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Life cycle assessment of an average European car tyre

□ CONTEXT

The European tyre manufacturers¹ organised in BLIC (European Association of the Rubber Industry) have pro-actively performed together during 2000 and the beginning of 2001 a full Life Cycle Assessment² (LCA) study of a representative European 195/65 R15 passenger car tyre (summer H rated new carbon black and silica based tread tyres and retreaded carbon black based tread tyre).

They commissioned an external and prestigious LCA practitioner, PRÉ Consultants (Netherlands), to help them to perform the actual LCA study.

The critical review of this major study has been performed by a no less prestigious and independent LCA practitioner, CIT Ekologik, a company of Chalmers Industriteknik (Sweden).

It is of first importance to stress that the results of this study relate only to CAR tyres and not to TRUCK tyres. It would lead to misinterpretations if results listed below were extrapolated to truck tyres.

It is important to note that car tyre LCA study only describes environmental impacts that relate to tyre «system» (the tyre during use phase and also the linked processes which are needed to produce the raw materials, the car tyre itself, to dispose the part worn tyre, etc ...) and does not position the LCA results in comparison with impacts from other categories of “systems”.

In this context, an environmental impact induced by car tyres which may appear here as a major one should be put in a more global perspective before to formulate some valid and robust conclusions. Unfortunately, it is outside the LCA methodology to do this task.

Finally, the European tyre manufacturers within BLIC consider that complete participation of the European tyre industry provided a high quality database and puts this study as the reference in Europe for car tyre LCA.

¹ Bridgestone-Firestone; Continental; Cooper-Avon; Goodyear-Dunlop; Michelin; Nokian; Pirelli; Trelleborg; Vredestein.

² According to ISO 14040 series, Life Cycle Assessment is a technique for assessing the environmental aspects and potential impacts associated with a product, by :

- Compiling an inventory of relevant inputs and outputs of a product system,
- Evaluating the potential environmental impacts associated with those inputs and outputs,
- Interpreting the results of the inventory analysis and the impact assessment in relation to goal and scope.

□ MAIN FINDINGS

Life cycle perspective

An overview of the environmental impacts **throughout the life cycle** of a car tyre leads to highlight the following main findings:

- **The use phase has the highest contribution to the environmental load in the life cycle of a car tyre.**
- **The most important aspect during use phase is the fuel consumption that can be attributed to the rolling resistance.**
Car tyre / road contact noise is potentially an important effect , but its specific magnitude cannot yet be determined (see below).
Car tyre contribution to the motor exhaust fumes emissions is also an important aspect , but of a lesser magnitude than the tyre induced fossil fuel depletion.
Car tyre debris which are emitted during use phase contribute to the overall life cycle. however , their role is modest in comparison with the fuel consumption induced by the rolling resistance phenomena and lower than the car tyre contribution to the motor exhaust fumes emissions.

The global magnitude of these impacts during use phase are greatly influenced by external factors such as for instance the driver behaviour: there is clearly a shared contribution of car tyre design and these external factors, to the final level of car tyre environmental impacts.

In any case, any decision that could be taken in order to try to mitigate the environmental impacts of car tyre should be put **into a more global perspective** (see § “Context”) and take into account the limited capacity of intervention during design stage with the major concern not to compromise the **safety of users**.

- **The contribution of distribution transport and end of life collection transport has little significance , compared to the other stages of the life cycle.**

The environmental impacts of carbon black and silica car tyres have also been compared.

In the production and the end of life phase there are no significant differences.

Also the tyre debris from both type of car tyres have no significant different properties.

However, the model silica car tyre has a lower rolling resistance, which results in lower fuel consumption during use phase. As the fuel consumption has a dominating effect, this means that over the entire life cycle the environmental load of silica car tyres is lower. So the following conclusion can be formulated:

- **Over the life cycle, silica model car tyres have a lower environmental load than carbon black model car tyres.**

Production steps

The environmental impacts of the **tyre manufacturing process** are relatively low in comparison with those of the **production of raw materials**. This can be summarized as follows:

- **The environmental load in the production phase of a car tyre is mainly due to the production of raw materials , and not to the car tyre production itself.**

End-of-life

The environmental impacts of the **end-of-life scenario** (a representative mix of the existing end-of-life processing routes) are low compared to the other stages of the life cycle.

A comparison has also been made over the different alternative end of life processes.

Except for **land filling** which is clearly the least attractive option, **all end-of-life processing routes** have a low or even negative environmental load (in other words a positive effect on the environment due to the production of useful by products).

The most attractive option is **tyre recycling**.

Incineration in a power plant and in a cement kiln has a neutral or positive effect on the environment, depending of the impact assessment methodology used.

- **The average end of life scenario has a relatively low contribution to the overall load of the life cycle. The contribution of the average scenario is less important than the use phase or the production phase.**
Of all the end of life processes, landfilling is the least attractive option.

Car tyre retreading

At first sight, the environmental benefit of **car tyre retreading** seems to be clear: each time a car tyre is retreaded, the production and disposal of a car tyre is avoided.

However retreaded summer car tyres tend to have a higher rolling resistance than new car tyres.

In this case the benefits of retreading can easily be lost.

A break-even analysis shows that the benefits from retreading disappear if the rolling resistance is about 8% higher than a new model car tyre, which illustrates the importance of rolling resistance.

Another unclear issue is dealing with the noise of retreaded car tyres. Tests show that retreaded car tyres may have significant higher noise levels.

- **It is not possible to determine precisely the environmental load of retreaded car tyres , as there is too much uncertainty regarding possibly significant additional fuel consumption in the use phase and possibly higher noise levels. But it has to be stressed, that only in the best case the use of retreaded car tyres would lead to no additional emissions.**

Car tyre / road contact noise

A large number of **noise** studies in many countries confirms that transport equipment is generally seen as the primordial source of noise.

In this context, the road transport is often considered as one of the main contributor of the transport noise.

Noise from the car tyre can contribute significantly to the total vehicle noise.

Therefore an assessment of the impact of noise should be included in the analysis. However, both available inventory data sets as well as impact assessment methodology are not developed in a way that reliable results can be produced (different impact assessment methods produce very different results!).

However, if it has not been possible to quantify the car tyre / road contact noise, all methods indicate that noise is at least a significant aspect.

In this context, more research needs to be done to assess the real magnitude of the impact.

□ **CONTACTS**

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