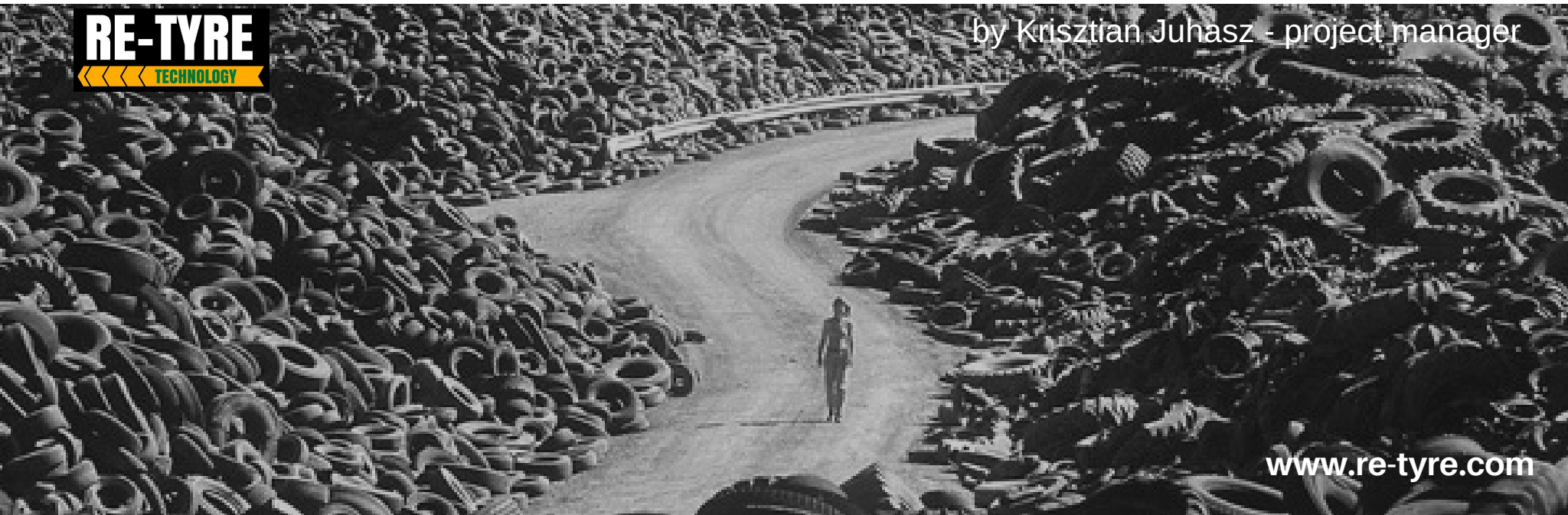
RUBBER ERADICATION WITH RE-TYRE TECHNOLOGY

Sustainable waste management and full recycling options with advanced ozone technology



Unrecycled tire waste is an enormous global problem because of their non-biodegradability, their flammability (see tire fires) and their chemical composition that leads to leaching of toxic substances into the ground on dumping and hazardous fumes on incineration. In 2007, around 300 million End Life Tyres had been produced in the United States. In 2008 around one billion ELTs were being produced globally each year with an estimated further four billion already in stockpiles and landfills. Global production in 2008 was about 1.5 billion new tires, while factory waste accounts for 5–15% of total production. 25% of the total number of waste tyres are placed into landfill worldwide.

Statistics

Global estimates for recycling

Based on Overview of the World Rubber Recycling Market

- Total amount of rubber recycled at its end-of-life: typically 3–15%
- Amount of waste rubber re-used in some way (e.g., retreading, new products and so on): 5–23%
- Amount of waste rubber consumed for energy recovery: 25–60%
- Amount of waste rubber sent to landfill or stockpiled: 20–30%-

Tire industry in China

Chinese rubber industry in 2010 showed the consumption of Natural Rubber at 2.89 million tonnes and that of synthetic rubber at 3.41 million tonnes.

In September 2010, China's Ministry of Industry and Information published a new strategic policy document that set out the future of the country's tyre industry. It covered all parts, from encouraging investment in indigenous Natural Rubber production to improvements in energy efficiency in tyre factories, and to the responsible disposal of waste tyres.

www.re-tyre.com

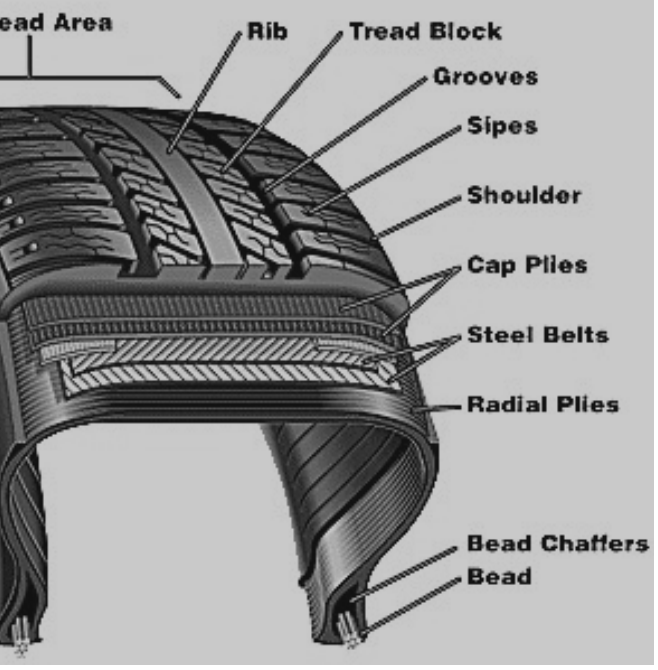
www.re-tyre.com

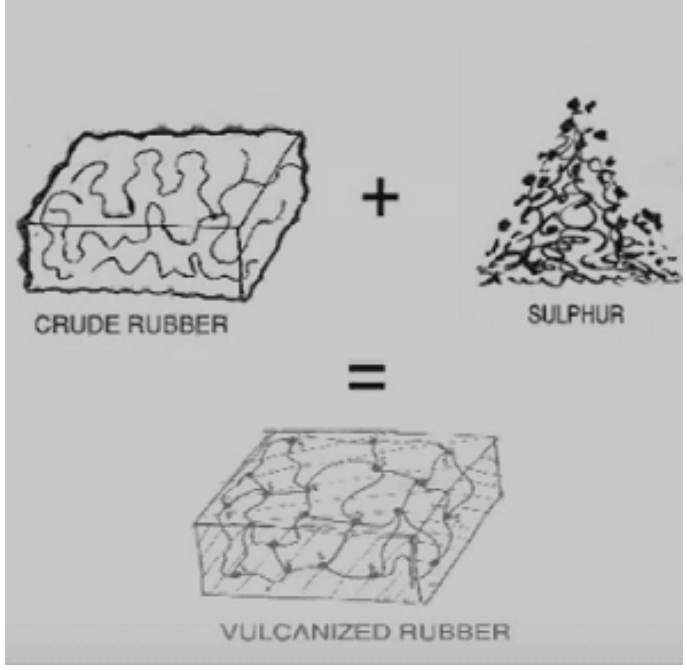
Need for scrap tire recycling technology

In 2013, the EU Used Tyres Arisings were estimated at 3.6 million tonnes.

The tyre industry has one legislation driven target with regard to ELTs: to prevent them from going to landfill. The single highest volume and quickest route to recovery of tyres was to use them for their energy and cement kilns, as the main user for tyre derived fuel (TDF). The reality is that markets for recycled rubber materials have been slow to develop and without the arrival of alternative large scale processes that consume or reuse tyre derived materials, TDF risks becoming the largest single route to deal with ELT. Achieving a "closed loop tyre-to-tyre recycling", with materials recovered from tyres going back into tyres, is not yet within reach due to tyre high safety and environmental performance and technological constraints.

The high-capacity Clean-Ozone technology is suitable for rubber recycling in industrial sizes, protects the environment, delivers inexpensive and excellent raw materials to manufacturers.





Tire processing

The reasons recycling is difficult

The aim is to grind scrap tires into crumb rubber, separate steel and fiber. Sell rubber as raw material is essential for sustainable tyre production.

- Tyres are manufactured by vulcanising diene rubbers using sulfur-based cure systems.
- The resistance of the rubber structure is enhanced by special metal and fabric parts.
- After vulcanization, high-strength tires can be cut only at high energy consumption.
- The greatest demand for recycling is the raw material, but devulcanization has so far not been economically possible

Why recycling is not obvious?

Economic and technology problems

- One of the major problems facing any organisation that is trying to develop a novel devulcanisation process, or run an existing one on a profitable basis, is the wide fluctuations that can occur to the market price of rubber, particularly NR and SBR rubber.
  Fundamental economic factors such as the crude oil price, and supply and demand, can affect the price of rubber.
- Much of the available tyre recycling technologies known today are highly complex and very energy consuming technological processes.

BASICS

During the process of vulcanization, by adding sulfur and heat the natural rubber become stronger and more elastic, thanks to its extremely strong crosslinked structure. This chemical process is illustrated in the following scheme.

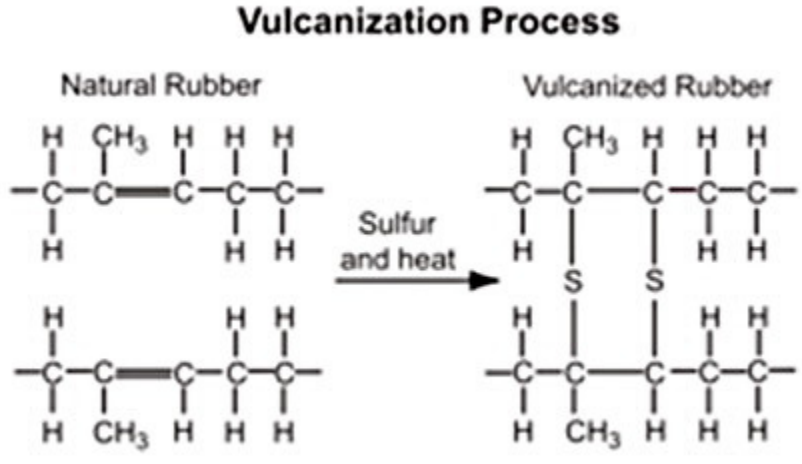


Figure 1. - chemical bond of vulcanized rubber

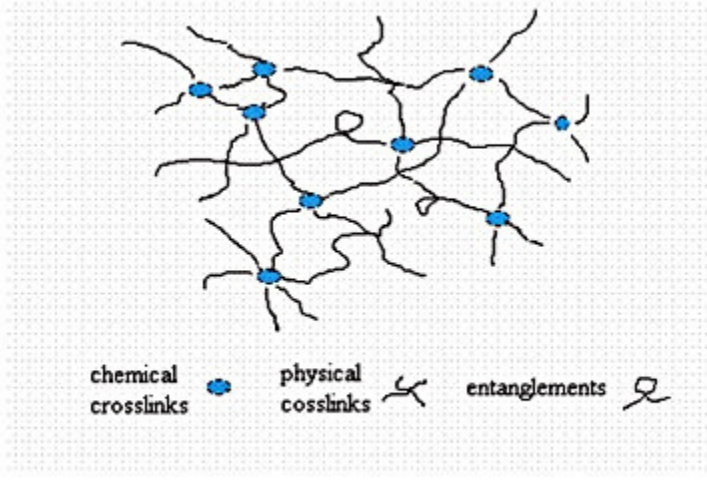


Figure 2. - crosslinked structure of vulcanized rubber

Chemical reaction

The polymers form a network of molecular chains, which consist of mainly carbon, hydrogen and oxygen. The corrosion changes the configuration of the polymer chain by chemical reaction. Below are a few instances in the environment in which chemical reactions affect polymers.

Heat: Chain cleavage by heat may occur, when polymers rises above a specified temperature limit by impact of heat, that is specific in case of every polymer

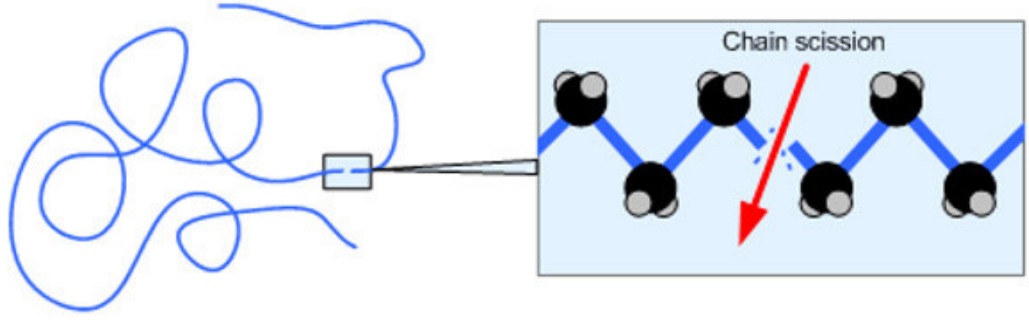


Figure 3.
chain cleavage pattern of heat

UV-radiation: At the presence of oxygen, UV radiation can cause breakdown of the polymer chain.

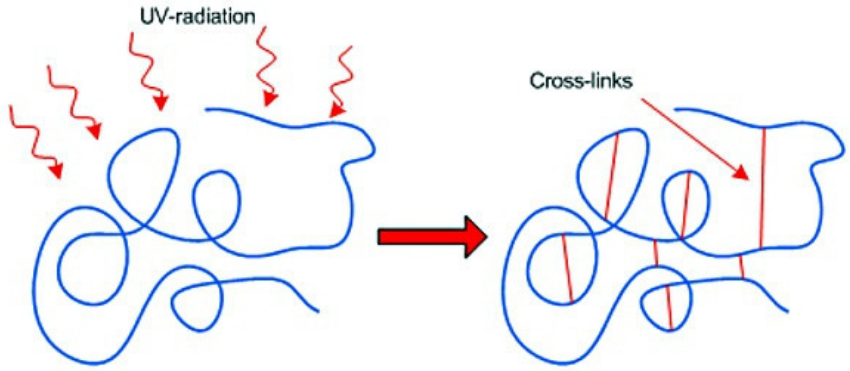


Figure 4. - chain cleavage pattern by the influence of oxygen

RUBBER ERADICATION WITH OZONE: Ozone causes characteristic cracks in unsaturated polymers (eg. natural rubber). The dynamic ozone tyre recycling method allows the disintegration of scrap tyres to its original components in a very environment friendly way, in addition it's ecologically safe and its effectiveness is economically well-established (output: crumb-rubber - which can weight even the 95% of the tire's original weigh - metal and textile).

The Re-Tyre rubber cracking technology is based on instant oxidation of rubber that leads to the destruction of intermolecular and intramolecular bonds. The process used to dust the tire by ozone with subsequent dispersal into the rubber crumb. Thus, steel and textile cords are completely separated. Shredding is greatly speeded up and requires less energy consumpt

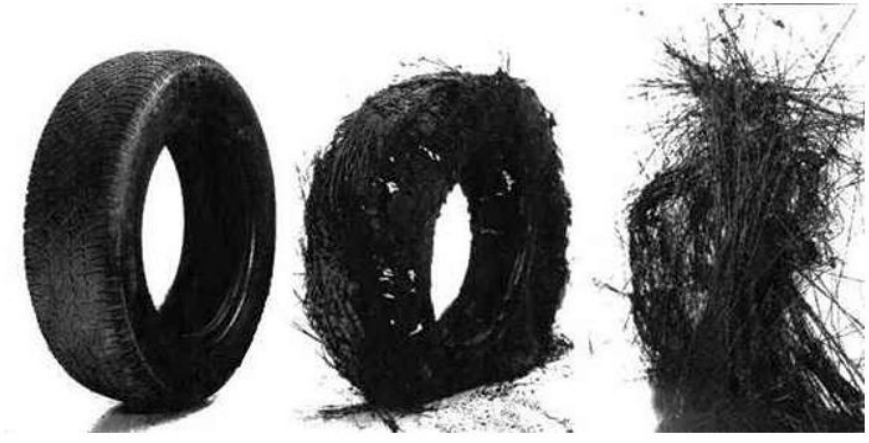


Figure 5. - tyre destruction by Re-Tyre Technology

This technological method has several advantages (energy demand, environmental impact, etc.) compared to the conventional mechanical crumb-rubber procession, in addition the crumb-rubber processed by Re-Tyre Technology can be reused (recycled) as input material (primary commodity) in tire production!

As the following montage shows (right), waste tire can be decomposed to its components by dynamic ozone technology. After the decomposition process, the cord and the stiffening metal easily can be separated from the devulcanized tire granulatum, what needs no further treatment to use as the input material of tire processing.

As a result of its advanced hydrophilic capacity, the scrap tire is also an ideal commodity for construction sector.

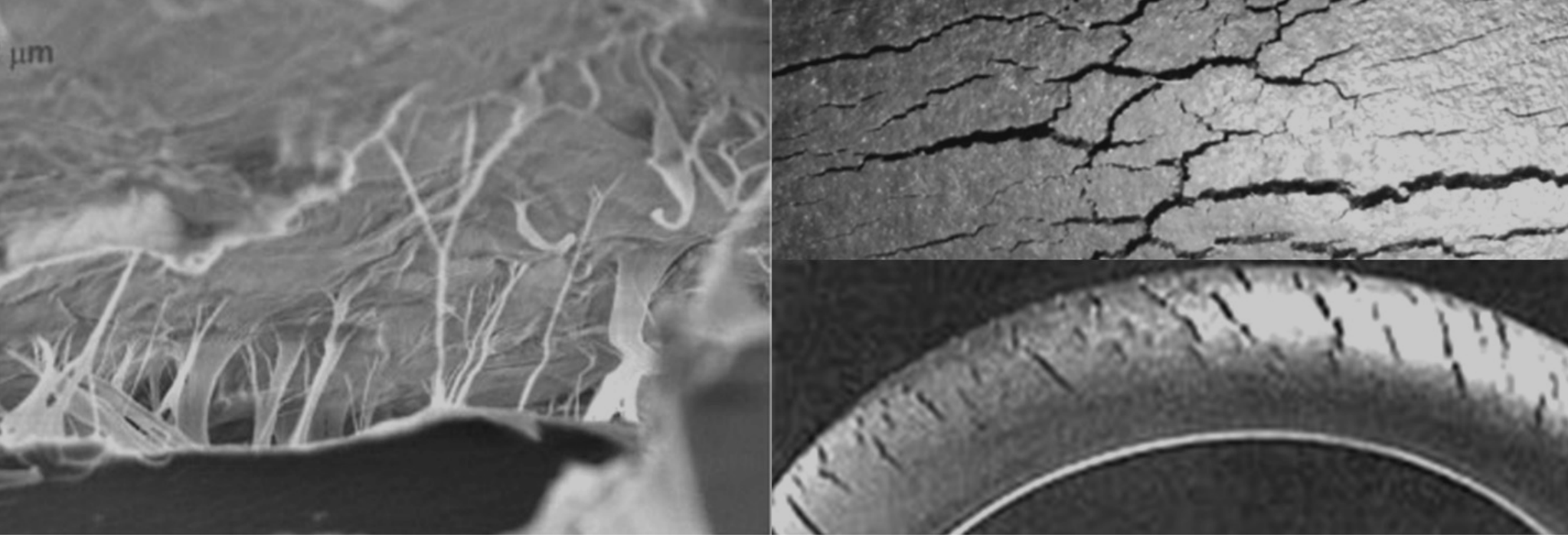
For the tire decomposition trial process we used a high capacity ozone generator with normal air + feed gas input.
Consumption: 200 (kW * h / ton tyre)
Ozone generator productivity: 500 g ozone / hour, 1200 PPM

Figure 6.
Tire decomposition with Re-Tyre Technology

ELT ozone eredication video:
https://youtu.be/zpB8BD_792Q

Advantages of Re-Tyre technology recycled tyre processing

- Reduction in the number of processing steps
- Less human resource requirements
- Minimum number of wear parts in the system
- Low power consumption
- High purity crumb rubber
- High economical efficiency
- Environmentally friendly technology
- Total separation of original components (crumb rubber-, textile-, reinforcing steel)
- Procession of crumb rubber is fairly cheap, so the recycling equipment is excellent for large-scale raw material production
- Devulcanized scrap tire, basic material, ready for tire producing
- High hydrophilic capacity scrap tire, ideal constructing material
- Patented technology
- Full know-how for tire (rubber) ozone recycling



DYNAMIC RE-TYRE TECHNOLOGY INDUSTRIAL RUBBER RECYCLING RESEARCH AND DEVELOPMENT

RE-TYRE TECHNOLOGY

www.re-tyre.com

Contact: Krisztian Juhasz
+36.30.950.2604
krisztian.juhasz@re-tyre.com

References

The mechanics of ozone cracking
M. Braden, A. N. Gent

The Determination of Threshold Strain of Rubber in Ozone Resistance Tests
G. J. Lake

Surface oxidation of rubber crumb with ozone
Franco Cataldo , Ornella Ursini, Giancarlo Angelini

Polymer Degradation under Ionizing Radiation: The Role of Ozone
R. L. CLOUGH and K. T. GILLEN

Oxidation and ozonization of rubber
Robert W. Keller

Ageing of Rubber - Accelerated Weathering and Ozone Test Results
R.P. Brown, T. Butler and S.W. Hawley

A Study on Functionalization of Waste Tire Rubber Powder Through Ozonization
Ping Fan, Canhui Lu

DEVELOMENT OF OZONE-DYNAMIC TECHNOLOGY FOR PROCESSING OF USED TYRES
V.I. Golota, G.V. Taran, A.A. Zamuriev

Mechanism of Exposure-Cracking of Rubbers With a Review of the Influence of Ozone
R.G. Newton