

Thermo-mechanical devulcanization of tire rubber crumb with supercritical CO₂: devulcanized rubber properties

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Outline

- **Introduction**

*Recycled Tires/ Rubber Crumb/
Vulcanization & Devulcanization
Background and Objectives*

- **Experimental**

Process/ Materials/ Scale up experiments/Characterization

- **Results and Discussion**

- **Concluding Remarks**

- ***Current Efforts***

Introduction

- Annual generation of Scrap tires :

World :1.6 billions

USA: 299 millions

Canada: 30 millions



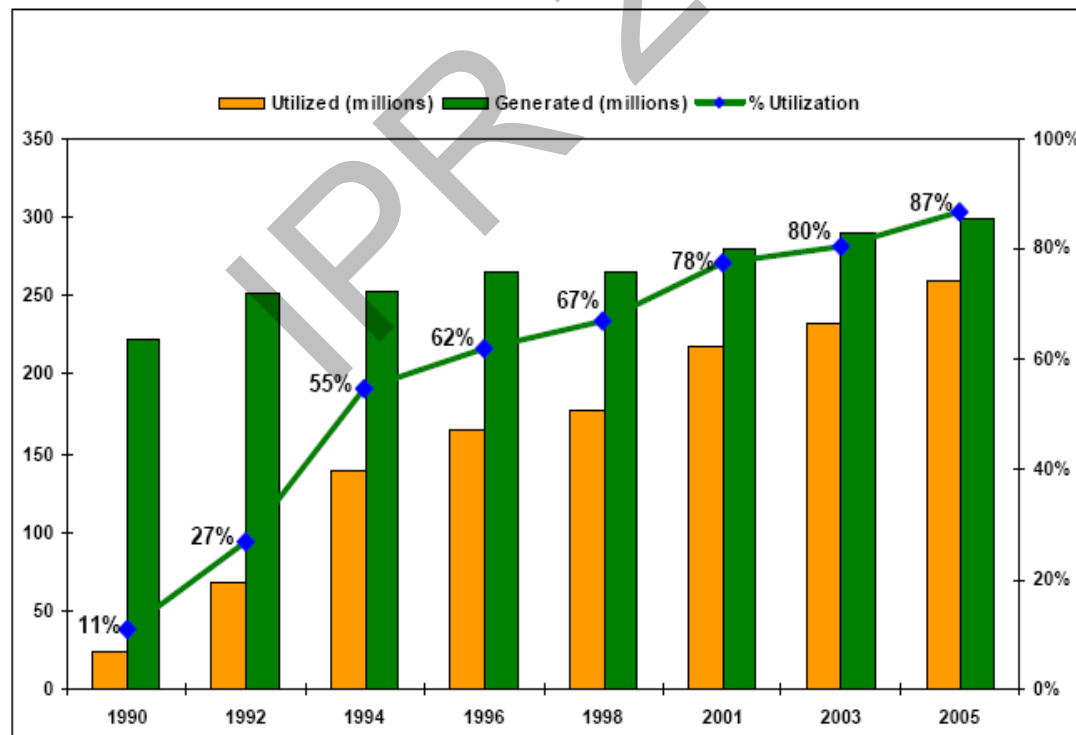
References:

- “Scrap Tire Market in The United States” , Rubber Manufacturer Association, Nov 2006 ,page 15
- Sangari, S.S.; Kao, N.; Bhattacharya, S.N.; Pavel, D and Silva, K. Mechanochemical Devulcanisation of Elastomers, Rubber Div. ACS, Oct., 2001
- Schnekenburger, Michael, Tire Recycling in Canada-1999, Rubber Division, ACS, Paper No.166, Set.21-24, 1999

Introduction

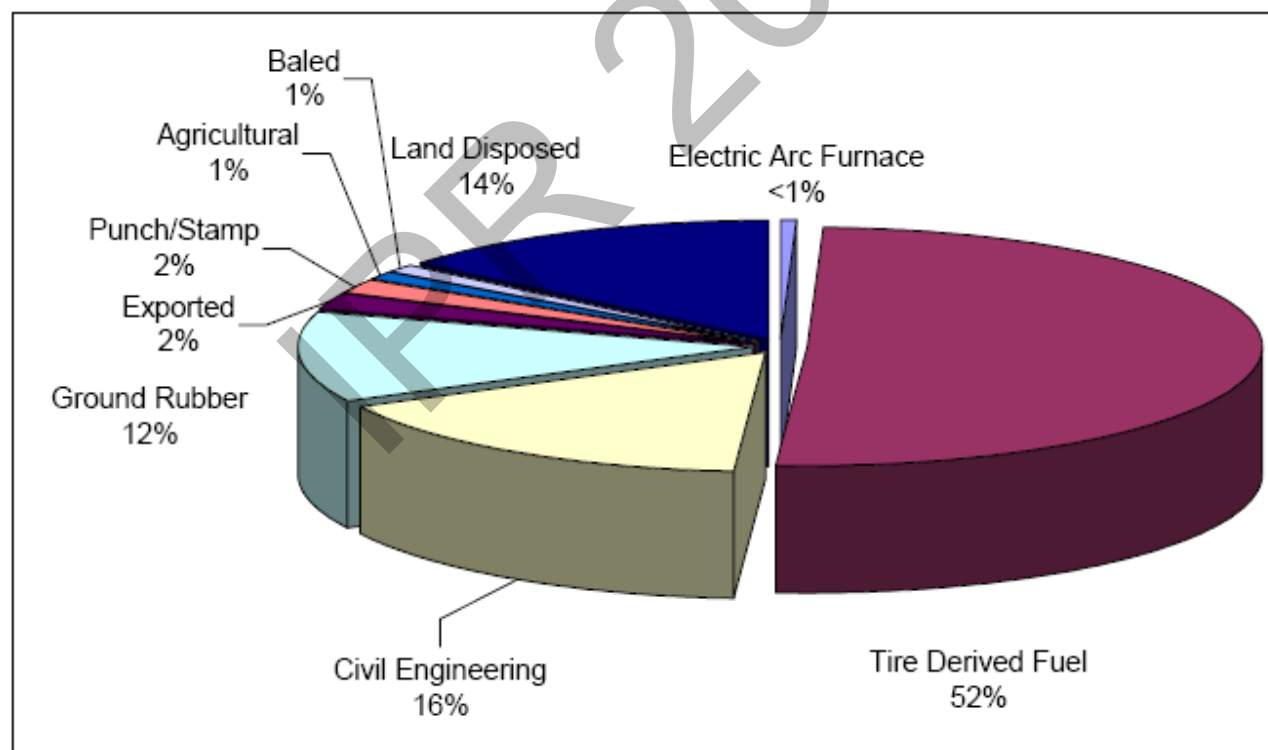
Tire Recycling

- Statistics in 2005 for the USA show that nearly 87% of scrap tires in the U.S. were used in end use market.
- Statistics show that there is an eight-fold increase in percentage of consuming of scrap tires by end use market annually since 1990.



Introduction

- TDF (tire derived fuel) application consumed about 52 % of total scrap tire in U.S
- Civil engineering market is another big consumer of scrap tires in U.S (16%)
- 12 % is consumed by ground rubber products



Introduction

Ground Rubber : Production Methods

- **Ambient grinding process**
- **Cryogenic grinding process**
- **Wet grinding process**
- **Extrusion**

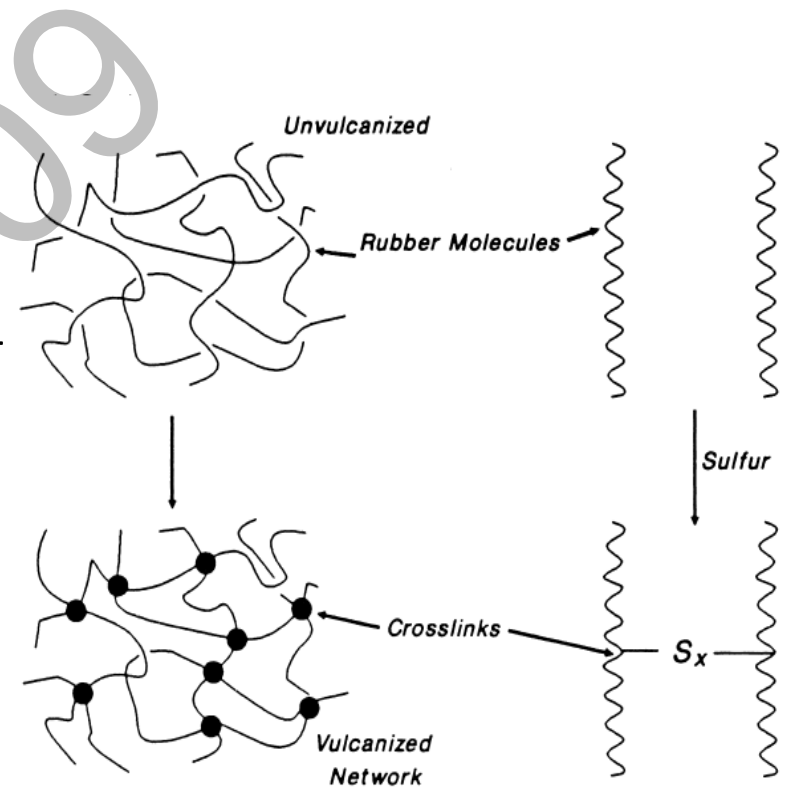
Introduction

- ***Rubber Crumb Applications***
 - **Sport Surfaces**
 - **Geotechnical/ Asphalt Applications**
 - **Rubber and Plastic Products**
 - **Automotive Industry**
 - **Adhesives and Sealants**
 - **Construction**
 - **Shock Absorption and Safety Products**

Introduction

Rubber Vulcanization

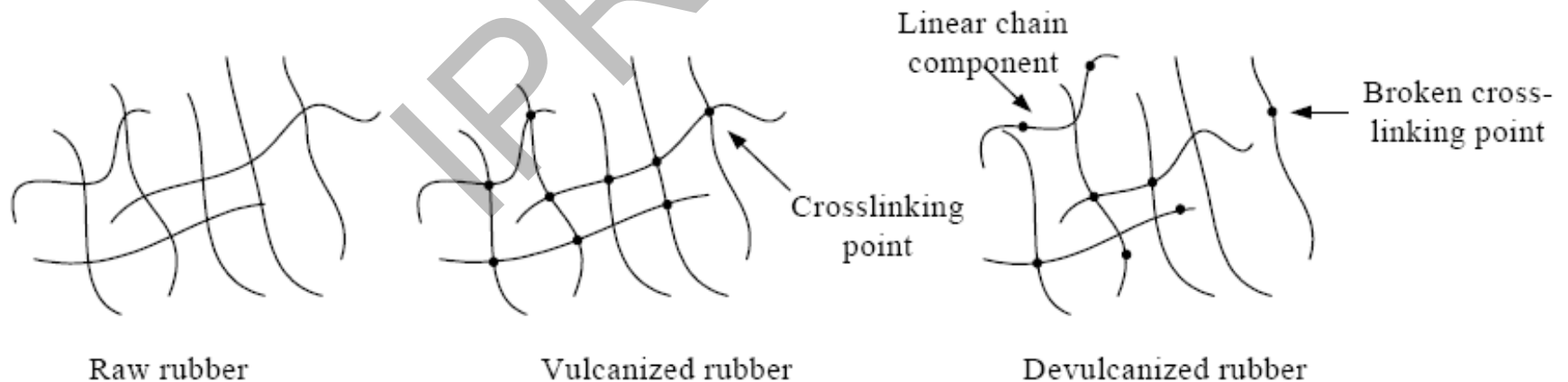
- Raw rubber is soft and sticky material with a low tensile strength and elasticity
- Atomic bridges composed of sulphur or carbon-carbon bonds link the polymer chains together
- First discovered by Charles Goodyear in 1839
- The vulcanized rubber is a thermoset material



Introduction

Rubber Devulcanization

- Devulcanization refers to a process in which the crosslink bonds in the vulcanized rubber cleave totally or partially.
- The devulcanized rubber is able to be re-vulcanized and utilized again like a virgin rubber



Introduction

Devulcanization Methods

- **Mechanical**
- **Ultrasonic**
- **Chemical**
- **Microwaves**
- **Microorganisms**

