HAL
open science

The role of processing parameters in an industrial thermo-mechanical devulcanization process

Rodrigo Diaz, Gael Colomines, Edith Peuvrel-Disdier, Rémi Deterre

To cite this version:

Rodrigo Diaz, Gael Colomines, Edith Peuvrel-Disdier, Rémi Deterre. The role of processing parameters in an industrial thermo-mechanical devulcanization process. 12th Rubber Fall Colloquium, Nov 2016, Hannovre, Germany. hal-01500717

HAL Id: hal-01500717

https://minesparis-psl.hal.science/hal-01500717v1

Submitted on 3 Apr 2017

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

12th Fall Rubber Colloquium

The role of processing parameters in an industrial thermo-mechanical devulcanization process

Rodrigo Diaz[1,2], *Gaël Colomines*[1], *Edith Peuvrel-Disdier*[3], *Rémi Deterre*[1]

[1]University of Nantes, IUT BP 539, 44475 Carquefou, France
Rodrigo.Diaz@univ-nantes.fr

[2]REP International, 15 rue du Dauphiné 69964 Corbas, France
[3] MINES ParisTech, PSL Research University, CEMEF - Centre de Mise en Forme des Matériaux, UMR CNRS 7635, CS 10207, 06904 Sophia-Antipolis, France

Introduction

The recycling of rubbers in the rubber industry has become increasingly important due to environmental and financial reasons. An approach to recycle is to devulcanize the rubber in order to reintroduce it as a raw material. This is a notably challenging process since one aims to rupture the rubber network by breaking sulfur bridges without damaging the carbon-carbon bonds.

This work aims to study a devulcanization process known as “High Shear Mixing” (HSM) that does not involve the addition of any chemicals.

High shear mixing process

A special HSM machine, heavily instrumented, has been designed and built with the main purpose of studying the different phenomena that occur during the HSM devulcanization process. The figure 1 shows a schematic representation of this machine.

In the HSM process, the treated rubber is sheared between two metallic cones with special geometries. One cone is static and the other cone simultaneously turns and applies pressure to the material. During this shearing the treated rubber is self-heated, a cooling system prevents the rubber degradation due to excessive heat.

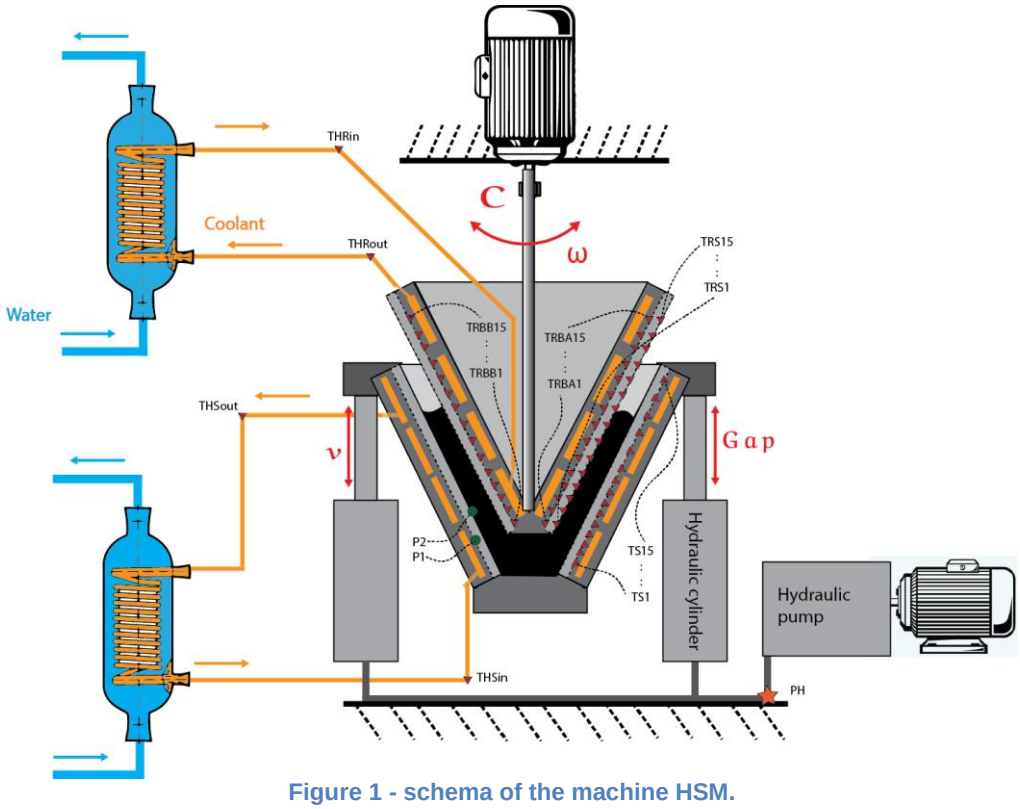

Figure 1 - schema of the machine HSM.

The rubber material used in this study, an 80 phr carbon black filled extended EPDM, is analyzed before and after vulcanization, and then again after the HSM treatment using solvent swelling and Soxhlet extraction. The goal is to determine the structure changes caused by the process. The Horikx analysis is used to determine the quality of the devulcanization [1], [2].

Sets of experiments were conducted where processing parameters such as the rotation speed, the duration of rotation, and the gap between the cones were systematically varied. A model that allows the estimation of the energy store in the rubber during the procedure will be presented. The correlation between data recorded during the process and the physical state of the material will be discussed.

Acknowledgements
The authors are indebted to the company SACRED for providing and processing the rubber gum and to the company REP International for building the prototype. This work was executed in the framework of the project ECOTHER supported by BPiFrance.

References

[1] M. a. L. Verbruggen, L. van der Does, J. W. M. Noordermeer, and M. van Duin, “Influence of the diene monomer on devulcanization of EPDM rubber,” *J. Appl. Polym. Sci.*, vol. 109, no. 2, pp. 976–986, Jul. 2008.
[2] S. Saiwari, “Post-consumer Tires Back Into New Tires: De-vulcanization and Re-utilization of Passenger Car Tires,” University of Twente, Enschede, 2013.