



Creating markets for recycled resources

The Composition of a Tyre: Typical Components

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1. Summary

Passenger car, lorry and off-the-road (“OTR”) tyres are products of complex engineering. They are made up of numerous different rubber compounds, many different types of carbon black, fillers like clay and silica, and chemicals & minerals added to allow or accelerate vulcanisation. The tyres also have several types of fabric for reinforcement and several kinds and sizes of steel. Some of the steel is twisted or braided into strong cables.

Tyres are made for their use on vehicles; they are not made as a recycling industry feedstock. Their composition makes them difficult to recycle.

This report deals with the composition of tyres, their toxicity (or lack of toxicity), and the likely result of processing for recycling by shredding and grinding.

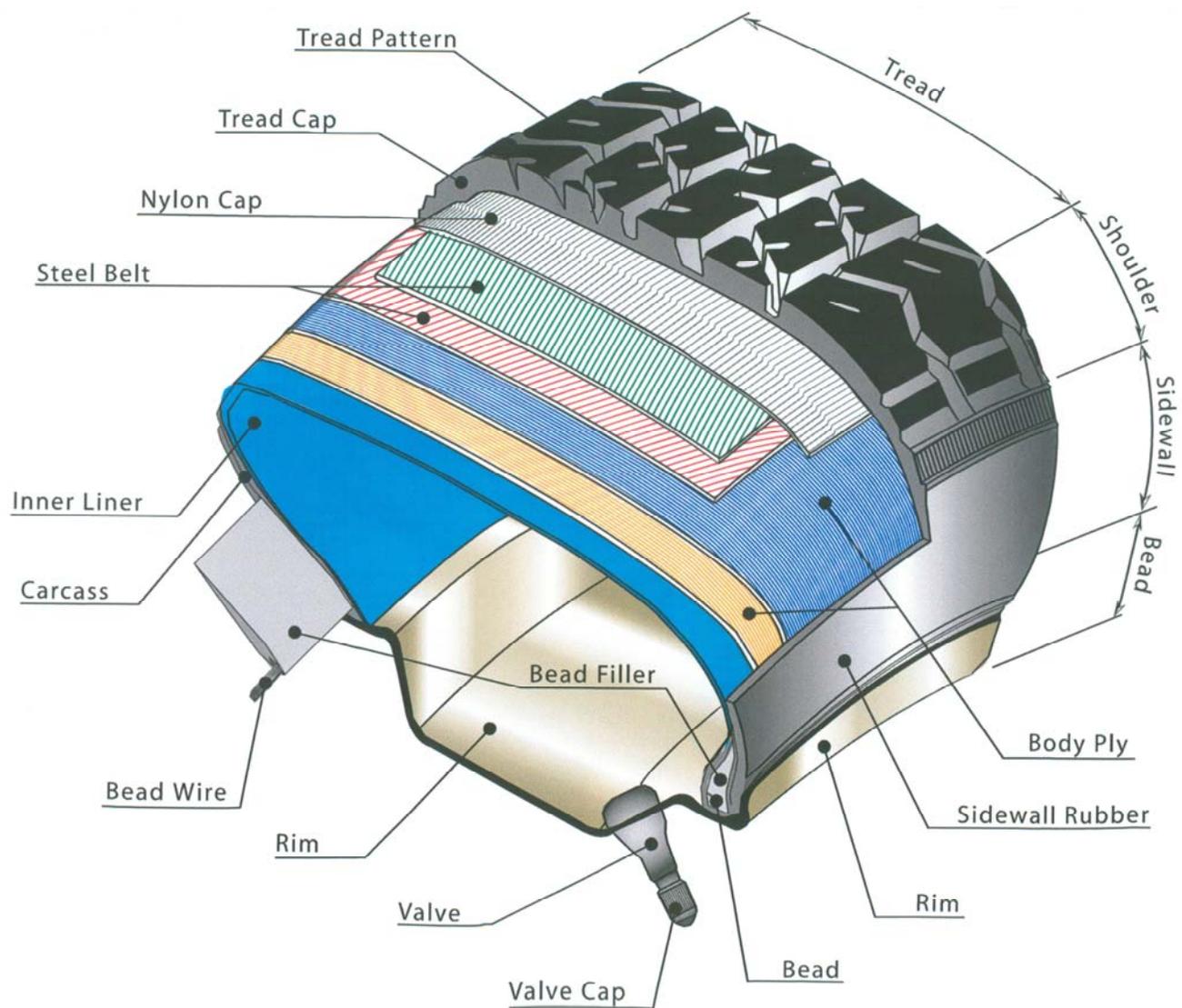
2. The Composition of a Tyre

Ingredient	Passenger Car Tyre	Lorry Tyre	OTR Tyre
Rubber/Elastomers ¹	∇47%	∇45%	∇47%
Carbon Black ²	∇21.5%	∇22%	∇22%
Metal	∇16.5%	∇25%	∇12%
Textile	∇5.5%	--	∇10%
Zinc Oxide	∇1%	∇2%	∇2%
Sulphur	∇1%	∇1%	∇1%
Additives ³	∇7.5%	∇5%	∇6%
Carbon-based materials, total ⁴	∇74%	∇67%	∇76%

- 1 Lorry & OTR tyres contain higher proportions of natural rubber than passenger car tyres.
- 2 Silica replaces part of the carbon black in certain types of tyres
- 3 Some of the additives include clays, which may be replaced in part in some tyres with recycled rubber crumb from waste tyres
- 4 These approximate totals would be slightly higher if clays were replaced by recycled crumb rubber from waste tyres

This is a simplistic view of tyre composition. A common-sized all season passenger tyre made by Goodyear, weighing about 10 kG (22 lbs) new, contains:-

- 30 kinds of synthetic rubber
- 8 kinds of natural rubber
- 8 kinds of carbon black
- steel cord for belts
- polyester and nylon fibre
- steel bead wire
- 40 different chemicals, waxes, oils, pigments, silicas & clays.



Tyres contain so many different compounds and ingredients because they are engineering miracles, expected to handle the tortures of heat and cold, high speed, abrasive conditions, and often not enough air pressure. They are expected to perform for tens of thousands of miles and retain their essential properties despite horrendous driving habits and sometimes poorly maintained or built roads.

The rubber compound alone is designed for nine different applications/components within a radial passenger tyre:

Rubber % by Weight in New Radial Passenger Tyre	
Application/Component	% of Total
Tread	32.6%
Base	1.7%
Sidewall	21.9%
Bead Apex	5.0%
Bead Insulation	1.2%
Fabric/Fibre Insulation	11.8%
Steel Cord Insulation	9.5%
Inner Liner	12.4%
Undercushion	3.9%
Total	100.0%

From the US Rubber Manufacturers Association

Tyres contain practically no hazardous waste constituents. According to the Basel Convention Technical Guidelines on the Identification and Management of Used Tyres¹, tyres contain the following:

Constituent	Chemical Name	Remarks	Content (% weight)
Y22	Copper Compounds	Alloying constituent of the metallic reinforcing material (Steelcord)	Approx 0.02%
Y23	Zinc Compounds	Zinc Oxide, retained in the rubber matrix	Approx 1%
Y26	Cadmium	On trace levels, as Cadmium compounds attendant substance of the Zinc Oxide	Max 0.001%
Y31	Lead Lead compounds	On trace levels, as attendant substance of the Zinc Oxide	Max 0.005%
Y34	Acidic solutions or acids in solid form	Stearic Acid, in solid form	Approx 0.3%
Y35	Organohalogen compounds other than substances in Annex	Halogen butyl rubber (tendency: decreasing)	Content of halogens max 0.10%

Prepared by the Technical Working Group of the Basel Convention with support from industry and adopted by the fifth meeting of the Conference of the Parties in December 1999, Basel, Switzerland

2.1 Properties & Characteristics of Tyres

At the request of BLIC (Bureau Liaison des Industries du Caoutchouc de l'EU) the Ecotoxicity tests were performed:

In 1995, studies were carried out at the Pasteur Institute in Lille, France using rubber powder generated from tyre tread (on Alga: *S. Capricornutum* and crustacean: *Daphnia magna* and Fish *Brachydanio rerio*) as per norms ISO 8692, 6341 and 7346.

In 1996, a supplemental study was done: "Determination of Acute Toxicity as per ISO 11268/1 - Observation of effect of tyre powder rubber on a population of earthworm placed in a definite substratum" - at the Pasteur Institute in Lyon, France using standardised norms, there showed no toxicity.

These four tests showed no toxicity.

3. Post-Consumer Tyre Material

Product Yield	Car Tyres	Truck Tyres	OTR Tyres
Crumb Rubber	∇70%	∇70%	∇78%
Steel	∇17%	∇27%	∇15%
Fibre & Scrap	∇13%	∇3%	∇7%

Product yields for post-consumer tyre materials do not correspond to new tyre composition because:-

- 1 Most waste tyres have significant tread wear, reducing the amount of rubber material available for product yield, and increasing the percentage contributions of non-rubber constituents such as metals and fibre;
- 2 Crumb rubber contains some contamination of metals and fibres in most grades. Only the finest grades/powders are completely wire and fibre-free;
- 3 What is identified as "crumb rubber" actually incorporates the rubber/elastomers, the carbon black, the sulphur, the "additives" and most of the zinc oxide;
- 4 Inevitably, some rubber materials adhere to the steel.

Important Warning

The information set out in the above is of a general nature only and not intended to be relied upon in specific cases.

The information does not take account of environmental issues which should be discussed as a matter of routine with the regulatory authorities (the Environment Agency in England and Wales, the Scottish Environment Protection Agency in Scotland and the Department of the Environment in Northern Ireland).

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