

# Recycling of whole passenger car tires

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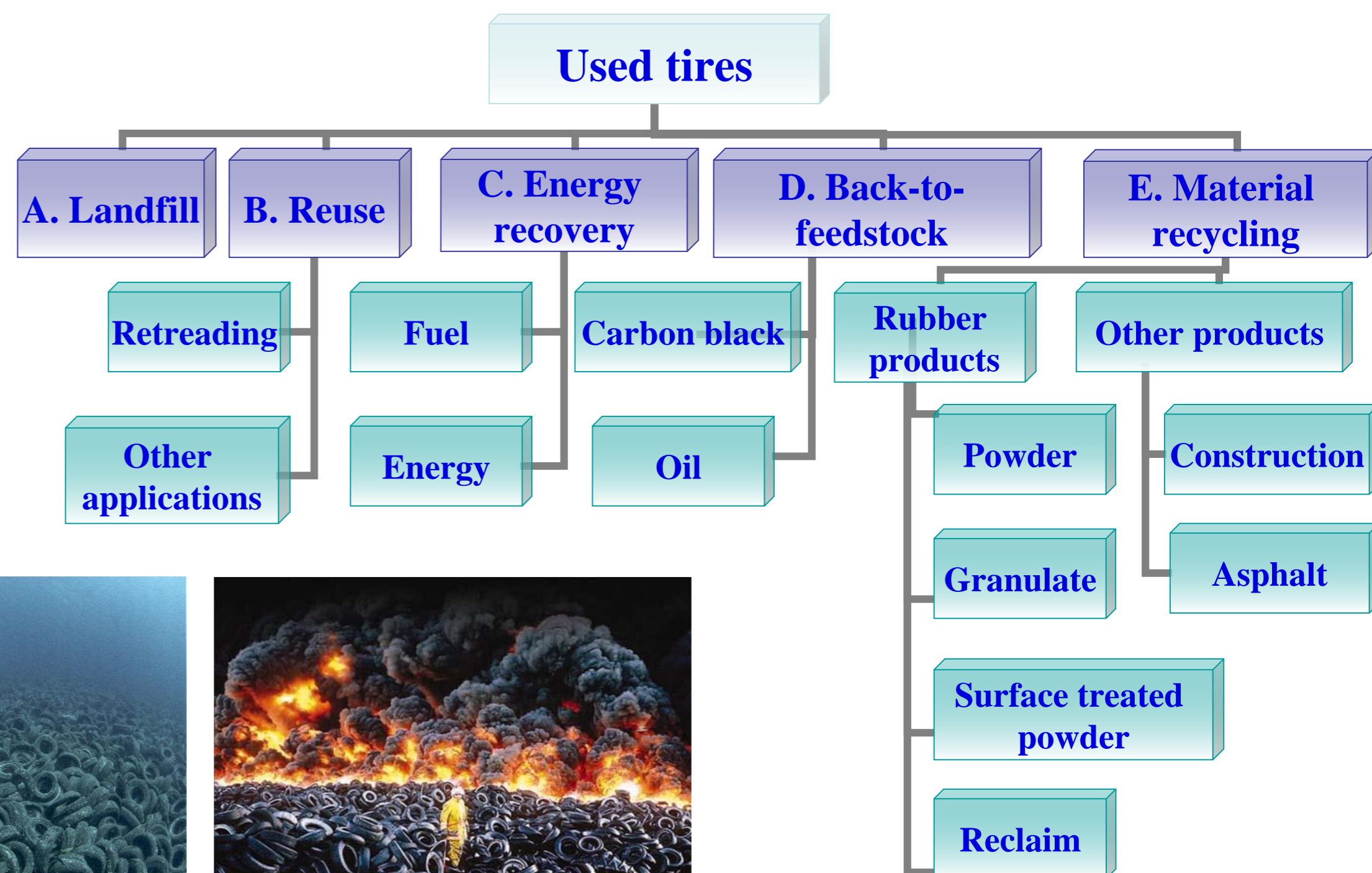
## Introduction

Used tires represent one of the most difficult materials to handle after their service life. In 2006, 2,669,219 tons of used tires were generated in the 25 states of the EU<sup>1</sup>; this shows the urgency of the used tire problem. Polymeric materials do not decompose easily, and especially used tires will not melt, dissolve, or lend themselves to the usual methods of chemical decomposition. Therefore, new processes have to be developed to make this material available for a second life.

Recycling of used tires not only solves the disposal problem and reduces the environmental burden, it also saves the valuable and limited resources of fossil feedstock. The potential outlets of used tires are shown in the flowchart.

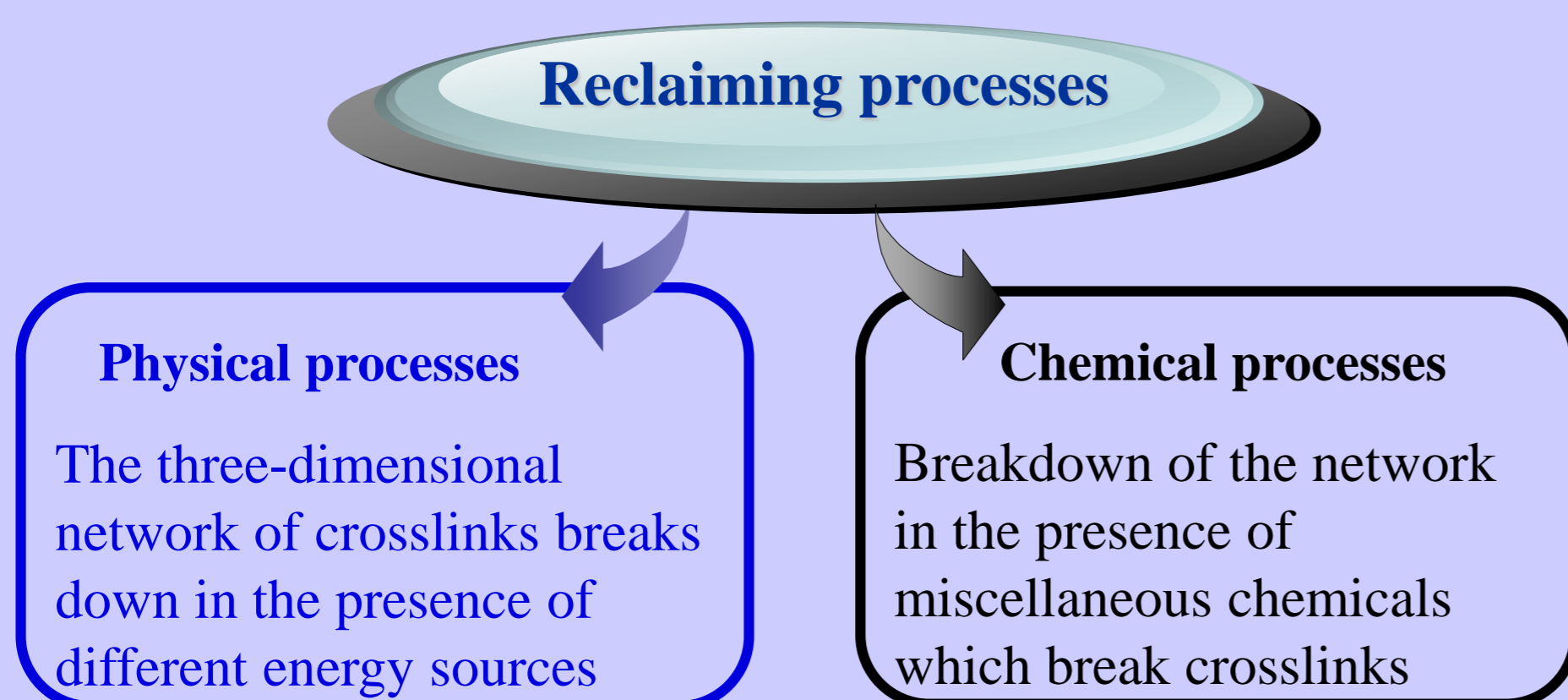


## Outlets of used tires

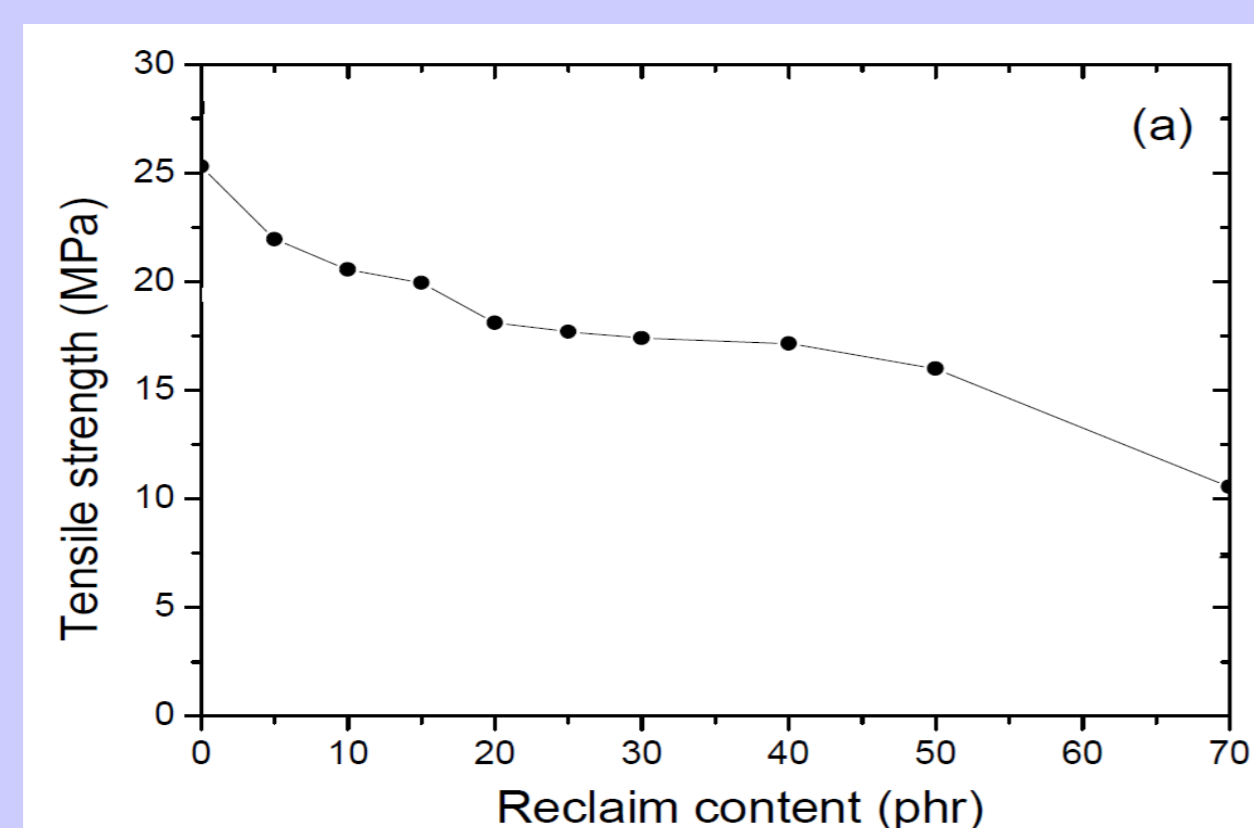
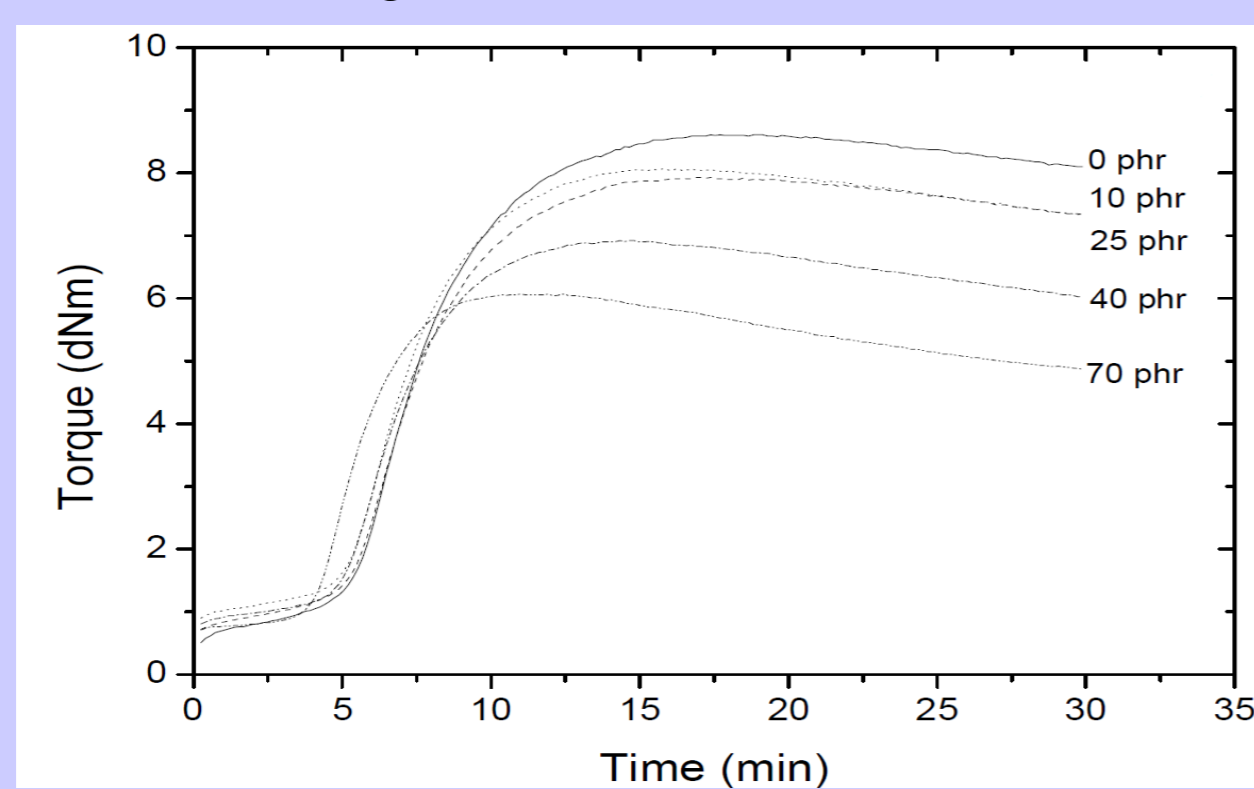


## Reclaiming processes for cured rubber

**Reclaiming:** a process in which vulcanized rubber is converted into a material which can be blended, processed, and cured again by using mechanical, thermal or chemical processes



Due to the polymer-scission during the non-selective conventional reclaiming processes, the properties of reclaimed rubber are poor compared to the original material.

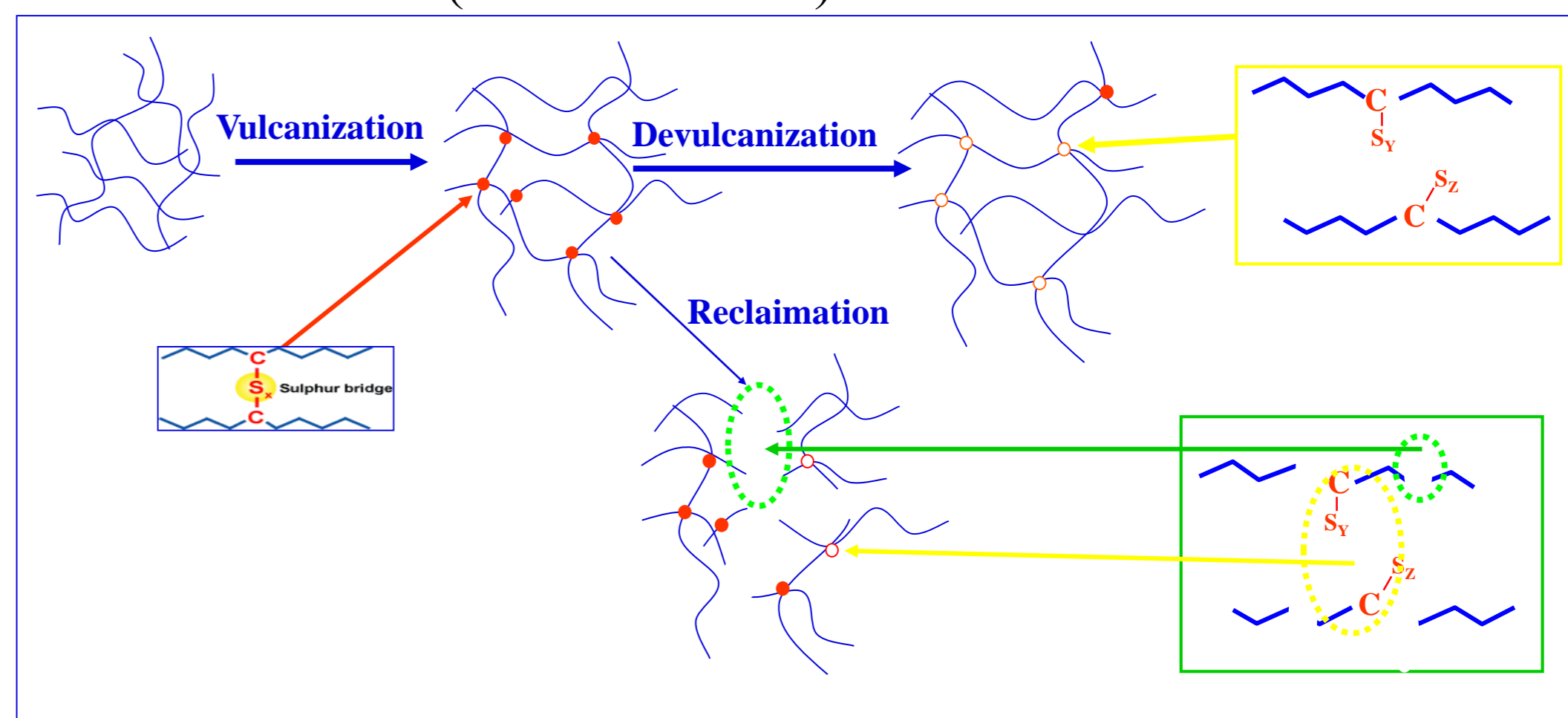


Reclaimed rubber / natural rubber blend  
(V.Rajan, 2005<sup>2</sup>)

## Devulcanization versus reclaiming

The limited use of reclaimed rubber is often contributed to the relatively poor mechanical properties compared to new rubber. These poor properties of reclaimed rubber originate from ageing during service life of the original product, and structural changes that occur during the reclaiming process.

Two reactions occur during reclaiming: polymer breakage and crosslink scission (devulcanization).



The difference between reclamation and devulcanization

In sulfur vulcanization, formation of carbon-sulfur bonds (C-S) and sulfur-sulfur bonds (S-S) takes place; therefore these bonds only should be broken during devulcanization.

Devulcanization: process of cleaving monosulfidic (C-S-C), disulfidic (C-S-S-C) and polysulfidic (C-S<sub>x</sub>-C) crosslinks of vulcanized rubber.

Reclaiming is different from devulcanization due to the scission of the carbon-carbon bonds of the polymeric chains.

**The ideal way of rubber recycling is devulcanization, in which all sulfur crosslinks are broken, while the polymer chains remain intact<sup>3</sup>.**

## Conclusion

Improvement of the properties of recycled rubber is the most important for broadening the application range of recycled rubber. Developing and investigating new processes and additives that can selectively break sulfur crosslinks and limit polymer chain scission is the best way to create more outlets for recycled used tires.

## References

1. European Tyre Recycling Association (ETRA), Introduction to Tyre Recycling, (2008).
2. Rajan, V.V., Ph.D.Thesis, University of Twente, Enschede, The Netherlands (2005).
3. Dijkhuis, K.A.J., Babu, I., Lopulissa, J.S., Noordermeer, J.W.M., Dierkes, W.K., Rubber Chem. Technol. 81, 190-208 (2008)

