



Vaccum tunnel coating protection for HYPERLOOP high-speed rail transport

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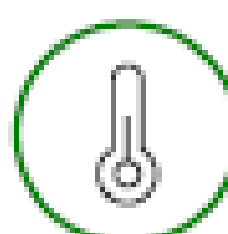
RASCoS project – Robotic Automated Sustainable Coating System

- > An international research project leveraging the **synergy** between materials chemistry, automation and robotics
- > Focused on the development of an automated system for coating deposition to be deployed with a newly developed bio-based coating formulation
- > Carried out within the framework of the 2nd edition of the **Swiss-Polish Cooperation Programme**



<https://eurotube.org/hyperloop/> "Representation of the vacuum transport system by the EuroTube Foundation"

Operational requirements – environmental challenges

-  **Low air density** and heat transfer mechanisms
-  **Vacuum sealant**
-  Resistance to **temperature fluctuations** during operation
-  **Chemical resistance** and long-term durability

Formulation design assumptions – selection of polymer binders

PREPARED COMPOSITIONS and tested systems

P1 + H1
H2
H3

PO1 + H1
PO2 + H2
H3

Ep1 + CA1
CA2
CA3
CA4
CA5

>>> **MILESTONE: ≥ 40% biobased content**

Polyurethanes

- > 3 types of high solid polyol (**solvent-free**)
- > Polyole biobased content determined by C14 analysis (**up to 80 %**)
- > **Biobased PDI isocyanate** (≈ 70 % biobased content)

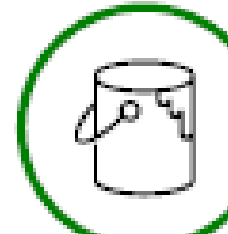
Polyurea & polyaspartic

- > 2 types of high solid polyol (solvent-free) based on **castor oil**
- > Polyole biobased content determined by C14 analysis (≈ 27 %)
- > **Biobased PDI isocyanate** (≈ 70 % biobased content)

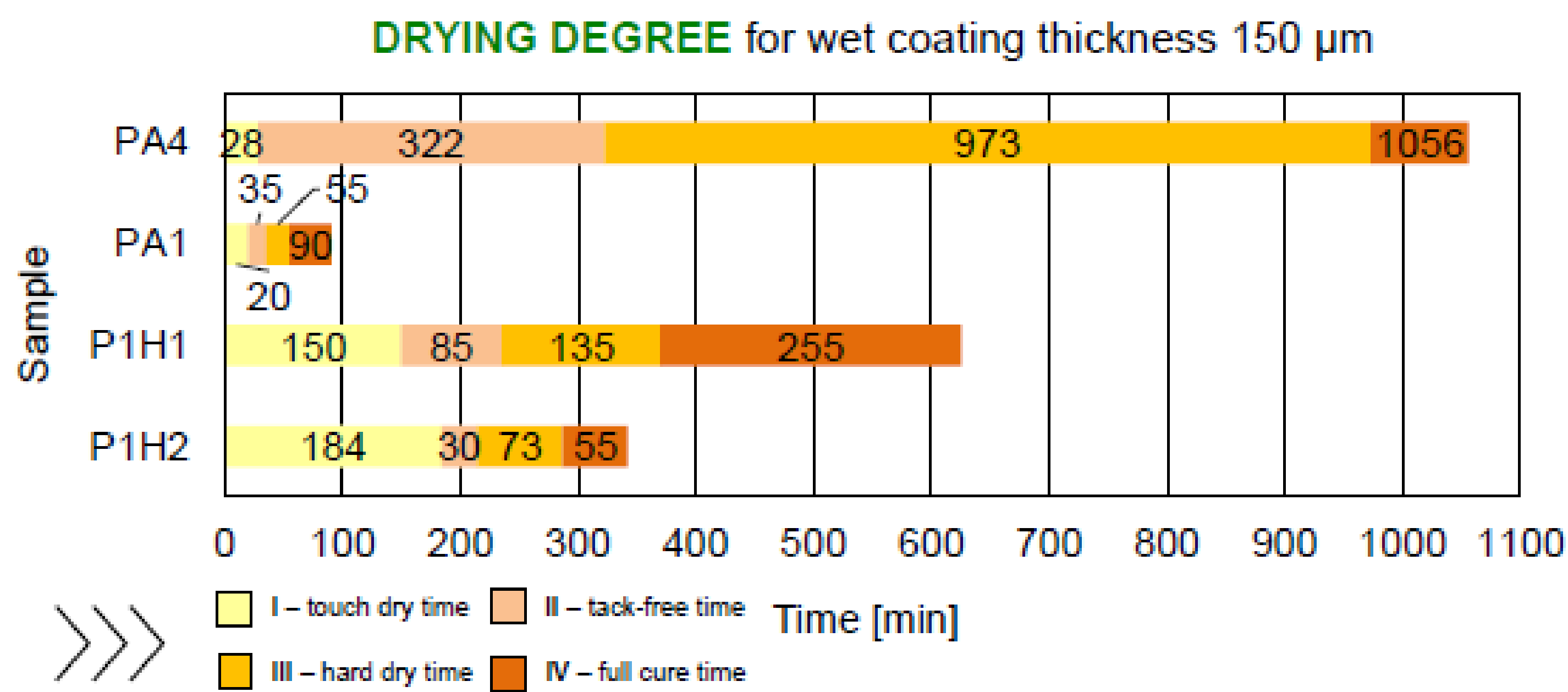
Epoxies

- > High solid epoxy resin (**biobased content ≈ 33 %**)
- > Fossil based hardners (no biobased content)
- > **Dimerized diamines** as biobased components for hardening

Formulation design assumptions – target coating properties

-  **Crack bridging** and **patching** capability
-  **Airtightness** and **Reduced permeability**
-  **Adhesion to concrete** substrates under vacuum conditions
-  **Long-term protection** and **application properties** of the coatings

Laboratory testing – preliminary results



PULL-OFF TEST for coating adhesion assessment (ø = 20 mm, P = 1,0 MPa)



Sample	Biocontent [%]	Drying time IV [25 C°]	Dry coating thickness [µm]	Persoz hardnes [s]	Impact strength [cm]
PA1	44	≈ 1 h 30 min	124-130	289-303	100
PA4	43	≈ 17 h 30 min	127-186	321-322	100
P1H1	43-50	≈ 10 h 25 min	53-70	20-21	100
P1H2	43-50	≈ 5 h 50 min	16-50	19-20	90

- 1 Development of **bio-based formulations** and evaluation of their performance using techniques and methods conventionally applied in the paints and coatings industry
- 2 Testing of the developed solutions under near-real operating conditions, including trials conducted using **DemoTube** – EuroTube's Hyperloop test track

Acknowledgments

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