



# **Versalis Revive<sup>®</sup>: new "circular" elastomers for more sustainable tyres.**

***Ecomondo 28/10/2021***

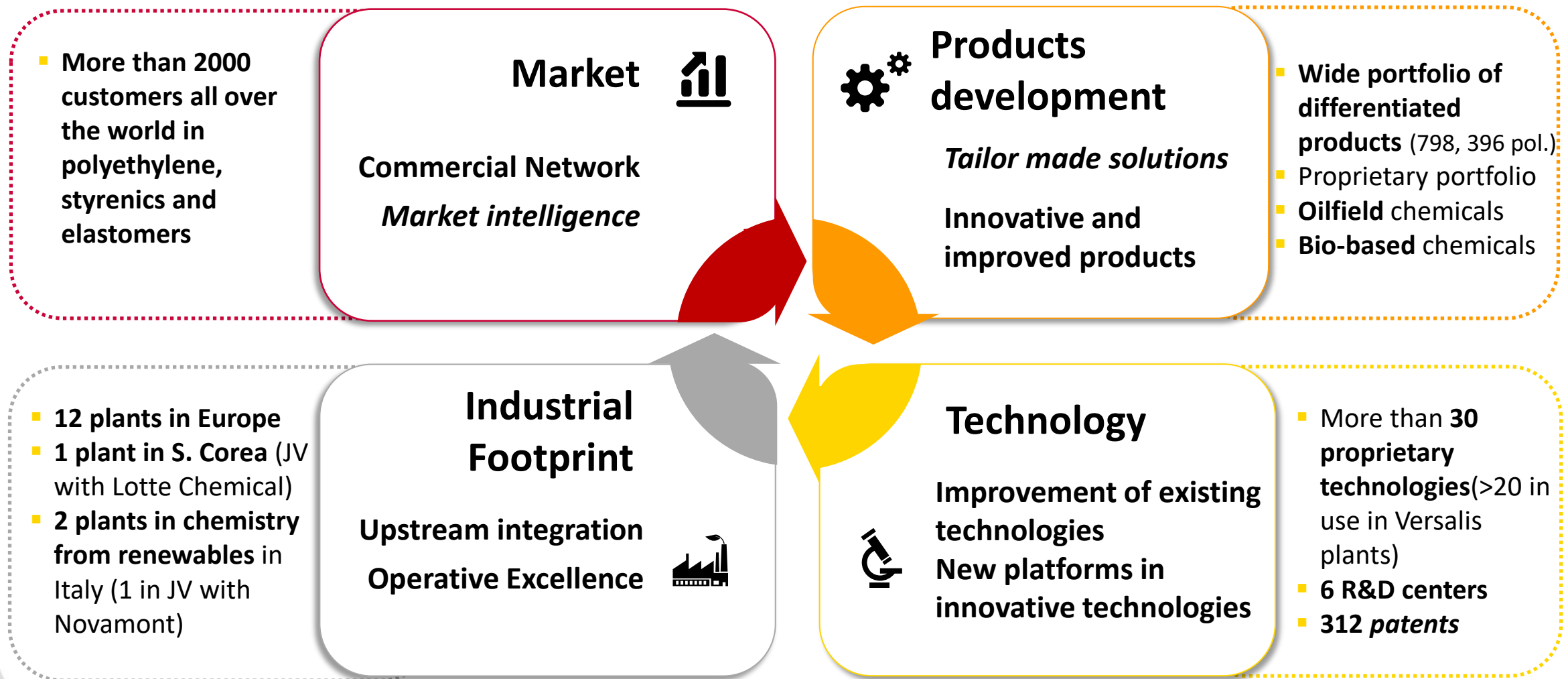
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*Co-authors: **Giovanni Regattieri**, Elastomers R&D General Manager*

***William Montanari**, Elastomers R&D Scientist*

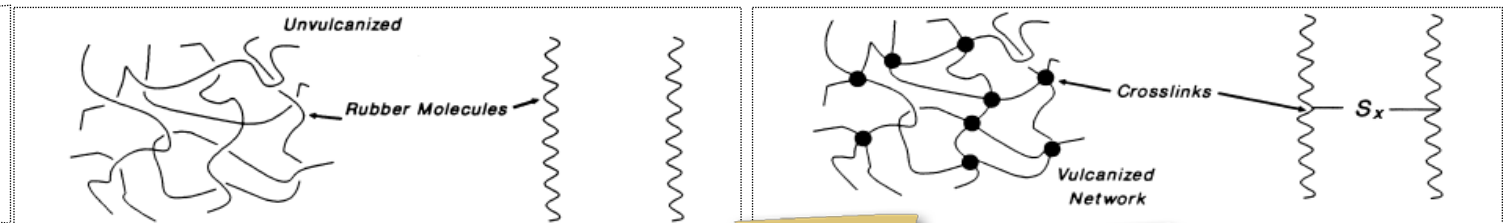
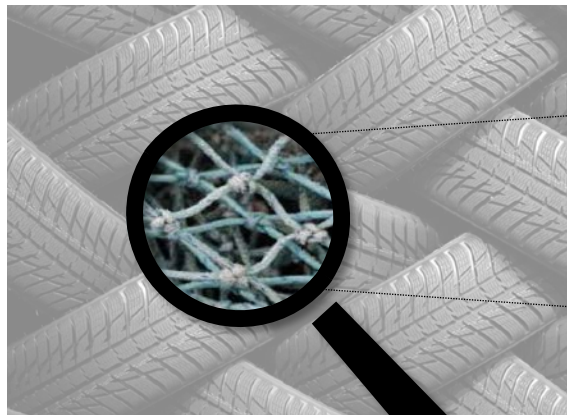
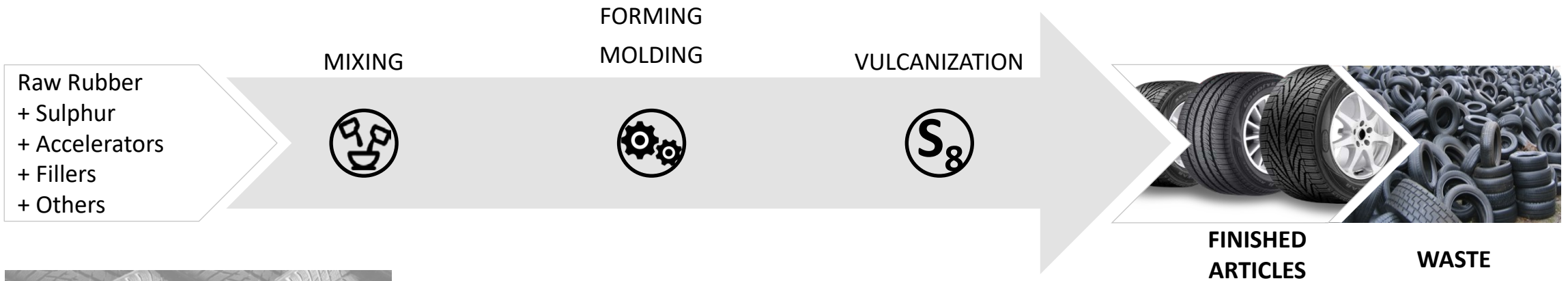
# Versalis: an integrated operative model



# Sustainability and Value



# Rubber Workflow



✓ Vulcanization → Elasticity

✓ Fillers → Strengthening

# VERSALIS R&D PROJECTS



Waste



COLLECTION



SORTING



GRINDING

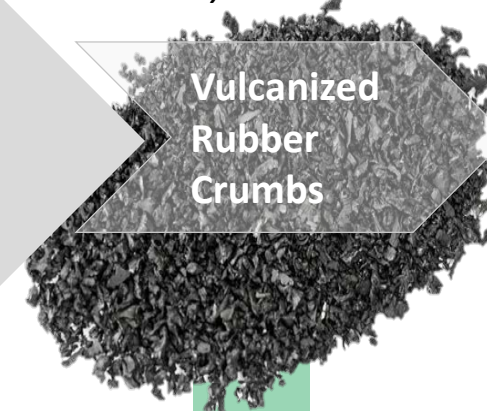


SEPARATION



Secondary Raw Material

Vulcanized Rubber Crumbs



*The quality of vulcanized rubber crumbs, in terms of dimension, metal content and fibers content, is essential for an optimal recycling process.*

*Partnerships and collaborations with companies which produce vulcanized rubber crumbs are needed.*



TARGET:  
FROM TIRE TO TIRE

## VERSALIS R&D PROJECTS

Devulcanization



Micronization



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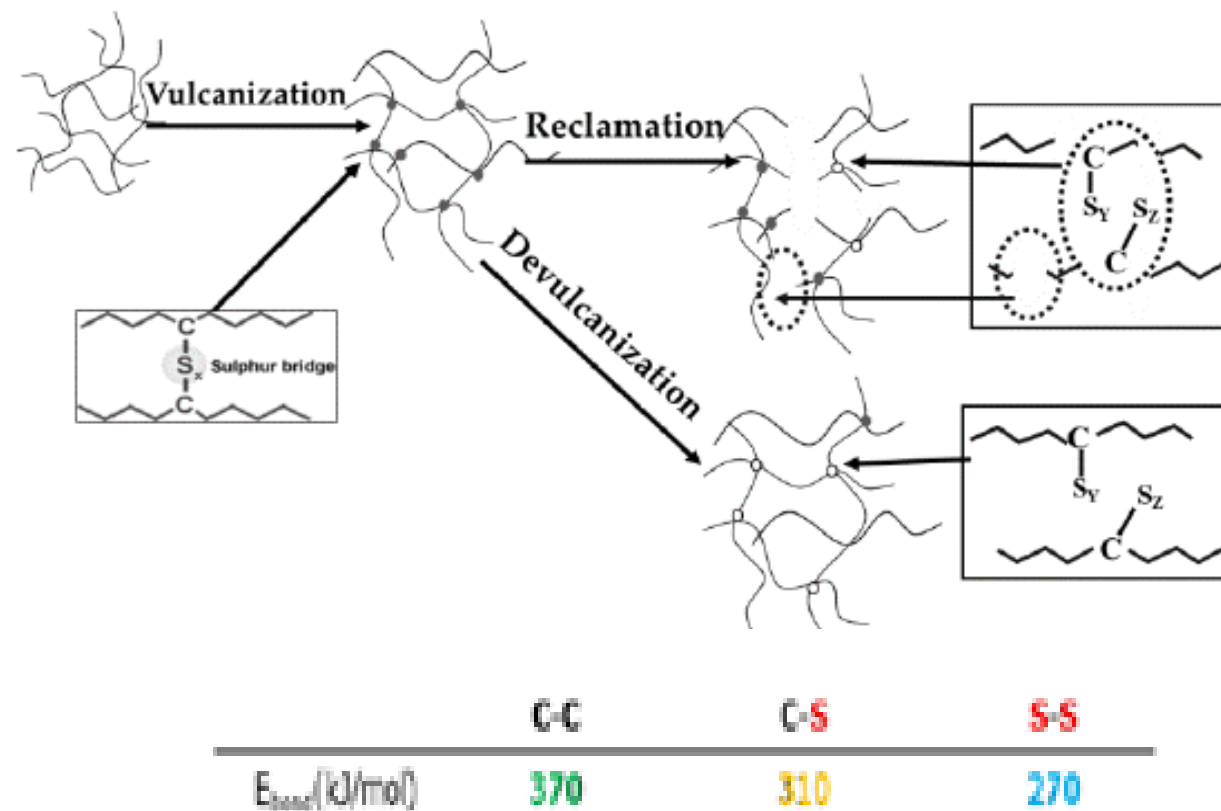
**Devulcanization:** selective cleavage of crosslinks (S-S bonds).

**Reclamation:** Cleavage of crosslinks and Carbon-Carbon bonds.

All the devulcanization technologies studied involve the main chain scission !

Different behaviour of raw polymers during devulcanization process:

NR  $\neq$  BR  $\neq$  SBR



# VERSALIS R&D PROJECTS: Devulcanization



**Target:** Develop and market a new products based on end-of-life tyre and improve the devulcanization technological platform in order to guarantee the right performance in the new compound.



**Development:** In collaboration with AGR.



**High quality  
vulcanized rubber  
crumbs**



- Selection of ELTs
- Removal of steel fibers
- Control of particle size distribution



**Optimized process  
conditions**



- Pilot plant
- Analytical characterization labs
- Application and processing labs



**Deep knowledge of  
polymers and their  
applications**



- More than 60 years in the synthetic rubber business
- High experience in the tire sector

# VERSALIS R&D PROJECTS: Case study in Winter Tread



- ✓ Selection of the application depending on the mechanical and chemical properties of the devulcanized material

FORMULATION		Ref.	DVC - 1	DVC - 2
NR CV 60	<i>phr</i>	Y		
S-SBR (functionalized, batch)	<i>phr</i>	Y		
DVC - 1	<i>phr</i>		20	
DVC - 2	<i>phr</i>			20
N339	<i>phr</i>	Y		
Ultrasil VN3	<i>phr</i>	Y		
Silane 75	<i>phr</i>	Y		
MES Oil	<i>phr</i>	Y		
6PPD	<i>phr</i>	Y		
Conventional curing system	<i>phr</i>	tuned		



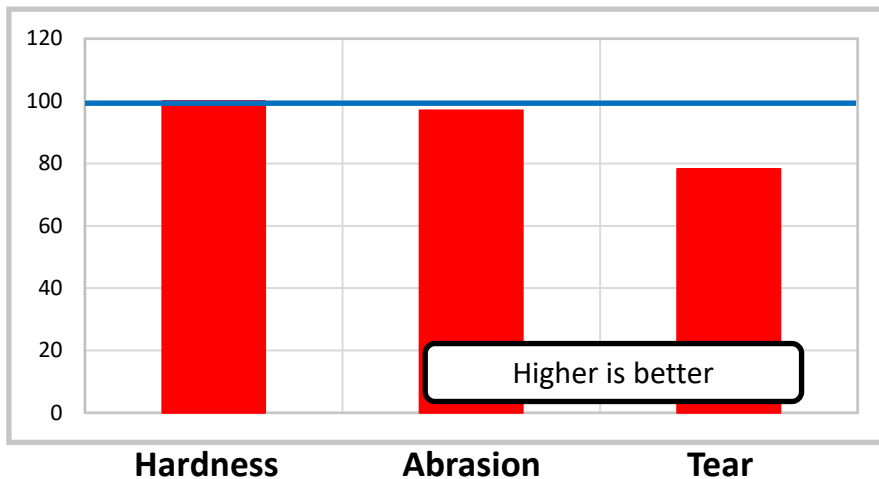
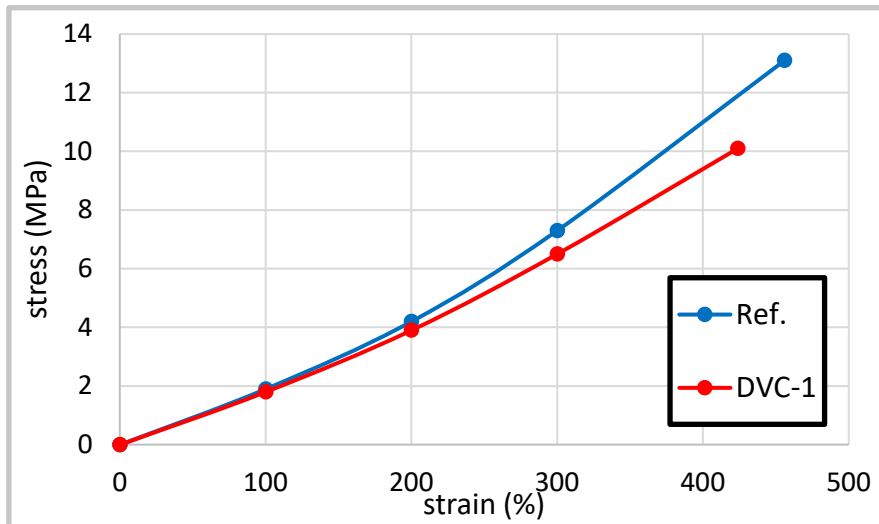
Winter tread



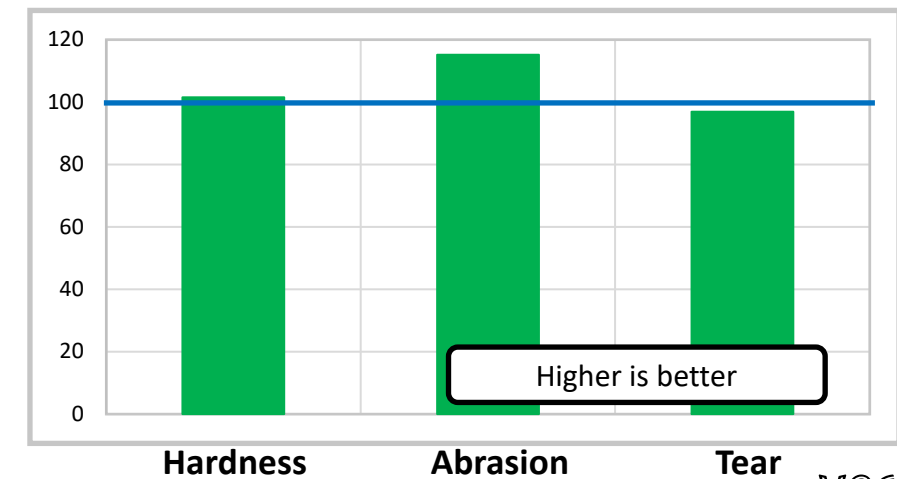
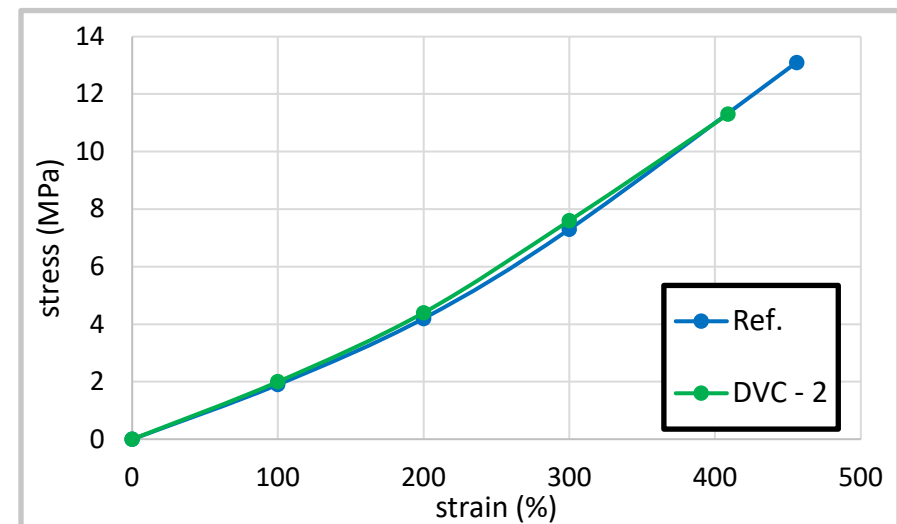
# VERSALIS REVIVE DVC: Case study in Winter Tread



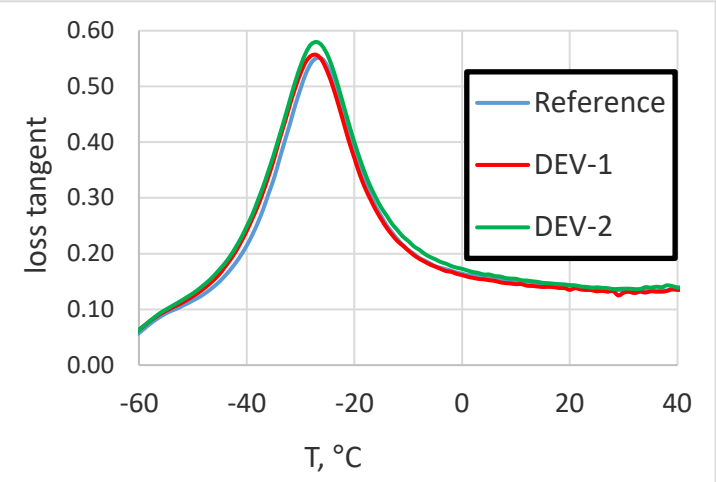
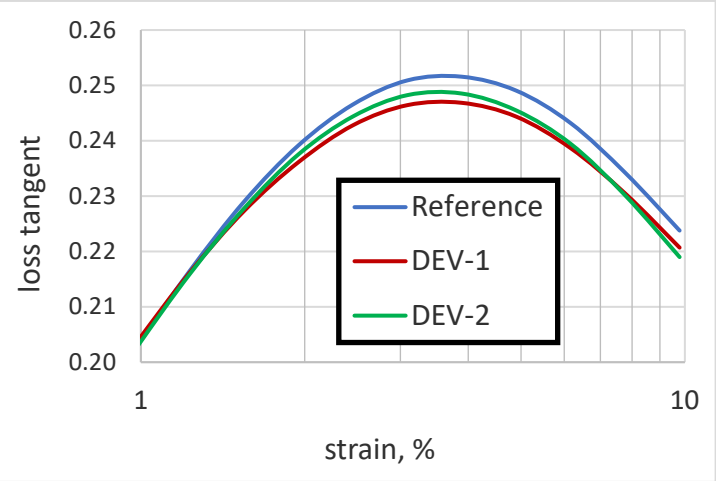
## DVC - 1



## DVC - 2



# VERSALIS REVIVE DVC: Case study in Winter Tread



	Ref	DVC-1	DVC-2
<b>RR index</b> (Tan $\delta$ , 60°C, 10Hz, 5% strain)	100	102	102
<b>WG index</b> (Tan $\delta$ , 0°; 1Hz)	100	94	105
<b>Winter performance index</b> (G', -20°C; 1Hz)	100	112	114




*higher is better*

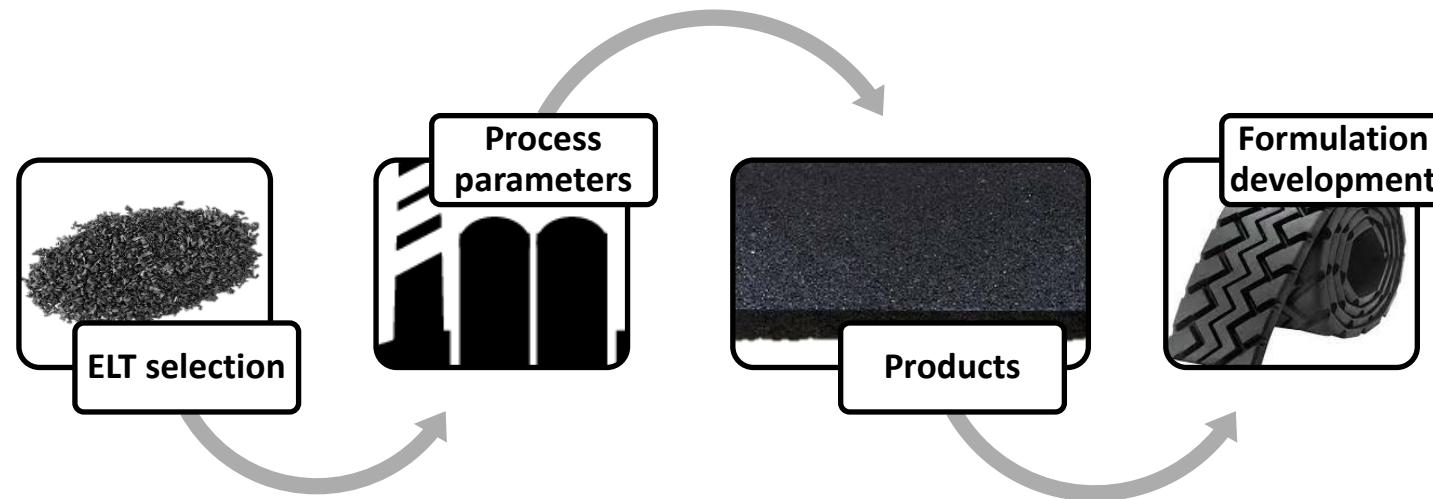
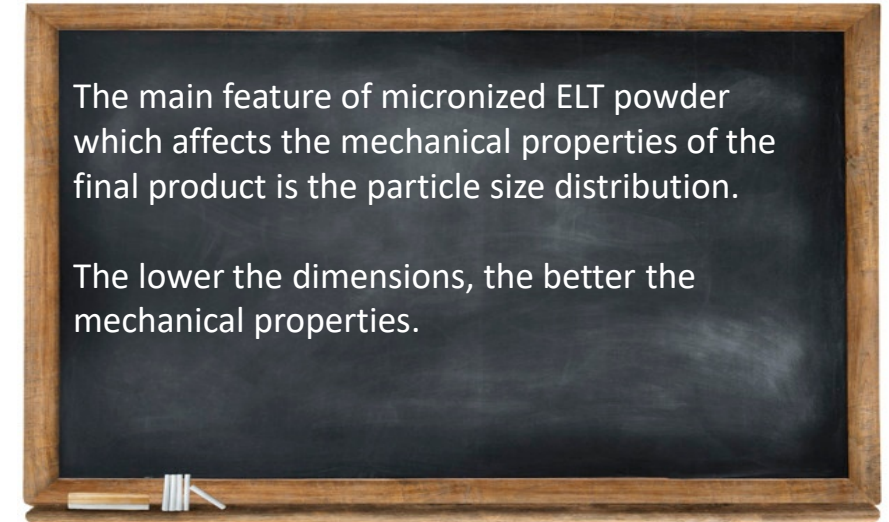


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# VERSALIS R&D PROJECTS: Micronization



-  **Process:** Proprietary technology for e-SBR with micronized ELT embedded.
-  **Specifications:** Micronized ELT powder smaller than 0.4 mm needed
-  **Target:** Identification of the maximum Elt powder content in order to guarantee the right performance in the new compound.

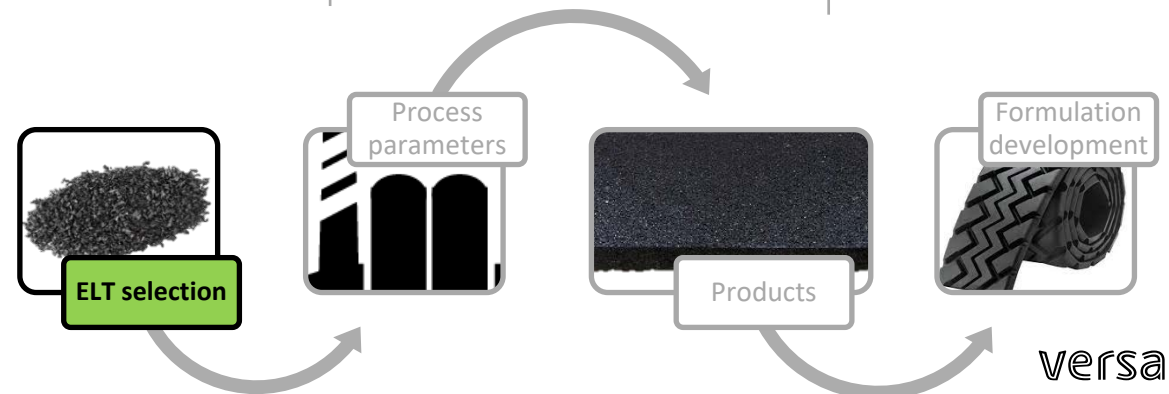


# VERSALIS R&D PROJECTS: Micronization



- ✓ Evaluation of micronization technologies

	Particle Size Reduction	Specific Surface	Composition Homogeneity	Price
Cryogenic	High	Low	Medium	High
Room Temperature	Medium	High	Medium	Low
Water jet	Medium	High	High	Medium



# VERSALIS R&D PROJECTS: Micronization



10-50% of recycled material from  
End of Life Tires



50-90% Versalis eSBR



Dry Types:

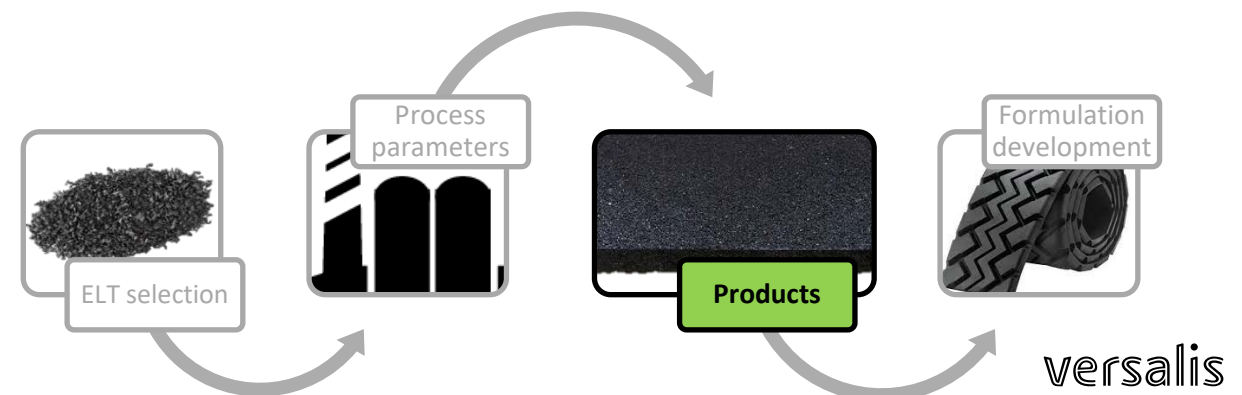
- 1500
- 1502

Oil Extended  
Types:

- 1723
- 1739
- 1789

Benefits from using REVIVE eSBR:

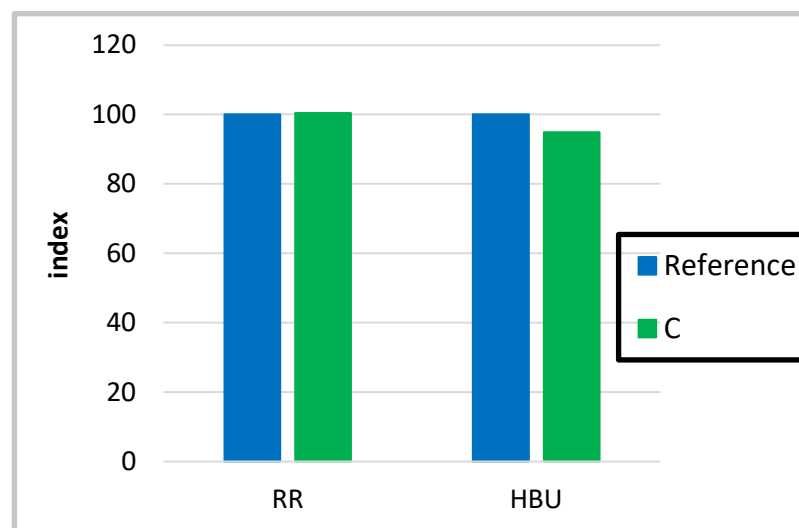
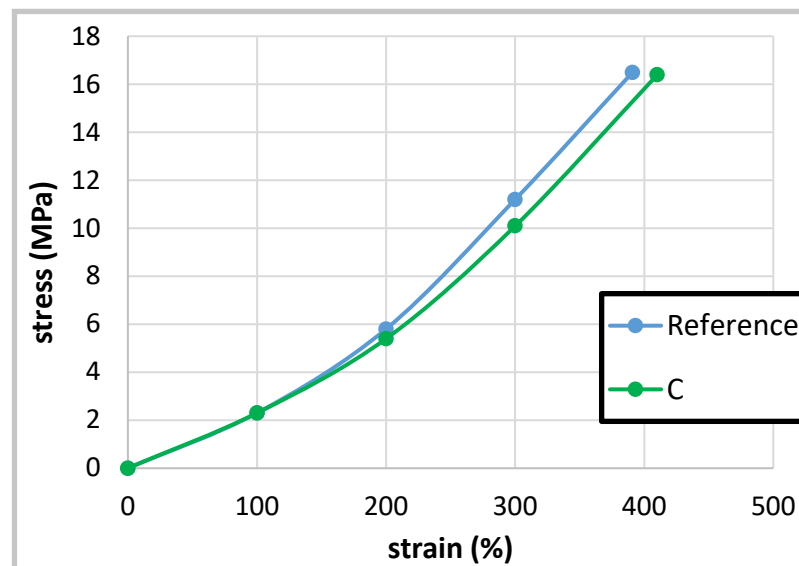
- ✓ Sustainability and Circular Economy
- ✓ Handling & storage of products in bale and not powder
- ✓ Lower dust emissions in the atmosphere
- ✓ Fewer ingredients in the mixing stage



# VERSALIS REVIVE ESBR: Case study in Pre-cured tread



Formulation	Ref.	C
eSBR 1502	Y	-
eSBR 1739	Y	
high-cis BR	Y	
<b>REVIVE eSBR</b>	-	Y
N234	Y	
TDAE oil	Y	
6PPD	Y	
Curing system	Conventional	
ELT %wt	0	6,0



higher is better

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# Conclusion



## Devulcanization

- **100%** products made with **recycled material**
- Ready to be mixed and **revulcanized** inside new compounds to replace virgin rubbers
- **Different grades** for **different applications** thanks to the accurate control of the feedstock used and the devulcanization process.

### ONGOING

- Promotion and sampling step.
  - **VERSALIS REVIVE® DVC grades**



## Micronization

- Versalis Revive eSBR **can be produced** with ELT derived **from all grinding technologies**.
- **Variable ELT powder content** inside rubber can be achieved.
- Handling & storage of products in bale and not powder

### ONGOING

- Promotion and sampling step.
  - **VERSALIS REVIVE® eSBR 15d02**
  - **VERSALIS REVIVE® eSBR 17o23**

**Thank you for your attention**

**[www.versalis.eni.com](http://www.versalis.eni.com)**