Environmental sustainability assessment (LCA) of PoroElastic Road Surface (PERS)

Henrik Fred Larsen, Danish Road Directorate
Guldalderen 12, 2640 Hedehusene, Denmark
+45 72447126 **hfl@vd.dk**

ABSTRACT

Poroelastic road surfacing (PERS) is promising regarding noise reduction as compared to traditional pavements. But how well is PERS performing when it comes to environmental sustainability? The relative environmental sustainability of PERS as compared to conventional pavement types like stone mastic (SMA) is tested by use of LCA in the EU FP7 project Persuade. Preliminary results on a PERS mixture as compared to a SMA mixture (cradle-to-gate) indicate that PERS may have 3-10 times higher potential impact on the environment. However, including the missing LCA stages (especially noise and rolling resistance as related to the use stage) may change this picture.

BACKGROUND

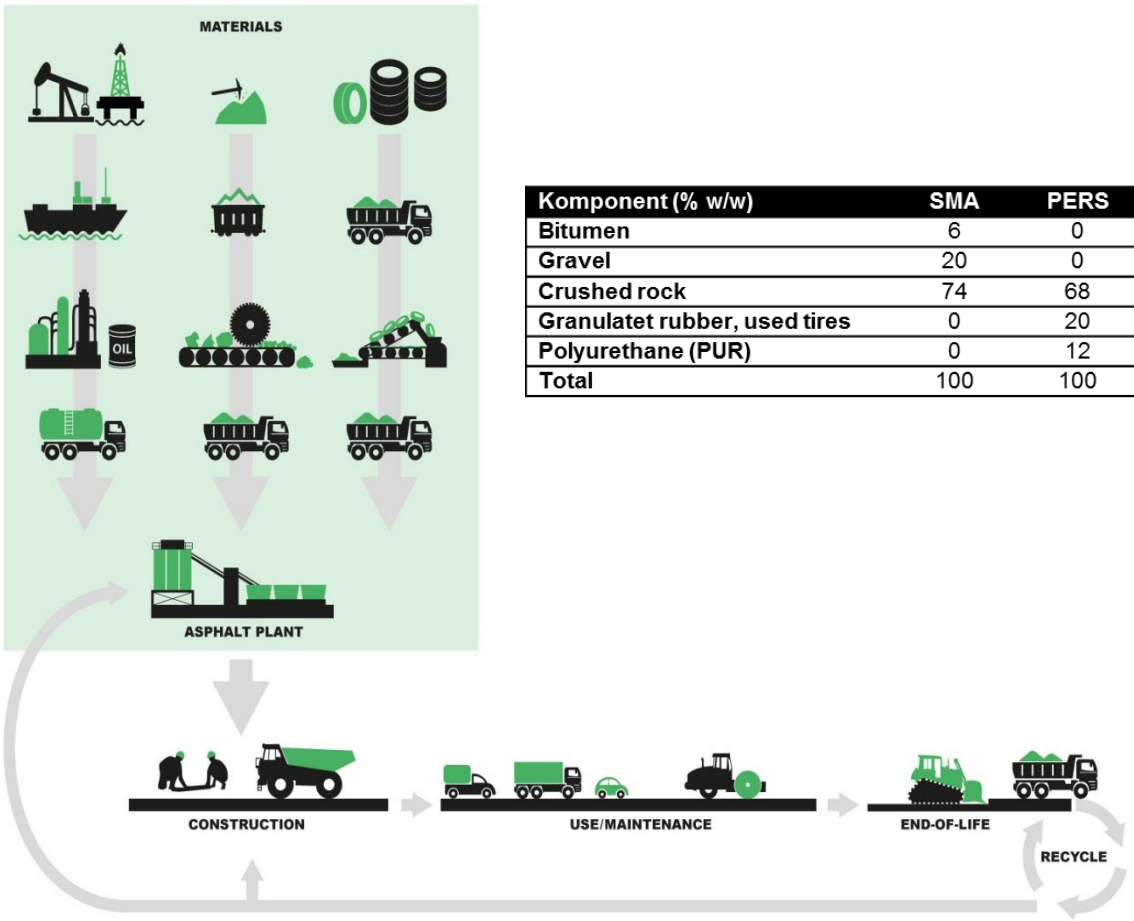
The PERSUADE project (http://persuade.fehrl.org/) aims at developing the experimental concept of a poroelastic road surfacing (PERS) into a feasible noise-abatement measure as an alternative to, for example, noise barriers. It is expected that PERS may provide substantially higher noise reductions than the best of the conventional paving materials. The specific feature of this new type of road surfacing is that it contains rubber granules from recycled car tires bound with a synthetic resin, such as polyurethane. Though, LCA's on pavement including recycled rubber have already been done (1) these existing studies deals with rubber bitumen (melted rubber) and not rubber granules build into the pavement structure as in PERSUADE. The environmental sustainability of the developed PERS pavements is currently assessed within PERSUADE by use of LCA.

METHOD

As illustrated in Figure 1 the first comparison (cradle-to-gate) of a PERS mixture with a stone mastic mixture (SMA) has already been done by use of project-/literature-data (foreground), EcoInvent data (background) (2) and the impact assessment methods ReCiPe, v1.06 (3) and EDIP97 (4). The LCA is modelled in GaBi 5 (5) and the functional unit is 1 kg mixture.

RESULTS

The preliminary results of this comparison indicate that the potential impact of the PERS mixture is 3-10 higher than that of SMA depending on the impact category/area of protection. The result for the LCIA method ReCiPe (end-point) is shown in Figure 2.



Komponent (% w/w)	SMA	PERS
Bitumen	6	0
Gravel	20	0
Crushed rock	74	68
Granulatet rubber, used tires	0	20
Polyurethane (PUR)	0	12
Total	100	100

Figure 1: The life cycle of pavements tested in PERSUADE. The composition of the mixtures SMA and PERS tested in this first LCA iteration (only cradle-to-gate) are shown in the table.

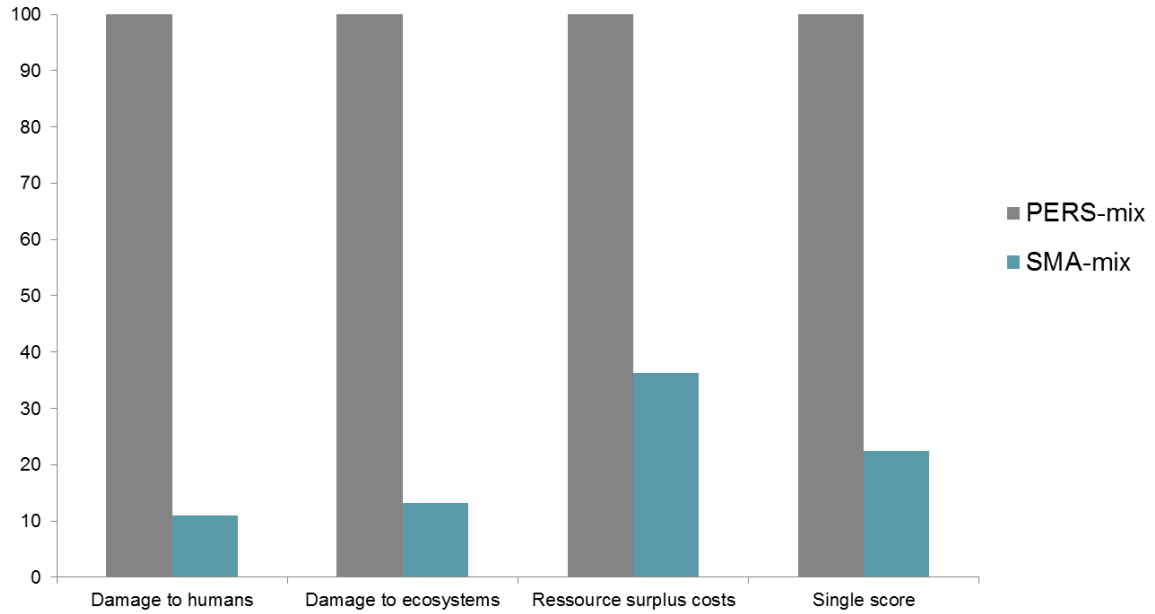


Figure 2. Comparison (relative values, %) of 1 kg PERS-mixture with 1 kg SMA-mixture by use of ReCiPe (end-point).

The main reason for the higher impact of the PERS-mix is relatively high energy consumption for the production of the binder polyurethane (PUR) as illustrated by the carbon footprint in Figure 3.

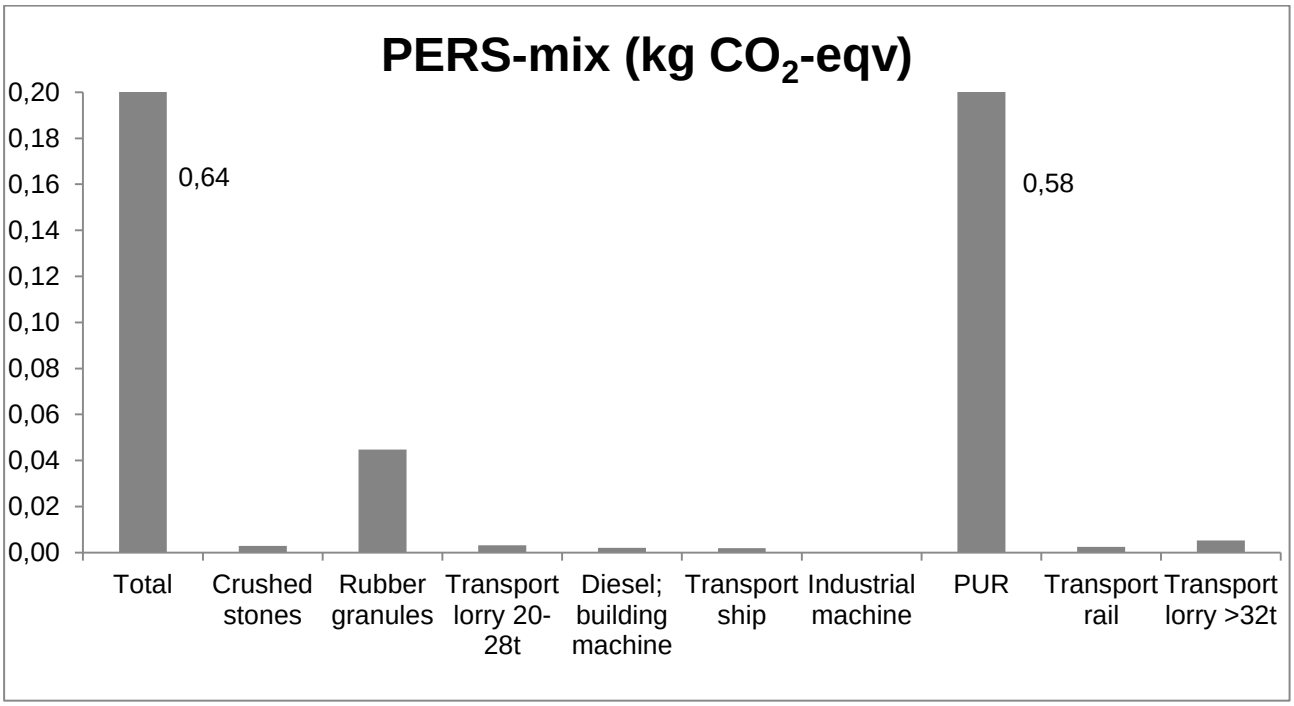


Figure 3: Carbon footprint of PERS-mixture (global warming potential according to EDIP97)

FURTHER RESEARCH

Research within the project is currently going on and the next step will be to investigate the robustness of the used datasets (first iteration) in more details (PUR production, granulation of tires, allocation principles….) even though the overall result seems robust.

The coming iterations aim at including:

- The application (paving)
- Noise reduction as compared to conventional pavement types – by including noise barriers or a noise impact category in the comparison
- Including USETox (6) and other ILCD recommended impact categories (7,8) in the impact assessment
- End-of-life scenario – as compared to conventional pavement types?
- Considerations and inclusion of maintenance if significant differences are expected
- Considerations and inclusion of rolling resistance (use phase) and leachate (road water) if significant differences are expected/measured within project
- Considerations and sensitivity analysis on pavement life time
- A consequential (marginal) LCA scenario as supplement to the main scenario (attributional/average)

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