Stronger, cheaper, greener roads with waste plastic?

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History of plastic in roads

- Asphalt modified by virgin polymers since 1970s – mostly styrene-butadiene-styrene (SBS), essentially synthetic rubber
- Studies on using high-quality recycled plastic streams since 1990s
- Research beginning early 2000s in India on using mixed plastic waste streams – huge need for road construction and reduction in costs, high recycling rates (60% plastic recycling in Delhi).


PLASTIC WASTE ROAD
First time in the Country
PERMANENT SOLUTION TO PLASTIC WASTE
BRUHATH BANGALORE MAHANAGARA PALIKE
&
K.K. PLASTIC WASTE MANAGEMENT PVT. LTD.,


JUSCO
quality services for life
ATATA Enterprise
THIS ROAD IS MADE
FROM
WASTE PLASTIC
IE-402000

History of plastic in roads

- Main material often street litter, collected by trash pickers and roughly washed and shredded
- >34000km laid over last 15 years
- Tests demonstrate it to be much more hard wearing
- At least 5000km/year laid now, and required by federal law within 50km of all cities

MADURAI

Indian Roads Congress clears code for plastic road

S. Annamalai

MADURAI:,DECEMBER 19, 2013 09:37 IST
UPDATED: JULY 29, 2016 17:27 IST

ADVANTAGE PLASTIC WASTE

- Cost of laying **10** square metres of road with plain bitumen: **Rs.3,93,750**
- With waste plastic coated stone and bitumen: **Rs.3,67,875**
- Saving: **Rs.25,875**
- Carbon credit achieved by avoiding burning of plastic: **3.5 tonnes**

Road gets its life doubled, remains pothole-free and withstands heavy load

The path for using plastic waste in the formation of roads all over the country has been cleared with the Indian Roads Congress (IRC) releasing the code, IRC: SP: 98: 2013, for application of the 'plastic road technology,' evolved by Thiagarajar College of Engineering (TCE) here.

The IRC has come out with the code on the basis of studies and investigations

Scotland, 2017 – Macrebur's "MR6"

Process

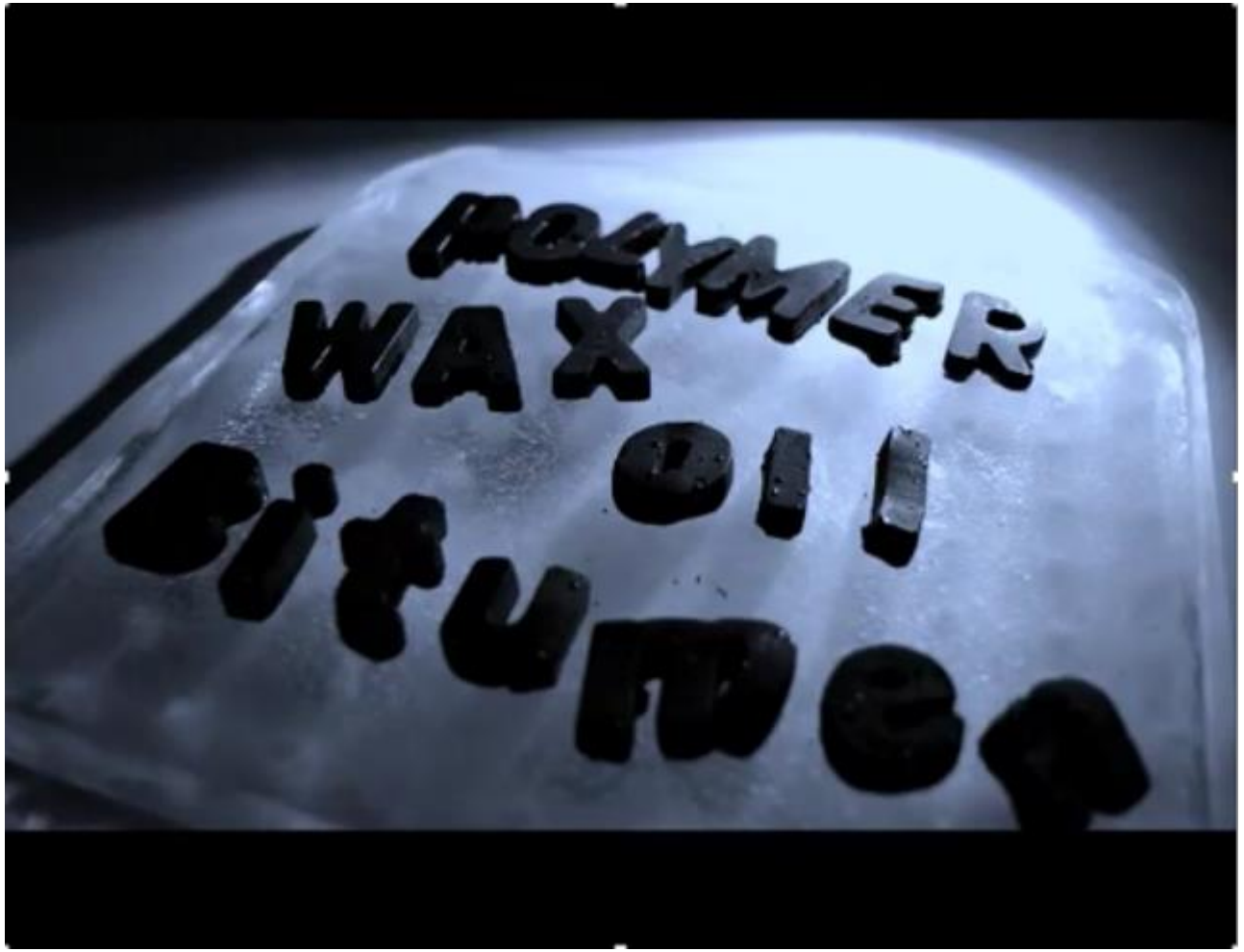
- All kinds of waste plastic except PVC accepted (e.g. HDPE, LDPE, PET, PE, PP, PS)


Dail
Gold
KETCHUP
Suave
Garlic
BODY LOTION
WINTER CHILL

Process

- All kinds of waste plastic except PVC accepted (e.g. HDPE, LDPE, PET, PE, PP, PS)
- Plastic washed and shredded to 2-4mm
- **Added to aggregate** heated to160-180°C (using cellulose additive system, or manually) – **not mixed with bitumen directly**
- Then coated with hot bitumen at similar temperature
- Plastic helps form interface between aggregate and bitumen
- Replaces 6-10% of weight of bitumen

Benefits: Temperature Range



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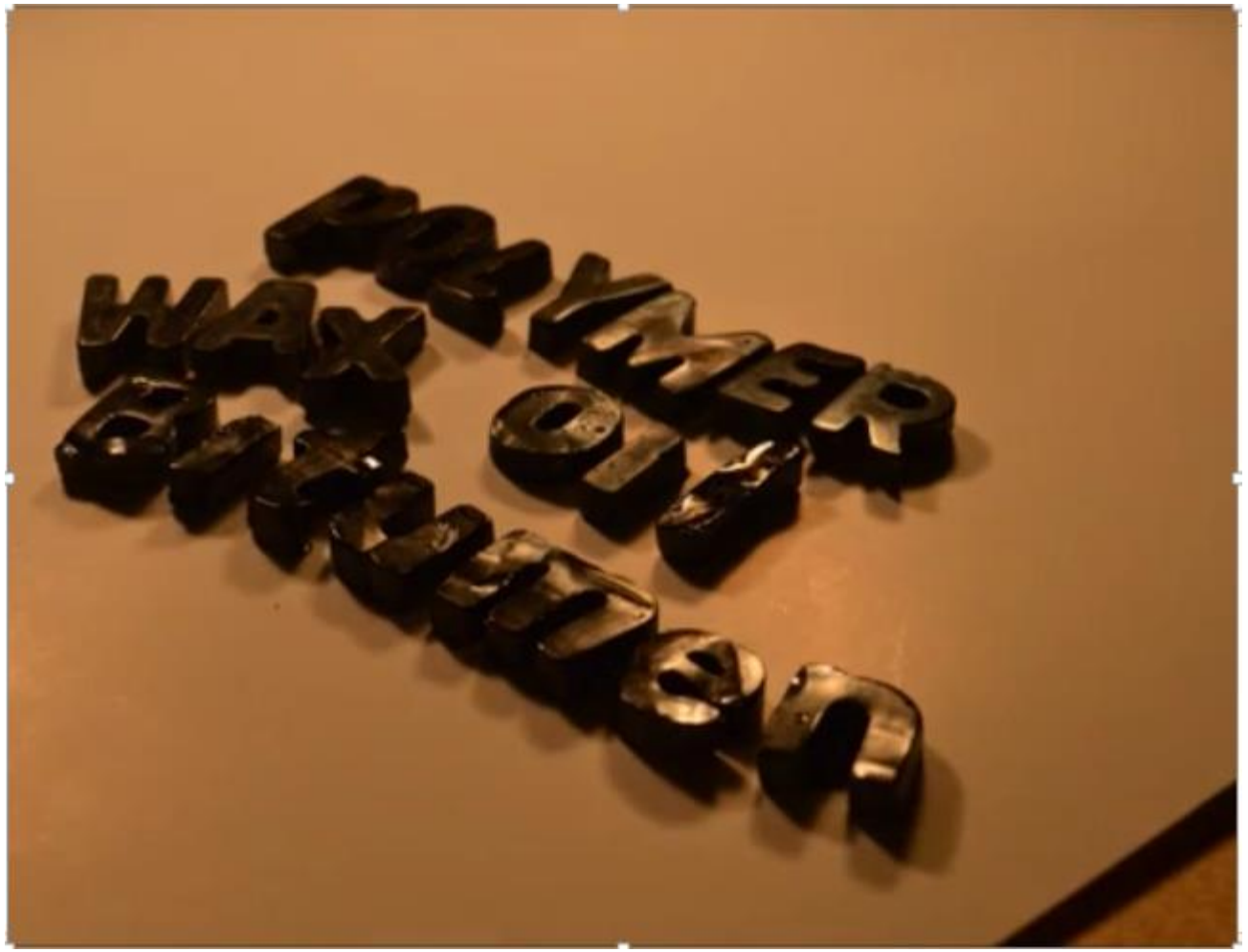

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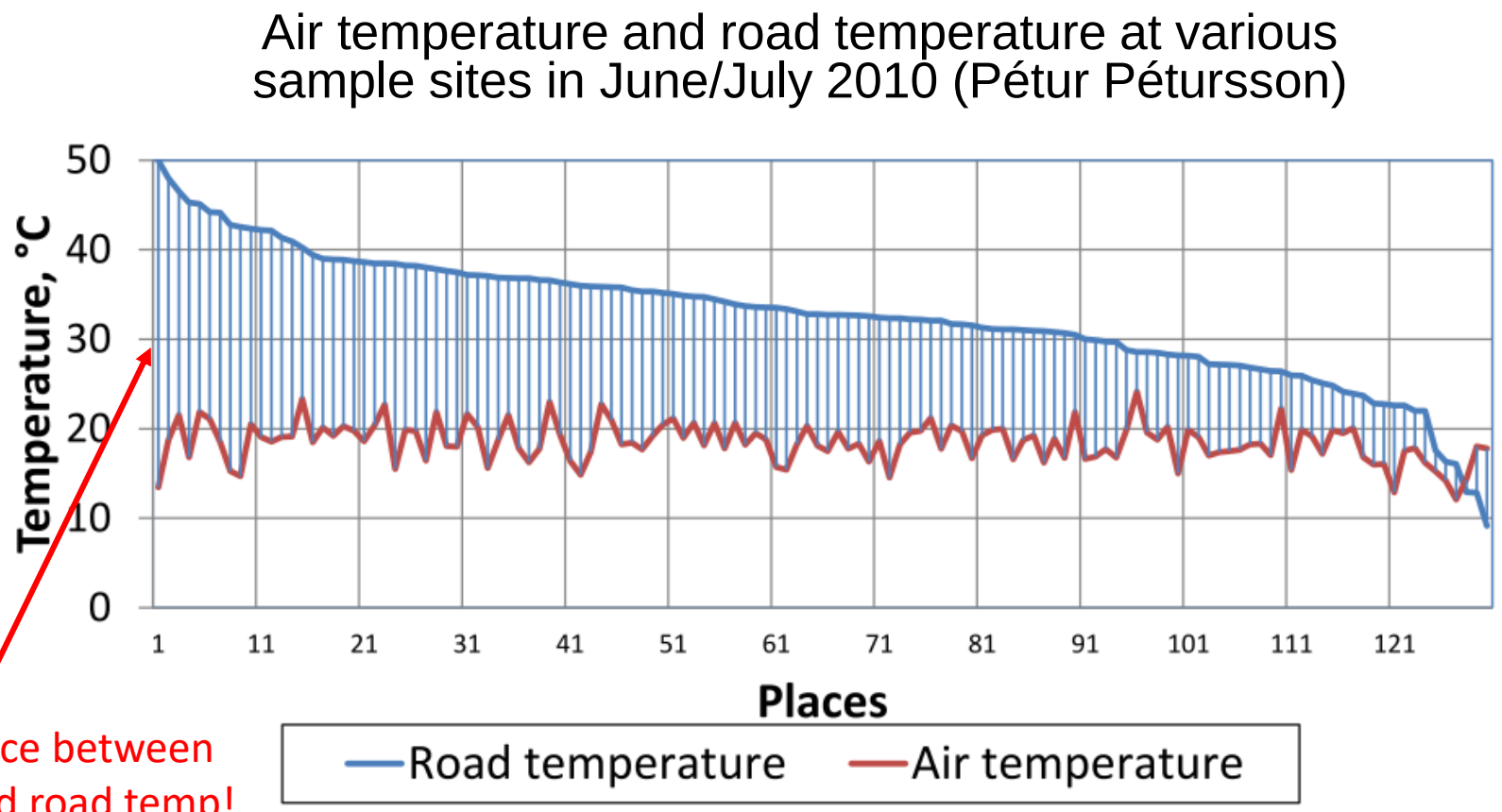

35° difference between air temp and road temp!

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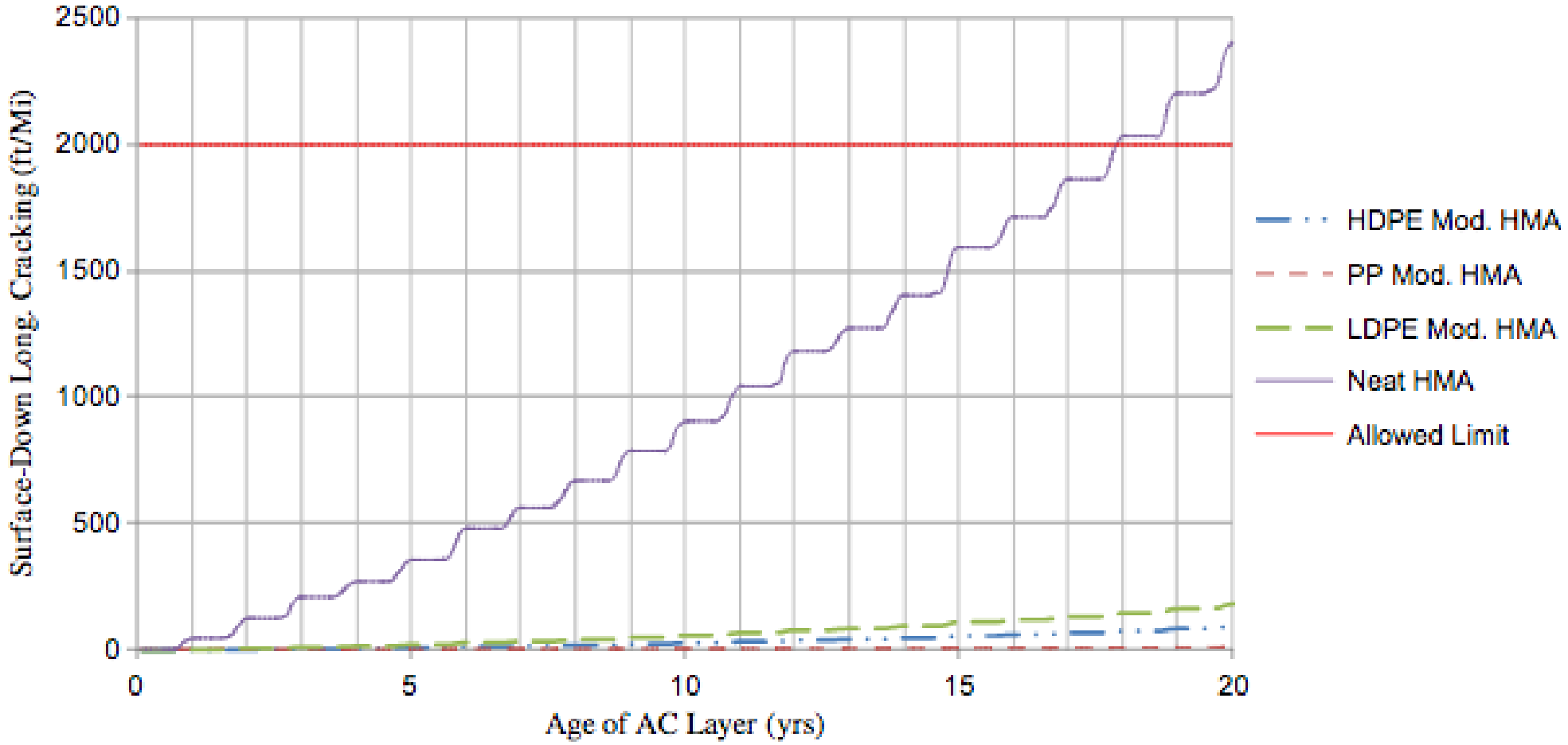
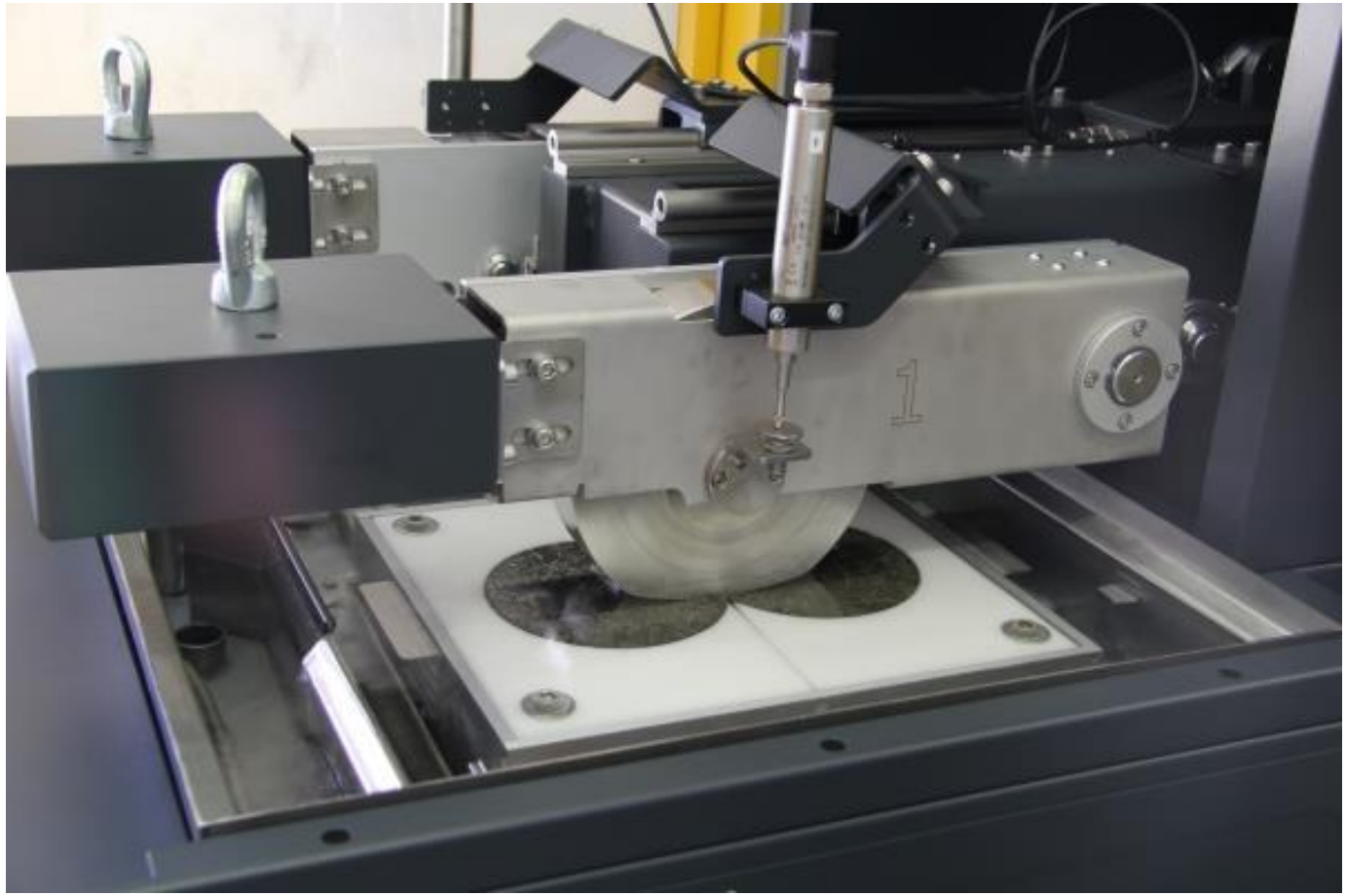


Benefits: Resistance to deformation

Marshall test
improved up to +60%

Benefits: Resistance to deformation



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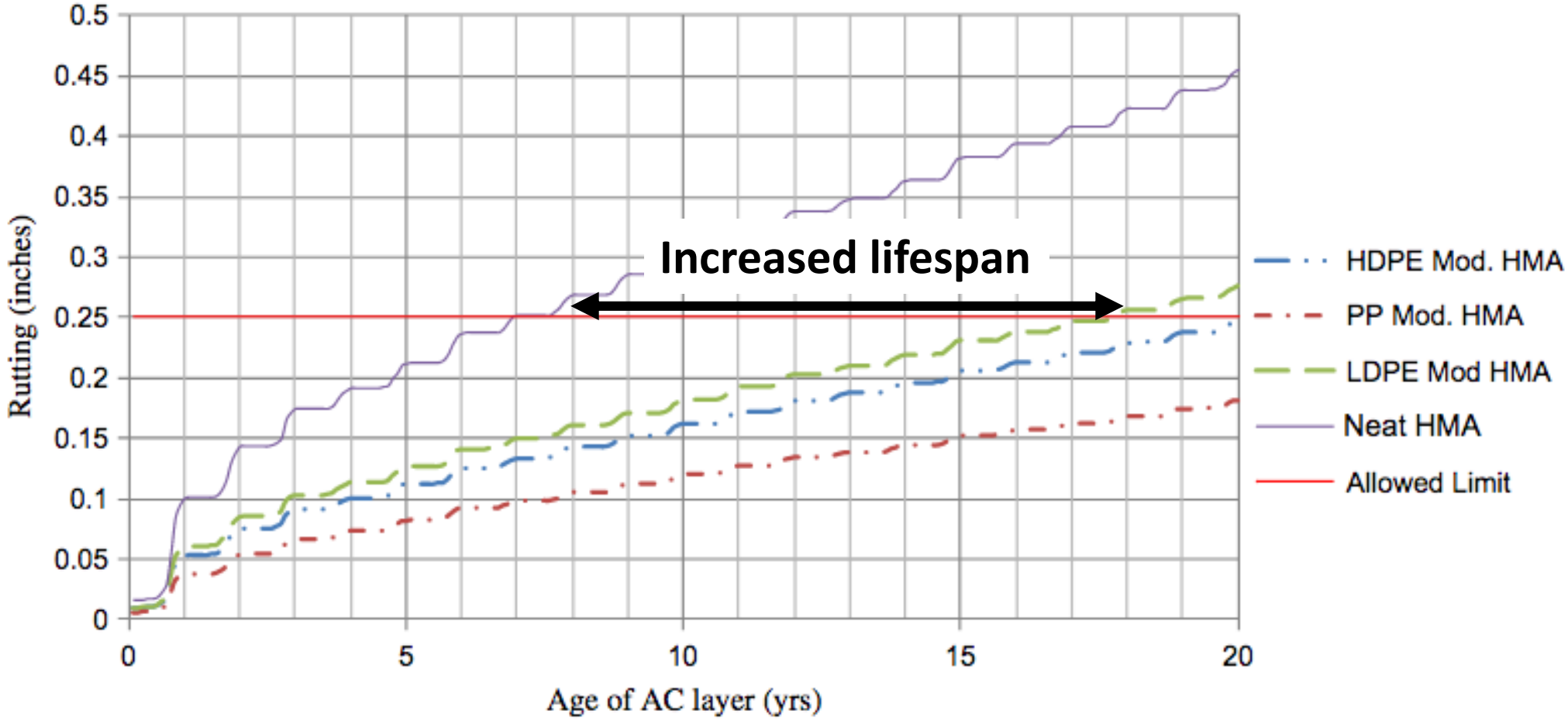

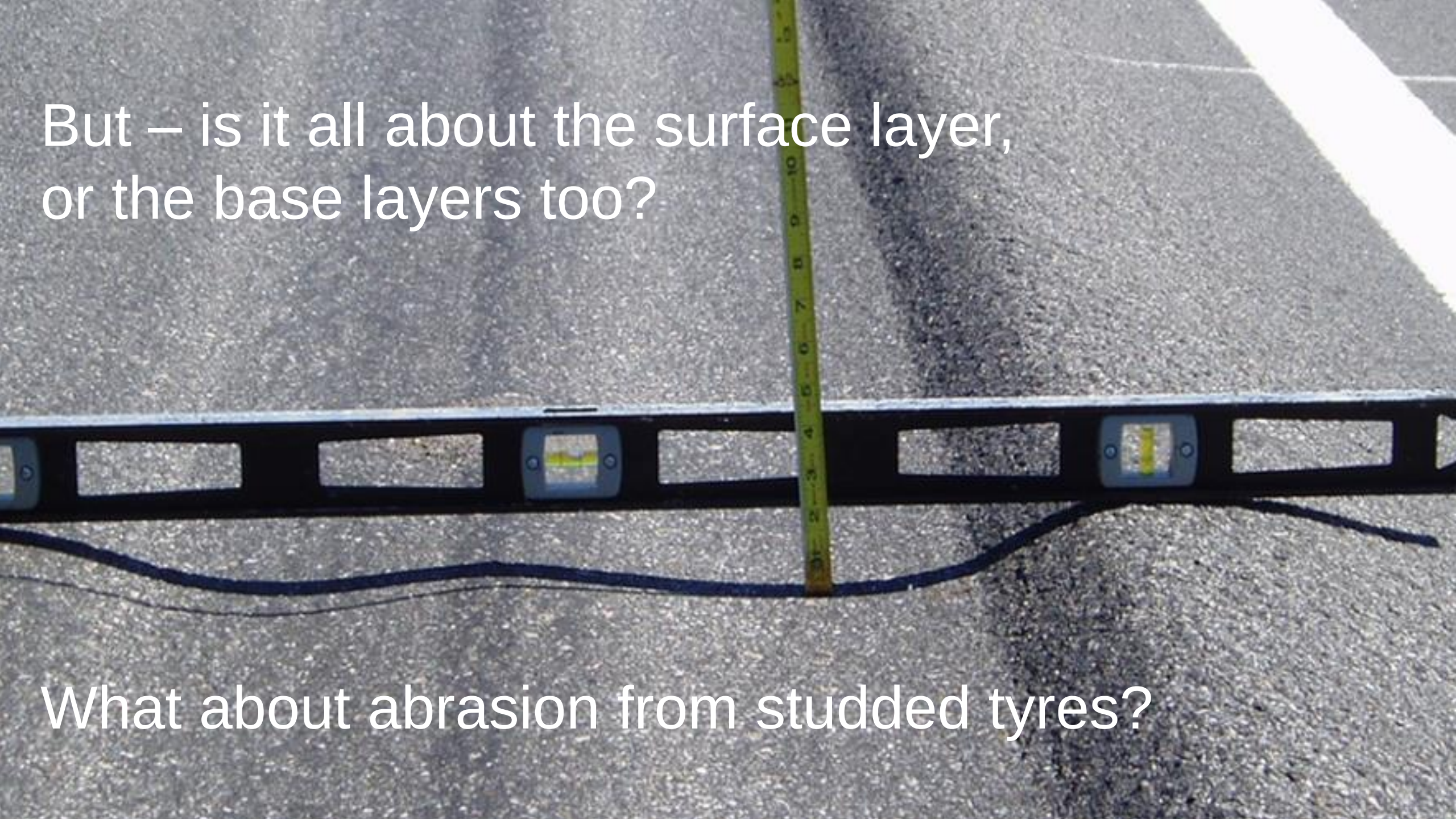
But – is it all about the surface layer,
or the base layers too?
What about abrasion from studded tyres?

Benefits: Other

- Elastic recovery/resilience – up to 100% better
- Abrasion – virgin polymers show up to 40% reduced wear – recycled?
- Reduced water penetration (and thus frost damage)
- Reduced stripping from oil and water
- Reduced ”drain-down” of binder in stone-matrix asphalt – replaces cellulose additives

Potential environmental benefits

- Reduced CO_2 emissions – 1,7-2,6 tCO_2e for every tonne of bitumen replaced by mixed plastic
- Most troublesome fractions of plastic recycled in a way that does not produce carbon emissions or pollute the environment
- Reduced impact from embodied energy in road production
- Reduced need to replace or repair roads, leading to further reductions in energy and material usage and less damage to cars

Potential economic benefits

- Helps the huge cost of disposing of mixed plastic waste (c. 30.000ISK/tonne; must be exported to Sweden for incineration)
- Reduced spending on materials (bitumen, aggregate), due to replacement and potential for reduced thickness – roughly1 bitumen tonne per lane-km replaced by plastic
- Reduced road repair and replacement rate long-term – could be the largest benefit of all – millions to billions of ISK saved

Potential Risks

- If PVC present at significant levels, dangerous levels of hydrogen chloride can be released (180° not hot enough for danger for other plastic)
  - Solution: remove the PVC
- How does it work in freeze-thaw cycles (30+ annually)?
  - Lab tests suggest it may be more resistant
- How does it change dust from the road? Microplastics? Leaching?
  - But less dust overall?
  - Plastics added to roads for a long time?
  - Is plastic any worse than bitumen?

Plan for 2018

- Plan specific tests
  - Select plastics for Icelandic waste streams
  - Marshall Stability, Prall, Wheel track etc.
  - Skid testing
  - Studded tyre-specific tests
  - Microplastics?
- Lay a test section at SORPA's Álfsnes site
- Build reliable bulk supply chain of shredded plastic

Funded MSc project available

- Funded by SORPA, more information: www.resource.is
- Collaboration with Höfði, Colas, NMÍ
- Plastic processing, lab testing and test section
- 300.000 ISK/month stipend for 12 months
- Potential for work with road authorities in Kazakhstan (!)


+40°c in summer!


Kazakhstan: -40°C in winter

27cm of asphalt concrete surface layer on major highways!

Questions

www.resource.is - jamie@resource.is