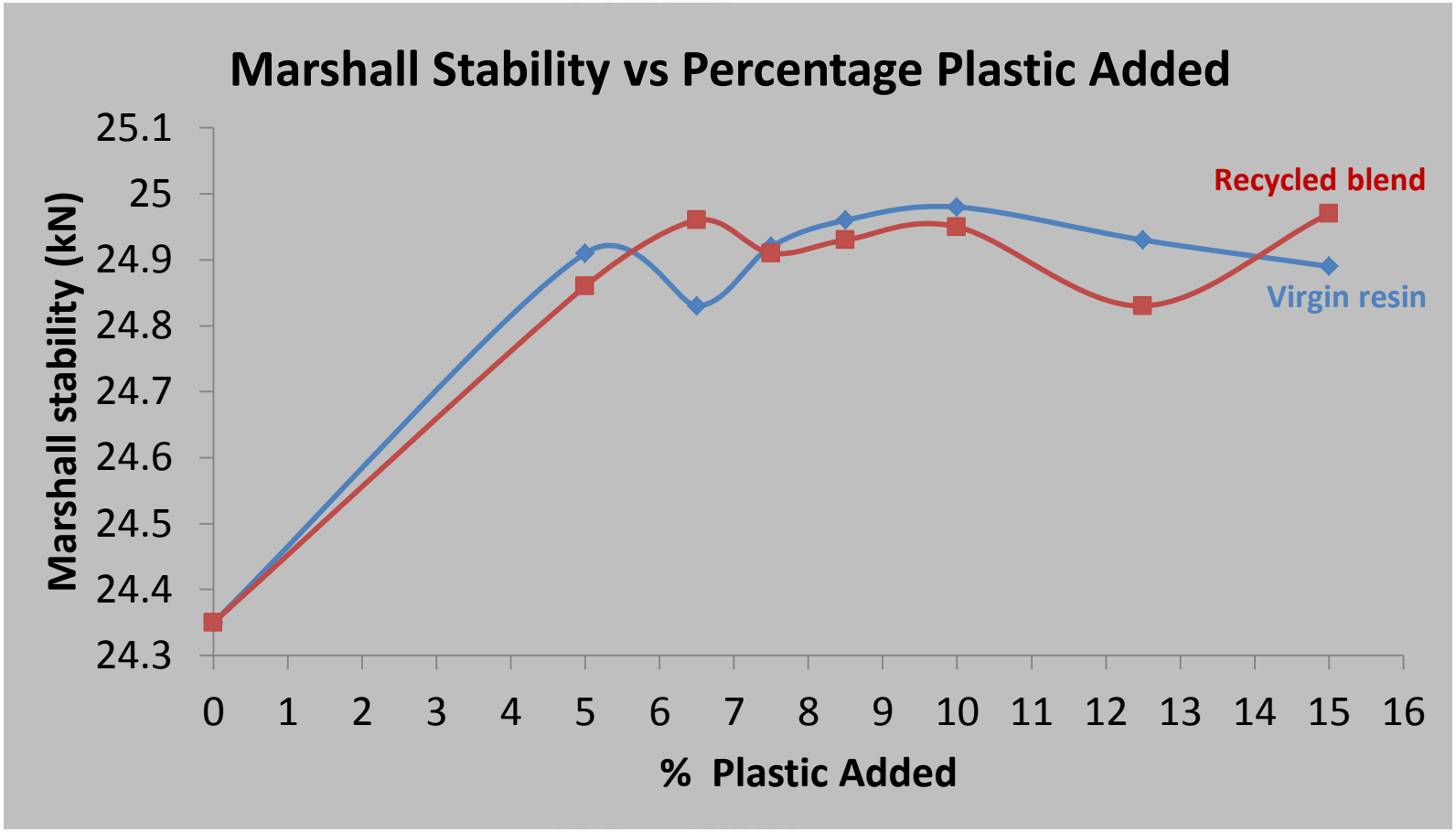


Marshall Stability

The Marshall Stability is a measure of how stable an modified asphalt sample (binder plus aggregate and filler) is once its maximum load is applied.

Performance Evaluation of Modified Bitumen

Marshall Stability

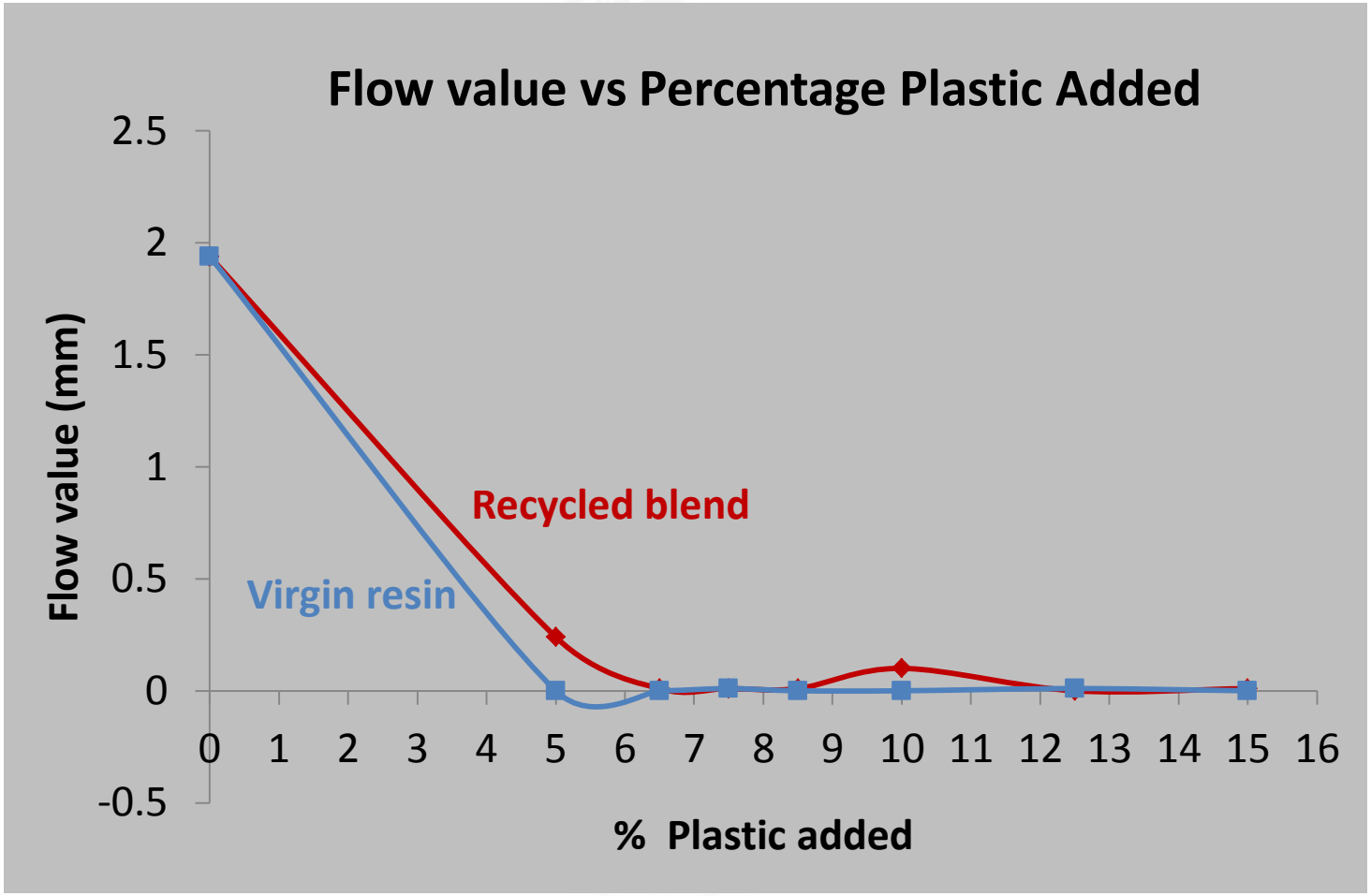


Flow

The Flow measures the degree of deformation from the initial state of the asphalt sample with an applied load.

Performance Evaluation of Modified Bitumen

Flow

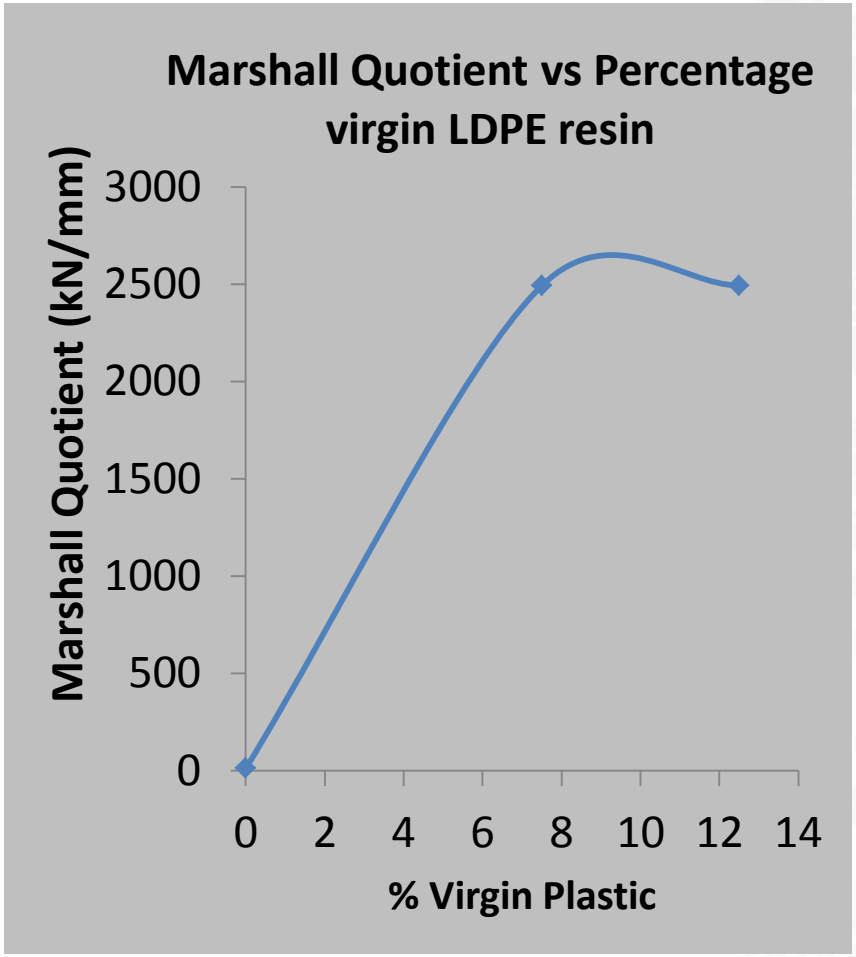


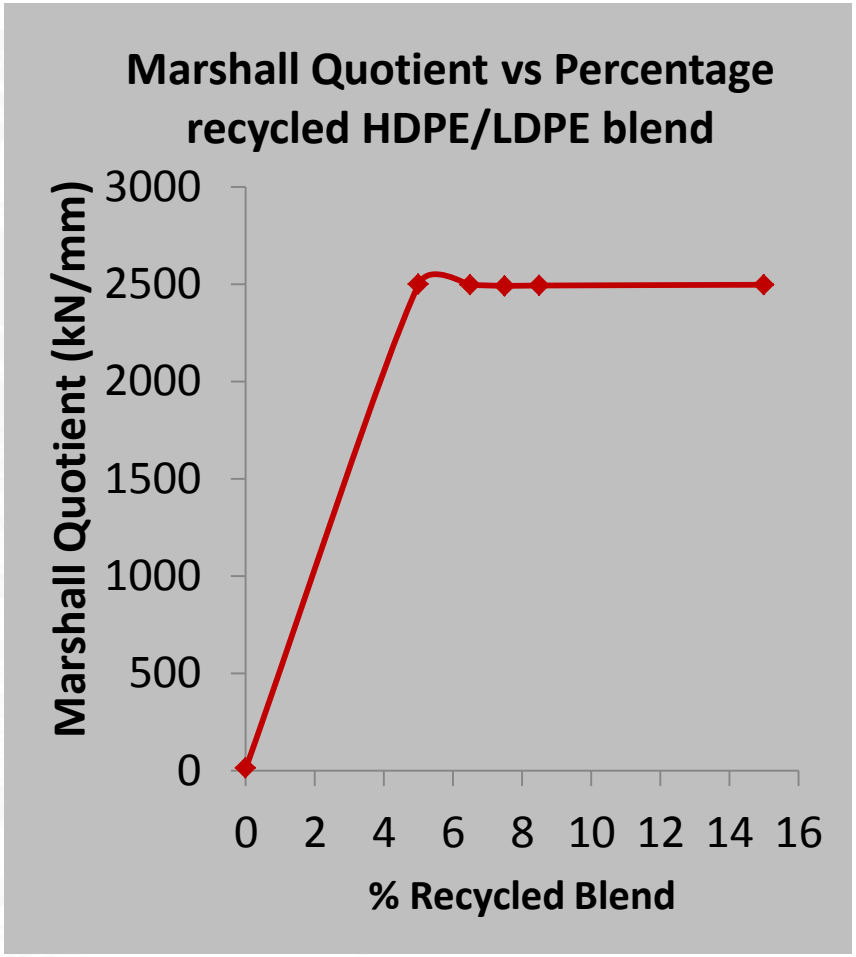
Marshall Quotient

The Marshall Quotient is an indication of the sample's susceptibility to permanent deformation.

Performance Evaluation of Modified Bitumen

Marshall Quotient





Flash Point

The Flash point is the temperature at which enough gases are given off from the heated bitumen sample to sustain combustion.

IN CONCLUSION…

- A small amount of plastic goes a long way

- Recycled plastic is a viable and cost-effective alternative to virgin plastic

- Adding polyethylene not only strengthens the asphalt mixture, but provides a safer product by increasing the flash point.

Implications….

- More durable, longer lasting roads
- Millions of dollars saved on maintenance of roads
- Reductions in pollution

Further Research…

- How is water drainage affected by bitumen modification?
- Does the polyethylene additive affect skid resistance?
- How can we increase homogeneity?

Thank You !