PERFORMANCE OF THE FLOW MIXING TECHNOLOGY IN ASPHALT CONCRETE AND THE ASPHALT RUBBER PROJECT IN SWEDEN

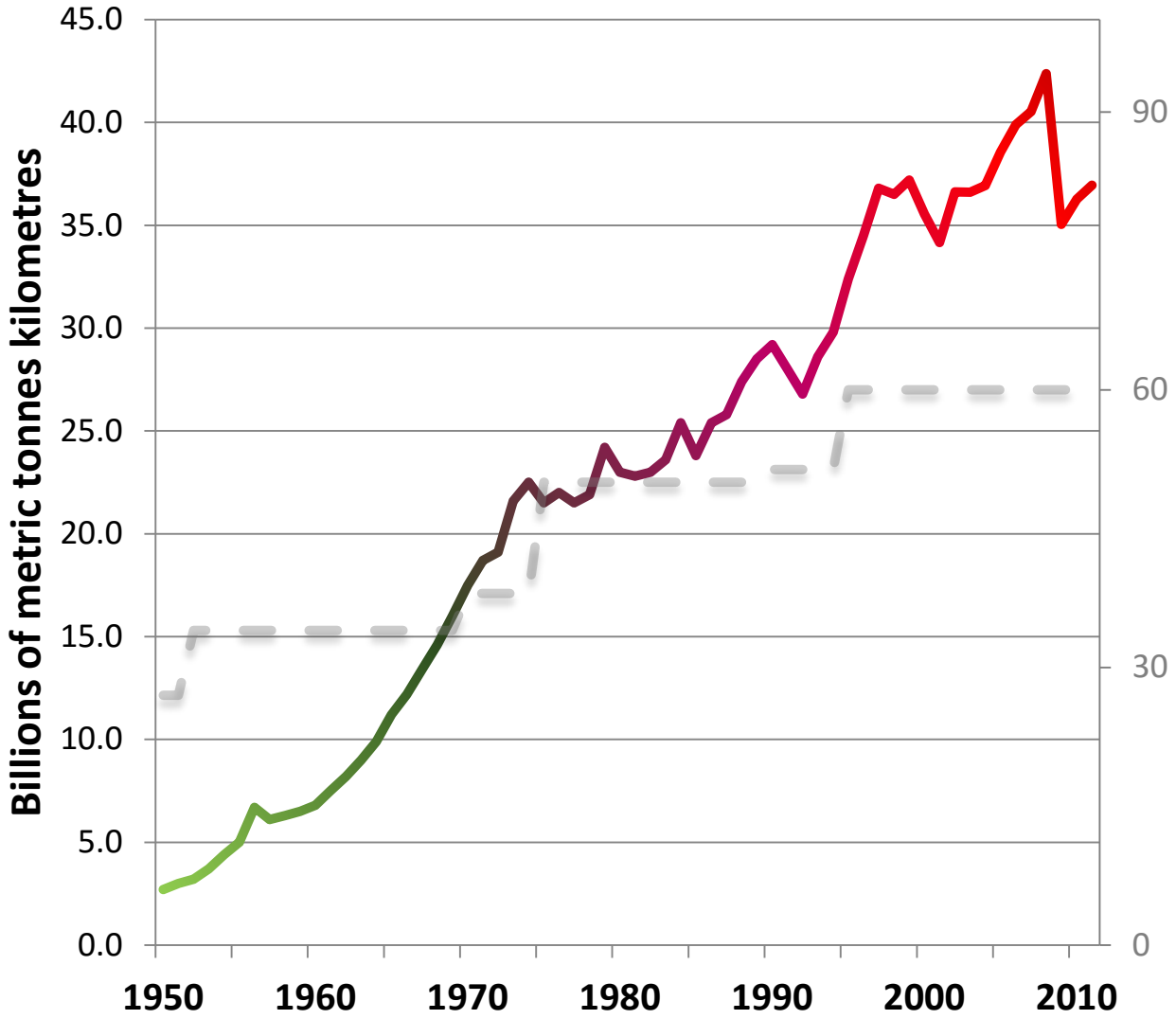
TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION

Mats Wendel
National Coordinator,
Road Surfaces

Where is Sweden?

Challenges for Sweden

Yearly increase of heavy traffic



2010, 86% of all conveyance of goods used vechicles with a maximum gross weight >55 metric tonnes

Source: trafikanalys mfl. www.trafa.se

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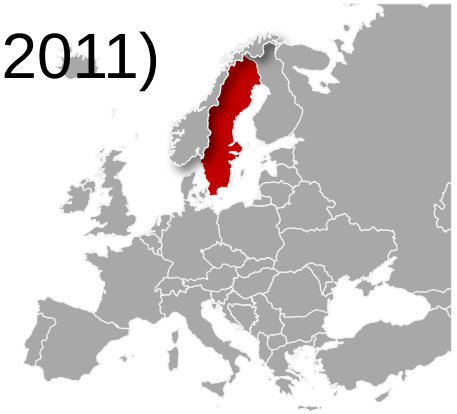

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Mats Wendel,
Senior Advisor, Road Pavements

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Aknowledgements

KGO Mixing AB, Finja, Sweden

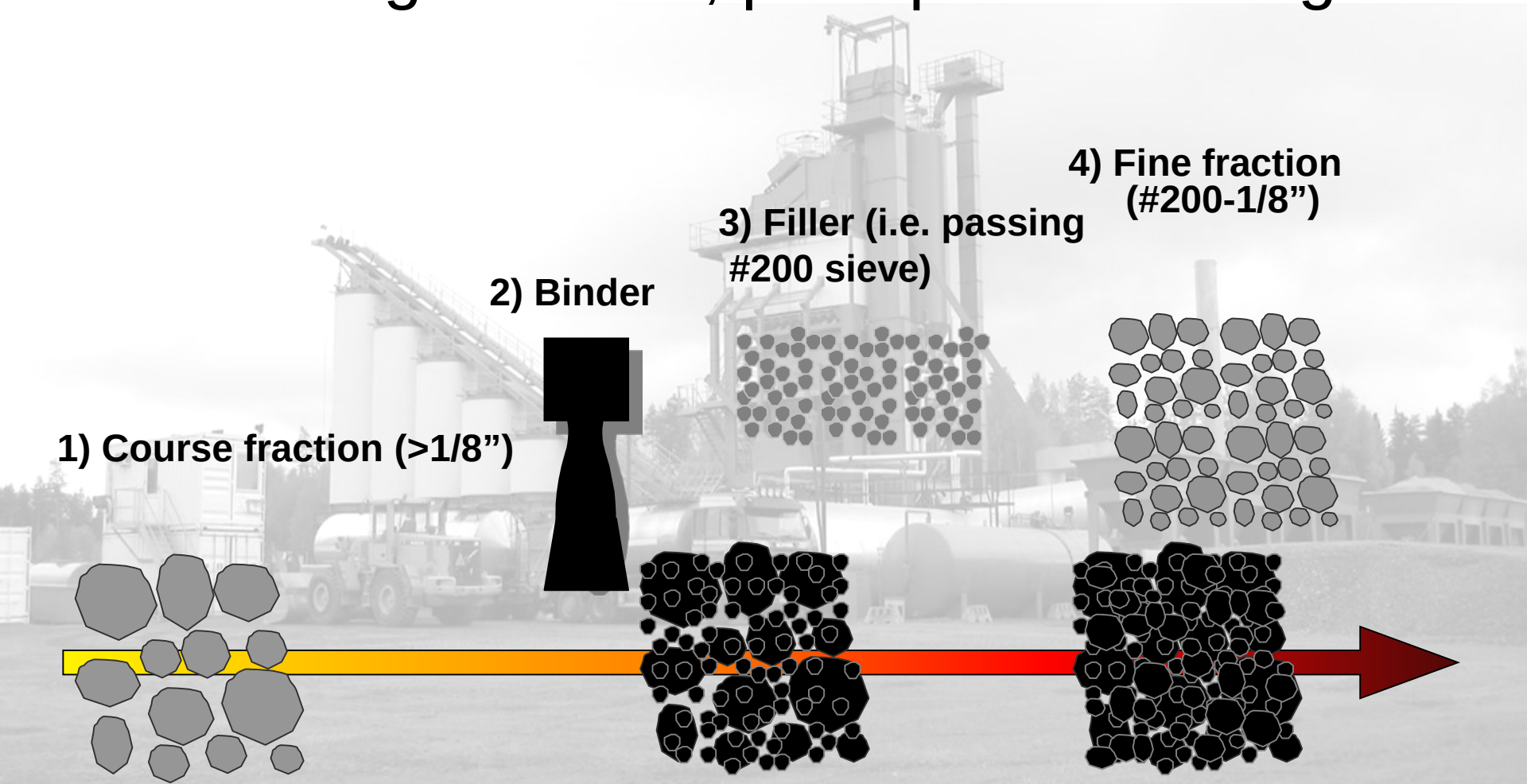
Swedish National Road and Transport Research Institute

What is the Flow Mixing Technology*?

- A technology to produce asphalt concrete mixes with same or better quality without use of extra additives.
- Through a controlled way of production, reduce valuable sources of raw material, save energy, and give long lasting products.

* The Flow Mixing Technology is also called the KGO-III method, which is patented technology by Karl Gunnar Ohlson, Sweden

Flow mixing method*, principles of mixing



Mats Wendel, Swedish Transport Administration

* According to KGO-III method

Normal mixing procedure

In the video, material is used to illustrate the method. All repeating has same amounts of material (water, filler (<#200 sieve) and sand (<No. 40 i.e. 1/12“)

Flow mixing procedure

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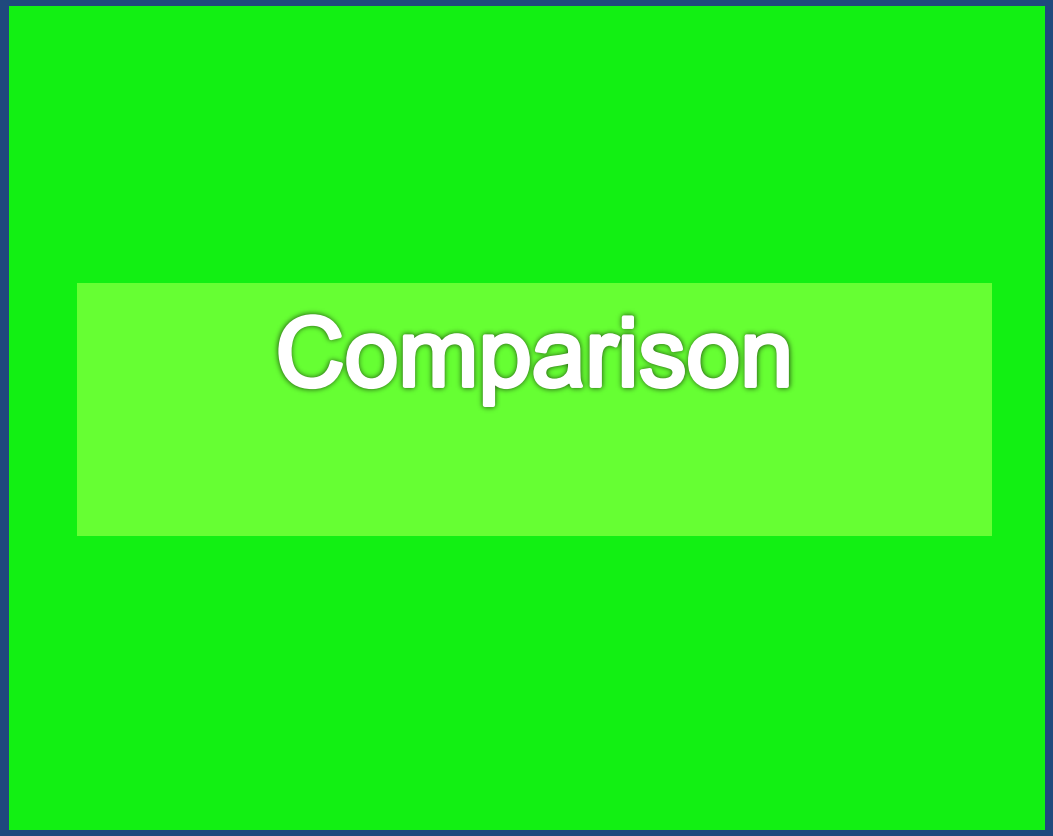
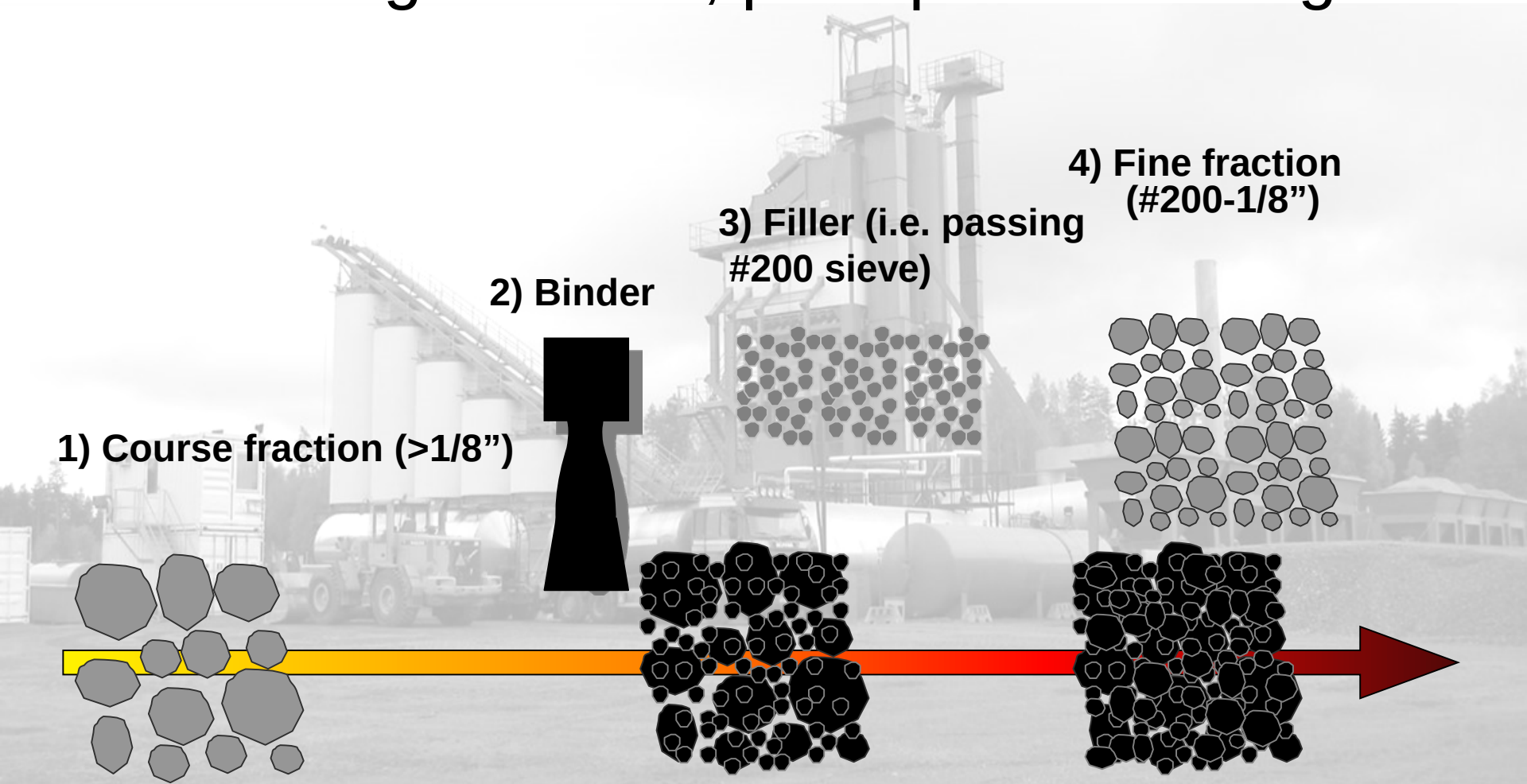
Comparison: Normal vs Flow mixing procedure



Under same conditions!

Flow mixing method*, principles of mixing



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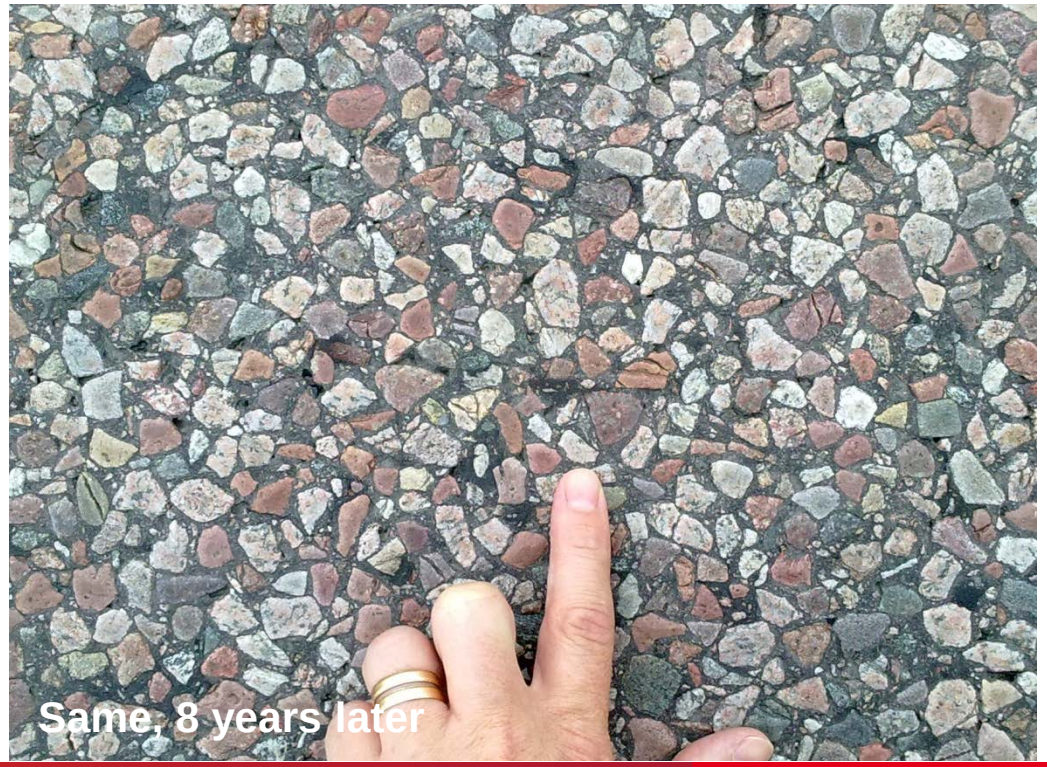
* According to KGO-III method

The pavement has a characteristic glow, which indicates thick film coating

SMA test section U537
7000 AADT, 10% heavy trucks

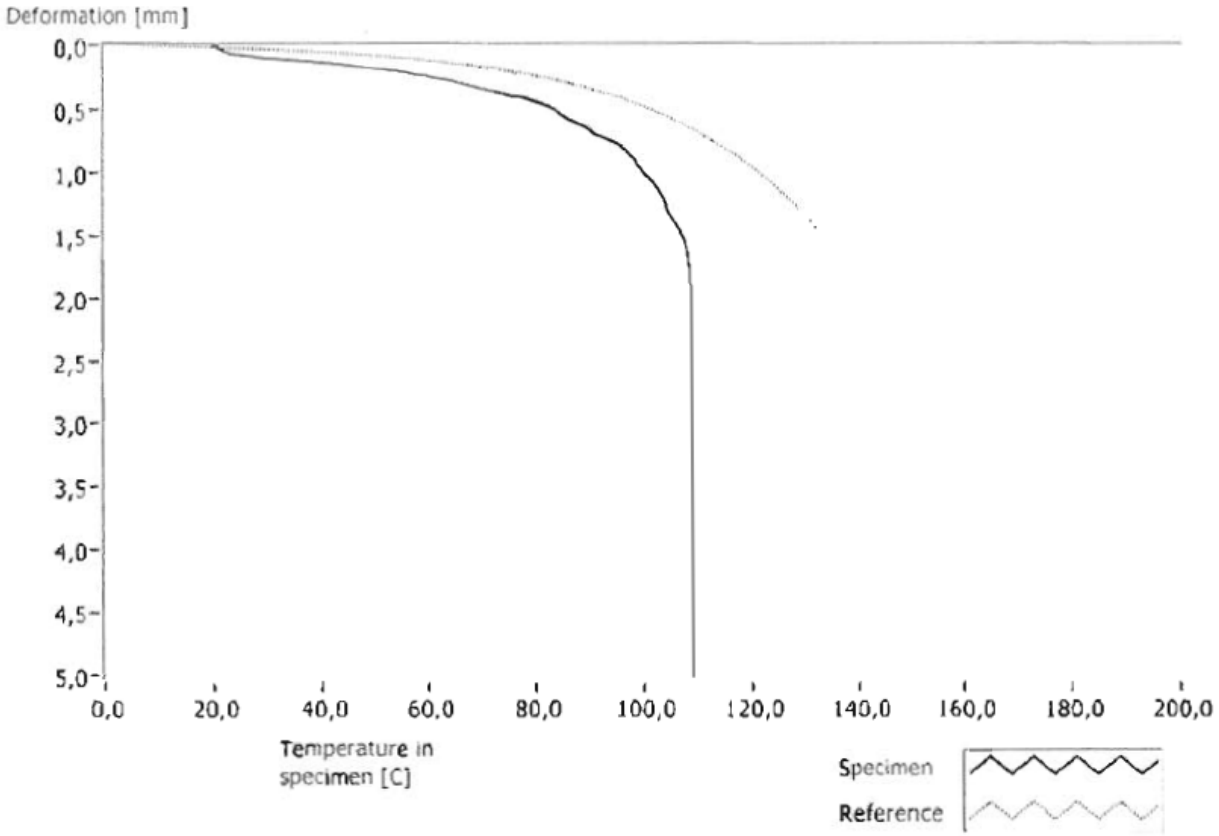


Positive effects due to observations and testing

- Production temperature can (and must) be lowered and not exceed 325 F – compactability not effected. (No smoke!)
- In Swedish (bitumen rich) top layers, the binder content (%AC), has to be decreased by 0.5%-units (equals approx 8% less bitumen).
- Better homogeneity (!) and the asphalt mix is more sticky and have visibly less segregation.

New test method: TOD – verifies the production

- TOD is a test method to verify that the production works.
- Both lab produced and drilled cores can be tested.
- This is the key to ensure quality.



The TOD test provide a measure of viscous deformation in the specimens.

Ocular comparison (the effect)

Base Layer (1”)

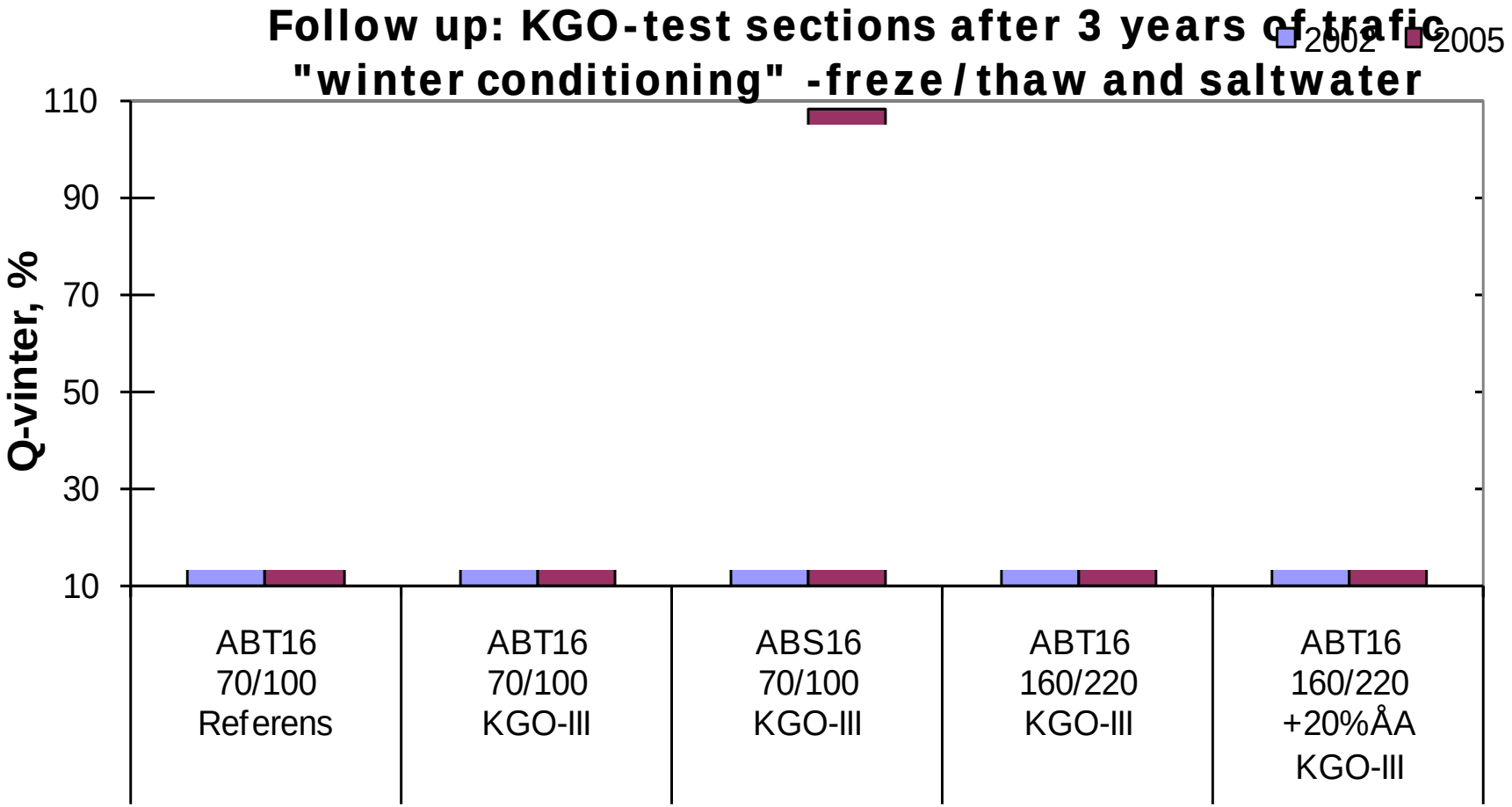
Flow mixed Base Layer (1”)

Performance of tested Asphalt Concrete

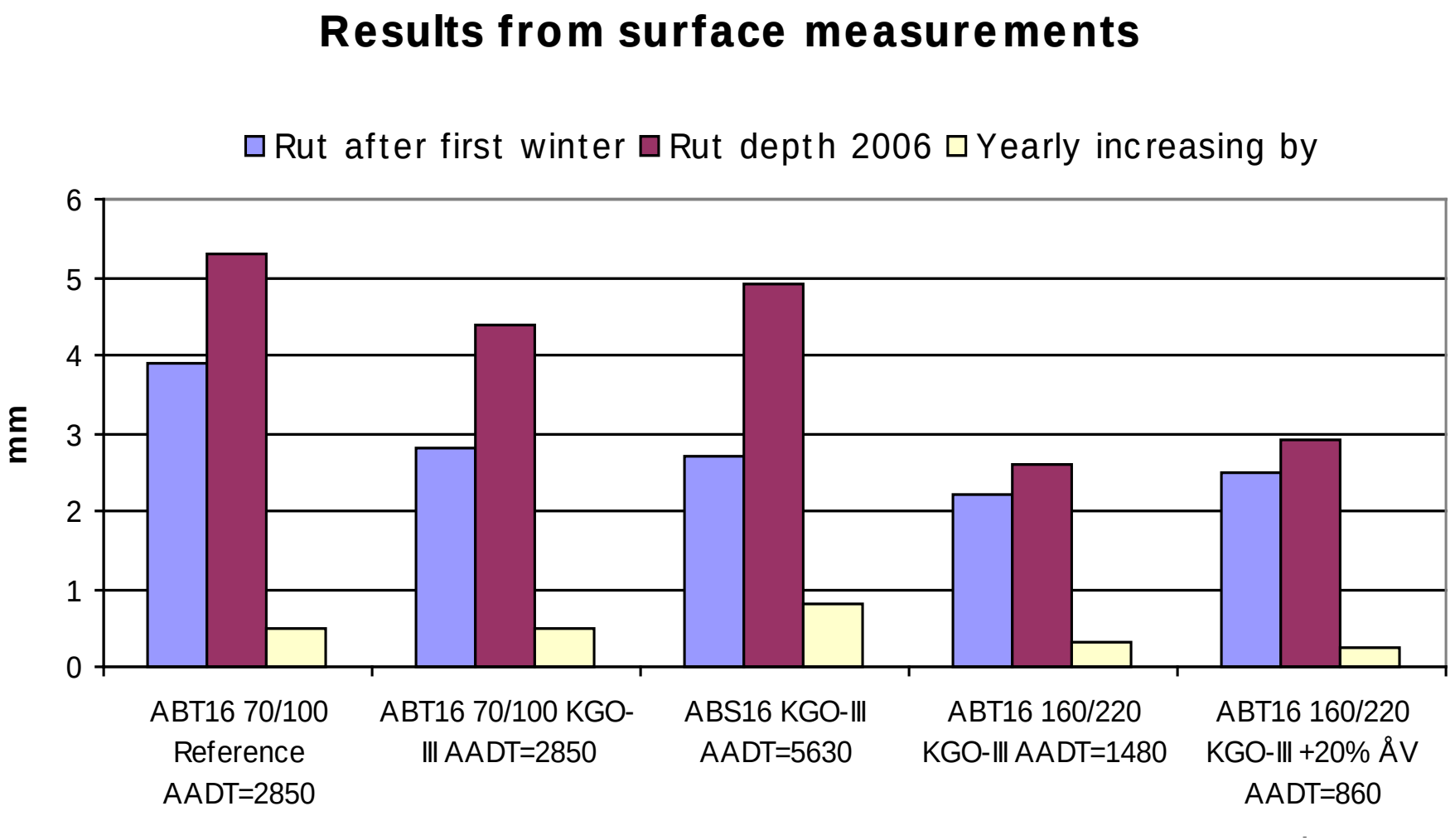
Mix types: Base layer, Binder layer, SMA, Dens graded, Open graded, Thin Asphalt Layers
Binder used: pen. 50/70, 70/100, 100/150, 160/220, PMB, PMA, RAP

- ✓ Friction
- ✓ Homogenity
- ✓ Compactability
- ✓ Deformation
- ✓ Water sensitivity
- ✓ Wear – the Nordic Abrasion test
- ✓ Rut depth

- ✓ Stiffness


Follow up: KGO-test sections after 3 years of trafic
"winter conditioning" -freze/thaw and saltwater
2002
2005
Q-vinter, %
110
90
70
50
30
10
ABT16 70/100 Referens
ABT16 70/100 KGO-III
ABS16 70/100 KGO-III
ABT16 160/220 KGO-III
ABT16 160/220 +20%ÅA KGO-III

Rut depth development



Environmental effects

>600.000 metric tons produced so far in Sweden since 1999

+ Lower temperature

+ Less bitumen

= better quality and better for our environment

There are several reports published, but unfortunately most are in Swedish…

Link:

www.vti.se/publications

Pictures from roads produced with the KGO-III method

Note. From 2008, the KGO-III method is allowed on “State roads” according to STA spec.

Flow Mixing Method

Main concerns

- So far, only applied in batch plants
- Old asphalt plants may have a reduced production rate.
- The dissemination of Know-How
- The lab procedure is difficult to perform
- Adjustments, such as gradation and AC-content, may be “out of spec.”
- “Not invented here” – effect and reluctance to try

Flow Mixing Method

Main advantages

- Less segregation
- Enhanced deformation stability
- It’s a “no tender zone” mix
- Known method, years of good performance
- Several positive environmental effects:
  - Energy efficiency (and CO_2)
  - Natural resources
  - Extended technical lifetime

KGO-III surface, paved in 2004,
picture from summer 2010.

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TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION

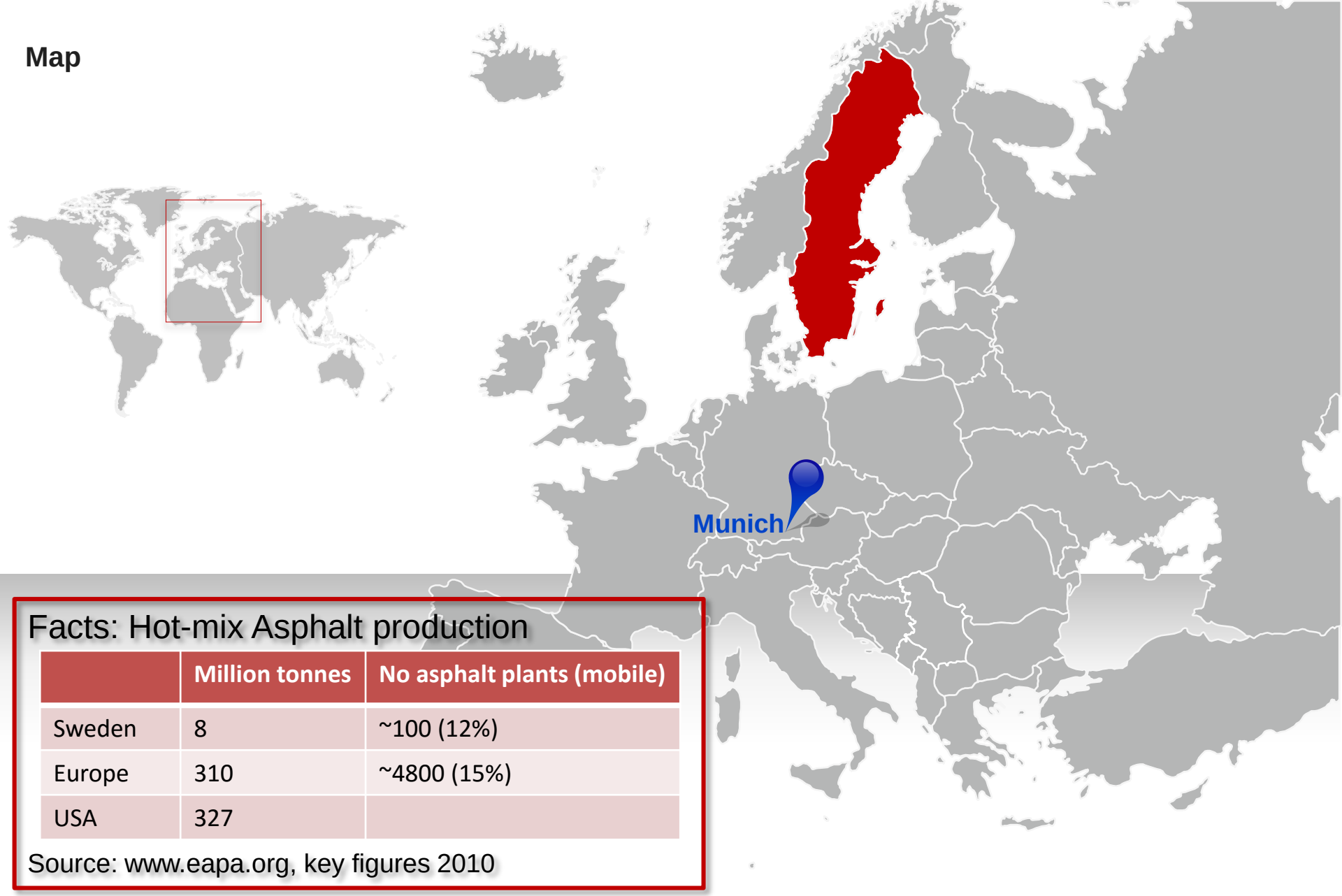
Schwedisches Amt für Verkehrswesen

Mats Wendel, EUR ING

Deputy Head of National Maintenance, Road and Railway

“Everybody arrives smoothly - the green and safe way”

Map



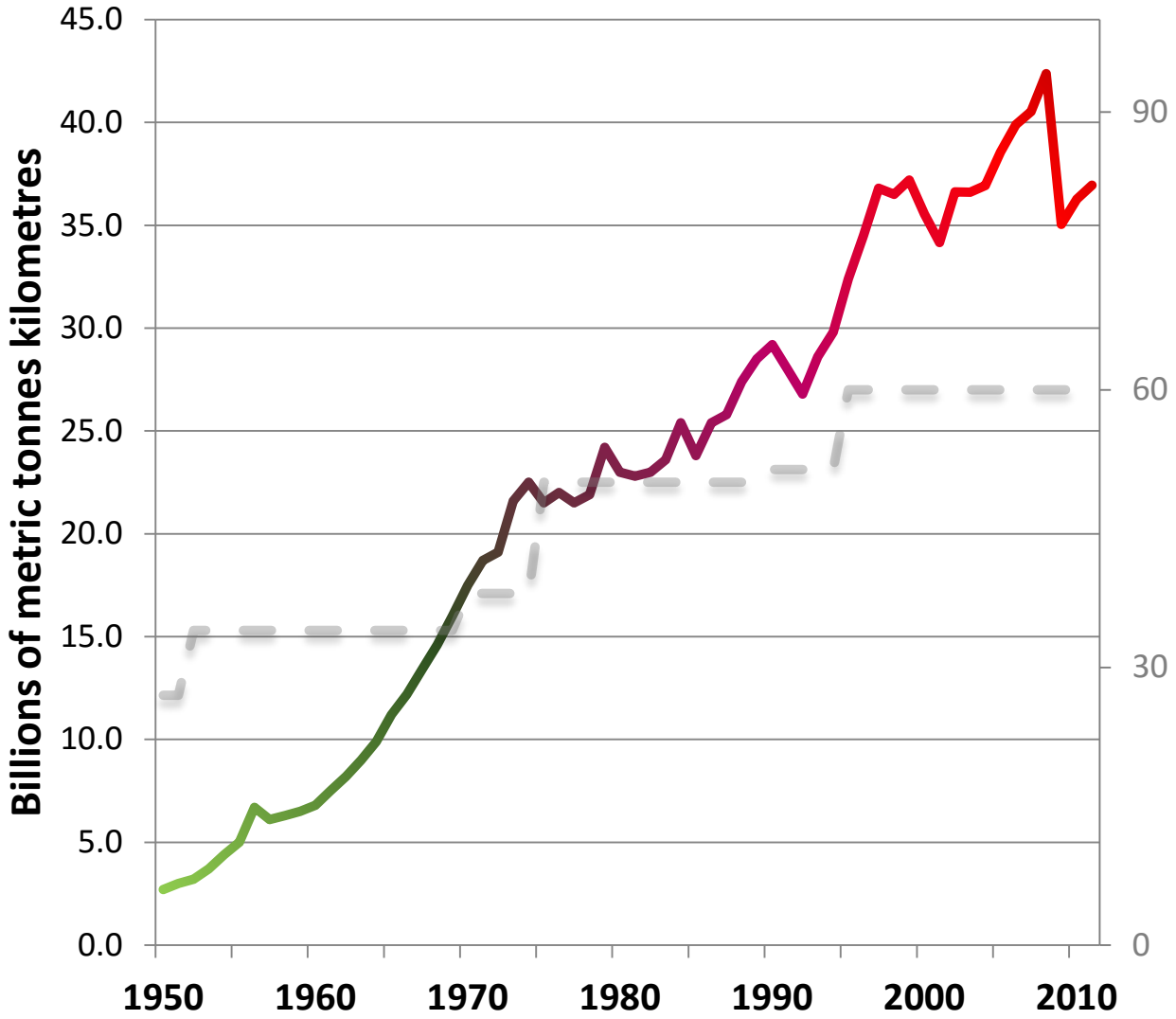
Facts: Hot-mix Asphalt production

	Million tonnes	No asphalt plants (mobile)
Sweden	8	~100 (12%)
Europe	310	~4800 (15%)
USA	327	

Source: www.eapa.org, key figures 2010

Challenges for Sweden

Yearly increase of heavy traffic



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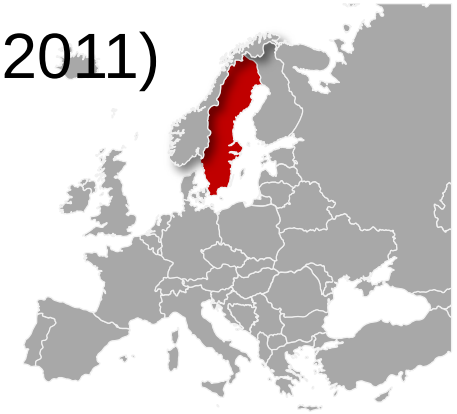


Asphalt Rubber – a new concept for road pavements in Sweden

- **"A three year (2007 – 2009) research and development project where the STA is the main responsible part "**
- **2010 – ongoing**
  - **continuous study of produced test sections**
  - **continued implementation**

Focus: Implementation of already existing technology

Tires with steel studs - an extra challenge for AR

Objectives

- **Reduced annual cost by increased technical life time (LCC)**
- **Environmental advantages**
  - **Reduction of noise (open concept)**
  - **Reduction of particle emission**
  - **Less wear from studded tires?**
- **Increased traffic safety**
  - **Better skid resistance**
  - **Open concept less water curtains - splash and spray**

TheGoodStuff...

History in brief (highlights)

2006: A literature study, education in US and AR2006. Decided to implement the wet technology.

2007: Lots of environmental (green) studies, the rent of binder-blender unit and first test sections.

2008: More test sections, training and a failure with one low noise section.

2009: Swedish specification, test sections on high volume roads.

2010: International conference, the project ended successfully.

History in brief (highlights)

2010: Decision to start a new project (2G), more low noise sections and follow up work.

2011: AR in really cold climate (dens graded AR), thin layer with AR and encounter capacity problems.

2012: Innovation contract about AR-blending service, test of 50/50 evaluation bid. Continued production.

2013: Produce test sections with AR-WMA, more 50/50 bids and encouraged contractors.

2014: Established product, put on market.

Some locations for the AR test sections

Close to city:

1. Malmö area
2. Norrköping
3. Gothenburg
4. Jönköping
5. Stockholm
6. Storuman
7. Uppsala

Several test sections at most places.

Challenges we needed to overcome

- **Environmental restrictions (Swedish Chemicals Agency)**
- **Technical possibilities for production**
  - **Equipment availability (CE marking)**
  - **The hook-up to Hot-Mix asphalt plants**
  - **Contractors for paving**
- **Crumb Rubber supply**
- **Mix design and laboratory work**
- **Workers surrounding (i.e. fumes and smell)**

Performance testing

- ASU Arizona State University Phoenix
- VTI Swedish Transport and Road Research laboratory Linkoping
- Contractors laboratories
  - Testing mostly according Swedish and European standards

Results are promising! Reality will prove this, and test sections are looking good.

Find out more by visiting our website:
www.trafikverket.se/gummiasfalt

Environment related studies

- **Workers exposure**
  - **PAH, far below limiting values**
  - **Weather conditions have influence on air quality for workers (Air temperature, Wind)**
- **AR binder increased leaching**
  - **PAH & Cresols found, but low according to limit**
  - **Benzothiazole – no acute toxic effect**
- **Particle emissions**
  - **AR pavement gave lower emissions than reference**

Note: A new workers safety study has started at the Universtiy of Lund.

AR production in Sweden 2007-2012

- > 110 000 ton of Mix
- > 100 km of test sections
- > 25 Different Projects
- Used around 2 000 ton of Rubber granules (0-1 mm)

What have we achieved with our AR project, so far

1) We can produce Asphalt Rubber with, as expected, good quality!
2) We have shown that environmental issues (leakage, emissions) can be managed. In a broader view there is no negative impact to the surrondings – benefits exists!
3) The workers health can be managed; especially with sharing information and a maximum manufacturing temperature (not to be exceeded).
4) We have a technical specification for AR - GAP graded pavements.
5) Asphalt Rubber is definitely a pavement concept for Swedish roads.

A word of advise,

- a successful project can be achieved if;

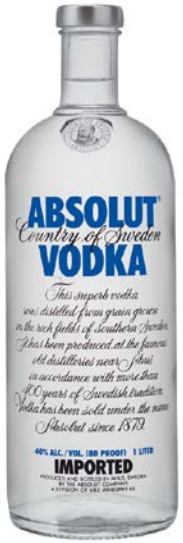
- You do your homework properly (investigate, get know-how)
- You make a good plan for the project and get the money
- Use skilled personnel
- You need champions

- Manage your risks – and see the opportunities!

- **Share your experience!**

IKEA

Thank you!



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