



TOTAL



STYRELIF® from TOTAL:
the unbreakable binder.

An exceptional bitumen, in constant evolution since it is the result of a collaboration set up 25 years ago with the French Laboratoire Central des Ponts et Chaussées (LCPC) and it continues to undergo development to meet today's changing demands (process products, applications). Its qualities have made it a specialty binder for roads with difficult characteristics ranging from Mount Evans (Colorado) at an altitude of 4,359 metres to the Formula 1 race track in Monaco.
www.bitume.total.com

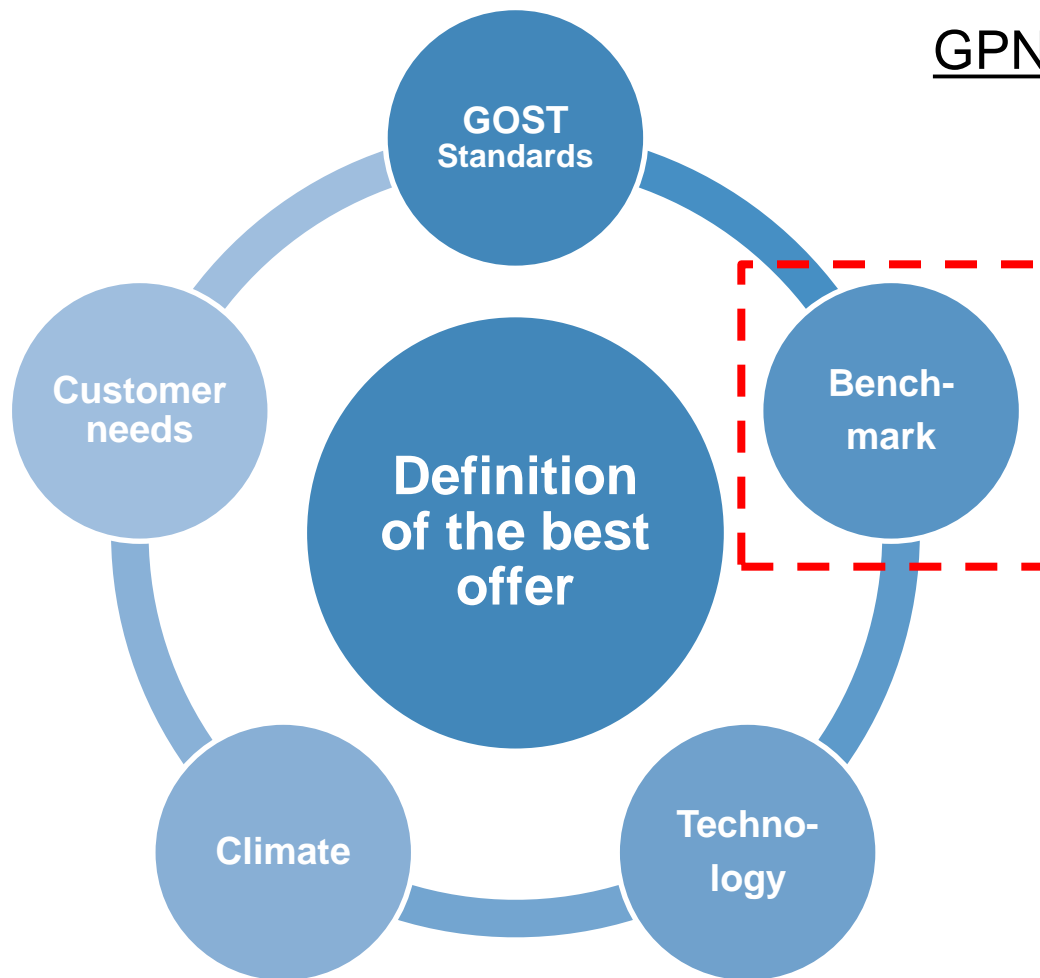


PmB: what relevant properties for Russian Market?

GPN Bitumen Day - St Petersburg
11 April 2014



MARKETING APPROACH



GPN TOTAL G-WAY STYRELF range

Grade	PmB 60	PmB 90
Class Premium	Premium	Premium
Class Regular	Regular	Regular

4 G-WAY STYRELF have been designed to be fully in compliance with GOST (term of reference applied to Total Research Center)

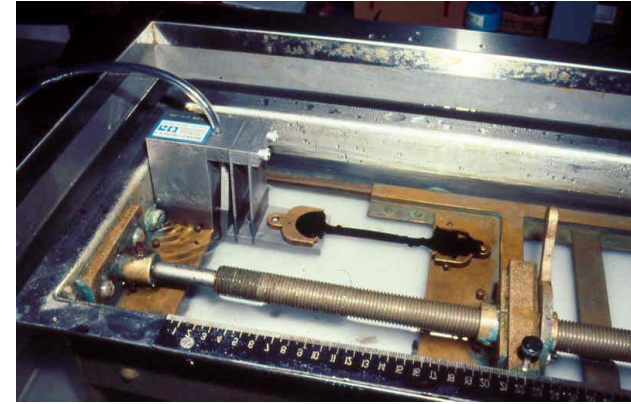
PMB RUSSIAN MARKET: BENCHMARK TECHNICAL STUDY

Technical contents:

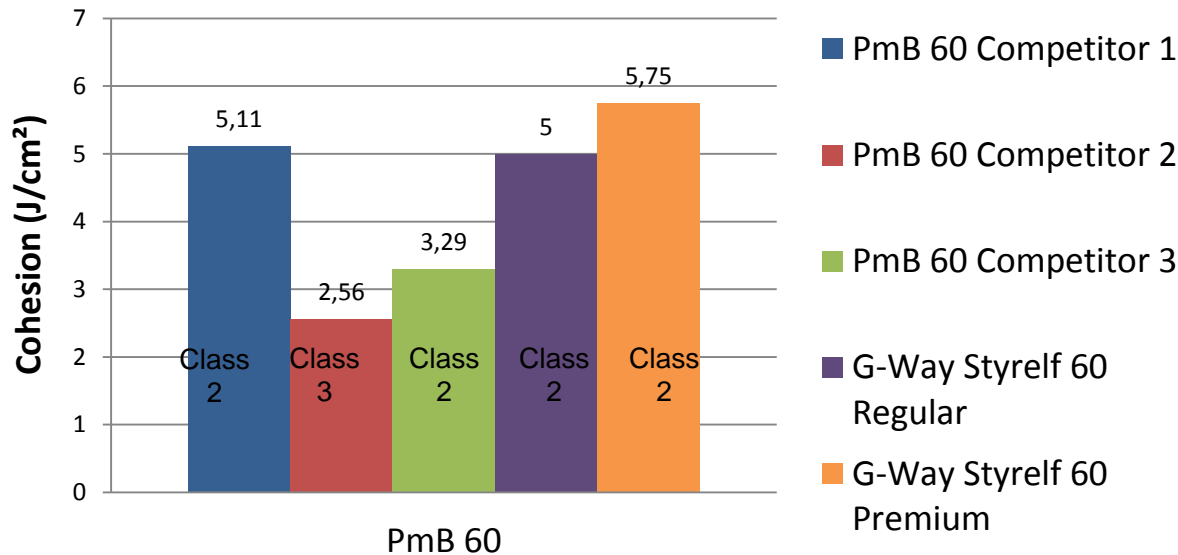
- 8 PmB
 - 4 PmB from Russian producers
 - 4 G-WAY STYRELF
- 3 standards
 - EN 14023 PmB standard
 - US Superpave Standard
 - R 52056-2003 PmB GOST standard
- 2 laboratories
 - Total Research Centre in Solaize
 - German laboratory certified for GOST R52056-2003
- >120 analyses performed

PMB 60 EN 14023

EN 14023 – FORCE DUCTILITY (@ 5°C)



Comparison of the cohesion of the different PmB 60

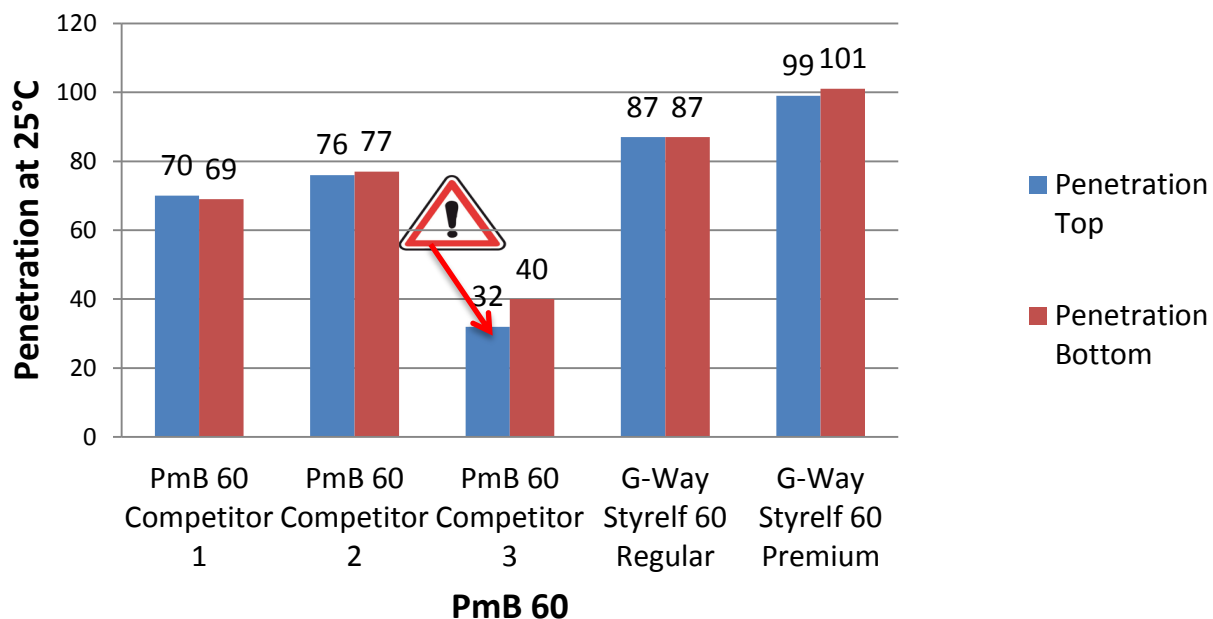


- Force-Ductility test at 5°C (50 mm/min) – EN 13589
- Energy required to deform the sample to 1333%
- Measure the force required to reach 1333% of deformation by stretching out the bitumen to 50 mm every minute (in J/cm²)

- **G-Way Styrelf 60 Premium: is the best product by far**

EN 14023 – VARIATION OF THE PENETRATION @ 25°C (STORAGE STABILITY)

Variation of the Penetration at 25°C during the storage

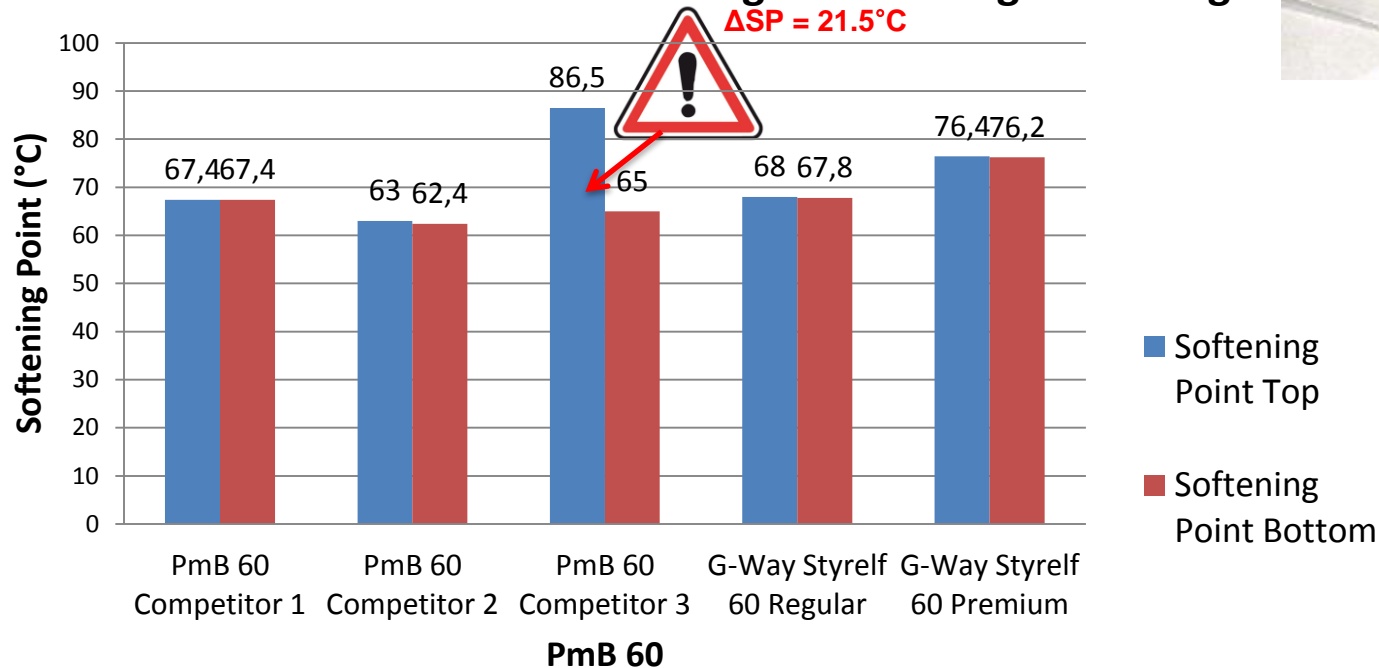


! PmB 60 Competitor 3: big drop of Pen during storage = not stable
Stability is achieved through TOTAL technology used in G-Way STYRELF

EN 14023 – VARIATION OF THE SOFTENING POINT (STORAGE STABILITY)



Variation of the Softening Point during the storage



- PmB 60 Competitor 3: not stable during storage

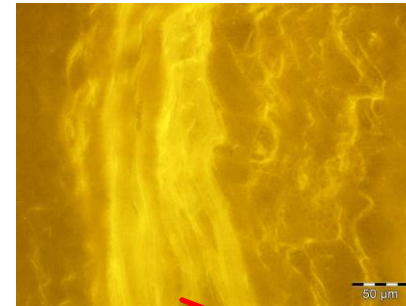
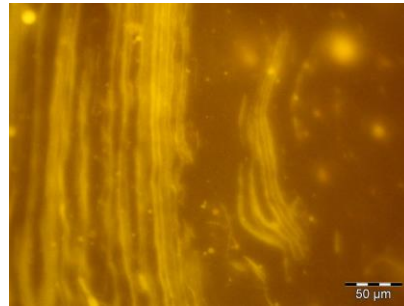
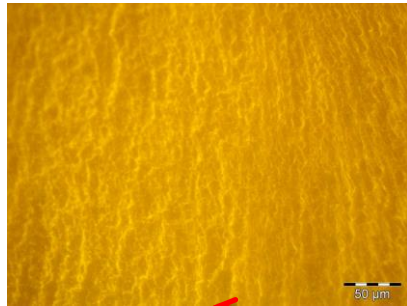
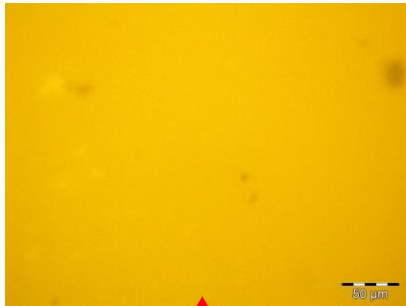
FURTHER CHARACTERIZATION – MICROSCOPY UV FLUORESCENCE (SCALE: 50 MICRONS)

PmB 60 Competitor 1

PmB 60 Competitor 2

PmB 60 Competitor 3

PmB 90 Competitor 3



Homogeneous structure

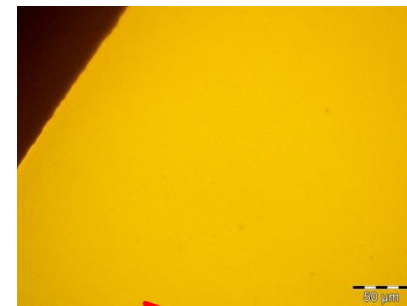
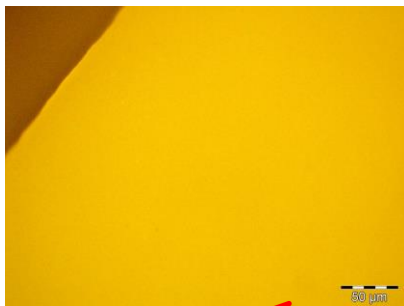
Heterogenous structure

PmB60 premium

PmB60 regular

PmB90 premium

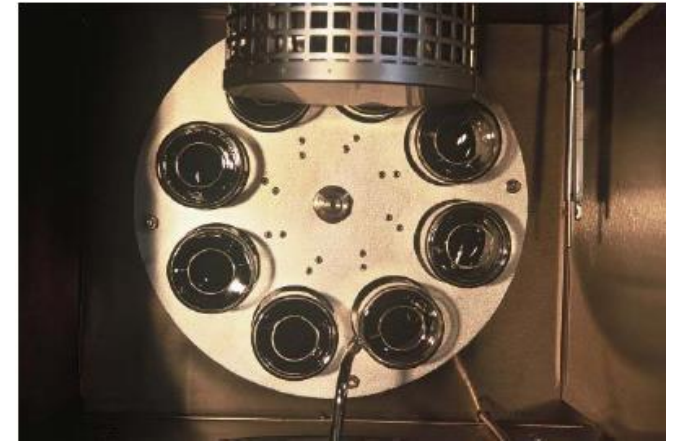
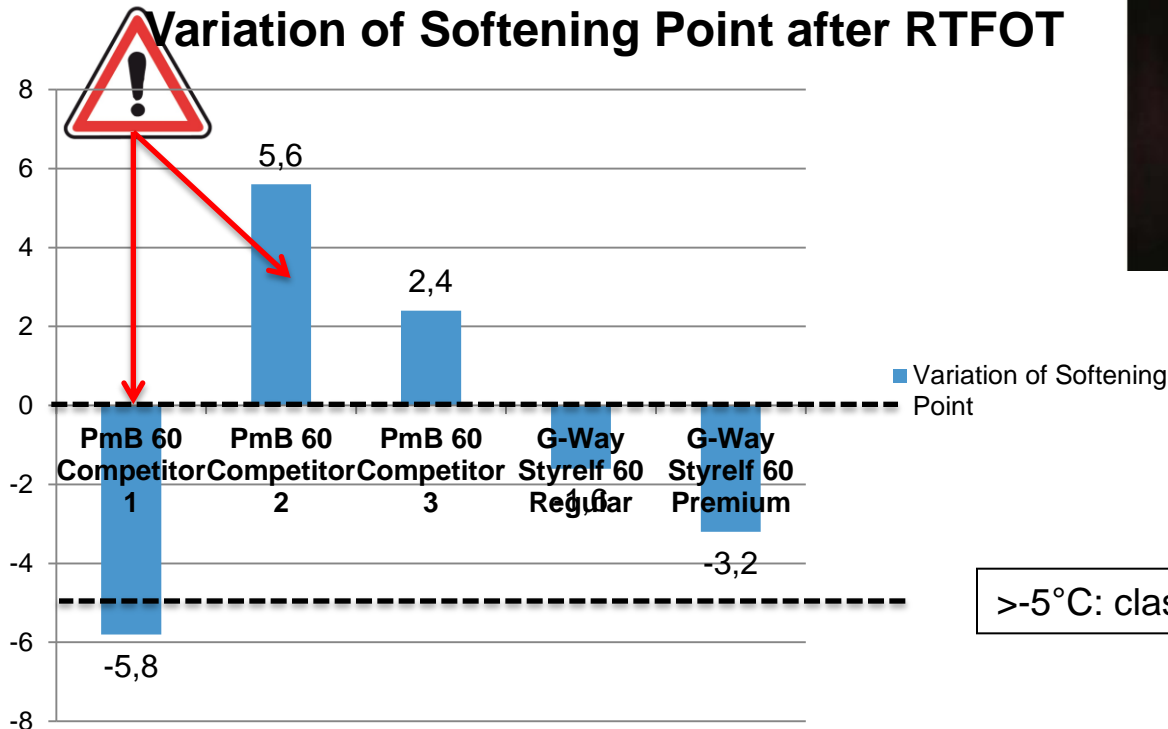
PmB90 regular



Consistent with storage stability tests

Homogeneous structure

EN 14023 – VARIATION OF THE SOFTENING POINT AFTER RTFOT (AGEING RESISTANCE)



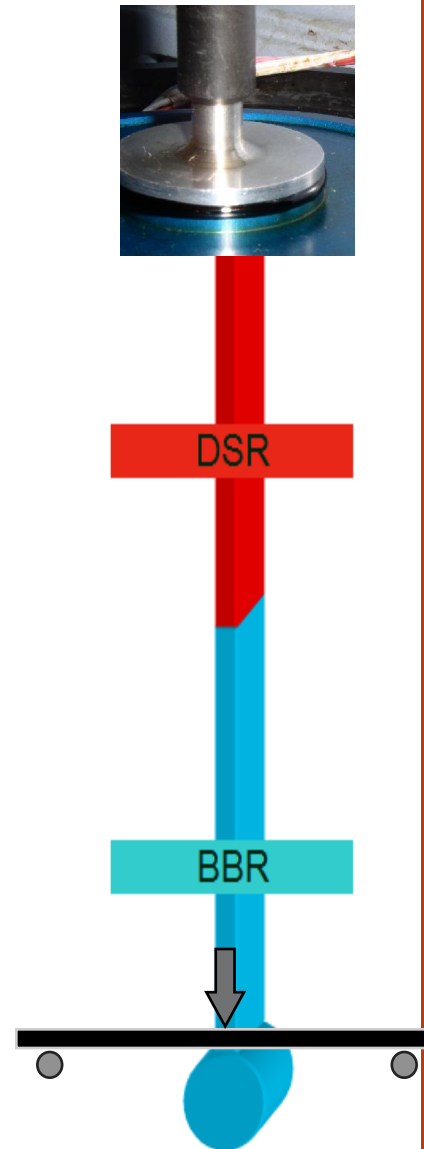
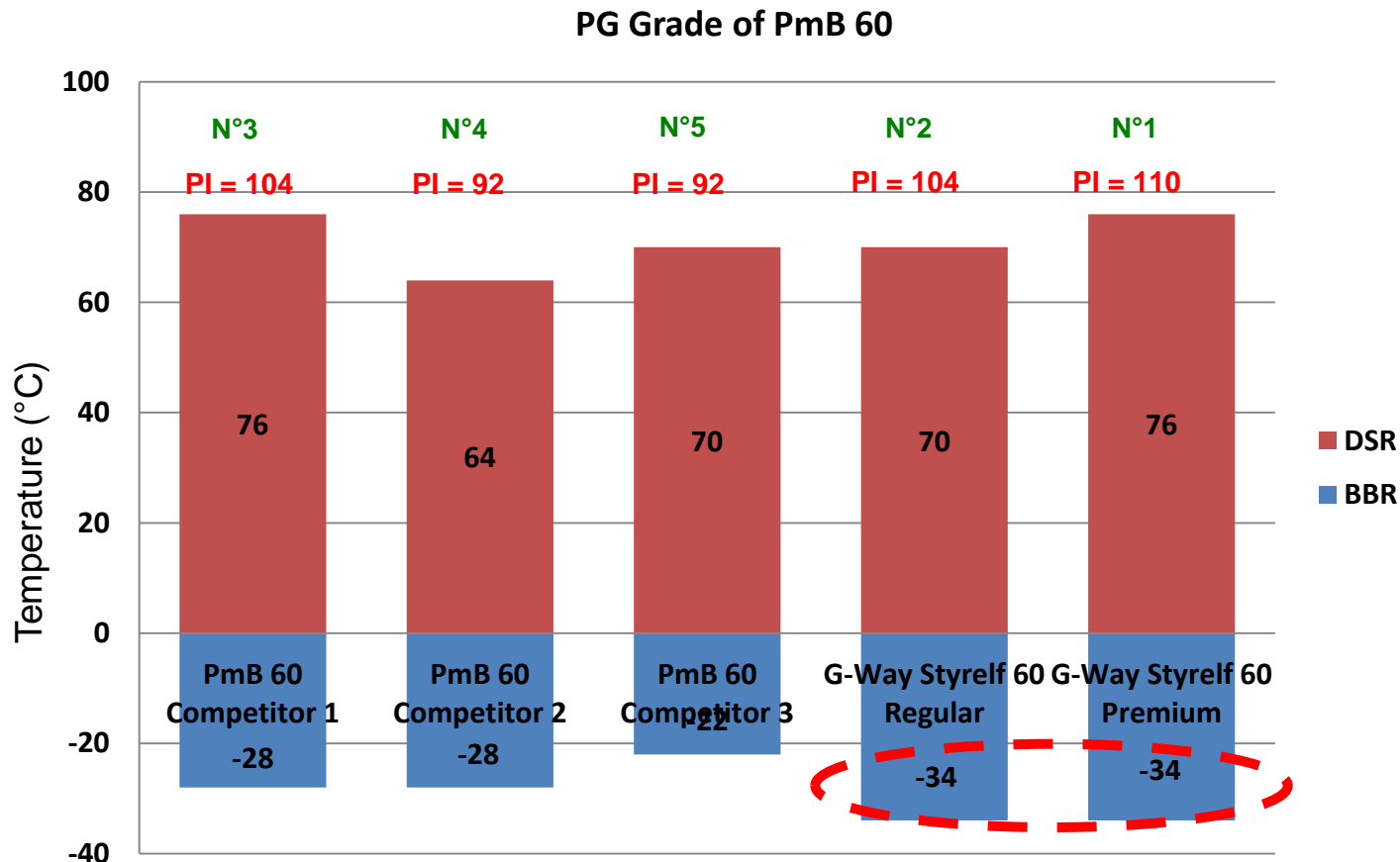
- PmB 60 Competitors 1 and 2: High variation of the Softening Point after RTFOT → more sensitive to ageing resistance
- Competitor 1 would be out of spec in EN standard class 3

EN 14023: PMB 60 VERSUS EN STANDARD

- General conclusion
 - EN spec are empirical (bad relation with performance)
 - G WAY STYRELF range:
 - G WAY STYRELF 60 Premium is the best product by far
 - G WAY STYRELF 60 Regular remains a good compromise between performance and cost
 - Competitors 1, 2 and 3, Pmb of fair quality but:
 - Competitor 1 out of spec in variation of Softening Point after aging
 - Competitor 2: low cohesion (class 3 while other PmB are in class 2 vs cohesion)
 - Competitor 3
 - Not stable during storage.
 - Introduction of storage stability in GOST standard highly recommended:
 - Guarantee for the client that the delivered binder is homogeneous and of constant quality
 - No risk of separation during transport or during storage at the mix plant
 - Introduction of short term aging (RTFOT) test

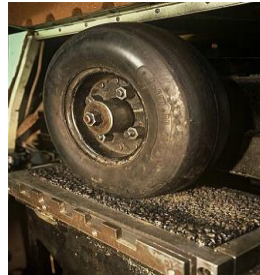
PMB 60 SUPERPAVE

SUPERPAVE – DSR & BBR



- Plasticity Index (PI) = Maximal Temperature – Minimal Temperature
- **G- Way Styrelf 60 Premium: best PG Grade achievable**
- G-Way Styrelf range: very good behavior at lower temperature
- Competitor 1 close to G-Way Styrelf 60 Regular but shifted toward the higher temperature

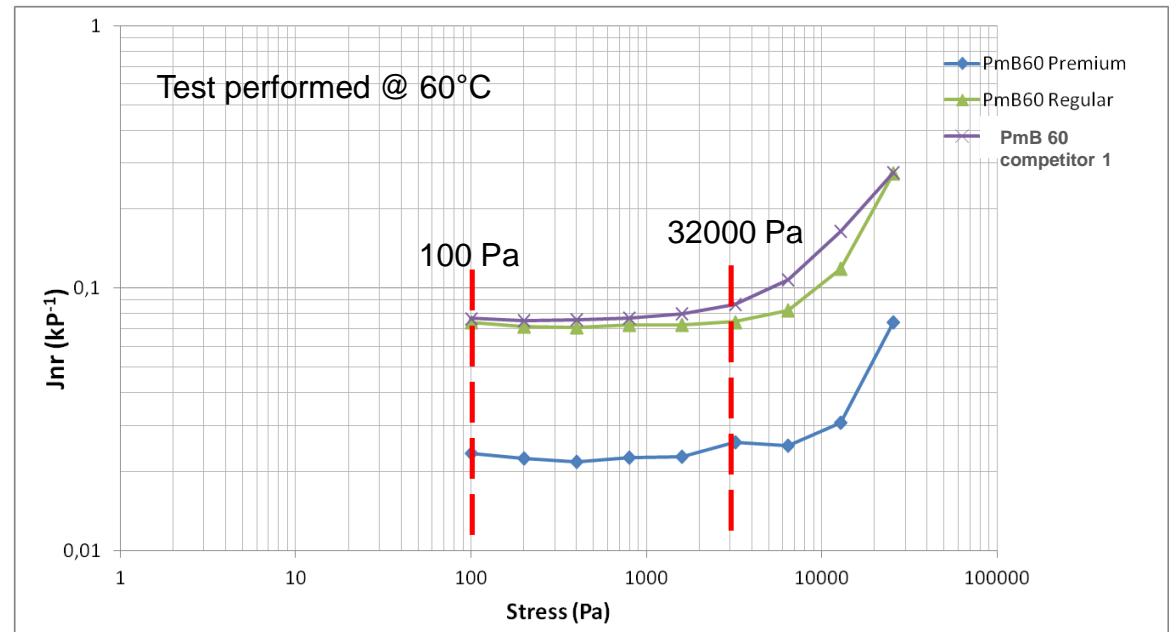
FURTHER CHARACTERISTICS @ HIGH TEMPERATURE (MSCRT)



□ The lower the J_{nr} , the higher the resistance to permanent deformation (rutting resistance)

□ G-WAY STYRELF Premium is the best by far: **250 times more resistance to load!**

□ G-WAY STYRELF Regular has better resistance to repeated load than PmB 1 at High temperature but much better at low temperature



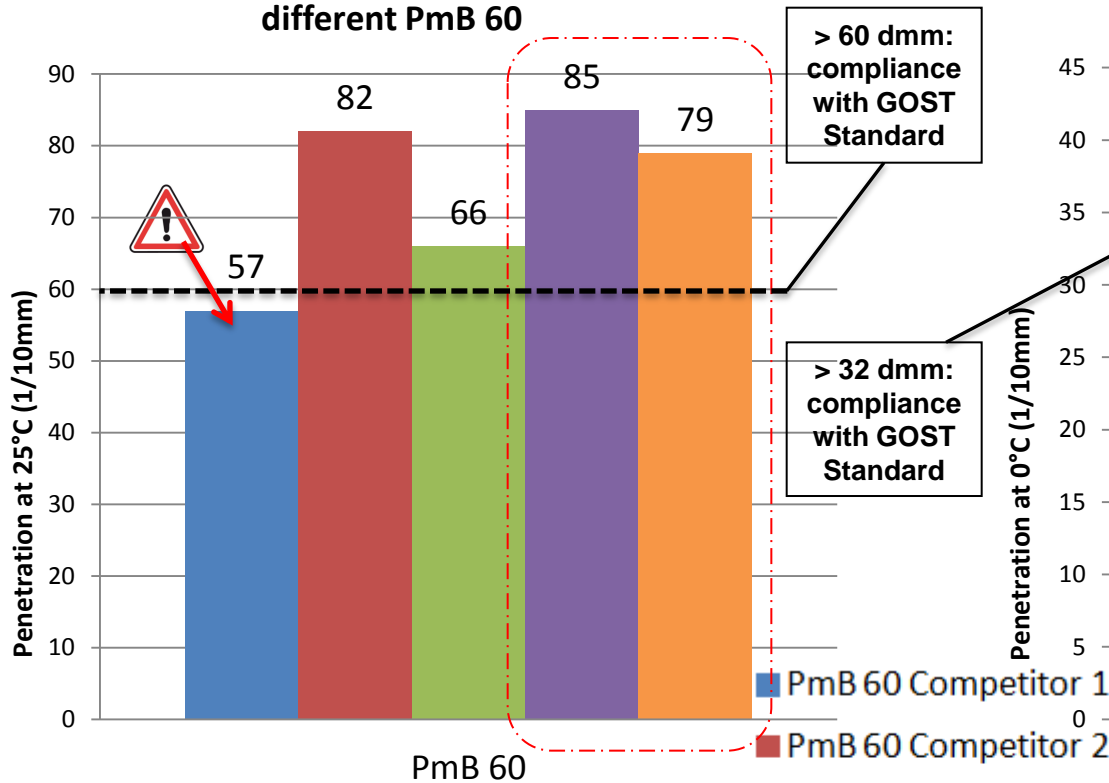
A permanent-deformation performance test

PMB 60

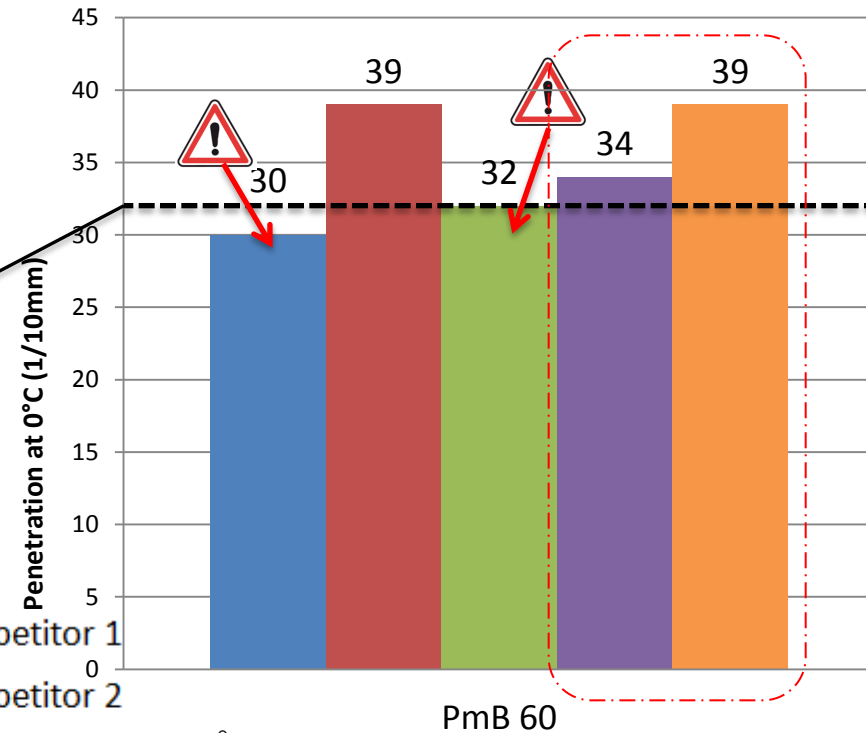
GOST R 52056-2003

GOST R52056-2003 – PENETRATION

Comparison of the Penetration at 25°C of the different PmB 60



Comparison of the Penetration at 0°C of the different PmB 60



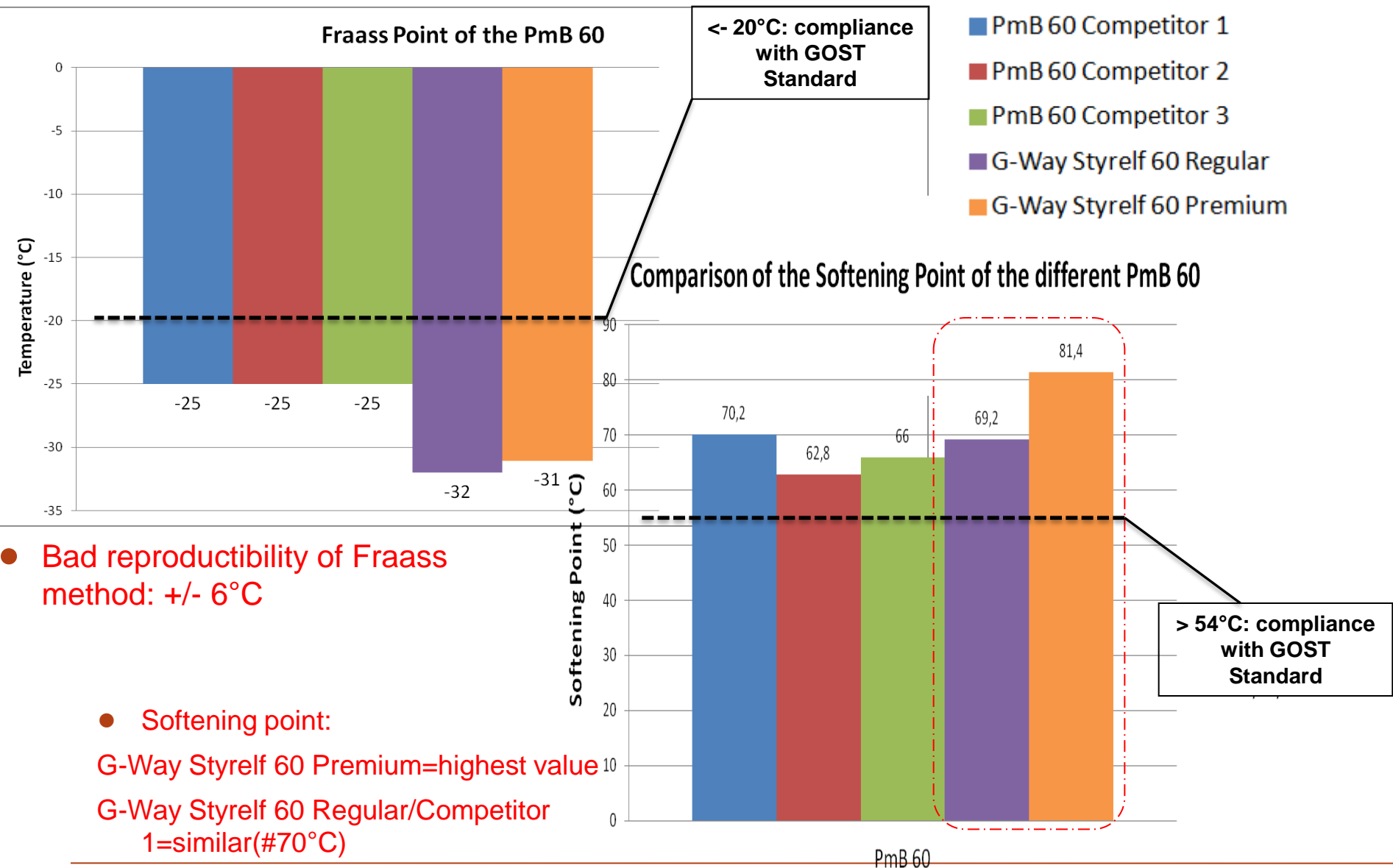
- Pen @ 25°C: PmB 60
- Competitor 1 out of spec

- PmB 60 Competitor 3
- G-Way Styrelf 60 Regular
- G-Way Styrelf 60 Premium



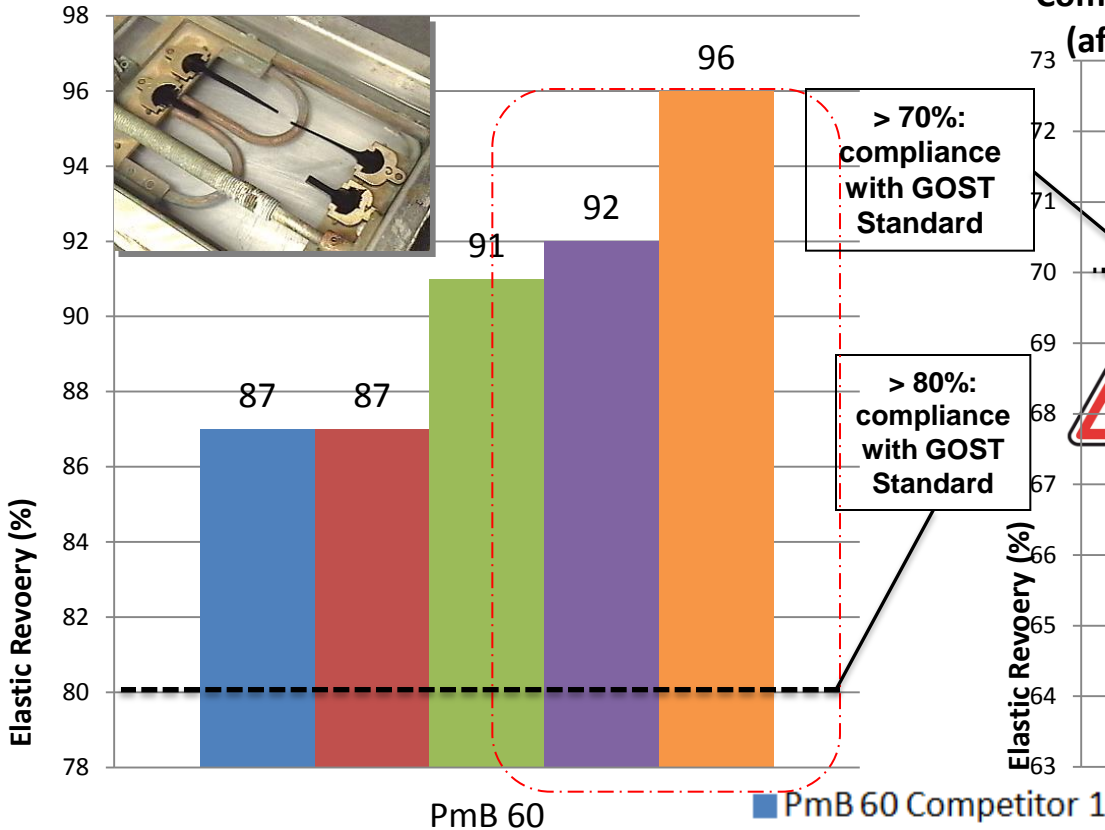
- Pen @ 0°C: PmB 60
- PmB 60 Competitor 1 out of spec
- PmB 60 Competitor 3 borderline

GOST R52056-2003: SOFTENING POINT & FRAASS

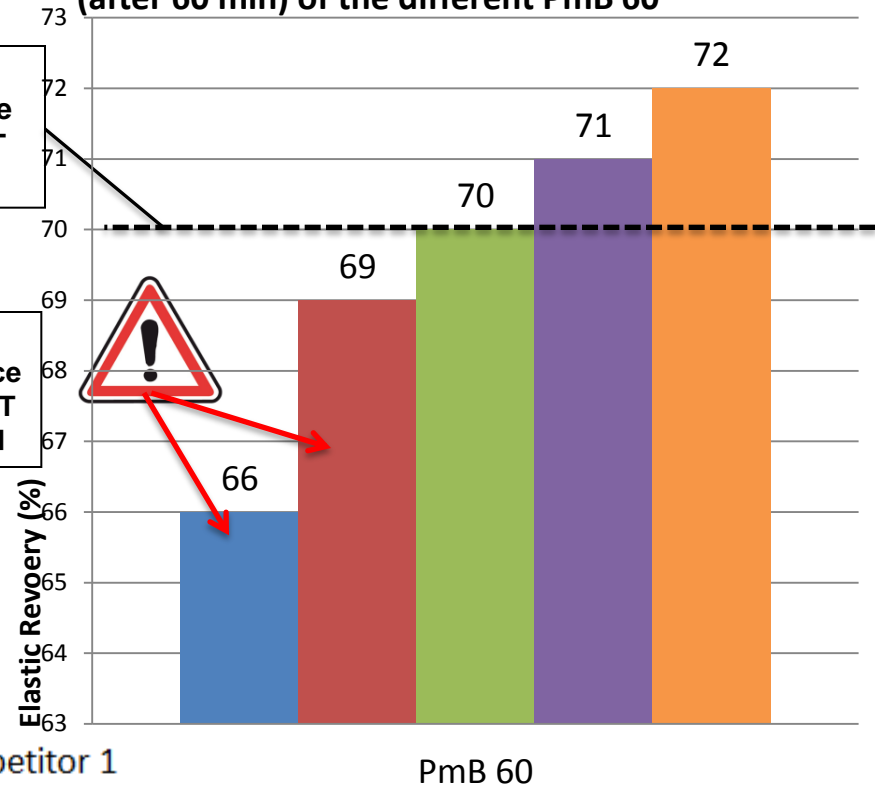


GOST R52056-2003 – ELASTIC RECOVERY

Elastic Recovery @ 25°C (after 30 min)



Comparison of the Elastic Recovery at 0°C (after 60 min) of the different PmB 60



● G-WAY STYRELF 60 Premium significantly efficient

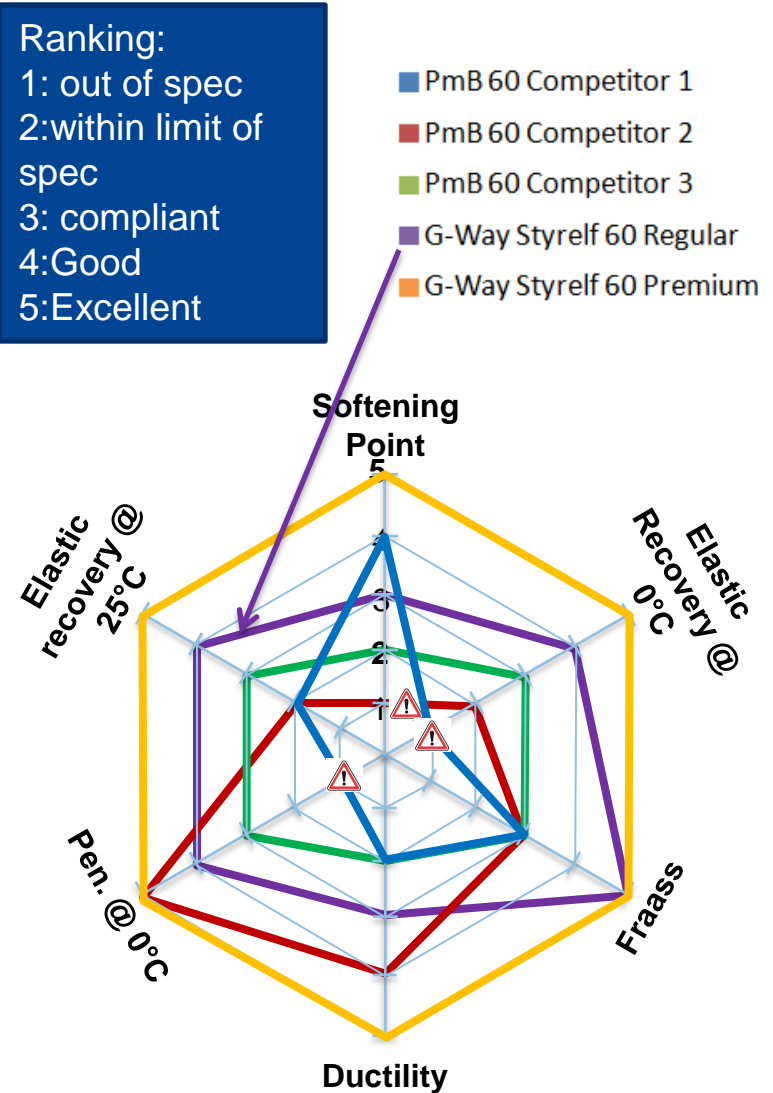
- PmB 60 Competitor 1
- PmB 60 Competitor 2
- PmB 60 Competitor 3
- G-Way Styrelf 60 Regular
- G-Way Styrelf 60 Premium

● Elastic recovery @ 0°C: is discriminating, 2 binders out of spec

GOST R52056-2003 : PMB 60 COMPARISON

● General conclusion

- Even if GOST spec are empirical it is very difficult for PmB to be fully in compliance with all the requirements
- Only G-WAY STYRELF fully in compliance whatever the requirement
 - G-WAY STYRELF 60 Premium is the best product by far
 - G-WAY STYRELF 60 Regular is a good compromise between performance and cost to comply with spec @ 0°C which requires more technological content
- Competitors 1, 2 and 3, Pmb of fair quality but:
 - Competitor 1 out of spec in Pen and elastic recovery @ 0°C
 - Competitor 2: lower Softening point , out of spec in elastic recovery @ 0°C
 - Competitor 3: borderline in Pen @ 0°C



PMB 90

GOST STANDARD: COMPARISON PMB 90

- General conclusion

- Even if GOST spec are empirical it is very difficult to be fully in compliance with all the requirements
- Only G-WAY STYRELF fully in compliance whatever the requirement
 - G-WAY STYRELF 90 Premium is the best product by far
 - G-WAY STYRELF 90 Regular is a good compromise between performance and cost to comply with spec @ 0°C which requires more technological content
- PmB 90 Competitor 3:
 - Out of spec in resistance to aging
 - Not stable during storage: separation between polymer and bitumen could lead to big concerns (pipe plugging, bad performance of road,...)
- Marketing argumentation for PmB 90 versus PmB 60 range is not obvious
 - Less properties at high temperature
 - Equivalent properties at low temperature

CONCLUSION

HOW TO IMPROVE EXISTING GOST R52056-2003?

PmB GOST R52056 – 2014

- Introduce storage stability
- Introduce RTFOT

THANK YOU FOR YOUR ATTENTION !

СПАСИБО ЗА ВНИМАНИЕ !