HSR

A rubber recycling solution

RUBBER DAY 2025

28/01/2025 MILAN

Rodrigo DIAZ

1907-2024 - over 100 years of innovation

- French company founded in 1907 by Robert Esnault-Pelterie
- Specialized in rubber injection technology since 1961.
- Headquarters ➔ Lyon, France.
- 9 subsidiaries and about 30 agencies worldwide.
- Issued Share Capital: 2 500 000 Euros.
- 12,000 injection molding machines installed in 77 countries.

HSR and the circular economy

Ingrédients

Mixing

Vulcanization

- *Injection molding*
- *Press molding*
- *Extrusion*
- *Calendering*
- …

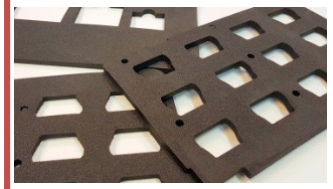
Final product(1er)

Final product (Neme)

End of life waste

Production waste

Production waste



Recyclage primaire

R. DIAZ

28/01/2025

HSR and the circular economy

Ingrédients

Mixing

Vulcanization

- *Injection molding*
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Final product(1er)

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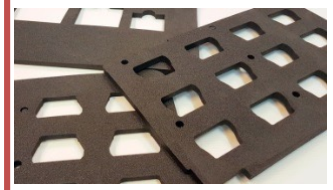
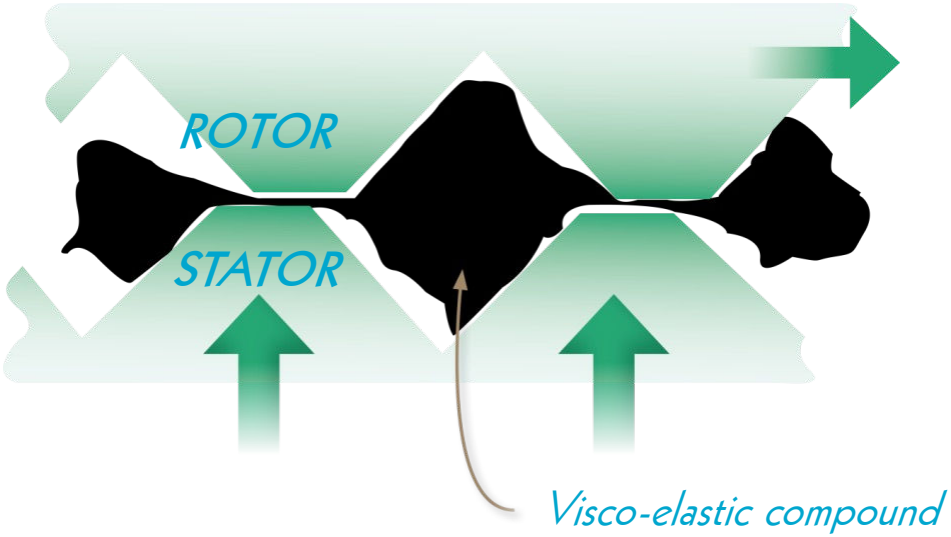


HSR process

R. DIAZ

High Shear Regeneration (HSR)

What is it?



The rubber is subjected to a series of "high levels of shear and extensional stressing that provides an efficient way of selectively breaking cross-linking bonds".

This processed rubber can be reintegrated into the original rubber blend.

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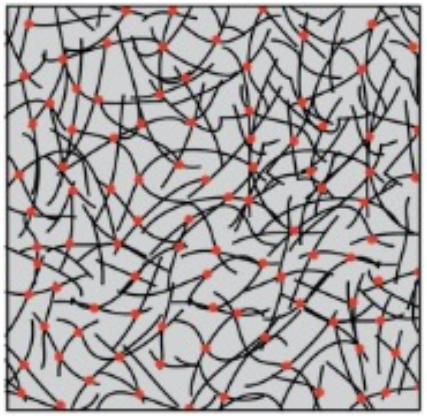
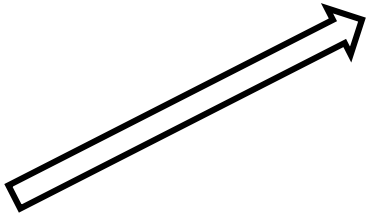
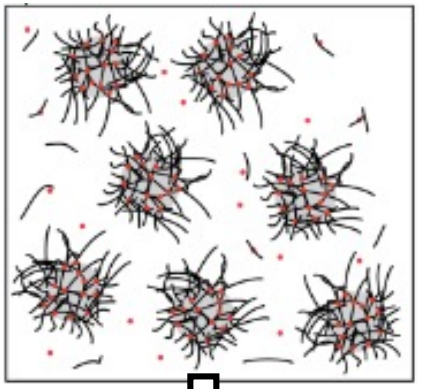
HSR process

- A model that describes the evolution of the treated rubber was proposed.*

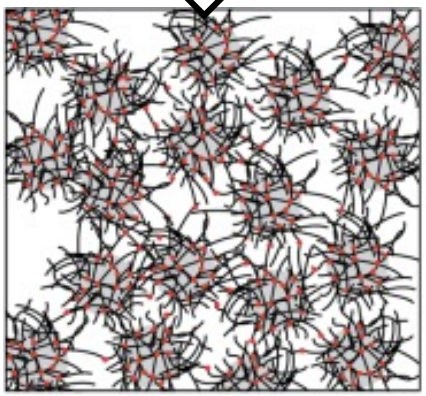


The rubber before treatment has an homogeneous crosslink density.





During the HSR process, rubber particles are created. The surface of these particles is mostly devulcanized.



While the heat and pressure increases the rubber particles agglomerate and start to vulcanize.

*Thermo-mechanical recycling of rubber: Relationship between material properties and specific mechanical energy
R Diaz, G Colomines, E Peuvrel-Disdier, R Deterre - Journal of Materials Processing Technology, 2018

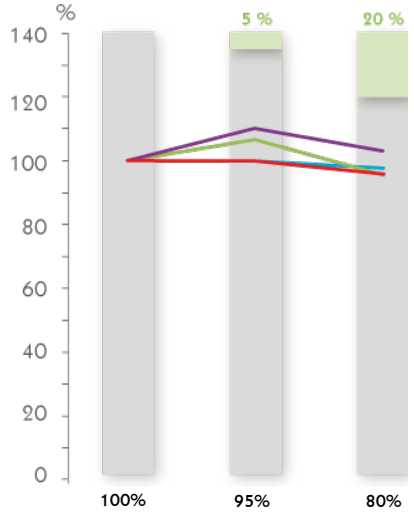
Economical and ecological rubber cycle

Impact on the basic mechanical characteristics

**Without adjusting the vulcanization system*

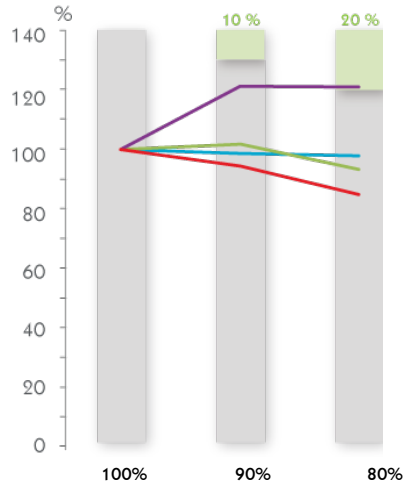
VARIATION IN **NATURAL RUBBER** PROPERTIES

Material used for studies < 500 µm



VARIATION IN **FKM** PROPERTIES

Material used for studies < 200 µm



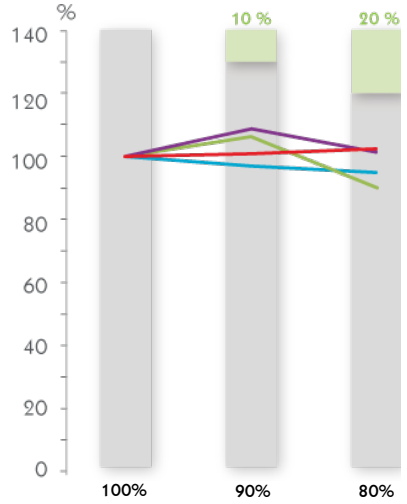
Devulcanized Compound
Virgin Compound
Elongation
Tensile Strength
Hardness
Tear Resistance

Impact on the basic mechanical characteristics

**Without adjusting the vulcanization system*

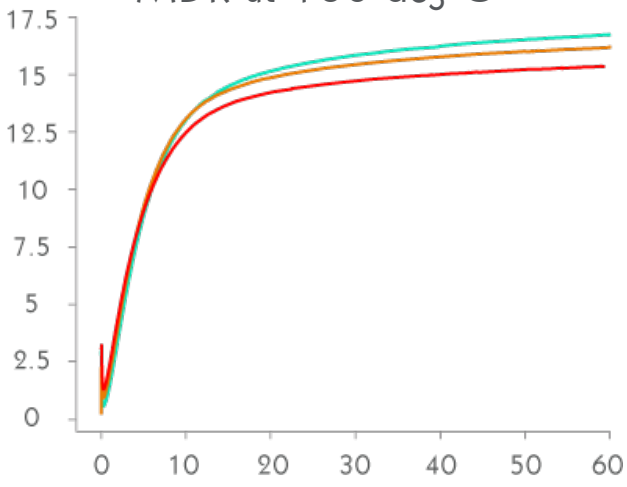
VARIATION IN AEM PROPERTIES

Material used for studies < 500 µm



VARIATION IN AEM VISCOSITY

MDR at 160 deg C



Devulcanized Compound
Virgin Compound
Elongation
Tensile Strength
Hardness
Tear Resistance

0% HSM
10% HSM
20% HSM

Cost analysis - Example

Price of original rubber formulation	5 € / kg
Cost for the disposal of waste rubber	0,10 € / kg
Total HSR functioning cost	50 000 € / year
Yearly HSR regenerated rubber production	61 200 kg

Savings with a yearly production of regenerated rubber **230 000 € / year**

CO_2 Emissions saved by using the regenerated rubber **408 156,67 kg CO_2**

On average, for every kilo of recycled rubber, we avoid the emission of **-4,5 kg of CO_2**

Ask us about running a cost analysis for your rubber waste !

Thank you !

Would you like more information?

Feel free to contact the salesmen of REP who will be at your disposal at the booth or contact us later.

+33 (0)4 72 21 53 53

commercial@repinjection.com

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