

Innovative rubber-bitumen, EU (or rubber-asphalt, US) granulate for silent road pavements

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ISAP WG6 By-products and Secondary Materials Recycling in Asphalt Pavements

ISAP WG6 (or 4) By-products and Secondary Materials Recycling in Asphalt Pavements

- ❑ The objective of the WG6 is the promotion of use of alternative materials (industrial by-products and secondary materials) in road asphalt pavements constructions
- ❑ Disposal of industrial by-product or secondary materials is becoming one of the most important topics worldwide
- ❑ One of the option is their application in road construction
- ❑ It may reduce the consumption of natural aggregates, and, on the other hand, saving the landfill areas



Tyre Rubber

- ❑ Some 900 millions of tyres are produced in the world per year
- ❑ 90% of tyres are used by cement industry (cement production ovens)
- ❑ Growing interest in application in road industry

Methods of rubber modification of asphalt

- McDonald's wet method
- Terminal wet method
- Dry method

Wet method

- ❑ ASTM: “A blend of asphalt cement, reclaimed tire rubber, and certain additives in which the rubber component is at least 15 percent by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles.”
- ❑ Asphalt blended with rubber granulate in a special installation at 190-225°C in 45 minutes at least
- ❑ Chemical and physical bonding of components
- ❑ The rubber modifier typically ranges from 18 to 22 percent by weight of the asphalt
- ❑ Extender oils are sometimes used to reduce viscosity and promote workability of the Asphalt Rubber as well as to increase the compatibility between the asphalt and crumb rubber
- ❑ „Maturing” of rubber–bitumen in 2 h at high temperature is recommended



Dry method

- Crumb rubber is added to the aggregate in a hot mix plant operation prior to adding the asphalt
- Relatively little reaction between the asphalt and crumb rubber in the dry process
- Crumb rubber replaces a portion of the aggregate
- Application in Poland – the specific crumb rubber modified asphalt mixture („GUF1”) with crumb rubber and polymeric fibers from tires
- Crumb rubber (2-5 mm) content up to 3% m/m
- Use of more crumb rubber used at lower cost than in wet method
- Low modification of physic-mechanic properties
- Effect of relative small reduction of road noise



New product and asphalt mixture rubber modification method

- ❑ The new European product - “tecRoad”
- ❑ Developed in Switzerland
- ❑ Rubber-asphalt granulate of high concentration of rubber at up to 40% m/m chemically and physically integrated to asphalt
- ❑ Constant granulate of dimension up to 30 mm, usually about 1 mm
- ❑ Composition of mainly road asphalt Pen 50/70 or 70/100 and crumb rubber, and fillers, and oils
- ❑ Softening Point range: 40 - 90°C



New product and asphalt mixture rubber modification method

- Shipped in portion bags or big bags
- tecRoad granulate can be stored for months without quality loss
- Granulate is directly added to the mixer of the asphalt mixing plant
- Mixing to the additional asphalt
- Asphalt mixture maturing not needed (rubber diluted in asphalt in the granulate, easy mixing with additional asphalt)
- Easier handling
- Reduction in costs



tecRoad applications

- Switzerland, Germany, Austria
- Other European countries (Belarus, Serbia), lately
- Year 2010 – first application in Poland
 - Three test sections – wearing course: Porous Asphalt, SMA and BBTM (French mixture for thin layer)

tecRoad applications

- Mainly in wearing courses
- Primary task – reduction of road noise
- Experience in numerous countries – effectiveness of rubber modification for noise reduction
- Noise reduction results:
 - Porous Asphalt: 5-8 dB(A)
 - Two layers Porous Asphalt system: 10-12 dB(A)
 - SMA or BBTM: 2-6 dB(A)

**Addition of tecRoad to
mixer
(May be added through
pneumatic installation)**



Switzerland, A1
motorway, Zurich –
Berno, 2006 - 2007



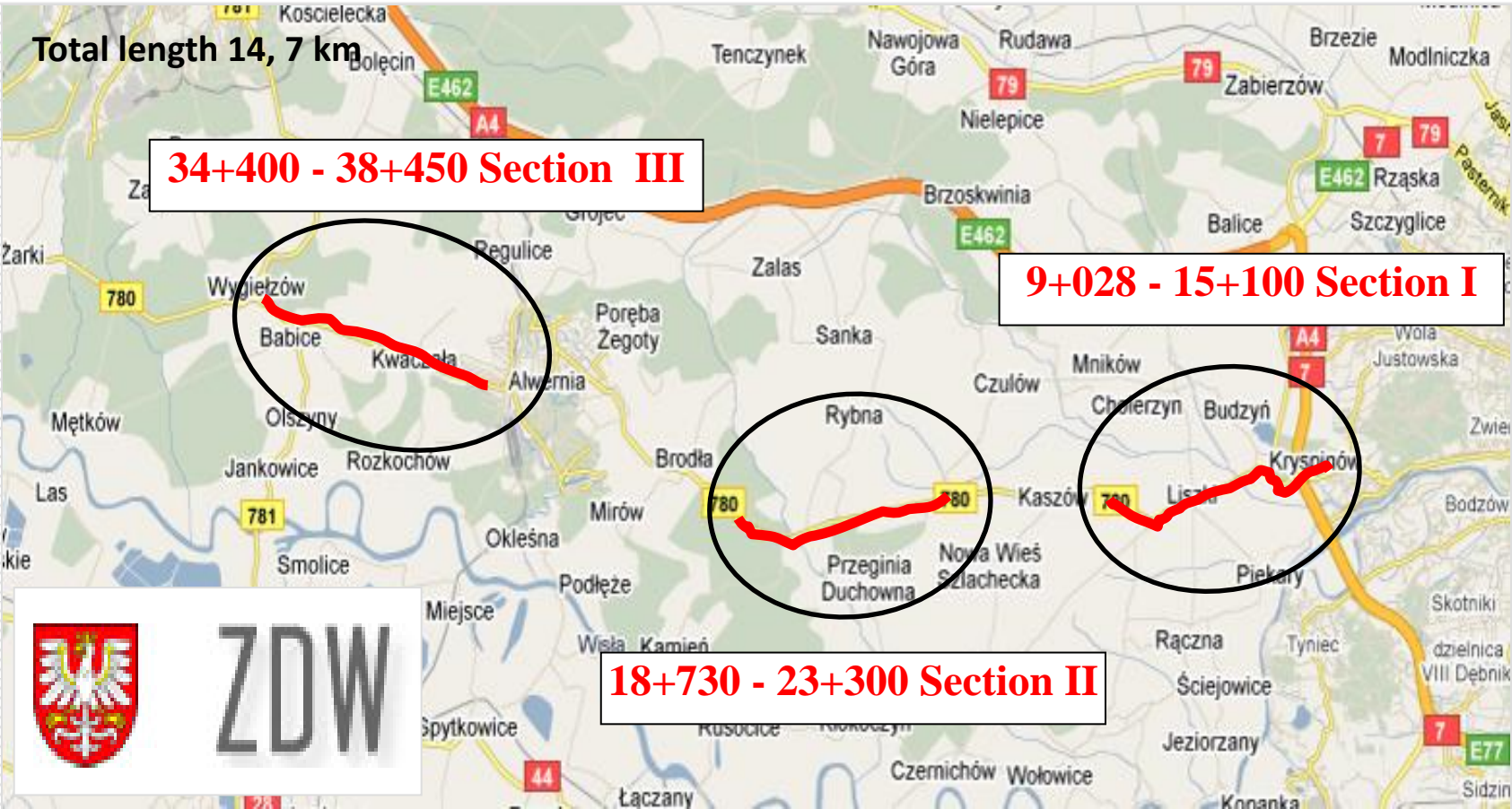
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First application in Poland, 2010



First application in Poland, 2010

- Porous Asphalt PA 8
 - Section length 554 m
 - Layer thickness 4,0 cm
 - Voids content $V_{\min} 18 - V_{\max} 24$
- BBTM 8
 - Section length odcinka 722 m
 - Layer thickness 3,0 cm
 - Voids content $V_{\min} 7 - V_{\max} 10$
- SMA 5
 - Section length 600 m
 - Layer thickness 2,5 cm
 - Voids content $V_{\min} 2 - V_{\max} 4$

tecRoad to mixer



Porous Asphalt



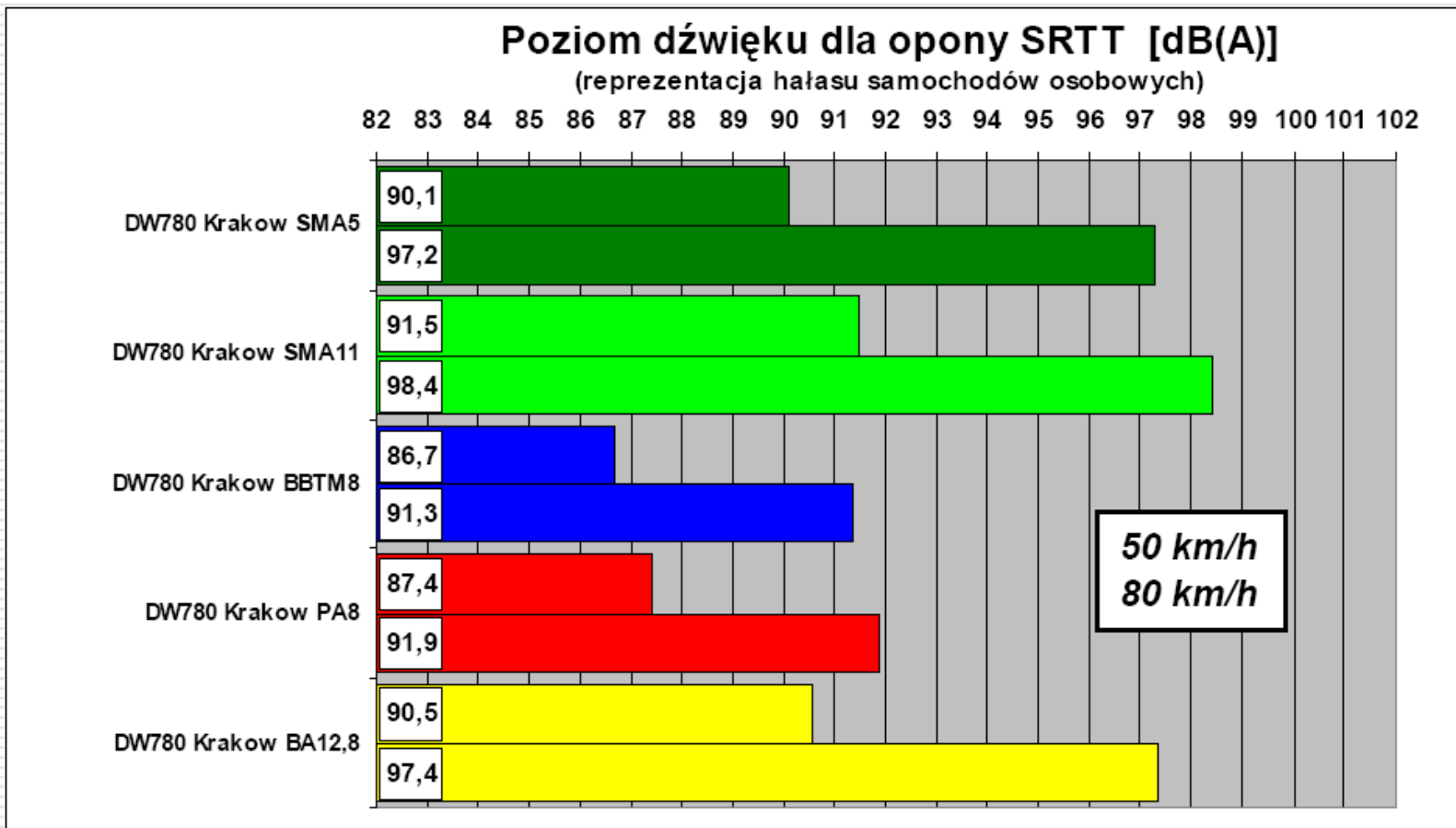
BBTM



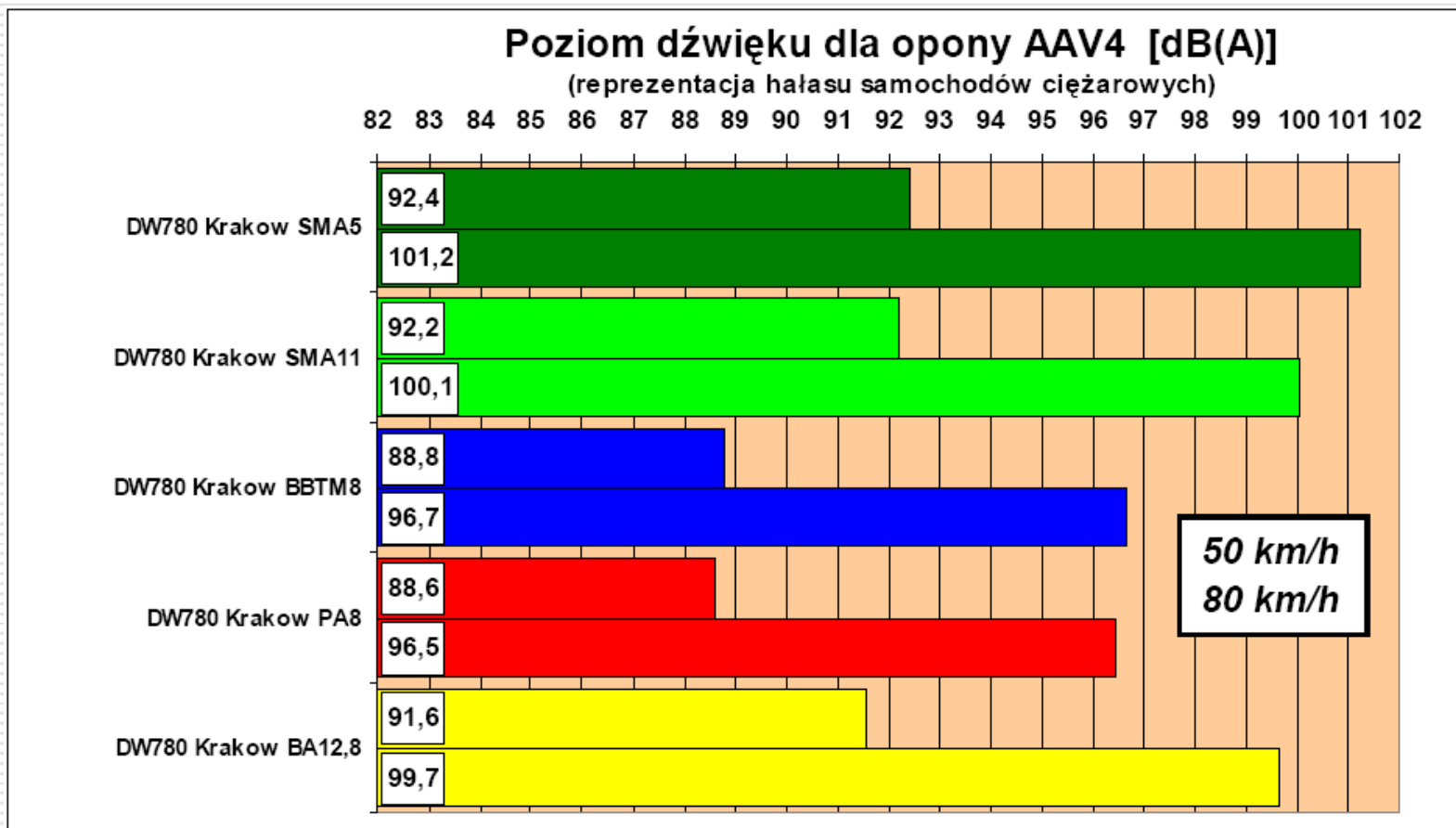
Noise measurement's results, CPX



Noise measurement's results, CPX, personal car tyre



Noise measurement's results, CPX, truck tyre



Warsaw, Poland, Górczewska Str., 2011





Warsaw, Poland, Górczewska Str.

- Wearing course
 - SMA 8 with tecRoad
- Noise reduction – 3 dB(A)

Laboratory tests at IBDiM (Road&Bridge Research Institute: Target

- Comparison of physical and mechanical properties of asphalt mixtures with application of rubber-asphalt granulate tecRoad and reference asphalt mixtures with PMB (SBS asphalt modifier)

Laboratory tests at IBDiM: Materials

□ Asphalt mixtures:

- SMA 11 for wearing course
- Asphalt concrete AC 16 P for base course

□ Binders

- PMB, SBS modified: PMB 65/105-60
- Road asphalt: 70/100
- PMB, SBS modified: PMB 25/55-60
- Road asphalt: 50/70
- tecRoad, rubber-asphalt granulate

Binders' basic properties

Property	Binder			
	50/70	70/100	PmB 25/55-60	PmB 65/105-60
Penetration at 25°C, 0,1 mm	62	72	33	54
Softening Point R&B, °C	49,0	46,4	71,4	68,2
Fraas Breaking Point, °C	-16	-18	-23	-23

Właściwość	Lepiszczce		
	50/70+ tecRoad	50/70 + tecRoad After heating at 180°C in 1,5 h	70/100 + tecRoad
Penetration at 25°C, 0,1 mm	31	30	38
Softening Point R&B, °C	66,8	68,0	62,4
Fraas Breaking Point, °C	-12	-12	-11

IBDiM Testing: Materials

Aggregates

- Limestone filler
- Basalt 2/5, 5/8, 8/11, 11/16 mm
- Granite 0/2 mm

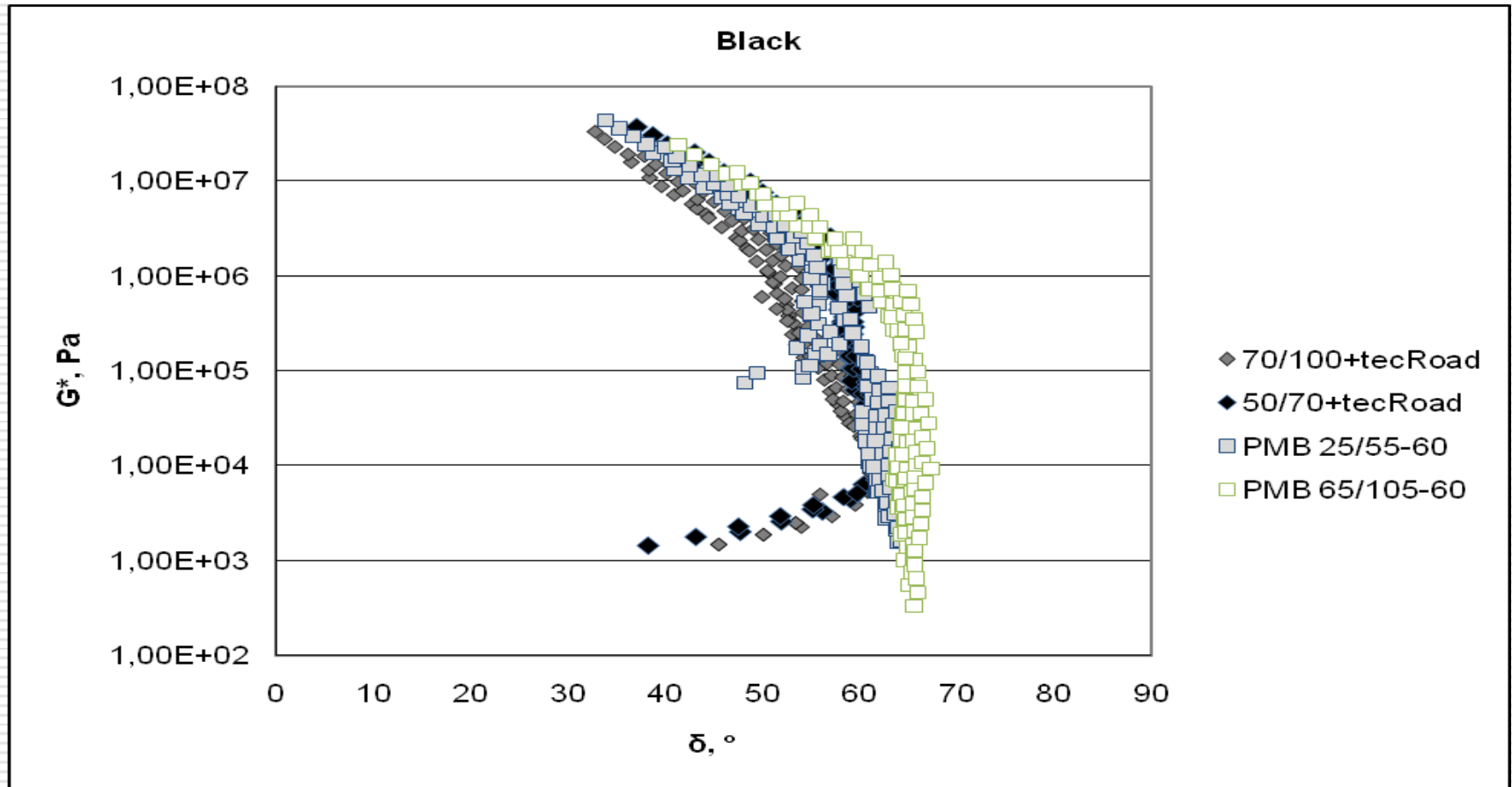
Asphalt mixtures

- SMA11 PMB 65/105-60
- SMA11 70/100+T (asphalt cement 70/100 + tecRoad)
- AC16 PMB 25/55-60
- AC16 50/70+T (asphalt cement 50/70 + tecRoad)

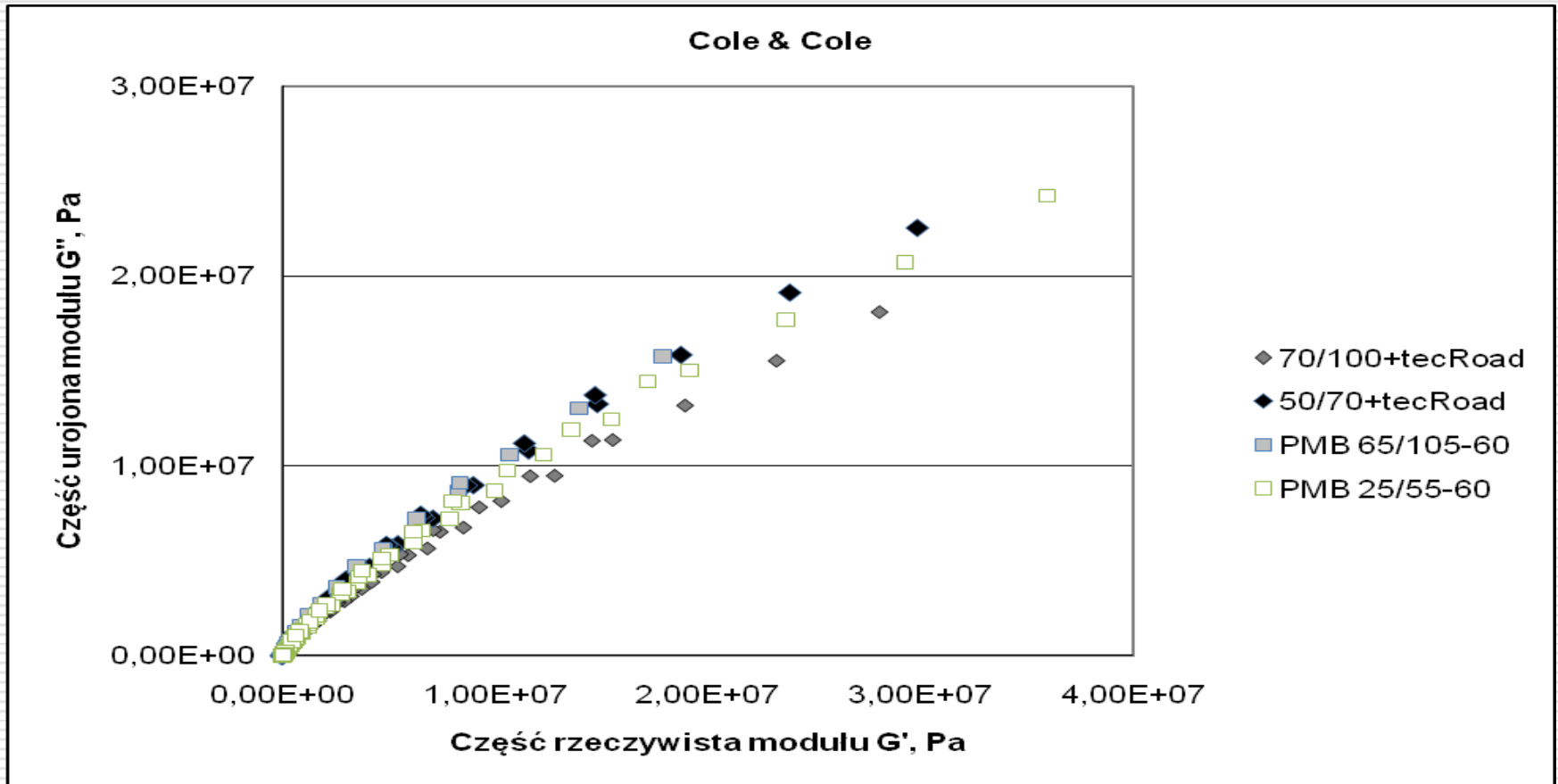
IBDiM Testing Program

- ❑ Resistance to permanent deformation, large apparatus, PN-EN 12697-22
- ❑ Fatigue, 4 Point Bending Beam, PN-EN 12697-24
- ❑ Stiffness Modulus & Phase Angle, wide spectrum of temperature and load frequency, PN-EN 12697-26
- ❑ Low Temperature Cracking TSRST (Thermal Stress Restrained Tensile Strength Test), AASHTO TP10-93
- ❑ Water Resistance, PN-EN 12697-12: Indirect Tensile Strength, PN-EN 12697-23, with Freezing Cycle

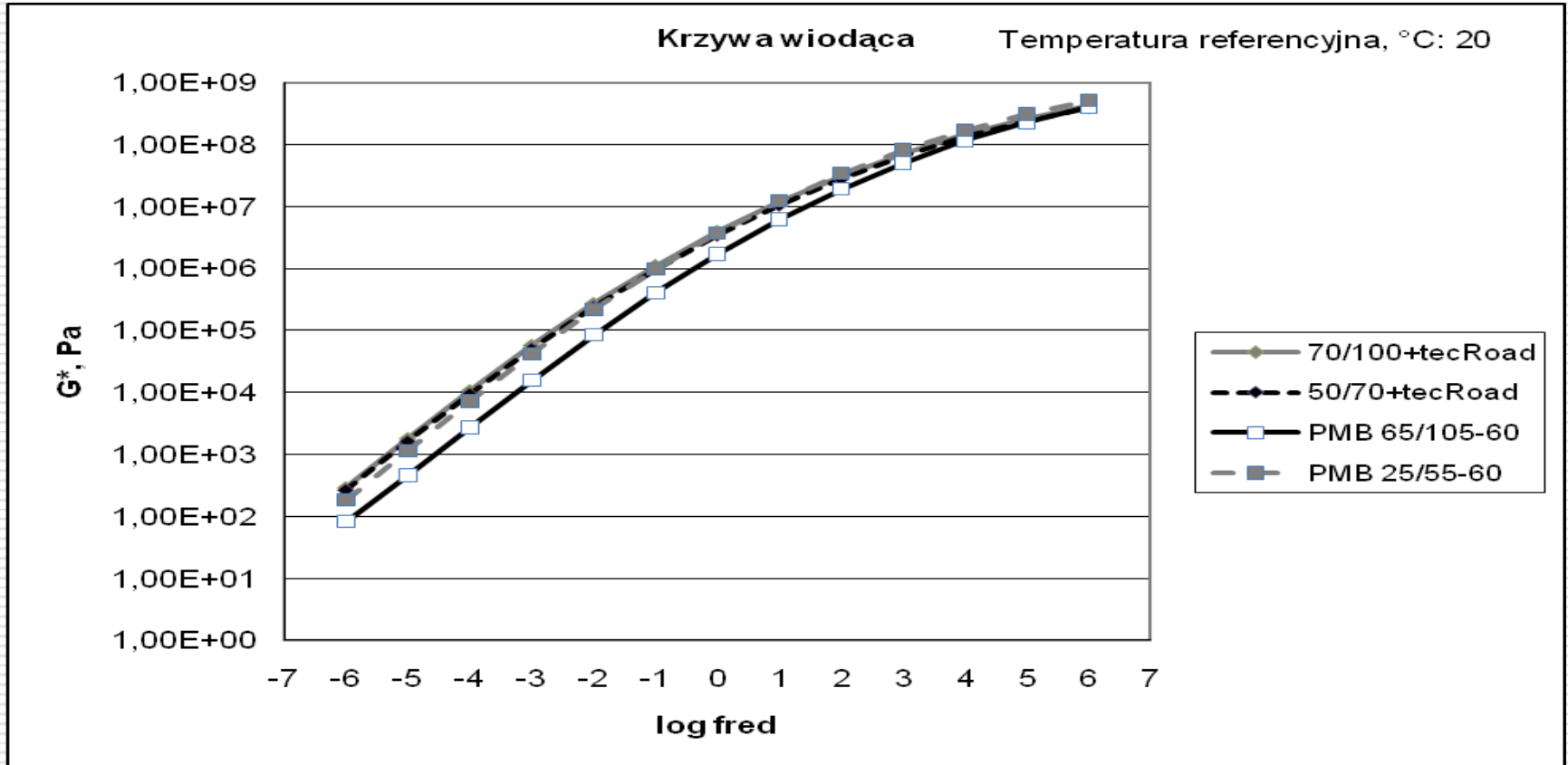
IBDiM Testing: Binders



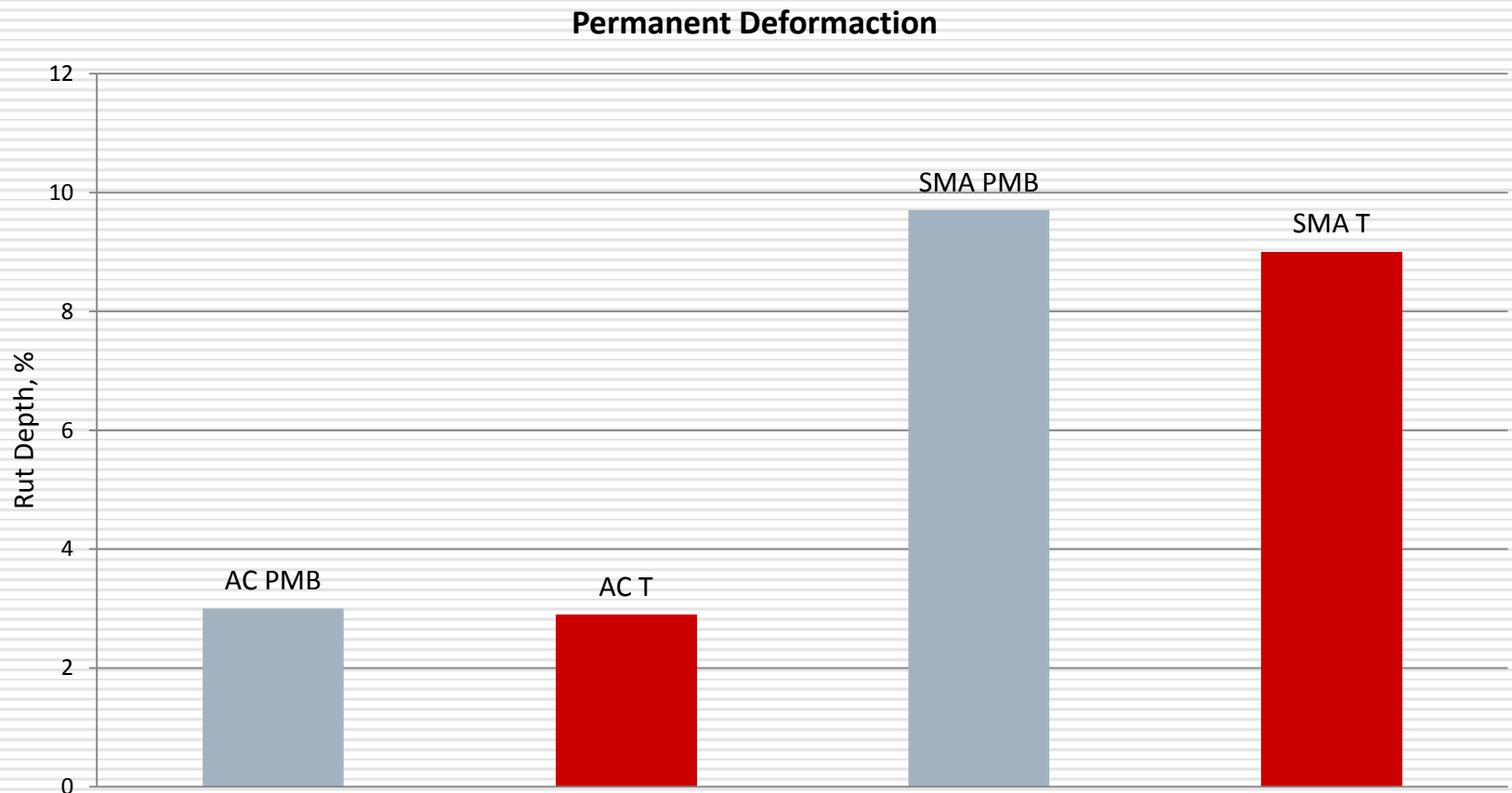
IBDiM Testing: Binders



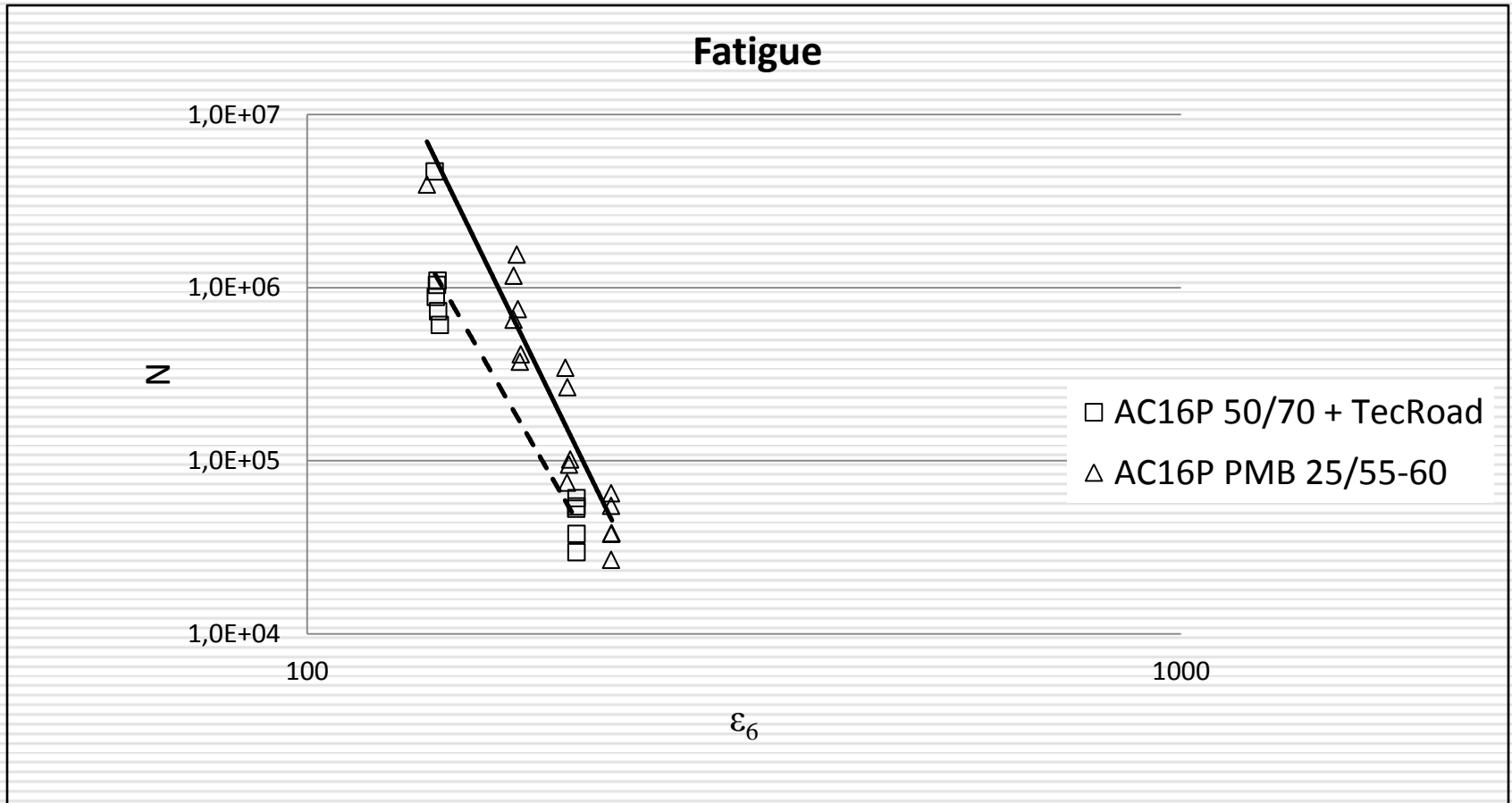
IBDiM Testing: Binders



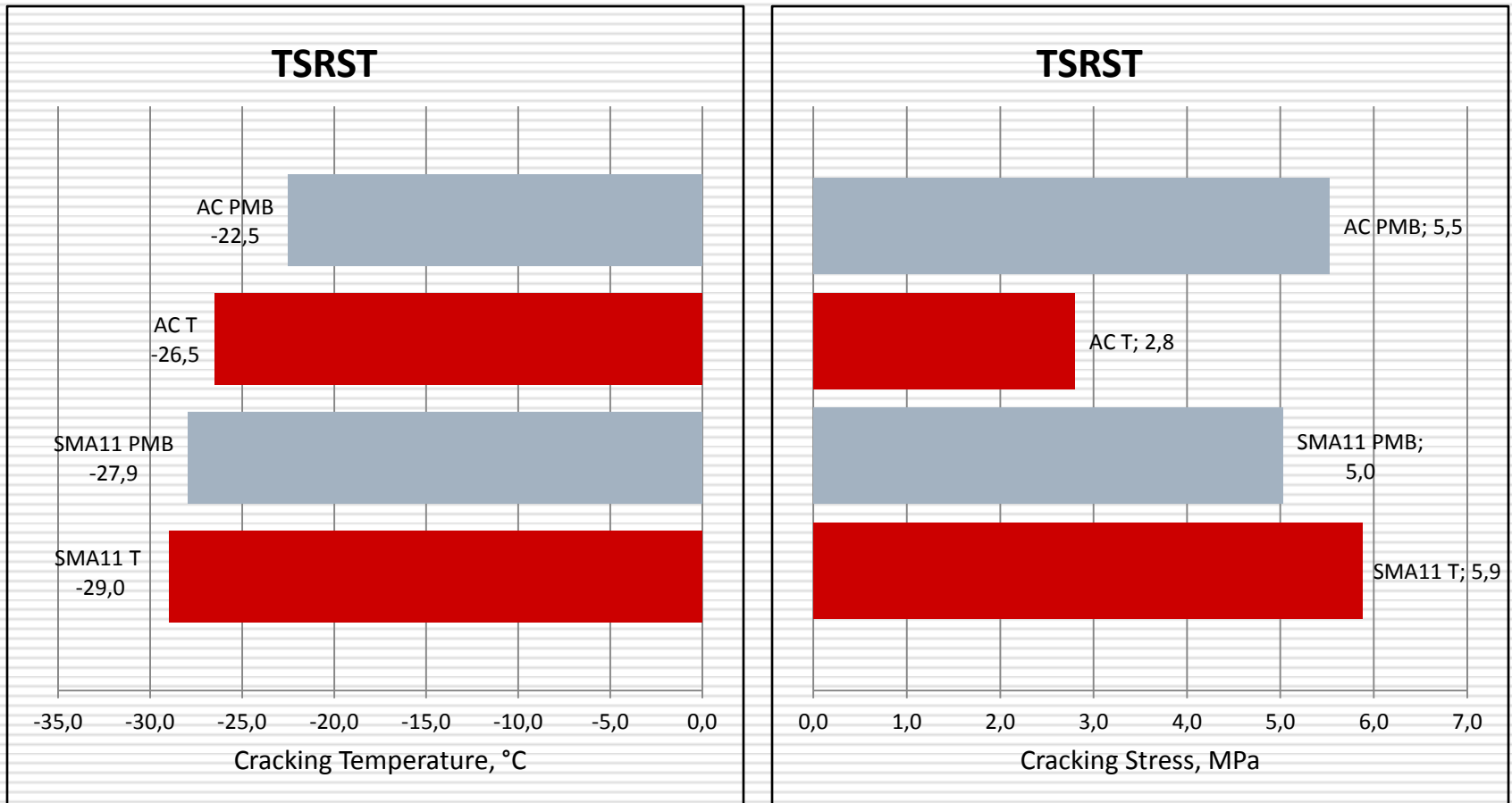
IBDiM Testing: Mixtures



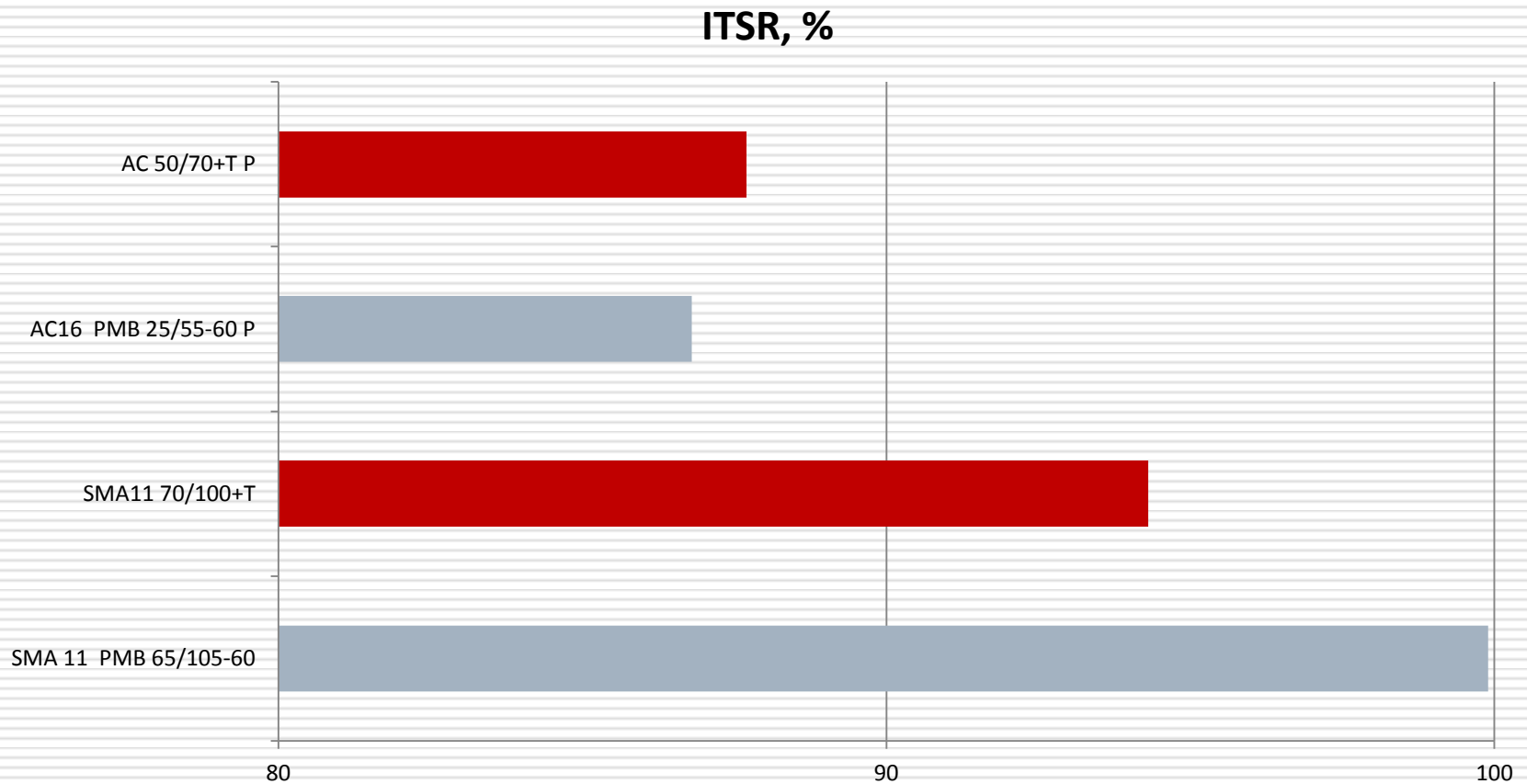
IBDiM Testing: Mixtures



IBDiM Testing: Mixtures

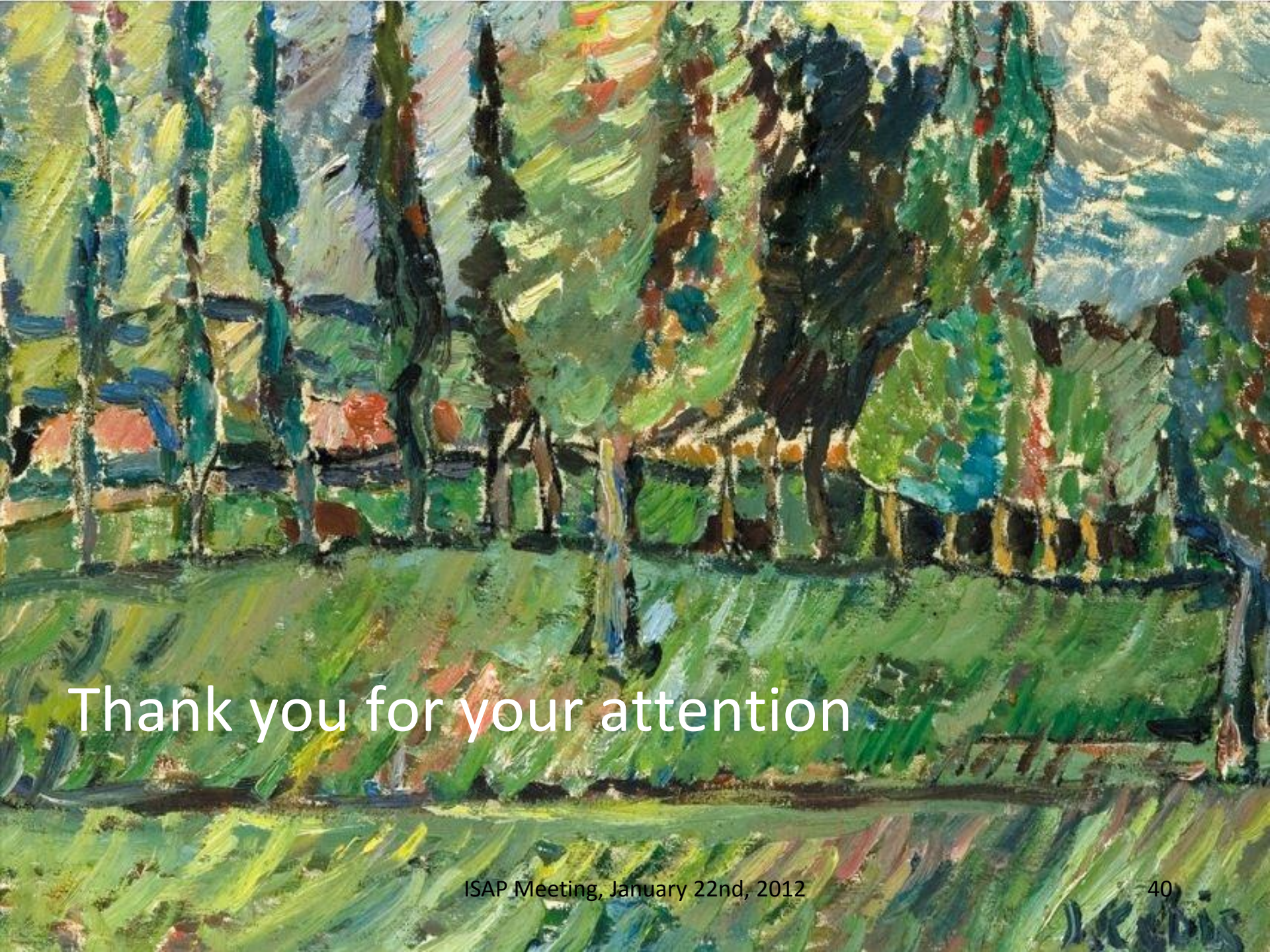


IBDiM Testing: Mixtures



IBDiM Testing: Results

- Performance testing of asphalt mixtures with rubber-asphalt granulate tecRoad – Asphalt Concrete and SMA proved efficiency of the modification method:
 - Improvement of rutting resistance at high temperature
 - Improvement of rheological properties (complex modulus and phase angle)
 - Higher resistance to low temperature cracking
 - Resistance to water
- Lower fatigue resistance in comparison to SBS modified asphalt mixture may be attributed to relatively low addition of rubber in binder (10% m/m)
- Experience in US indicate use of higher amount of rubber up to 20% m/m in total binder



Thank you for your attention