

Use of Temperature Reducing Materials in Bituminous Mixtures in Iceland

Gravel roads are common in Iceland, especially where the traffic volume is low

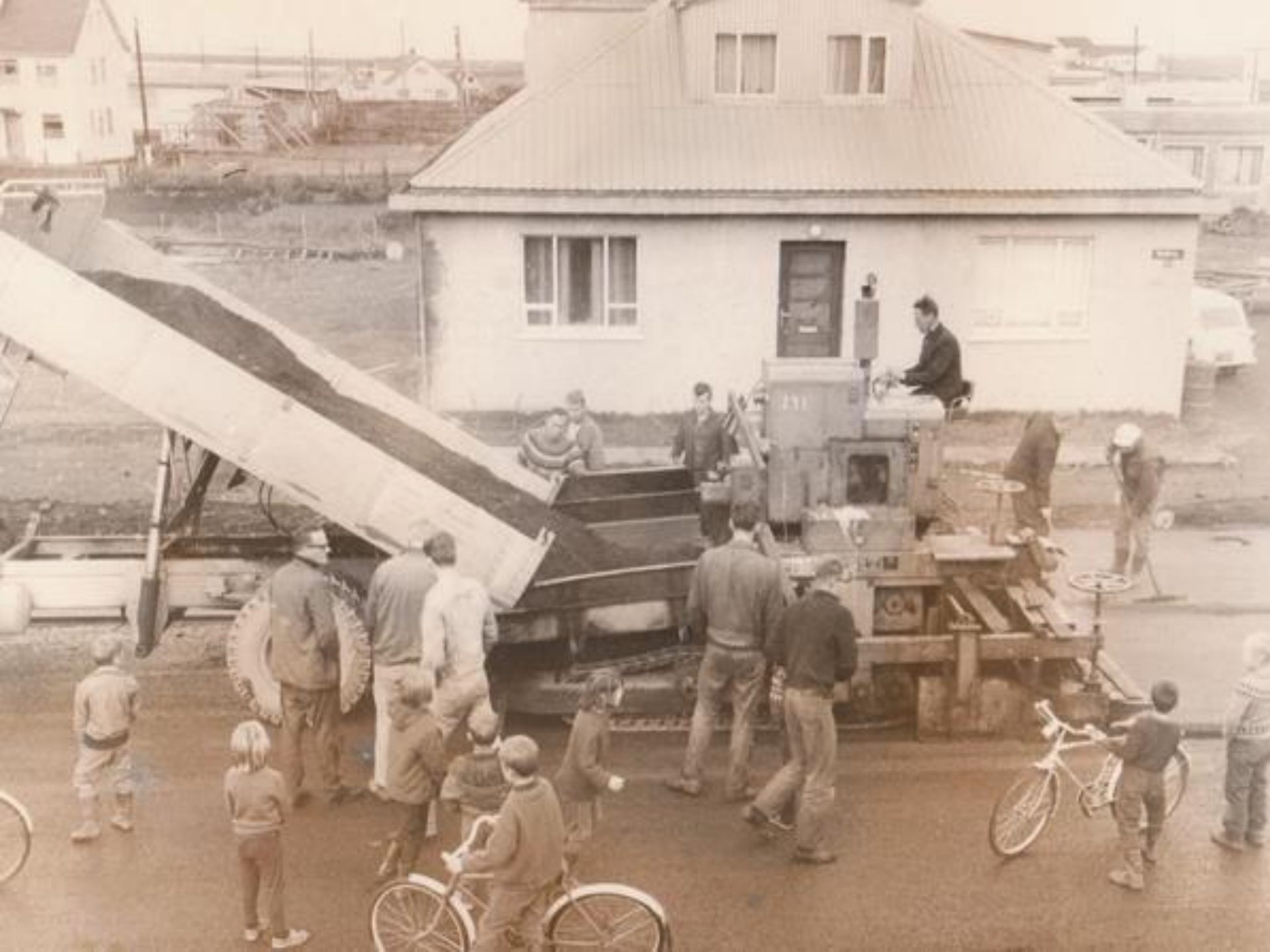
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in CEN/TC227/WG1 Bituminous Mixtures



However, surface dressing is the most used bituminous surfacing in rural Iceland



Of course we have used asphalt concrete for a long time, but mostly limited to urban areas

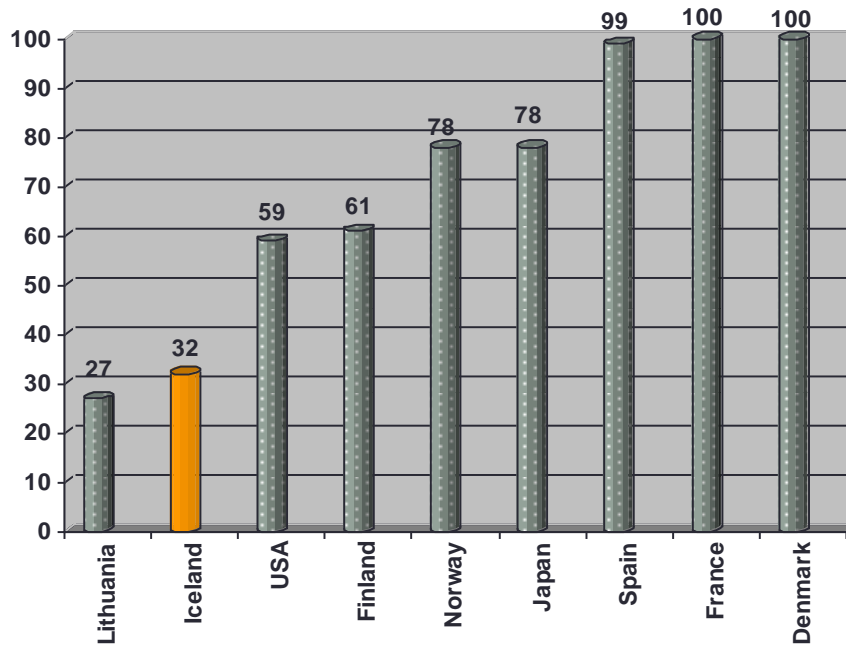




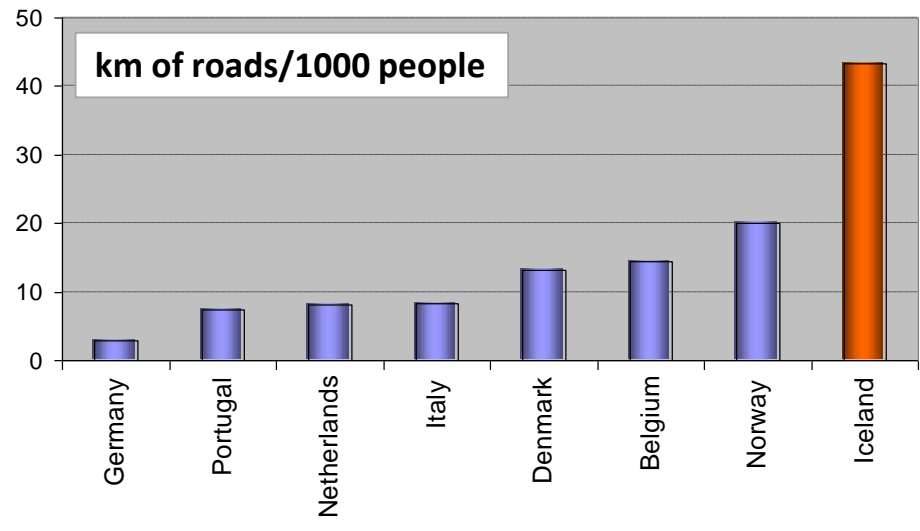
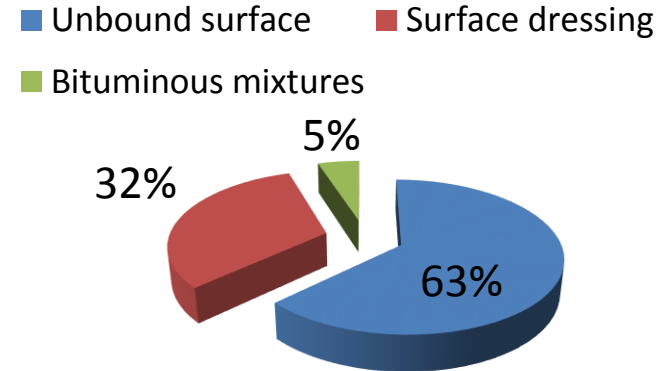
But we want to go further away from the asphalt plants with the bituminous mixtures and here we have a typical hot mix asphalt laid in our National Park of Thingvellir

Icelandic roads compared with some other countries

Bituminous bound roads (including Surface Dressing), % of total road system



Icelandic rural roads (total 13.000 km)



Iceland has no railways



***National Asphalt
Pavement Association***



***European Asphalt
Pavement Association***

The Asphalt Paving Industry

A Global Perspective

Second Edition

**Production, Use, Properties,
and Occupational Exposure Reduction
Technologies and Trends**

In Europe and elsewhere, paving bitumen is denoted by the permissible range of penetration value (expressed as a “pen grade,” e.g. 40/60 pen grade, 100/150 pen grade), which is indicative of the consistency of the material at a temperature of 25°C. The softer the bitumen, the higher the penetration.

**Pen grade 70/100
and 160/220 are
used in Iceland**

Definitions of Paving Bitumen in Europe/US

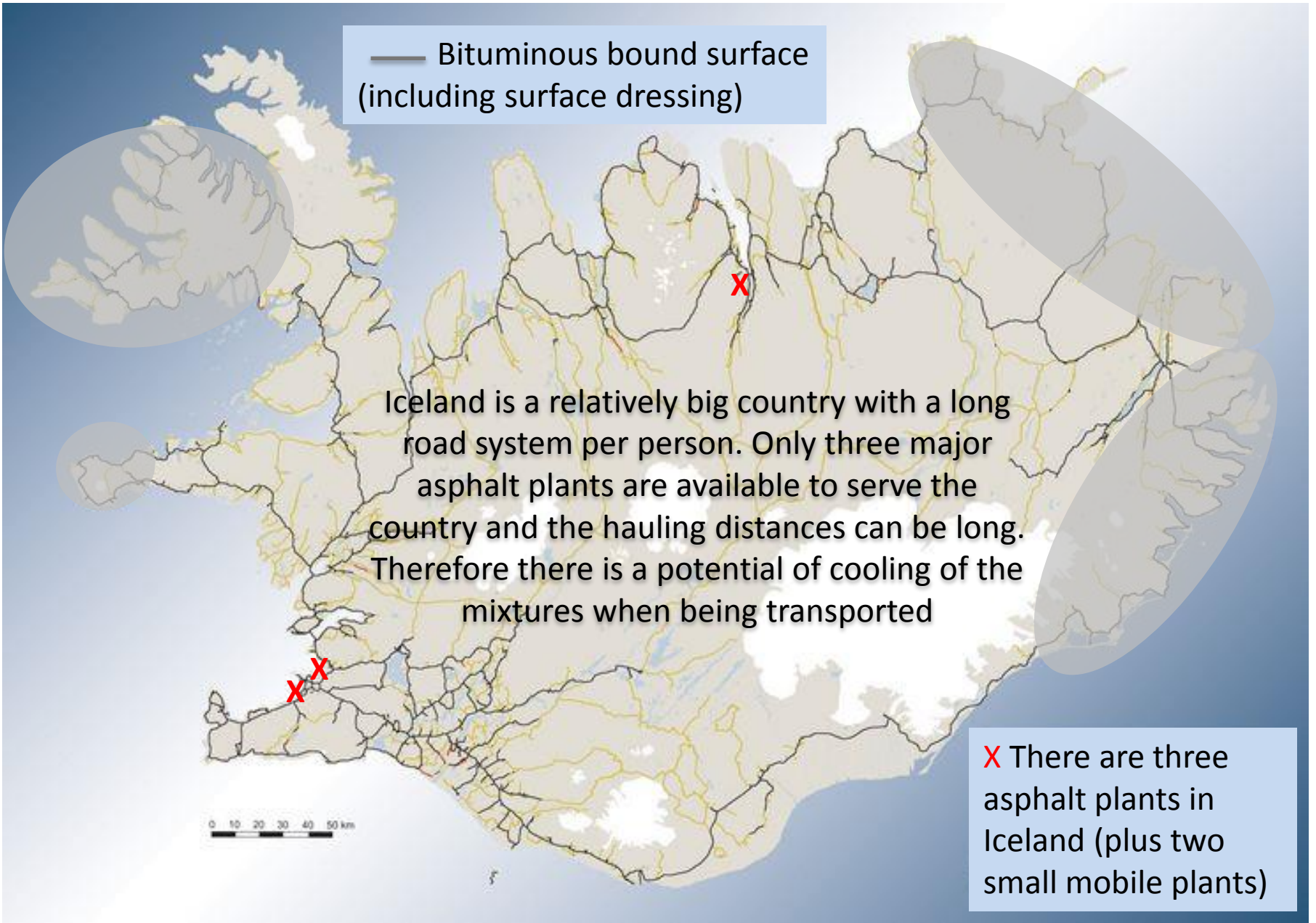
In the U.S. and elsewhere, a performance grade (“PG”) system has been in use since the mid-1990s. Under this system, both traffic levels and climatic conditions are taken into account. For example, a PG designation of PG 64-22 represents the high and low temperatures (in terms of degrees Centigrade) at which the bitumen would be expected to perform satisfactorily.

— Bituminous bound surface
(including surface dressing)

Iceland is a relatively big country with a long road system per person. Only three major asphalt plants are available to serve the country and the hauling distances can be long. Therefore there is a potential of cooling of the mixtures when being transported

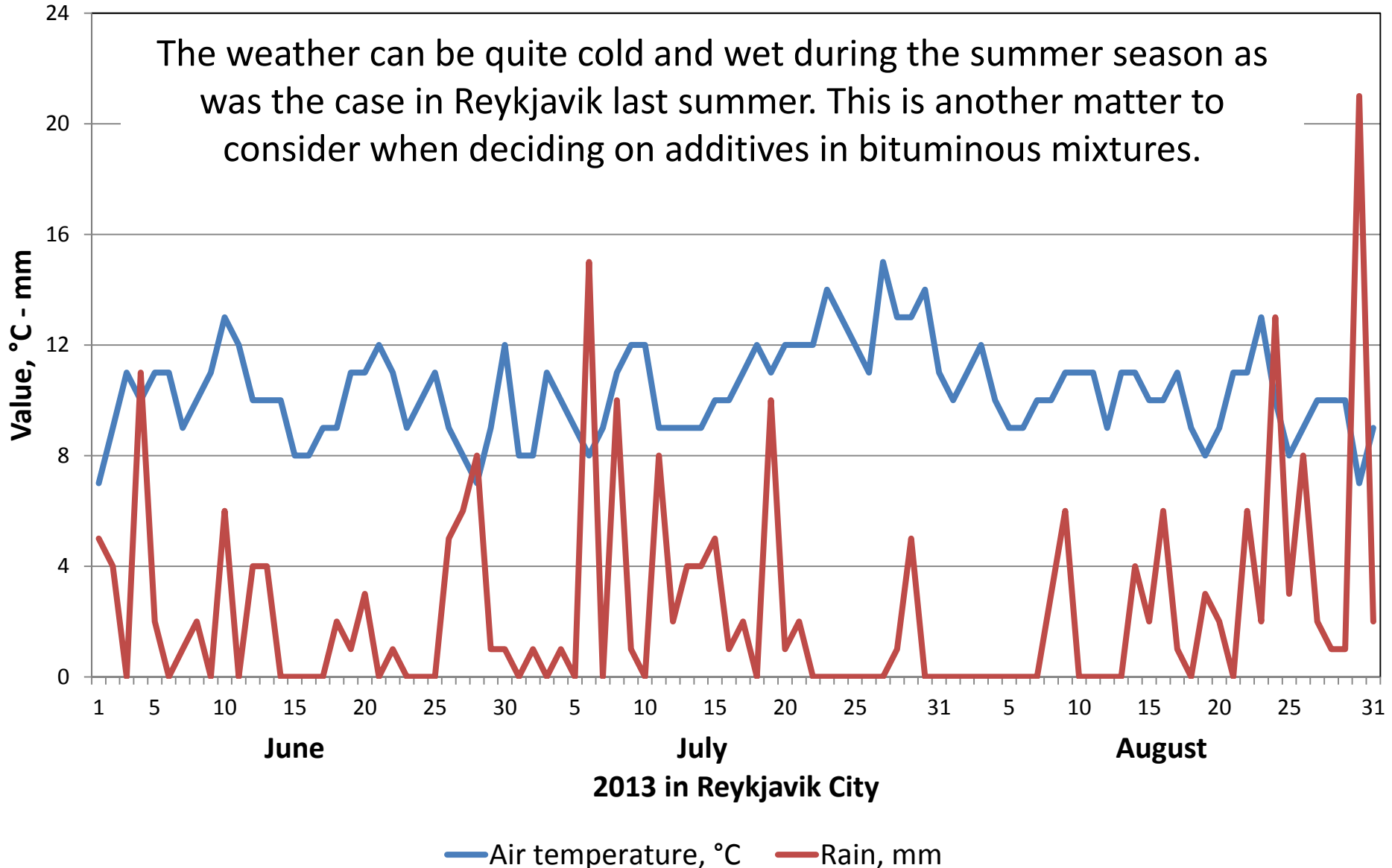
X There are three asphalt plants in Iceland (plus two small mobile plants)

0 10 20 30 40 50 km




Average daily air temperature and rainfall in Reykjavik in 2013

The weather can be quite cold and wet during the summer season as was the case in Reykjavik last summer. This is another matter to consider when deciding on additives in bituminous mixtures.

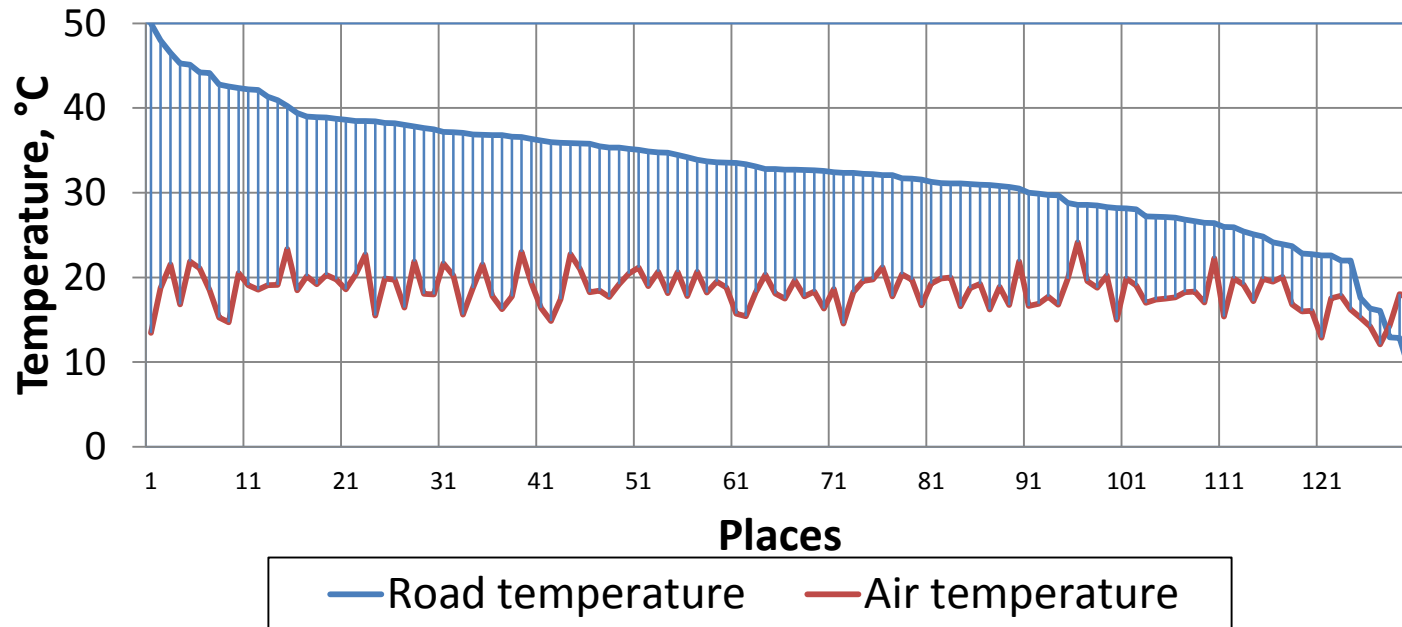


Wet and cold aggregate needs more heating

A photograph of an aggregate processing plant. In the foreground, there are several large, dark grey piles of aggregate material. In the middle ground, a large pile of aggregate is covered with a white plastic sheet. In the background, there is a complex of industrial buildings and machinery, including a tall white tower and various pipes and structures. The sky is overcast and grey.

Additionally, aggregates are usually stored under open air and when the weather is like last summer the aggregates tend to be wet and cold when brought inside the drying drum, meaning that the drying temperature in the plant needs to be high

Maximum air temperature and road temperature in selected places in Iceland in June and July 2010



- The maximum road surface temperatures can occasionally go up to 45-50°C on sunny days (global warming?), making the asphalt layer vulnerable to deformation
- Relatively soft bitumen has mostly been used in Iceland to enable satisfactory compaction
- Total traffic has increased, heavier vehicles, more tyre pressure....
- **DEFORMATION HAS INCREASED RESULTING IN RUTTING OF WHEEL TRACKS**

SOLUTION? LOOK FOR ADDITIVES THAT CAN INCREASE THE RUTTING RESISTANCE OF ICELANDIC BITUMINOUS MIXTURES AS WELL AS MAKING COMPACTTION POSSIBLE AT LOWER TEMPERATURES

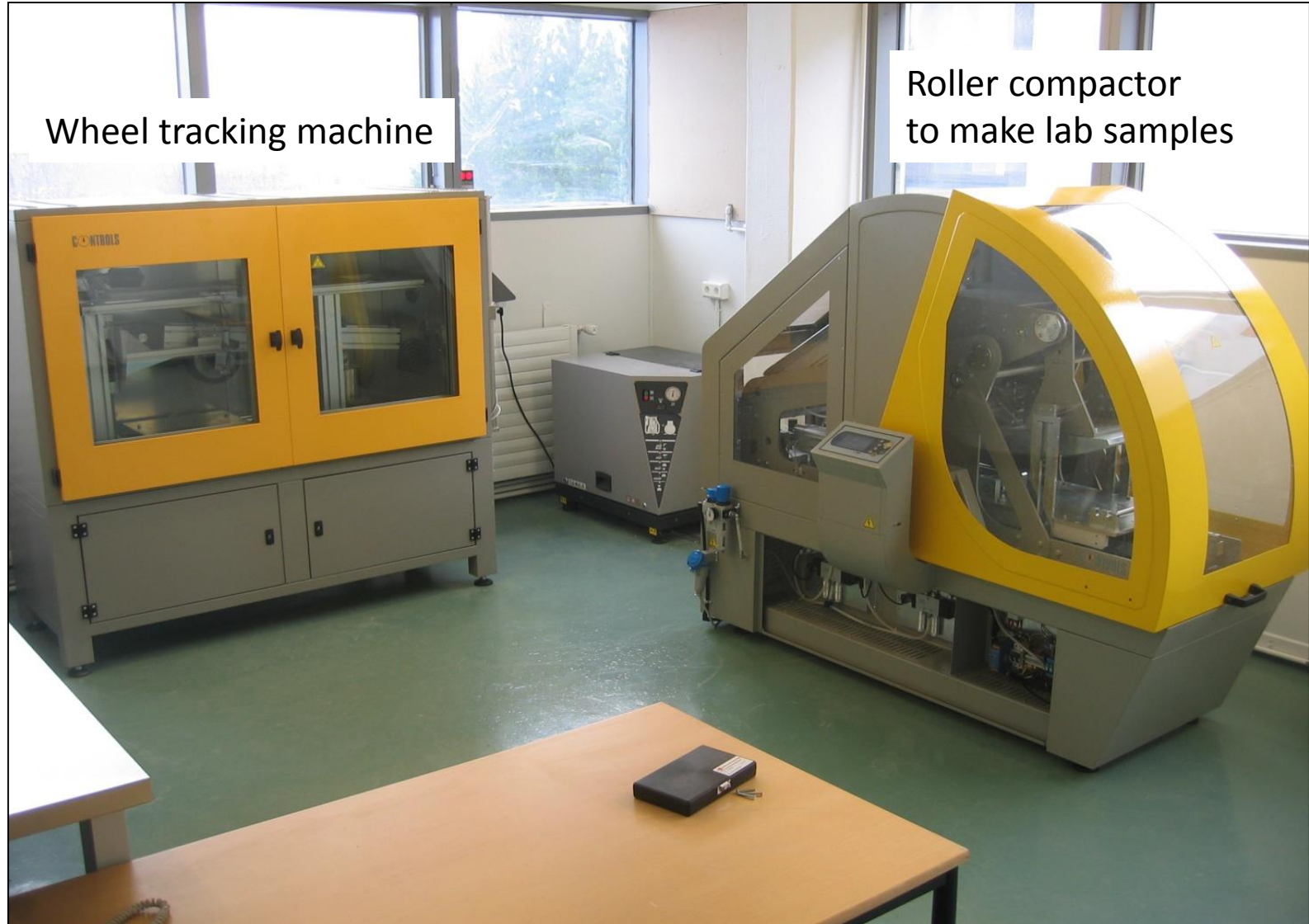
Just a few trm's for WMA

- Sonneborn - SonneWarmix™
- Cecabase® RT-Surfactants/Amines
- **MWV: Evotherm®** - surfactants/Amines
- Akzo Nobel Rediset RMX - surfactants/Amines
- Iterlow - surfactants/Amines
- Revix - surfactants/Amines
- LEADCAP - organic additive
- Advera - zeolite foaming
- Aspha - min® - zeolite foaming
- **Sasobit** (a Fischer-Tropsch wax) - hydrocarbon wax
- Licomont BS (fatty acid amide)
- Asphaltan B (a Montan wax)

... and Polymers

- Dynasol - **styrene-butadiene-styrene (SBS)** block copolymers
- BassTech International - synthetic rubbers, plastics, and polymers
- Petrochem - Natural Rubber Latex

Wheel tracking is a good method to measure the effect of temperature reducing materials on the rut resistance of bituminous mixtures



Wheel tracking machine

Roller compactor
to make lab samples

Samples taken from the road





AC sample in a testing mould

Thermometer



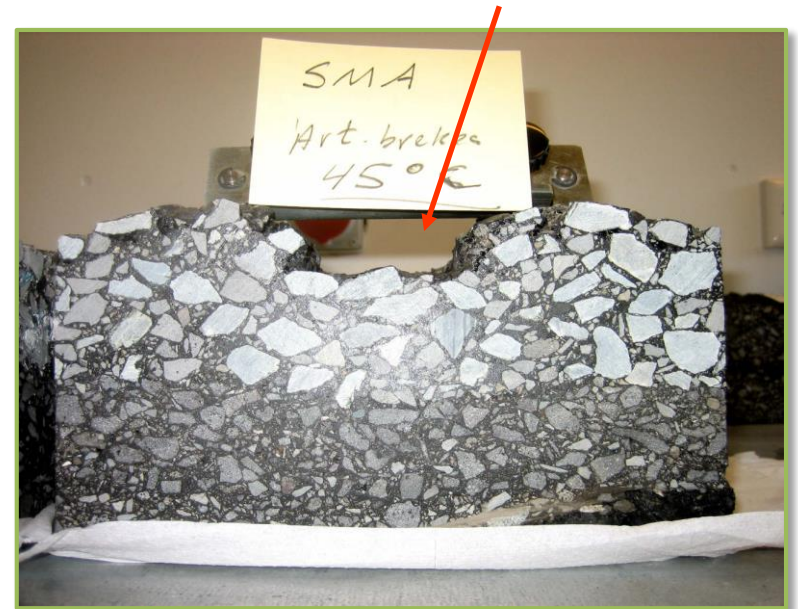
10.000 cycles of the wheel

Two examples of deep rutting in the wheel track test of traditional bituminous mixtures taken from the road surface

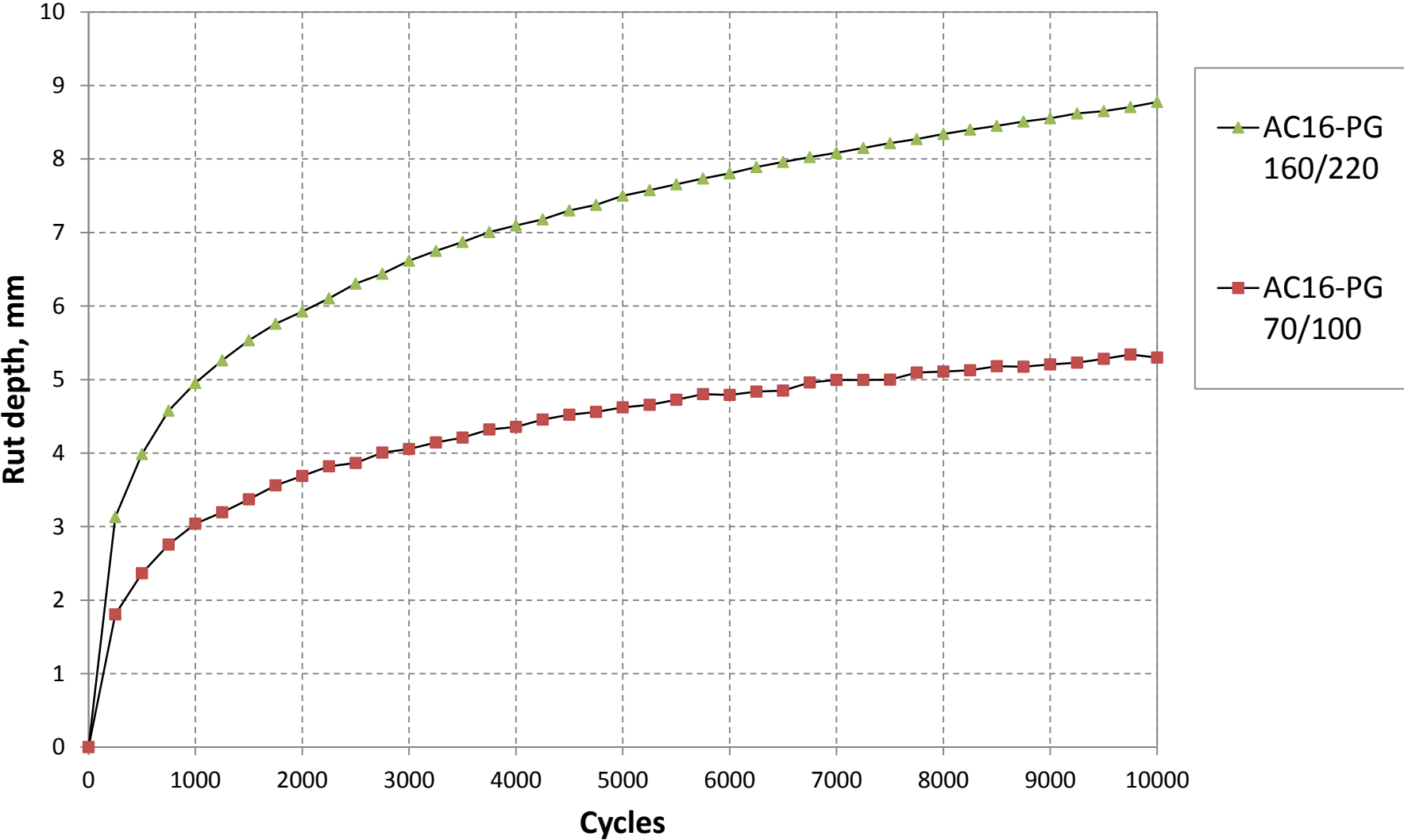
Rut depth 12,2 mm, tested at 45°C



Rut depth 13,7 mm, tested at 45°C

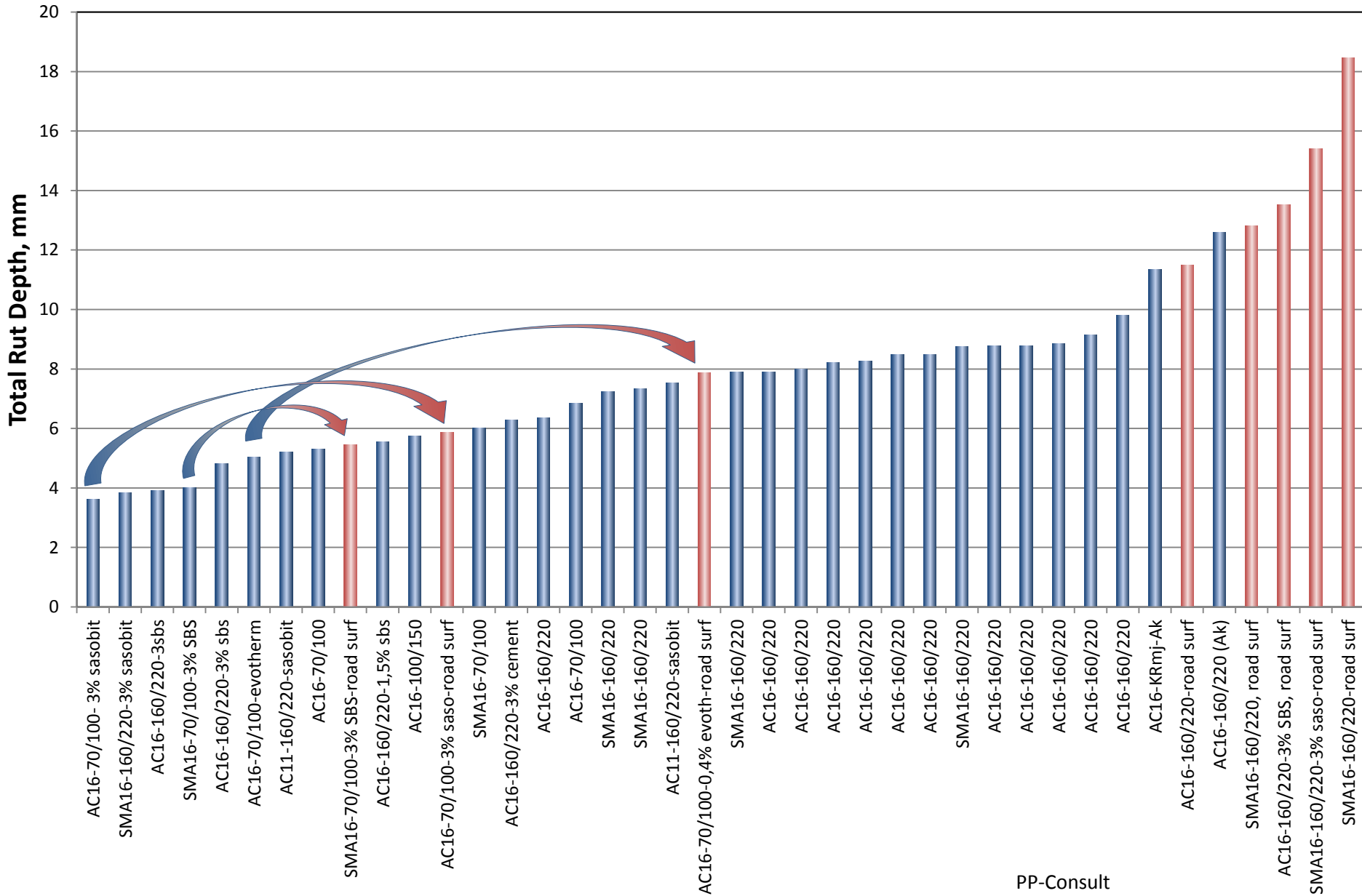


Effect of Pen Grade of bitumen on rut formation (average values, lab. compaction)



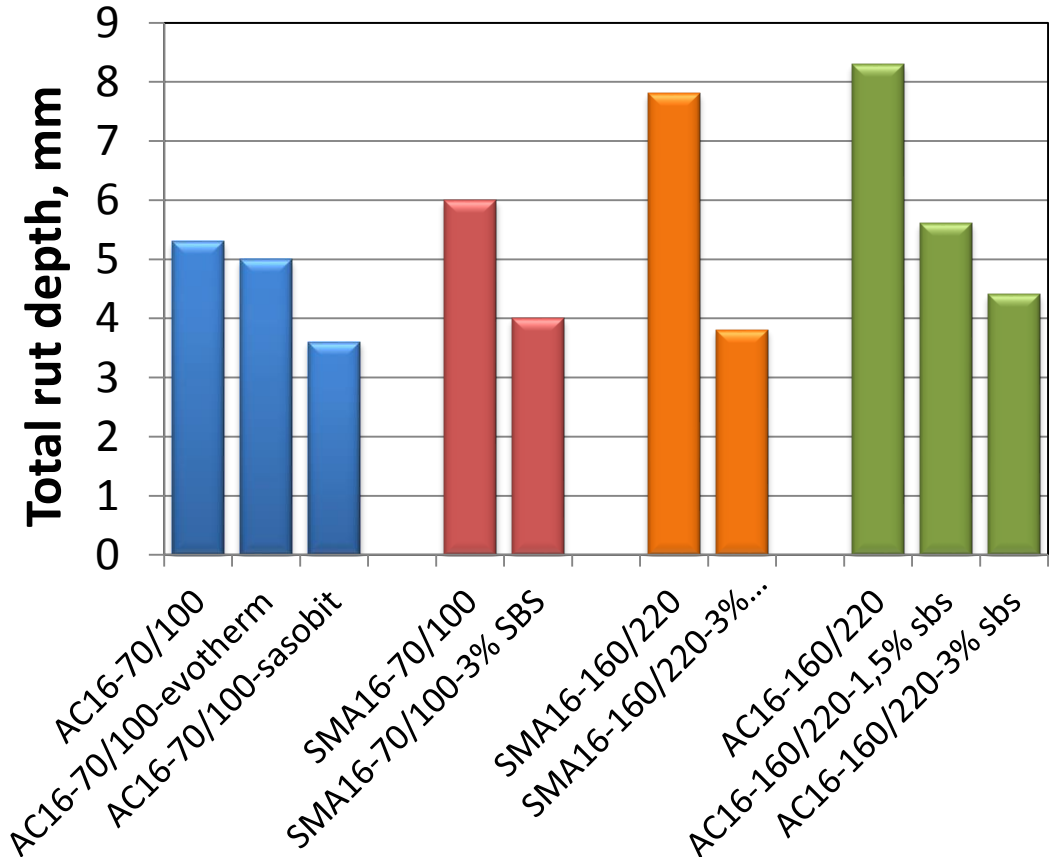
Distribution of values from the wheel tracking test (average of two plates)

blue=lab compacted, red=from road surface

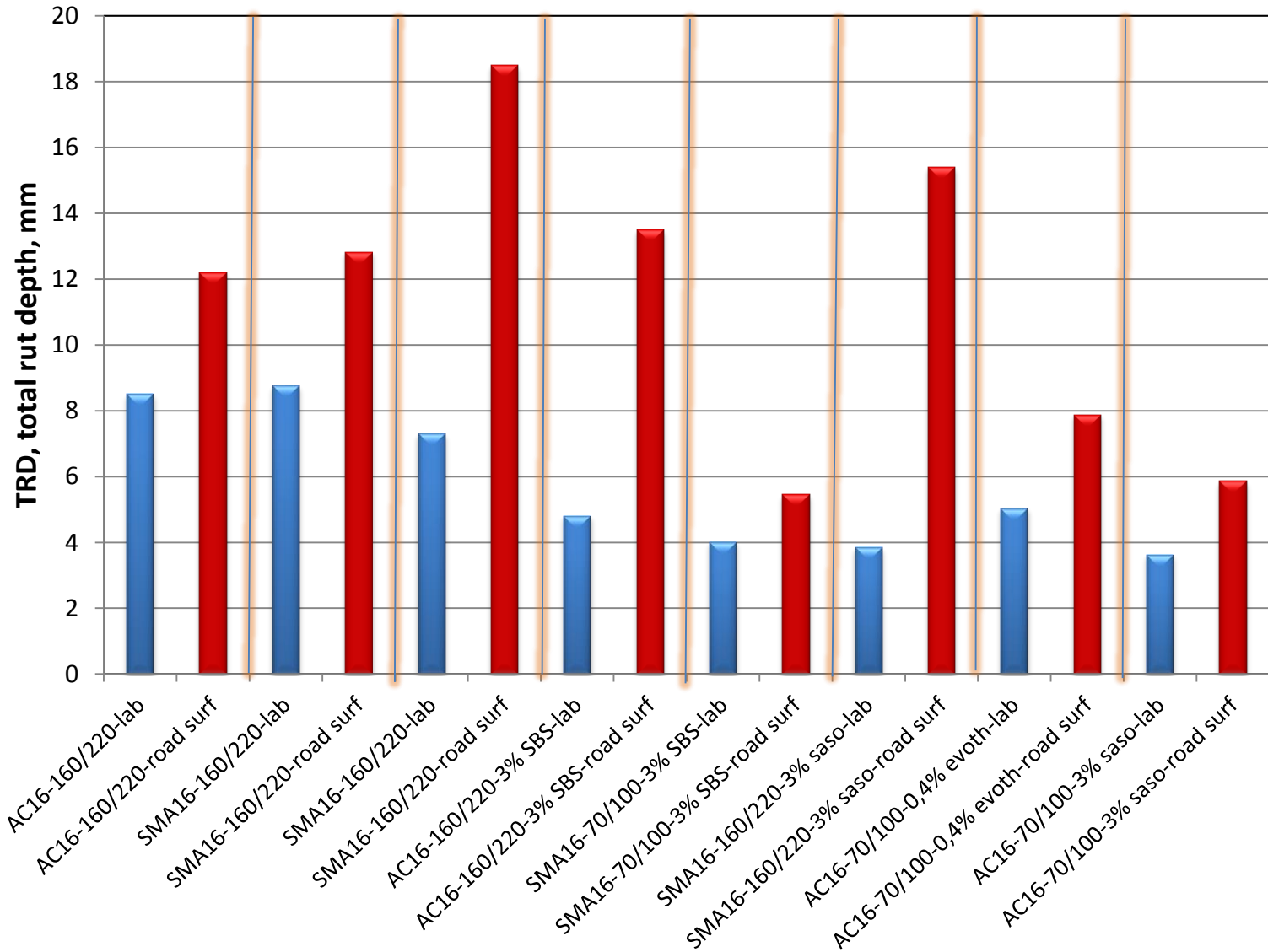


Typical effect of adding materials to a traditional bituminous mixture (average values, lab compaction)

- Evotherm is not doing as much as sasobit for AC 70/100
- SBS is doing a good job for SMA 70/100 and even better job for SMA 160/220
- Different dosages of SBS have different effects on rut resistance of AC 160/220

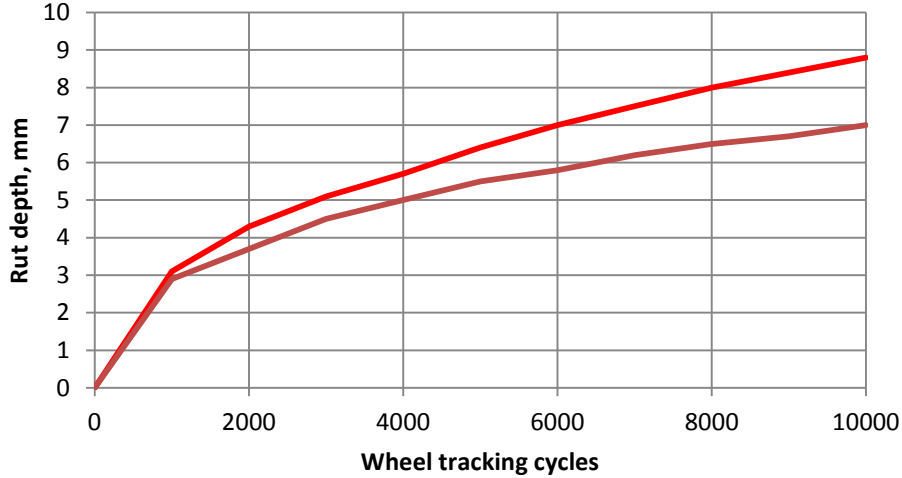


Comparing lab. compacted samples and samples taken from the road

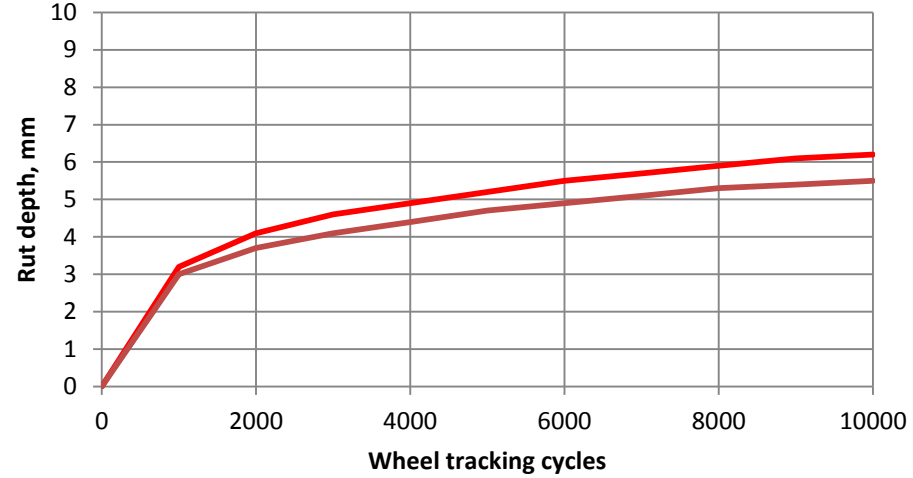


Comparing samples from the road, one with Evotherm (0,4 %), one with Sasobit (3 %) and one with SBS (3%), all with 70/100 pen bitumen

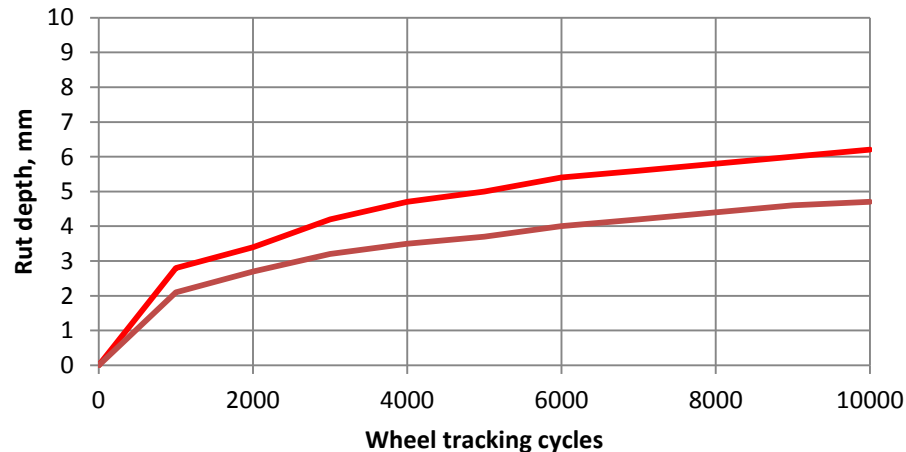
AC16 with pen.bit. 70/100 and 0,4 % Evotherm, road samples



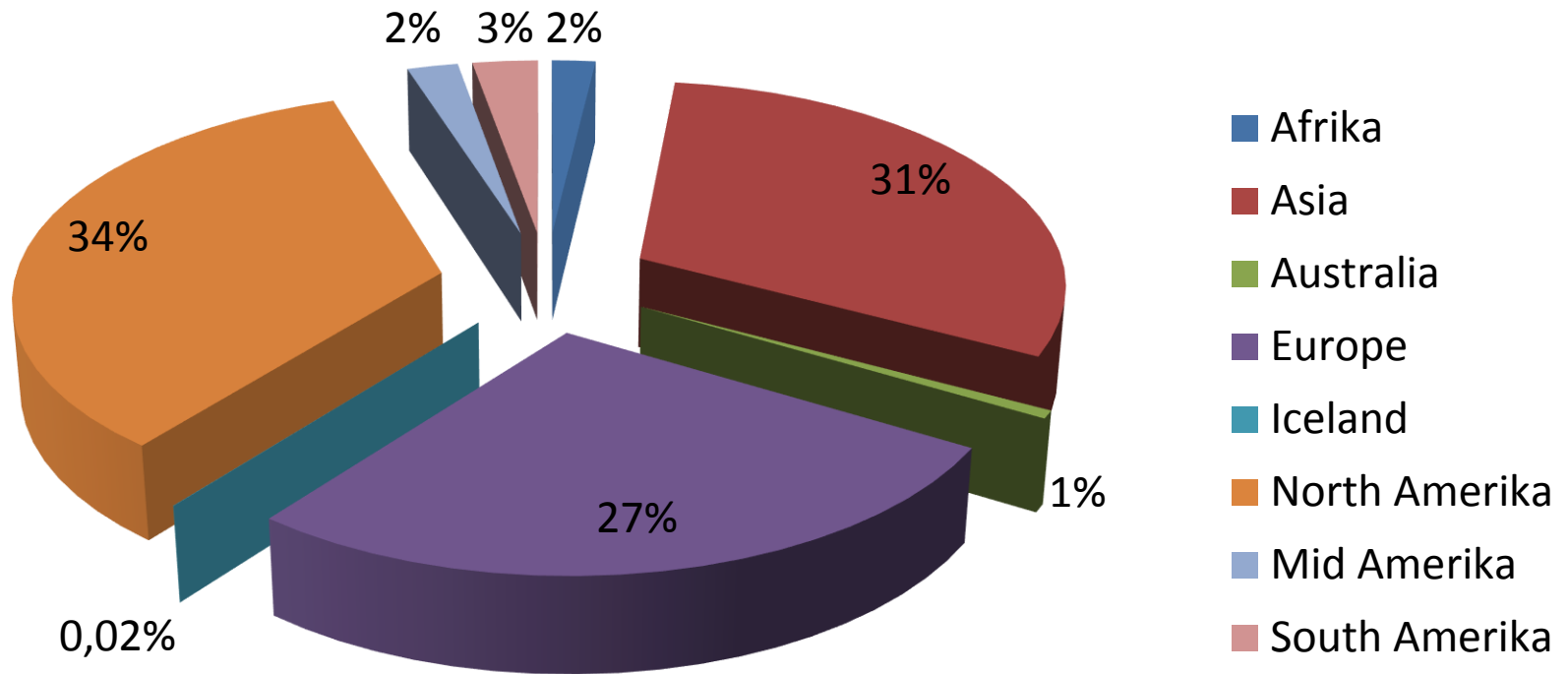
AC16 with pen.bit. 70/100 and 3 % Sasobit, road samples



SMA16 with pen.bit. 70/100 and 3 % SBS, road samples



Estimated world production of asphalt in 2007: 1600 million tons (Iceland 0,25 m. t.)



(www.eapa.org/default_news.htm)

Conclusions

- As Iceland is a very small producer of asphaltic layers (~0,02%), energy saving and emission reduction on the global scale is hardly significant
- On the other hand some trm's have proven locally to increase the stability (rutting resistance) of asphaltic layers to a similar level as polymers (SBS)
- Additionally, trm's increase the workability of bituminous mixtures at lower temperatures, which is important for the industry (hauling distances – cold weather conditions)
- However, long term performance has not yet been established.



It is my believe that trm's will help us to make gravel roads a smaller part of our road system in the near future

And here you see a couple you may recognize, visiting Iceland in the summer time and getting acquainted with gravel roads



THANK YOU