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RAP & ASM recycling

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Présentation outline

- *Introduction*
- *Experimental methodology*
- *Experimental results*
- *Conclusions*
- *Questions*

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Introduction

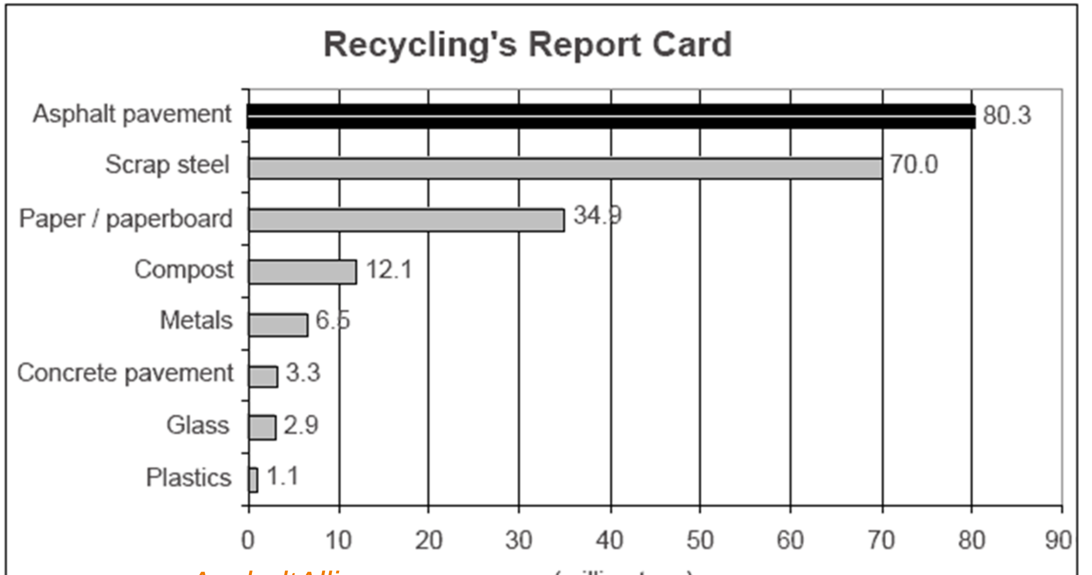
➢ ***Recycling becomes a major challenge for the asphalt industry in the 21st century***

➢ ***Economical: Important saving of raw materials (bitumen & aggregates) and landfills cost***

➢ ***Ecological: CO_2 emissions reduction, raw materials preservation, landfills preservation***

➢ ***Social: Contribute to the creation of a positive image of the asphalt industry as leader in the recycling of waste materials***

➢ ***Several recycled materials used in the asphalt***



source www.AsphaltAlliance.com

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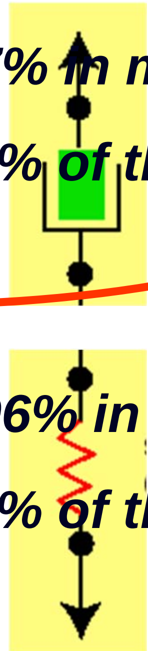
Introduction

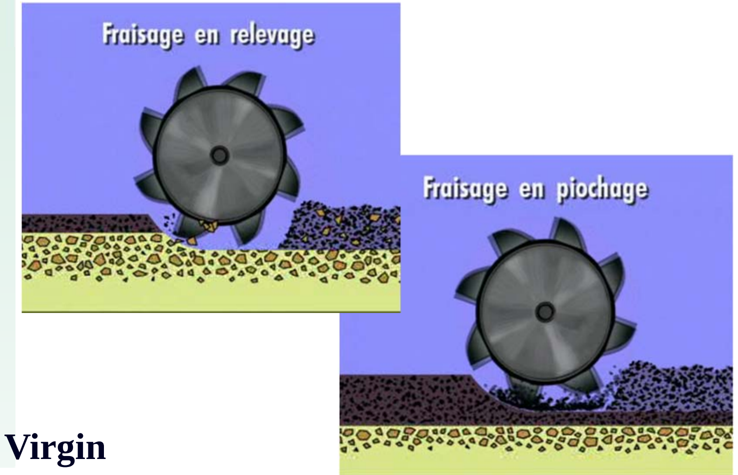
Hot Mix Asphalt

Bitumen		***4 to 7% in mass***
Neat or modified		***40 to 65% of the cost***
Aggregates		***93 to 96% in mass***
Stone, sand and filler		***25 to 45% of the cost***
Energy		***10 to 15% of the cost***
Drying and heating		



Introduction

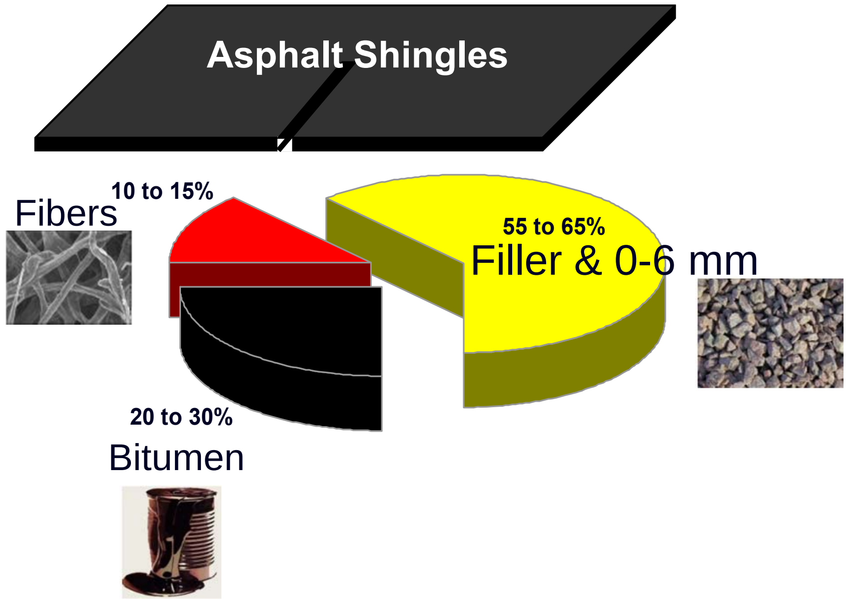
RAP: Reclaimed Asphalt Pavement



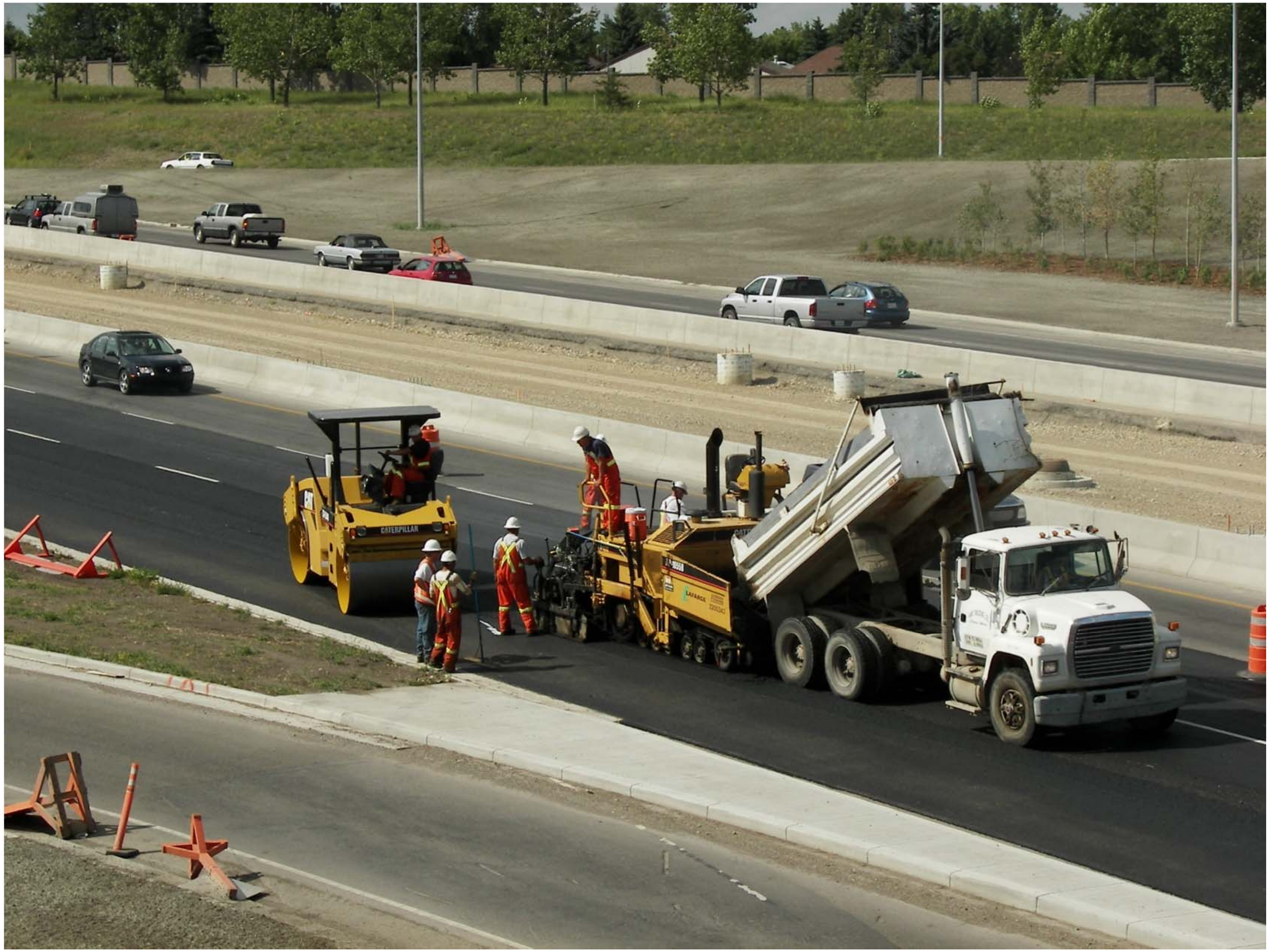
Virgin Aggregates

RAP

Roofing Asphalt Shingles

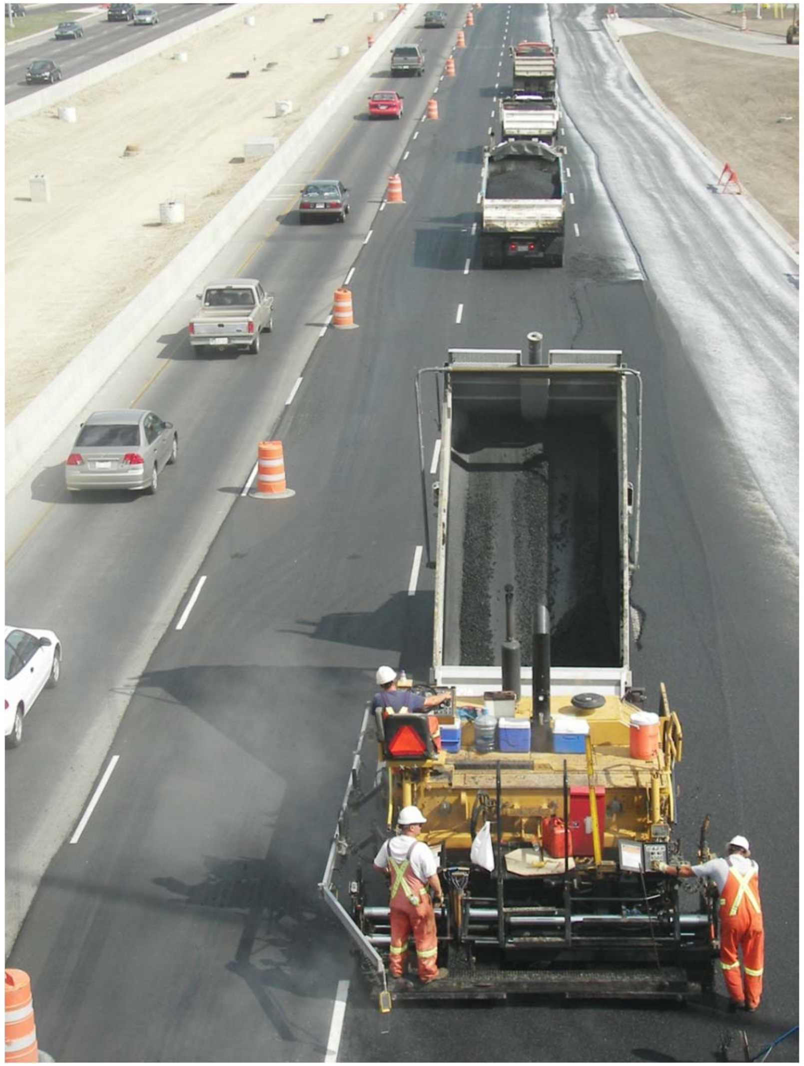


Introduction



Lafarge Western Canada – Project ASM&RAP

Introduction



Lafarge Western Canada – Project ASM&RAP

Introduction

Objectives of the research

- ***Contribute to the understanding of the behaviour of asphalt mixes with high rates of recycled materials (ASM & RAP)***

- ***Propose a simple mix design procedure based on the findings of the performance approach***

- ***Identify technical solutions to address potential performance issues related to mixes with high recycling rates***

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Research Methodology

Mix design approach

- ***A Control Mix using virgin materials was designed using the Superpave Mix Design Method (NMAS = 12.5)***
- ***Experimental mixes with RAP and ASM were designed using the Superpave Gyratory compactor (4% air void)***
- ***Two types of ASM were used: Fiberglass (G) and Cellulose fibres (C) shingles***
- ***One Straight run asphalt binder (PG 58-28) used in the first part of the research (content 5.18%)***

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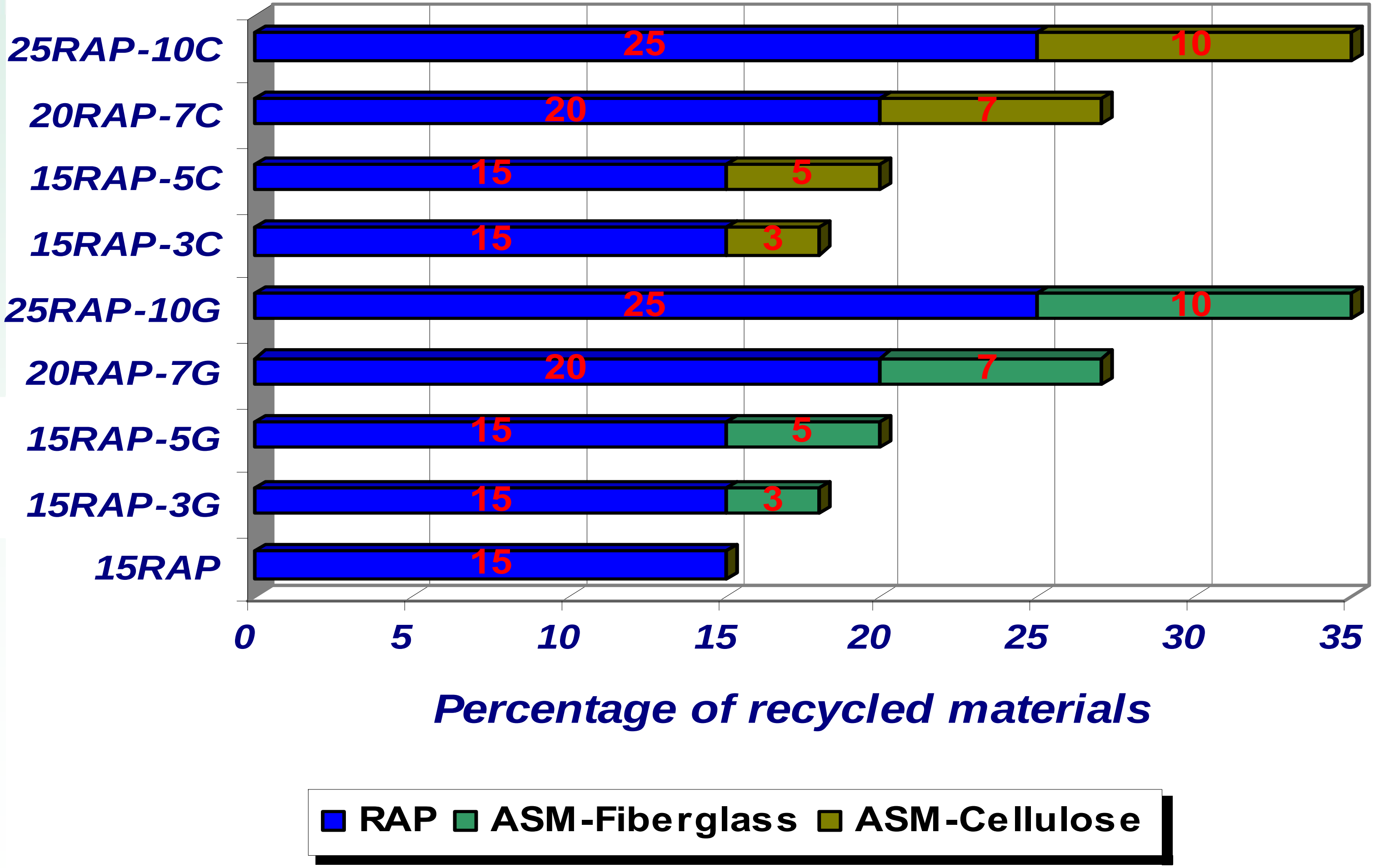
Research Methodology

Tested experimental materials



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Research Methodology

Experimental approaches

Photo of the LCPC slabs' compactor

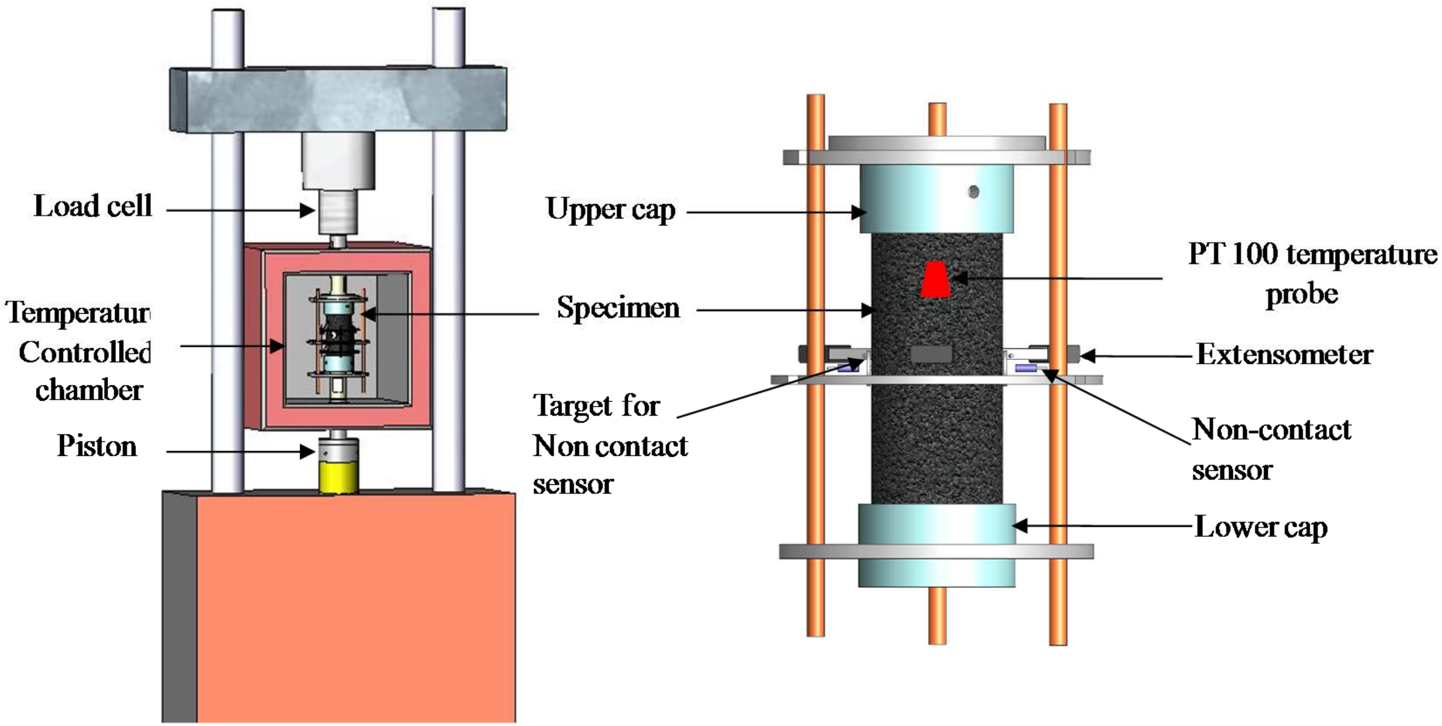
Research Methodology

Experimental approaches
Rutting test

Photo of the LCPC rutting test

Research Methodology

*Experimental approaches TSRST, Fatigue & E**



Schematic presentation of the fatigue and complex modulus test setup

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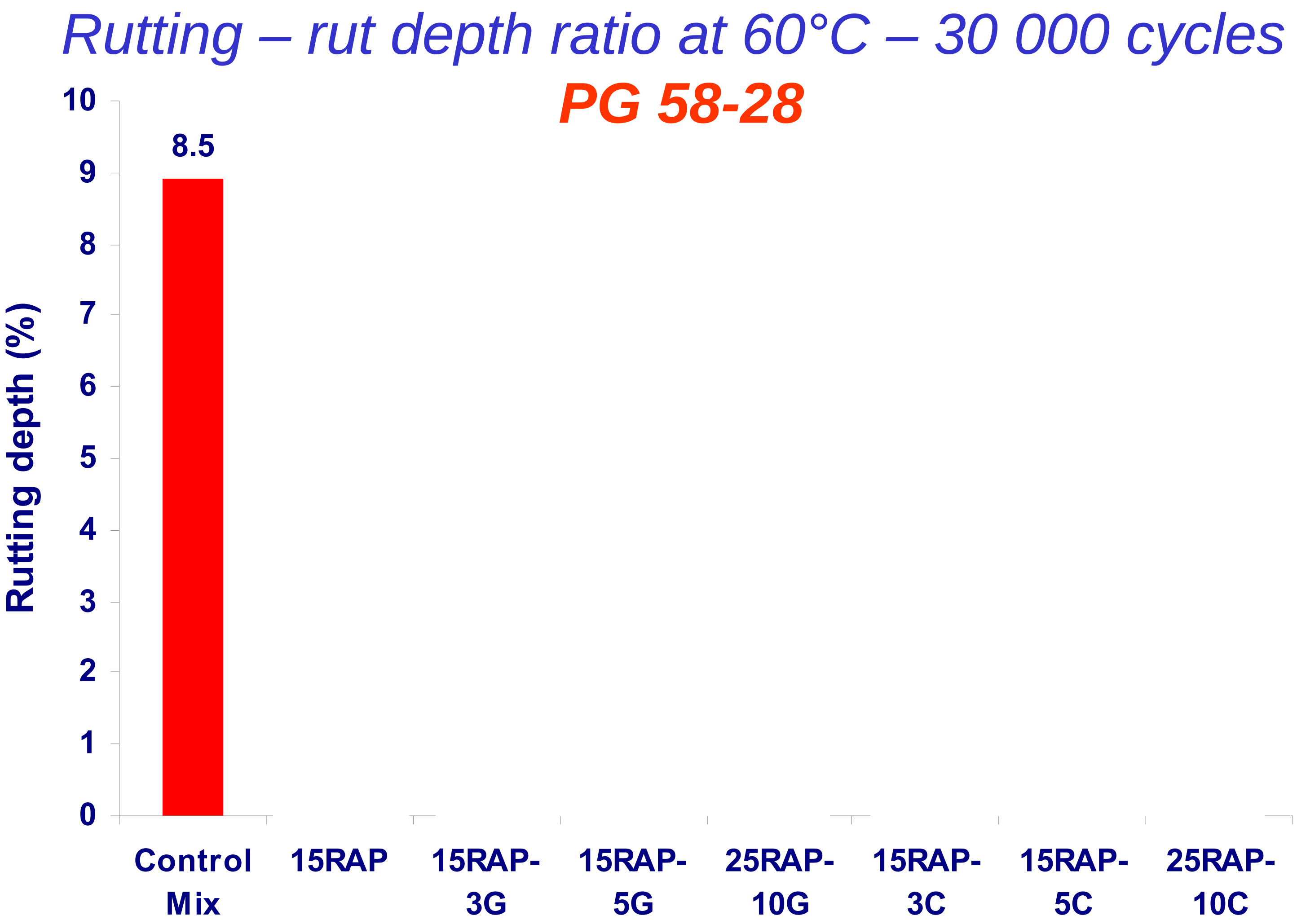
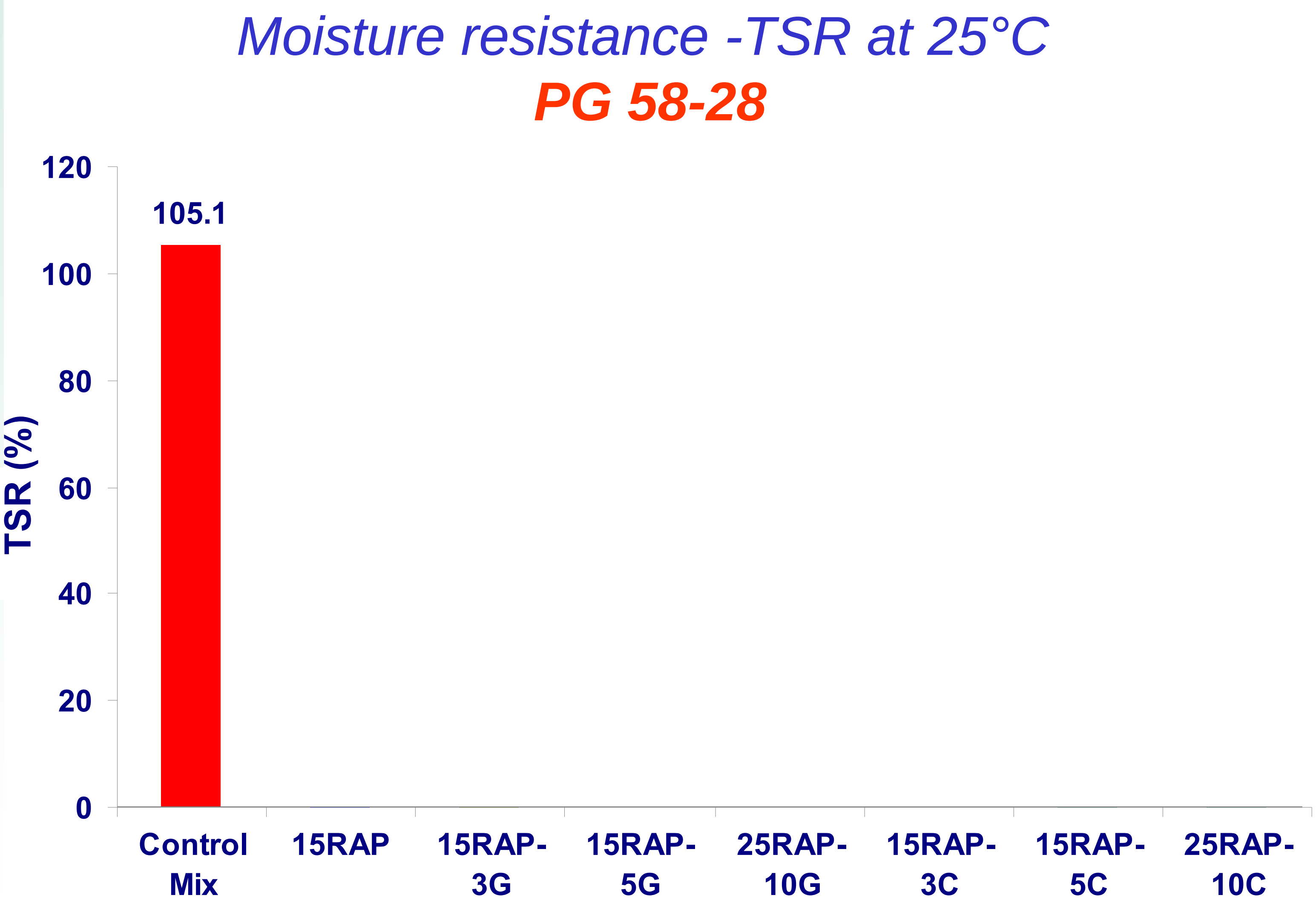
Experimental Results

Experimental Results



➢ ***Excellent resistant to rutting of all experimental mixes***

Experimental Results



➢ ***Moisture resistance criterion TSR may be affected at high recycling rates***

Experimental Results

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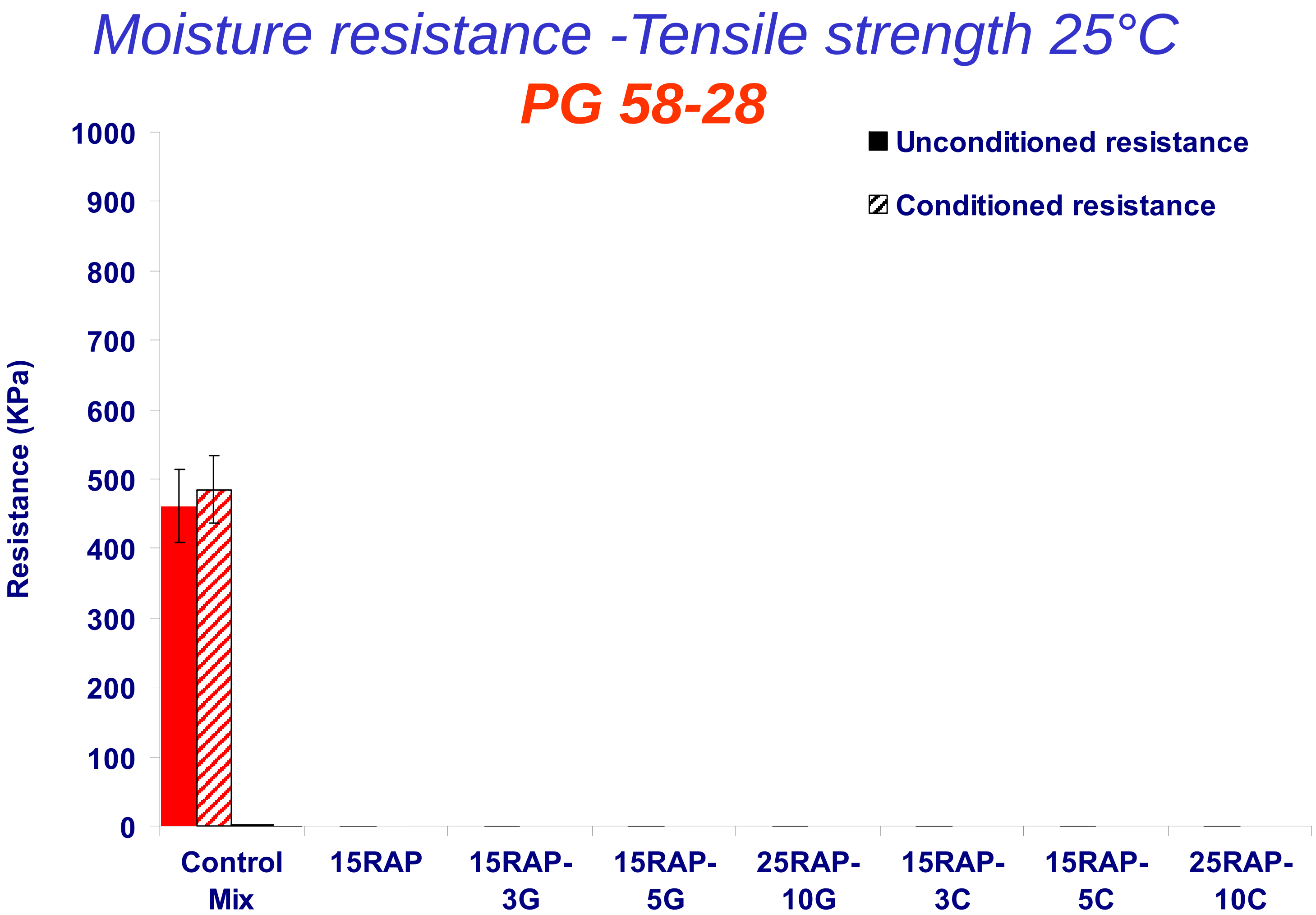
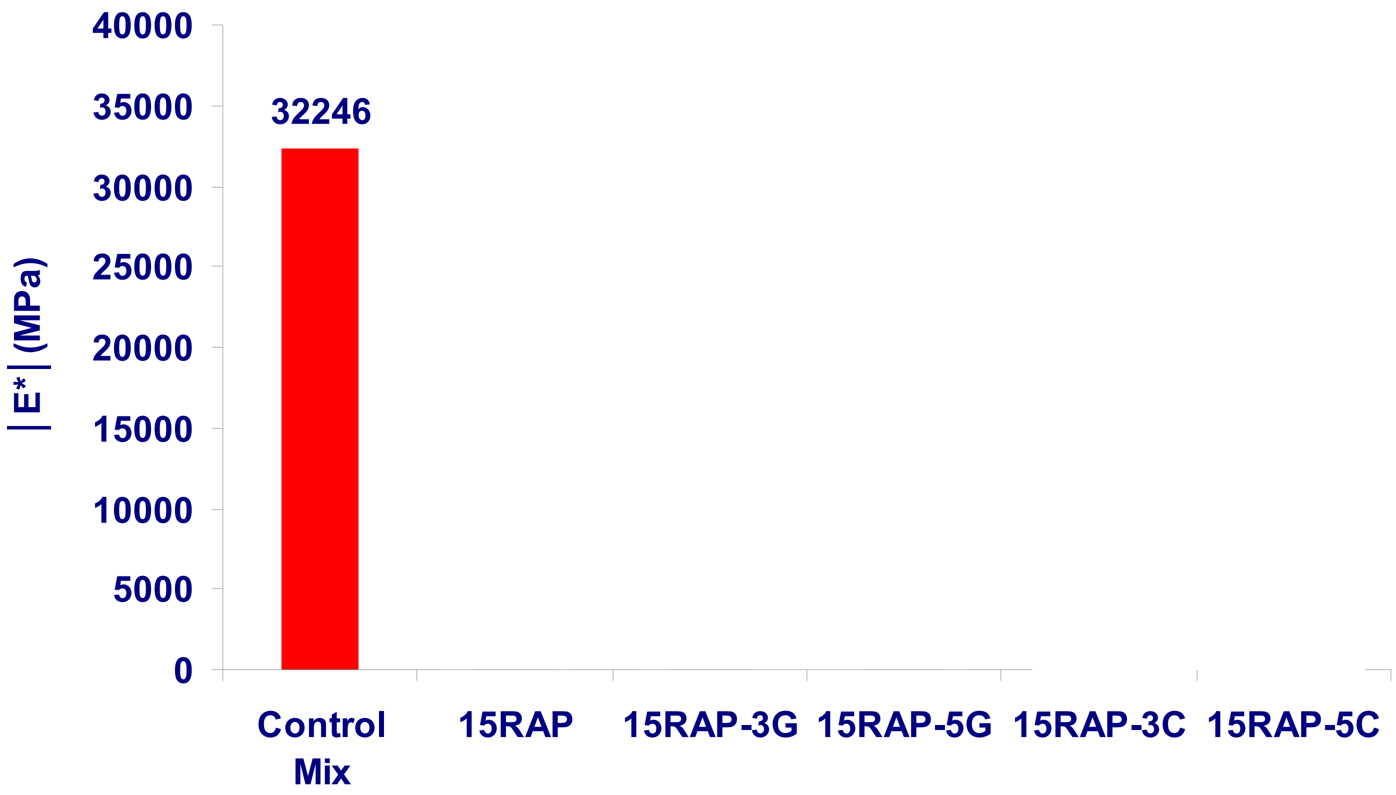


➢ ***Tensile strength of RAP&ASM mixes is generally higher than that of the control mix ⇨ Validity of the TRS criterion?***

Experimental Results

Complex modulus – E at -30°C & 10 Hz*

PG 58-28



➢***Similar stiffness values at low temperatures***

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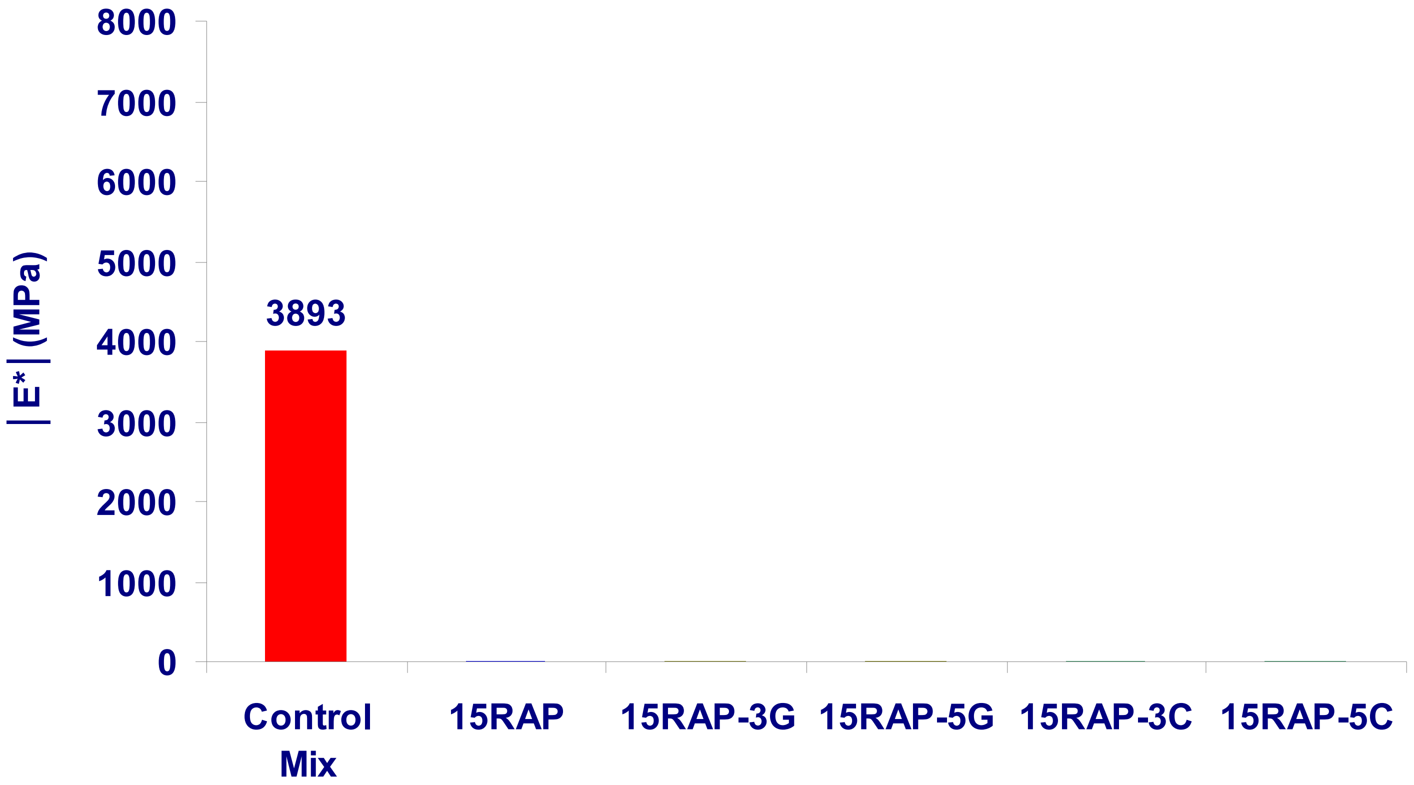
Experimental Results

Complex modulus – E at 20°C & 10 Hz*

PG 58-28

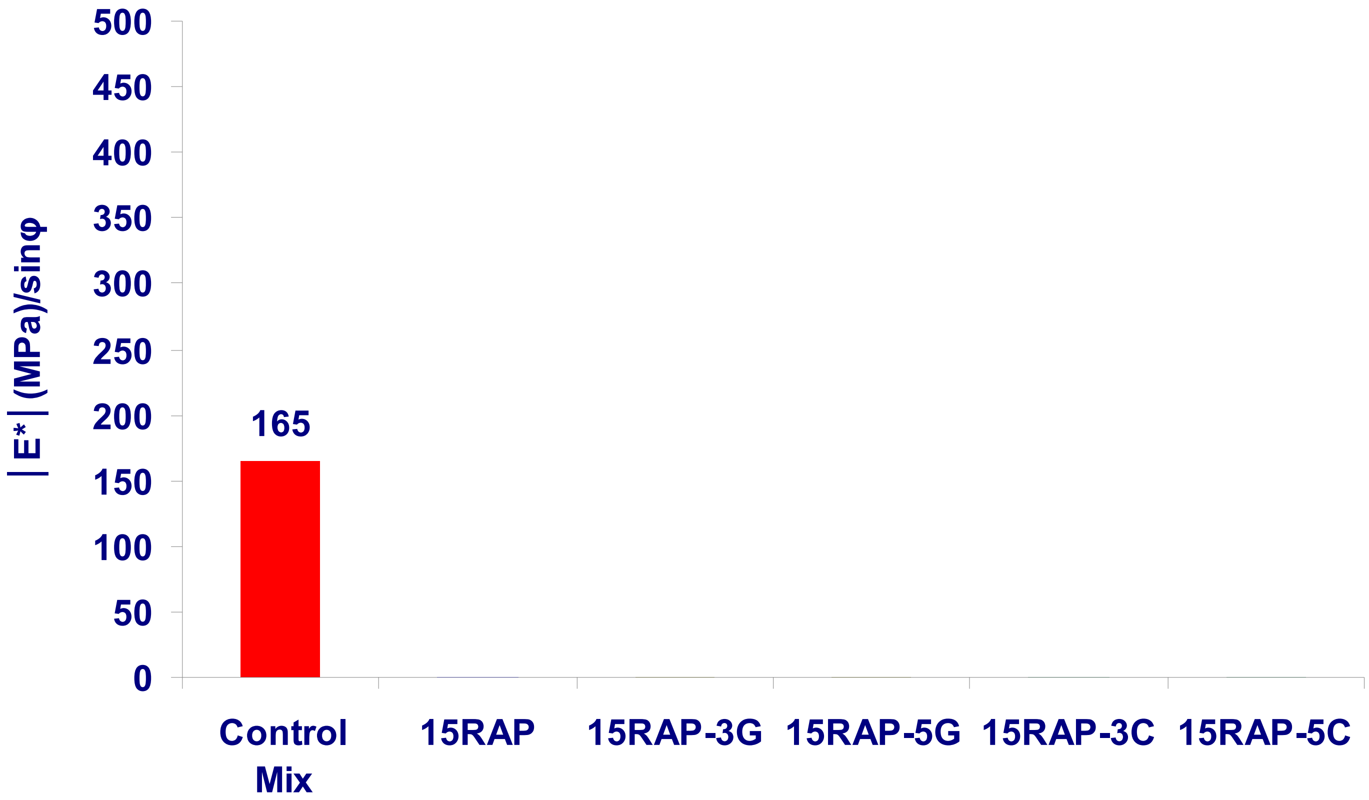


➢***Higher stiffness values of experimental mixes at pavement design temperature***

Experimental Results

Complex Modulus – E/Sin (φ) at 40°C & 1 Hz*

PG 58-28



➢***Higher rutting index of experimental mixes at high temperature – Confirmed by rutting tests***

Experimental Results

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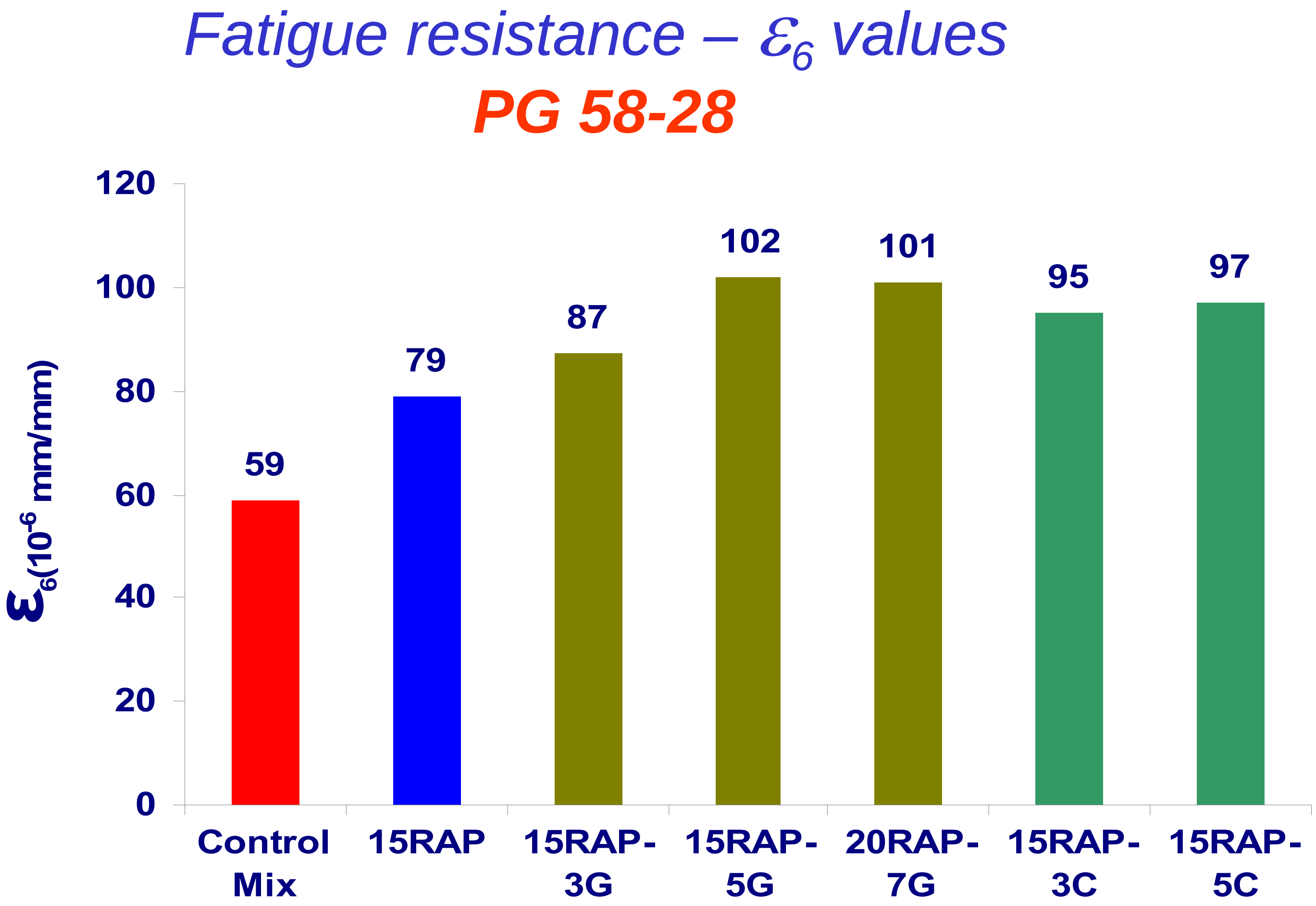
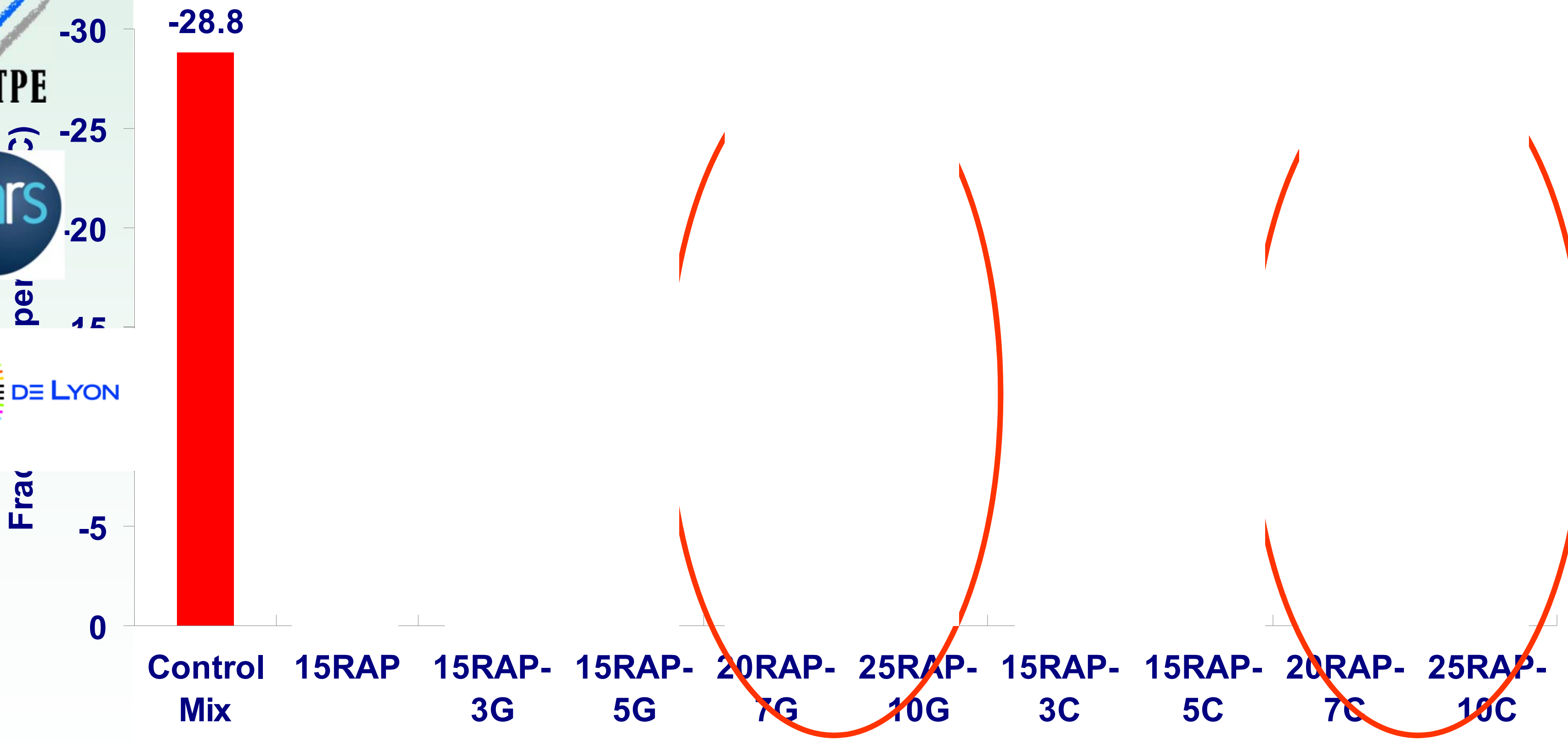


➢ ***Higher resistance to fatigue based on the classical fatigue criterion ε_6***

Experimental Results

Low temperature cracking – TSRST

PG 58-28



➢***Similar cracking temperatures below 15% RAP & 5% ASM***

➢***Risk of premature thermal cracking beyond these limits***

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Experimental Results

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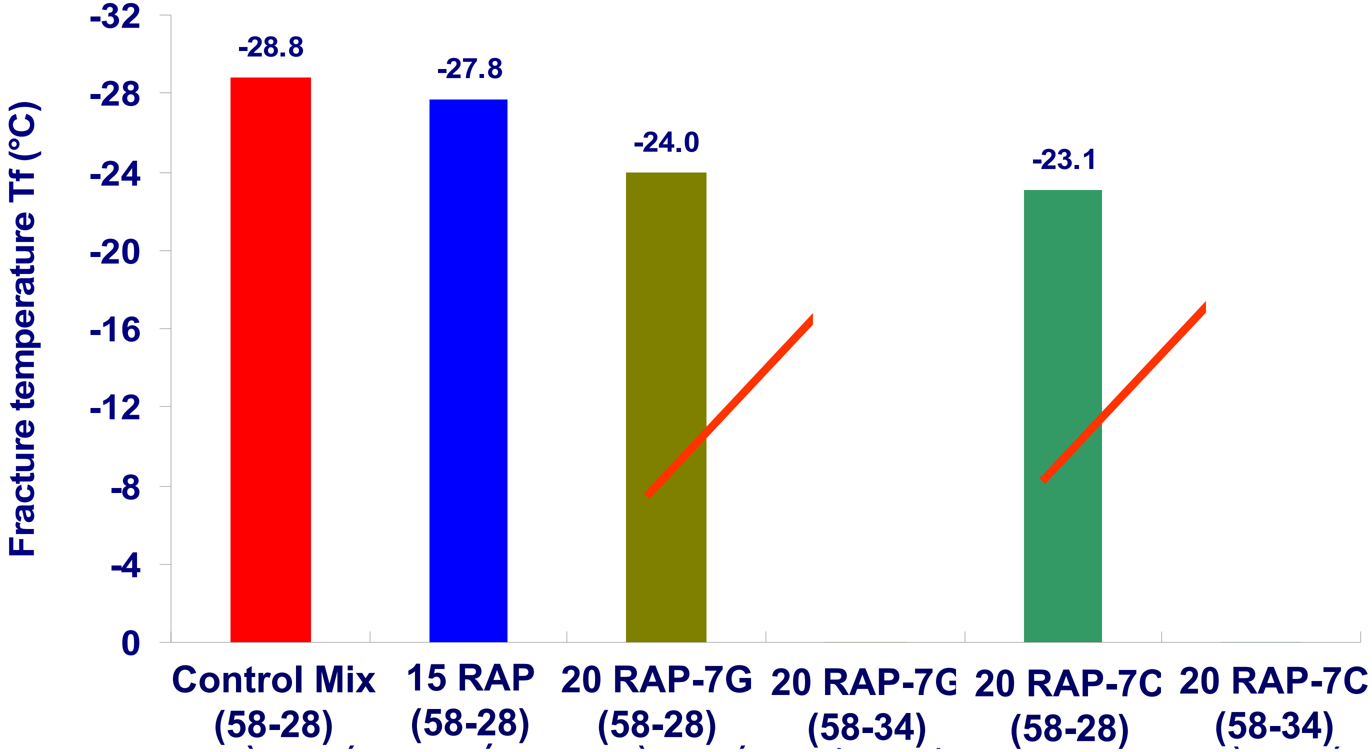
Low temperature cracking – TSRST

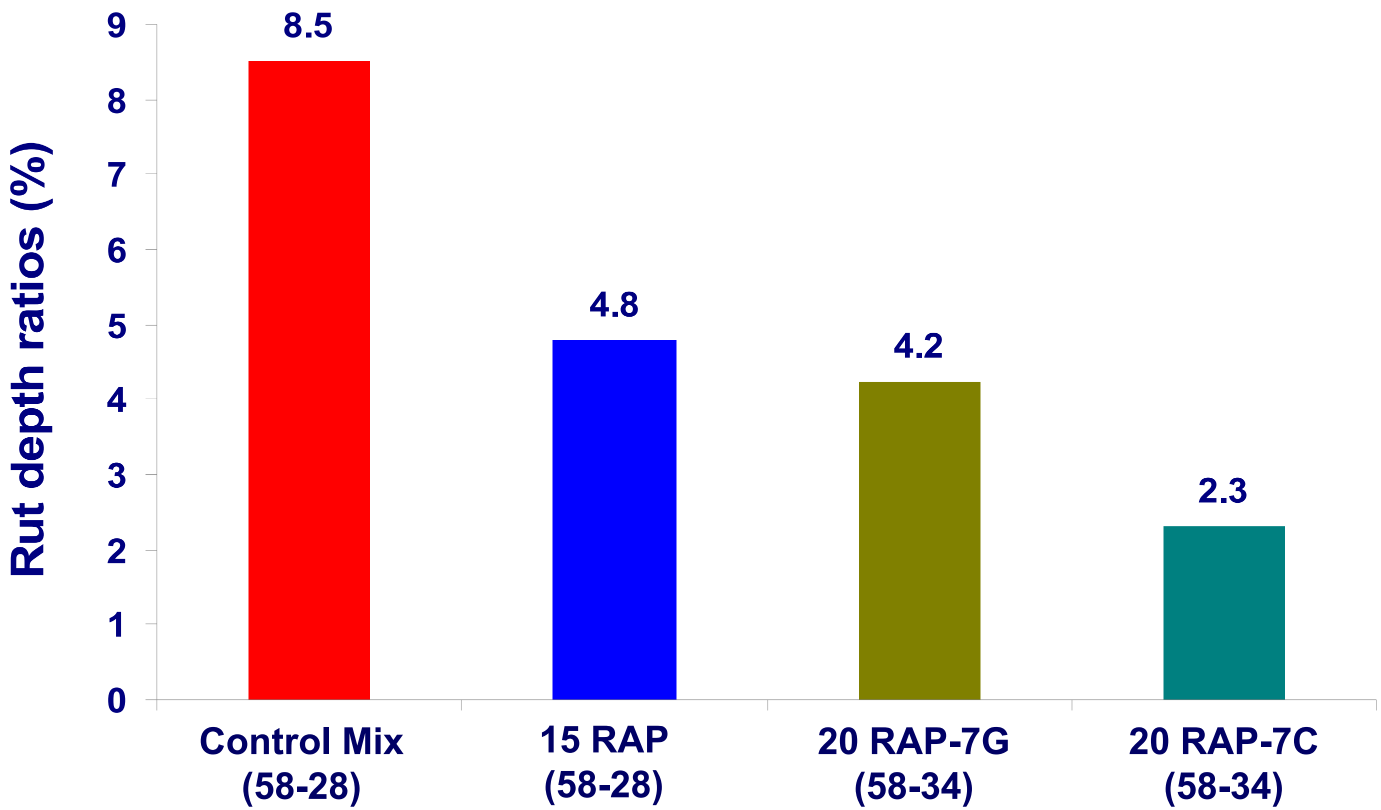
PG 58-28 & PG 58-34



➢ ***The use of a softer binder enhances significantly the resistance to thermal cracking***

Experimental Results

Rutting – rut depth ratio at 60°C – 30 000 cycles
PG 58-28 & PG 58-34



➢***The rutting values of RAP&ASM mixes with a softer binder are excellent***

Conclusions

- ➢*Recycling is a major social, economical and ecological necessity*
- ➢*The behaviour of recycled mixes is comparable or better than that of mixes prepared with virgin materials when adapted mix design approach is used*
- ➢*Mixes with up to 15% RAP + 5% ASM showed good behaviour and performance*
- ➢*Mixes with higher rates should be modified to address potential low temperature cracking or moisture resistance issues*
- ➢*The use of a softer binder enhanced significantly the low temperature cranking resistance*

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Questions??