ECO-INNOVATIVE BITUMEN BINDERS: A WAY TOWARDS GREENER ROADS

Workshop: Promoting Circular Economy for a Greener Road Construction
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OUR WORLD IS CHANGING...

**Linear model**
- Take
- Make
- Waste
- End of life

**Circular model**
- Restoration
- Energy & resources → Closed loop
- Target:

![Zero Waste Image]
SOME IMPORTANT ASPECTS ON CIRCULAR ECONOMY

- Use waste as a resource
  Target: 0 waste

- Use as less raw resources as possible
  Keep resources in circulation as long as possible

- Design for the future
  - Build to last
  - Build so that components can be reused

- Preserve and extend what is already made

- Collaborate to create joint value across the supply chain

We are working on that!
BUT THERE IS STILL A LONG WAY TO WALK...

Each second 60 tons of residues are generated worldwide.

In 4 months we could have Madrid covered by 1m height layer of solid waste.

What can we do with residues?

- Make them raw materials
- Find new uses
OLD MATERIALS, NEW USES

**Crumb rubber**

- Crumb rubber FCC Catalyst residue Lignin

- Crumb rubber are disposed of each year alone in the USA.

- Resembles bitumen...

**FCC Catalyst residue**

- Zeolites

**Lignin**

- 30% SBS rubber

Beware! Roads are not dumping sites!!
CRUMB RUBBER: IT IS RUBBER STILL

300 000 tons of tyres are disposed in Spain every year

- 30% Styrene-butadiene rubber
- They can be transformed into rubber powder

How can we use it in bitumen binders?
- Full range of products with **better properties** than standard penetration bitumes:
  - High viscosity binders
  - High modulus bitumen

But not any crumb rubber powder works...
The key: Its **surface**
CRUMB RUBBER BITUMEN BINDERS: TYPES

- Crumb rubber improved bitumen
  Better performance that conventional bitumen

- High viscosity modified bitumen
  For high cracking resistance applications

- Crumb rubber modified bitumen
  CR enables reaching EN-14023 PMB properties
FCC CATALYST RESIDUE: ZEOLITES

Zeolites
- Microporous material
- High water adsorption: up to 30% w/w
- Fully reversible hydration-dehydration

How can we use it in bitumen binders?
- Warm mixes: Indirect foaming
  - Zeolites can release water in a controlled manner
- Reduce working temperature $\approx 20^\circ C$ ➔ Energy saving, improving safety
- Performance of mixes ➔ Similar or even better than reference hot mixes

But not any catalyst residue works...
LIGNIN: FULLY RENEWABLE

- Waste from wood industry and bio-refining: Dispose or burn
- Complex chemical structure... quite similar to asphaltenes.

Where does lignin come from?

- Blend with gasoline
- Biogas or additional ethanol production
- Fuel green power

[Diagram showing the Inbicon process with wheat straw inputs and outputs like ethanol, C5 molasses, and solid biofuel]
LIGNIN: FULLY RENEWABLE

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- Complex chemical structure... quite similar to asphaltenes.

Can we use it in bitumen binders?

- Collaboration with ACCIONA
- Greener modified binders meeting PMB 45/80-60 and PMB 45/80-65 specifications
- It will be tested in a real road in a couple of weeks

Key aspect:

Storage stability and sedimentation
SOME THINGS TO KEEP IN MIND:

An important advantage of bitumen is its **RECYCLABILITY**

- New compounds added to bitumen may damage its future reciclability

- **Recycling ≠ Reusing**! Specific binders are required (rejuvenators, additives, etc.)

- Recycling asphalt requires high control of the mixing process
FINAL REMARKS: ECO-INNOVATION IN BITUMEN BINDERS

• A variety of residues can be used as raw materials for greener bitumen binders.

  At that point, they must be **controlled** and have **specifications** (as any other raw material!)

• Roads are not dumping sites: We must focus on incorporating materials that **improve** the performance of our roads
Keep on innovating!

Thank you