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IRF WORLD ROAD MEETING 2017

/ 14-17 NOVEMBER / DELHI / INDIA /

Organosilane 'Warm Compaction' Technology for Green Roads

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Zydex

PREAMBLE

We have taken this earth on lease from future generations. It is our duty to return it to the future generation in liveable condition if not better.

Striving for sustainability through prudent use of limiting natural resources and restraint in emissions is the call of the day.

This realization is at the core of all innovations at Zydex

PAVEMENTS & SUSTAINABILITY

Extending life means sustainability and so is conserving limiting resources in pavement construction.

Saving Aggregates

Saving Bitumen

Saving Fuel

CONVENTIONAL WARM MIX - BACKGROUND

- Concept of WMA has been around since the 90's.
- Developed in response to EEC countries signing the Kyoto Treaty to reduce greenhouse gases.
- Warm mixes have received some attention in Europe and Australia since around 2000.

Limitations of conventional WMA

- Lower temperatures results in incomplete drying of the aggregates and the resulting trapped water in the coated aggregates may cause moisture damage.
- Finding the right balance between lowering the production temperatures, applying anti-stripping agents and achieving a sufficiently moisture resistant asphalt mixture might be a challenge when using WMA

ORGANOSILANE ‘WARM COMPACTION’ TECHNOLOGY

- The new Organosilane technology **improves coating efficiency**, leading to faster and complete coating of even the fines. This is because the Organosilane chemistry reduces the surface tension of bitumen for faster and better wetting.

- The workability of the Organosilane mixes is also observed to be better and the compaction easier.

- The low temperature mixing, low temperature compaction and the other benefits mentioned above are verified by laboratory studies.

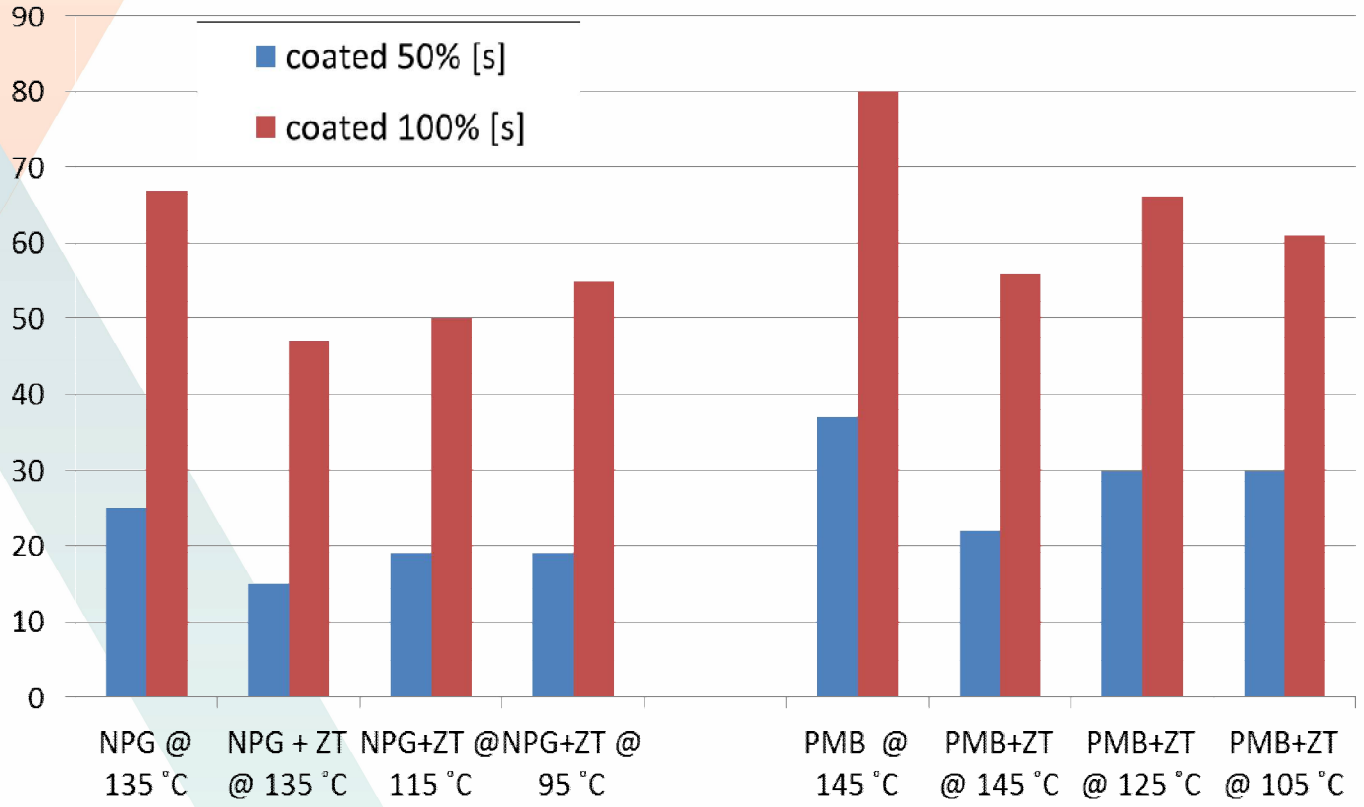
CASE STUDY - TRANSFER CENTRE FOR THE ROAD SECTOR (TSW),

BRAUNSCHWEIG UNIVERSITY, GERMANY

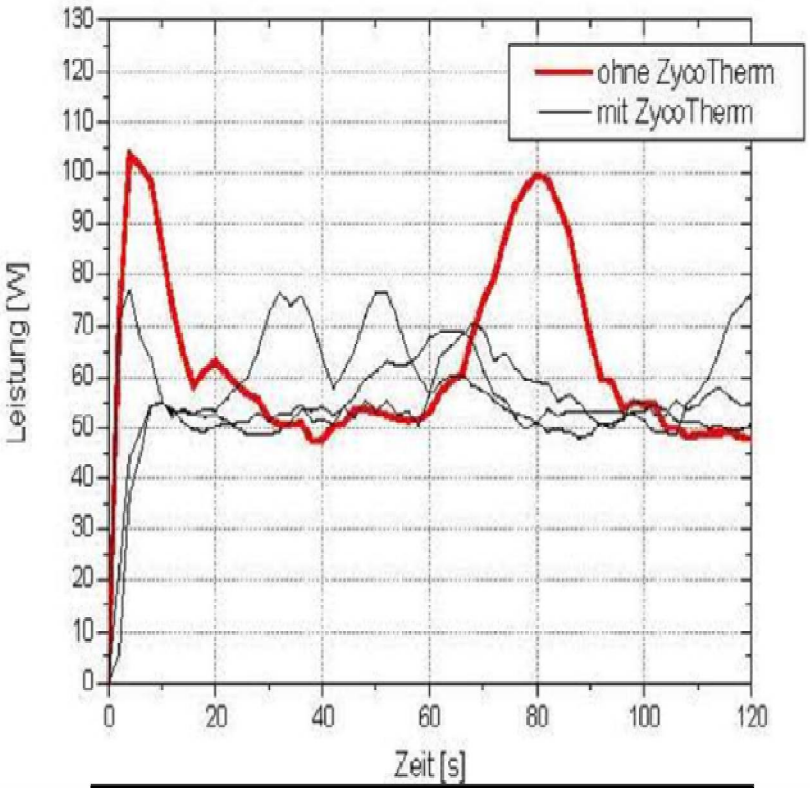
Compositions of the type of asphalt applied

Asphalt		AC 16 B S	AC 11 D S
Bitumen		50/70	25/55-55 A
Bindemittelgehalt	M.-%	4,3	6,0
Anteil ZycoTherm®, bezogen auf den Bindemittelgehalt	M.-%	0,10	0,15
Gesteine		Gabbro	Gabbro
> 16,0 mm	M.-%	2,8	-
11,2 - 16,0 mm	M.-%	28,5	0,5
8,0 - 11,2 mm	M.-%	12,1	20,2
5,6 - 8,0 mm	M.-%	12,8	10,8
2,0 - 5,6 mm	M.-%	15,2	23,3
0,063 - 2,0 mm	M.-%	22,0	37,6
< 0,063 mm	M.-%	6,6	7,6

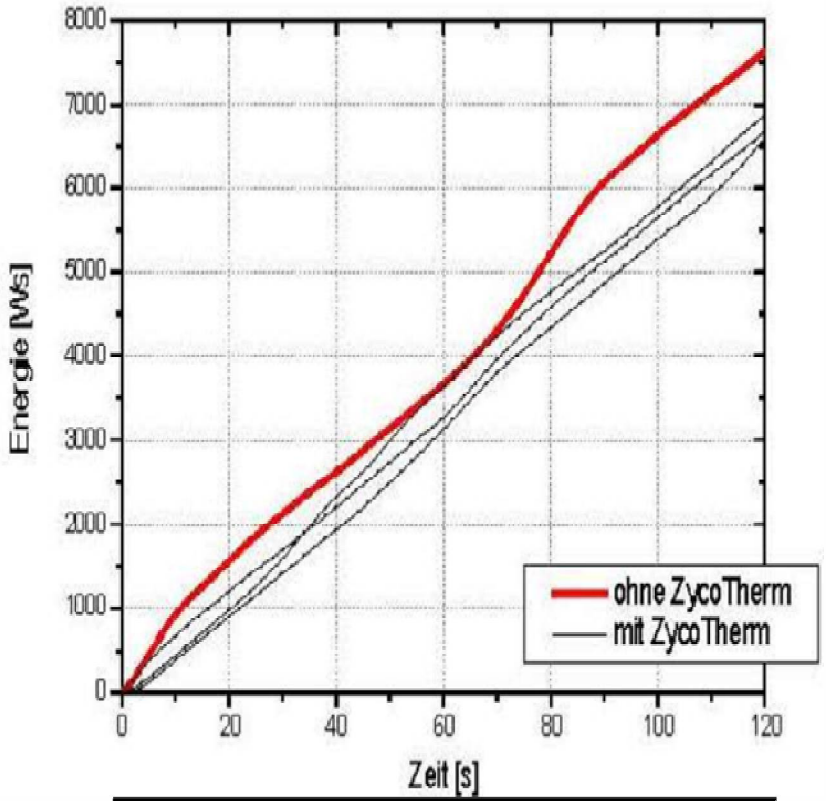
Coating Efficiency with ZycoTherm at different mixing temperatures



Effect of ZycoTherm on Power / Energy Consumption while mixing



During Mixing



Accumulated over time

AC 16 BS 50/70

Overview for producing the asphalt variants

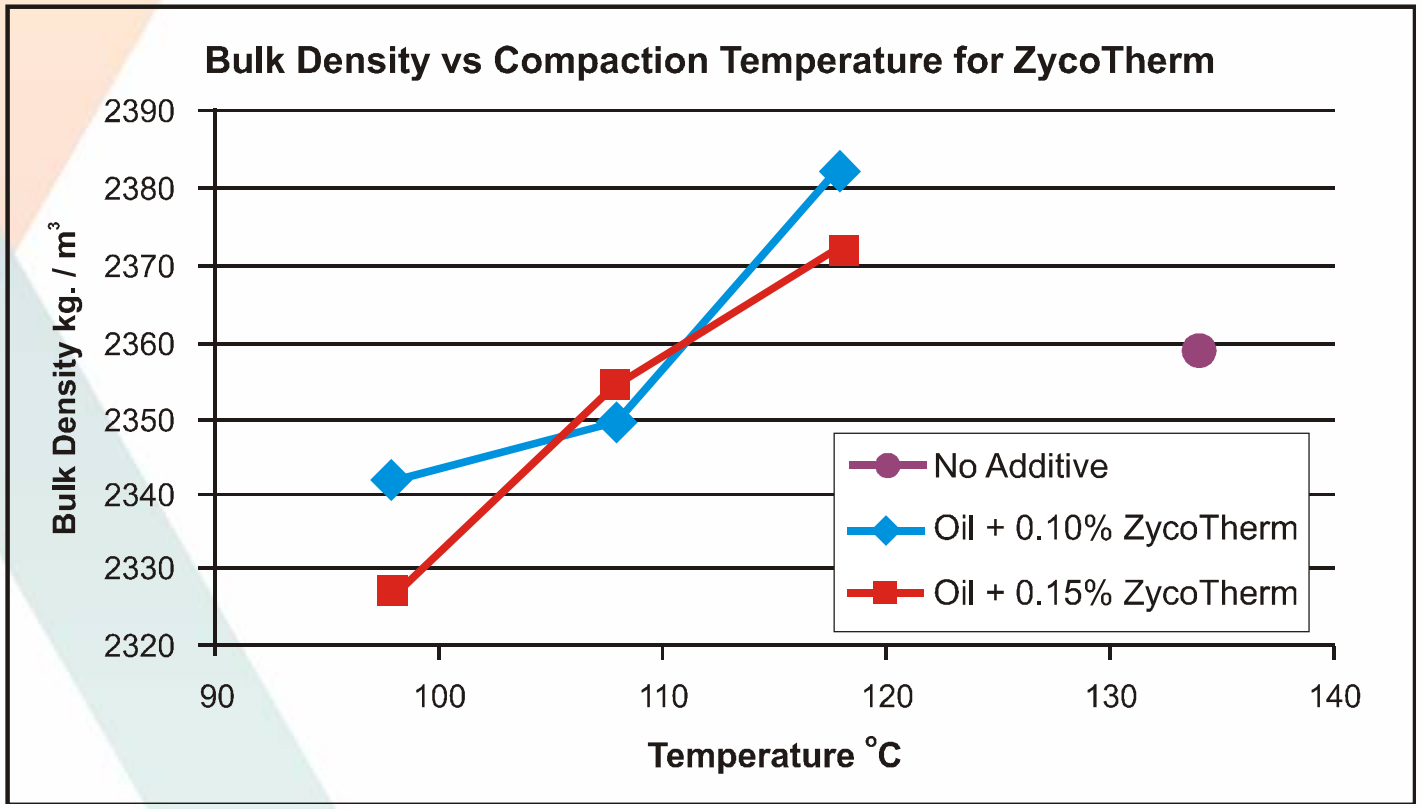
Variant	Mix type	Binder type	Addition of ZycoTherm®	Compaction Temp.	50% Coating achieved	Compaction resistance	Void content
-	-	-	-	°C	s	21 Nm	Vol.-%
1a	AC 16 B S	50/70	No	135	25 s	41.6	7.0
1b			Yes	135	15 s	43.5	7.1
1c			Yes	115	19 s	42.8	7.2
1d			Yes	95	19 s	41.3	6.9
2a	AC 11 D S	25/55-55 A	No	145	37 s	37.3	4.3
2b			Yes	145	22 s	34.2	4.6
2c			Yes	125	30 s	36.5	5.0
2d			Yes	105	30 s	36.5	5.3

CONCLUSION BY BRAUNSCHWEIG UNIVERSITY

- The compression resistance does not show any difference for both asphalt types when adding ZycoTherm®
- The raw density of the asphalt mixture produced can be considered as equal for both types of asphalt.
- The densities by volume of the roller compressed asphalt test plates only indicate small differences.

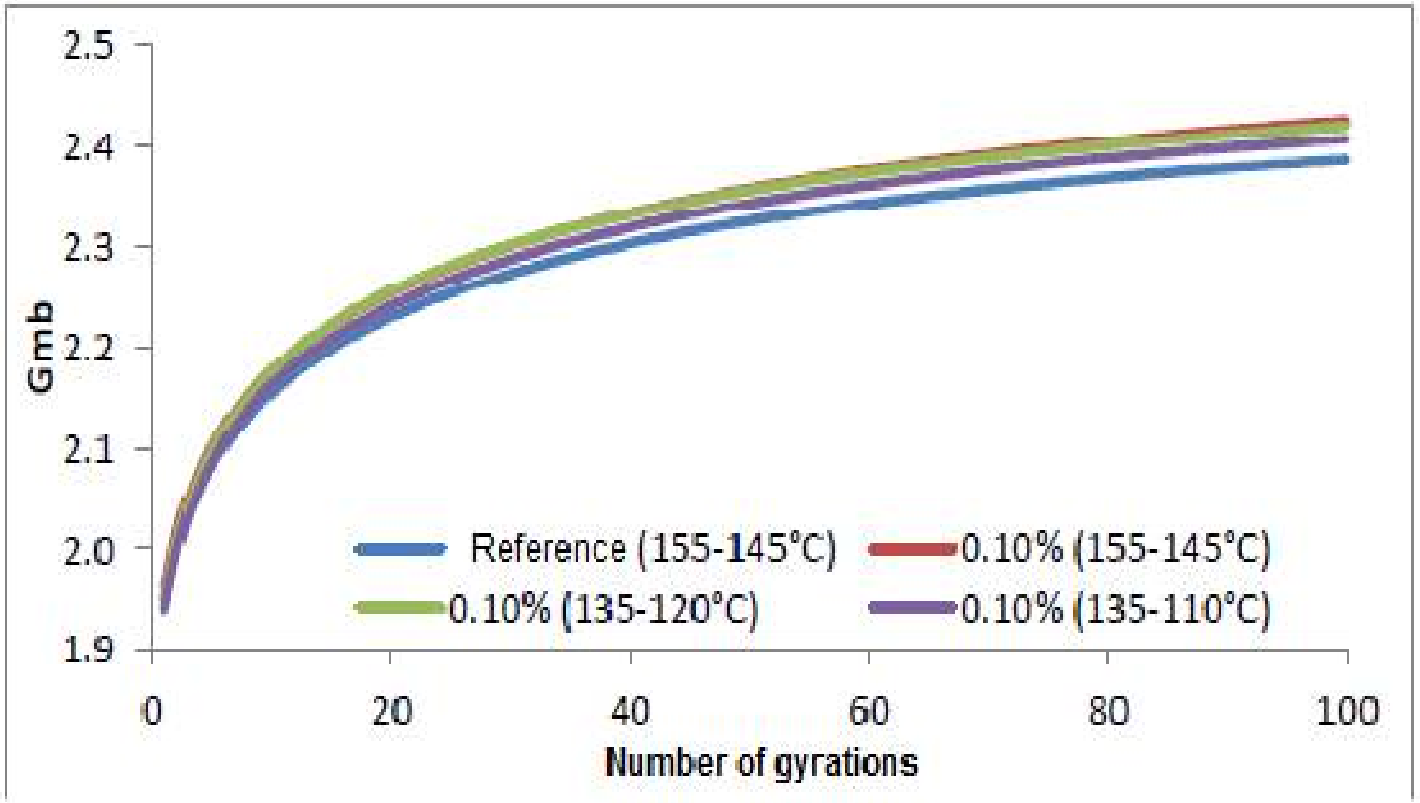
LOWER TEMPERATURE, COMPACTION & FATIGUE RESISTANCE

COMPACTION AT LOWER TEMPERATURE



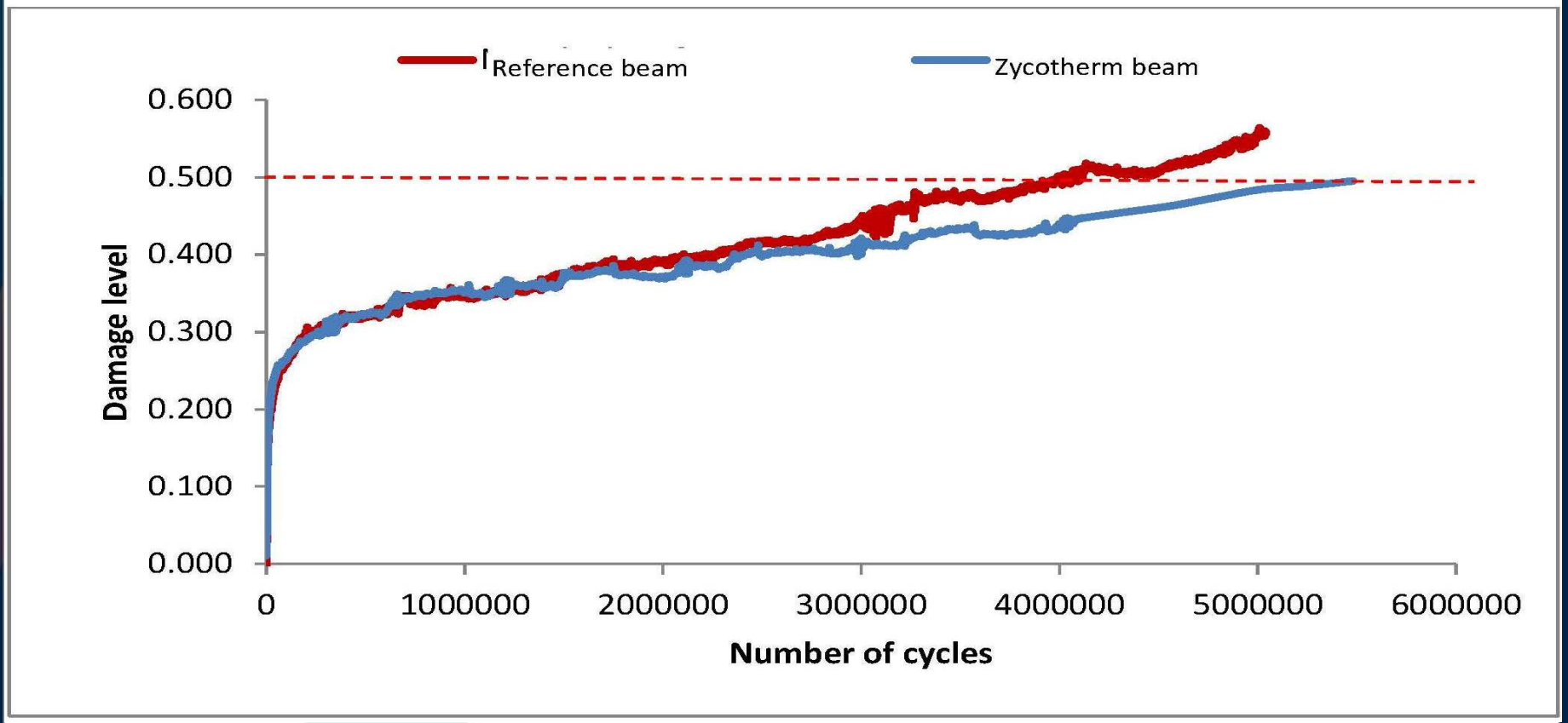
Compaction temperatures for unmodified PG 58-22 in the range of 131-136 ^{0}C in Nova Scotia, AMEC Americas Ltd

ZYCOTHERM & LOW TEMP COMPACTION



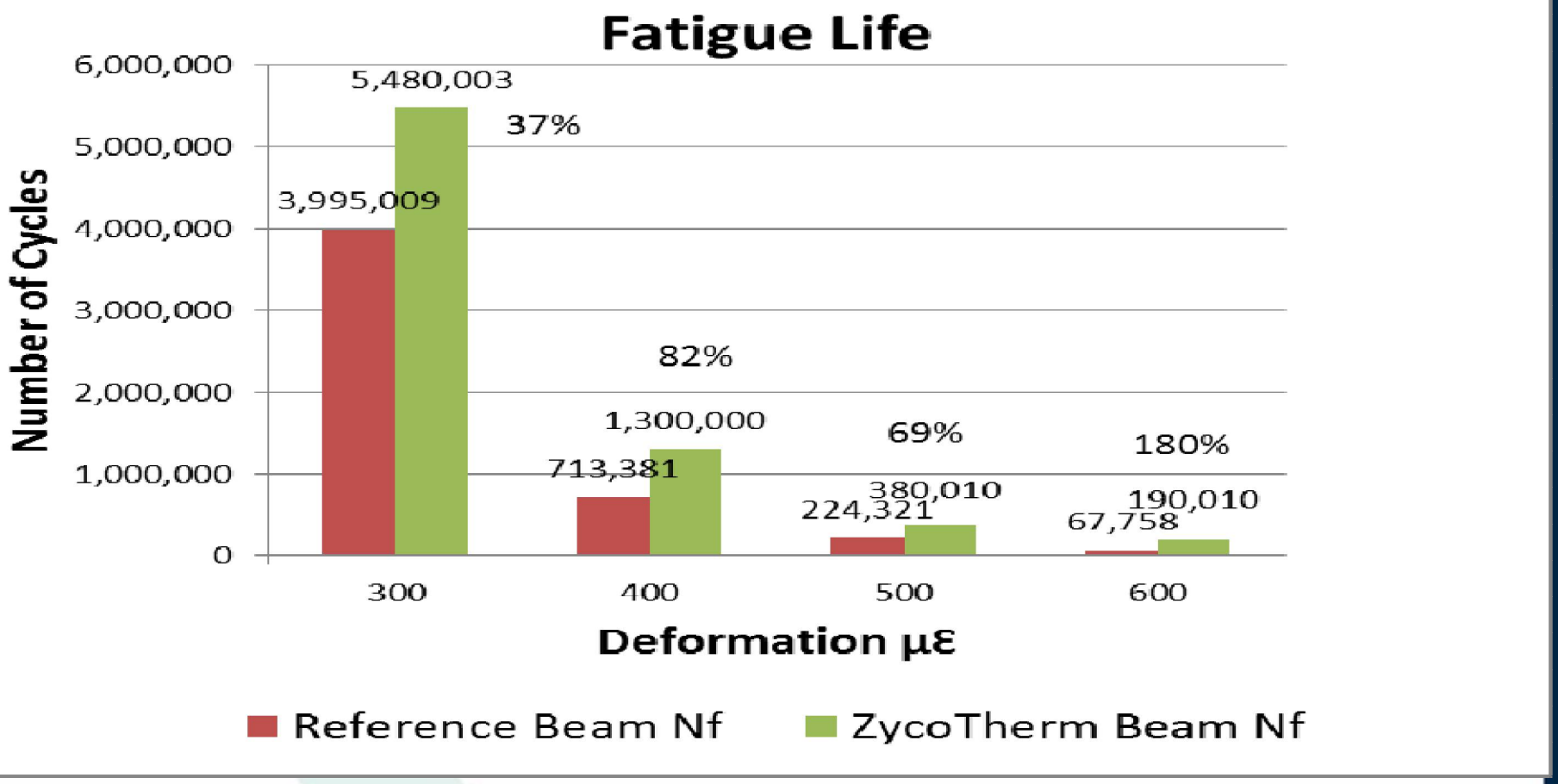
- With ZT a greater compaction can be achieved for the same and lower temperatures than the reference mix
- Fuel savings during the mixing process and less carbon footprint benefits can be obtained as well.

FLEXURAL FATIGUE TEST AASHTO T321-07



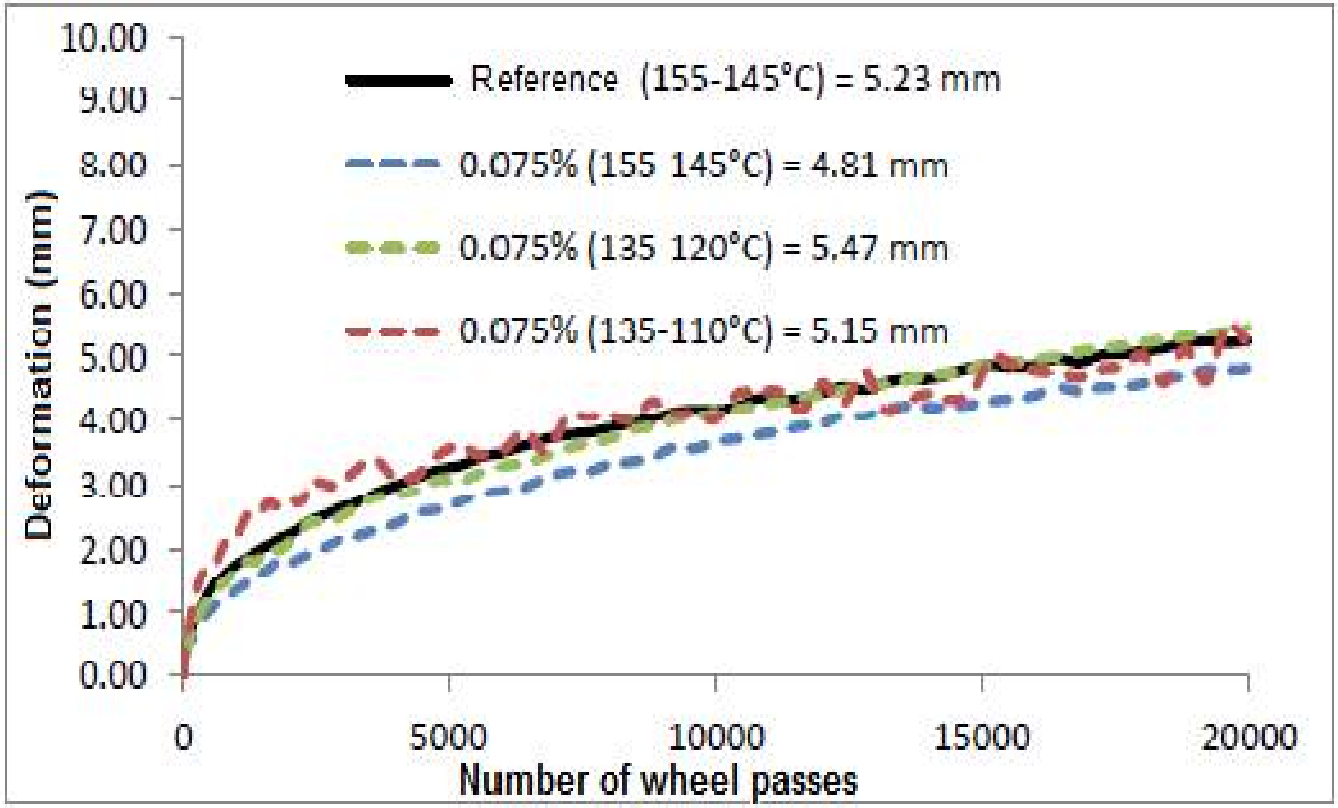
Damage level evolution for beams tested with 300 μ□

FLEXURAL FATIGUE TEST



Higher Number of Cycles means Higher Fatigue Life

ZYCOTHERM & RUT RESISTANCE

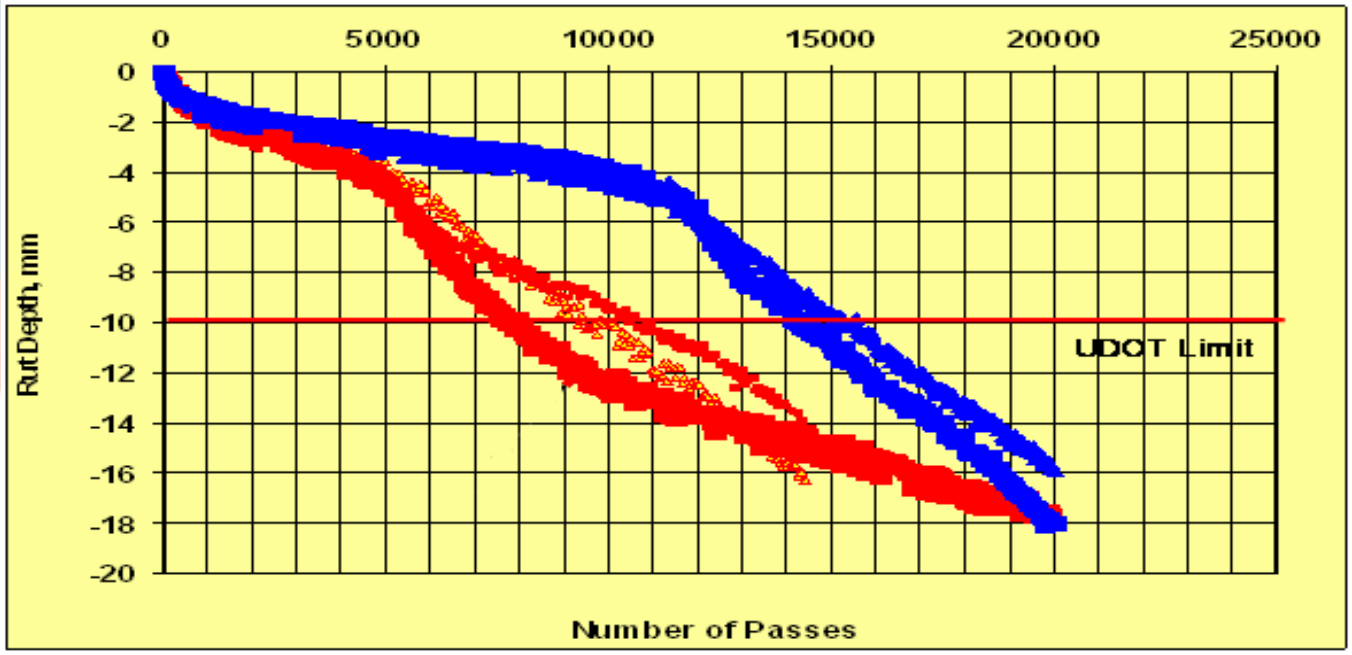


- Deformation maintained with acceptable tolerance, for similar temperatures as the reference mix, according to AMAAC specifications
- Lowering mixing temp. and compaction temp. does not affect rutting behavior.

ZYCOTHERM & RUT RESISTANCE

MOISTURE SUSCEPTIBILITY – WET WHEEL TEST AASHTO T324

Moisture sensitive Dolomite Aggregate
Keystone Quarry under wet condition at 50 ^{o}C



Measure	Control	ZycoTherm modified
SIP	4600	11000
Rut Depth 10 mm Utah DOT	9300	14300

Dongre Laboratory Services Inc.

Thank You