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Fact Sheet

Paper sacks – your better choice for the climate

About the research

Paper sacks and polyethylene form-fill-seal (ffs) sacks are used for packaging cement throughout Europe. Several LCA studies have been published by stakeholders claiming environmental benefits for polyethylene ffs sacks for cement. However, these studies have lacked transparency, especially in terms of the data applied and the assumptions made.

Subsequently, CEPI Eurokraft and Eurosac requested RISE Innventia to make a transparent comparative study comparing the carbon footprint of the two solutions using the ten toes framework and the CITPA calculation tool. The two systems have also been modelled in the LCA software tool GaBi, with secondary data from GaBi database and Ecoinvent database to enable an analysis of other important emissions. The study has been peer reviewed by the Sustainability team at Intertek, a leading Total Quality Assurance provider to industries worldwide.

Specifications of the two compared sack systems

The functional unit considered in the comparisons is a typical single filled 25 kg cement sack. The underlying specifications for both sacks are:

Typical 25 kg paper cement sack:	***Typical 25 kg polyethylene ffs cement sack:***
45g outer ply (bleached) 4g HDPE poly liner 42g inner ply (unbleached) 3.7g starch glue 1.1g ink Total sack weight = 95.8g	67.8g PE (85%LDPE, 15% LLDPE) 2.2g ink Total sack weight = 70g

System boundaries

For this study, the system boundaries are “cradle to gate”. For the polyethylene ffs cement sack this covers the production of the film, printing of it (flexo printing) and the converting process into a tube. This tube is delivered as a reel to the filler. At the filler, the tube is formed into bags, filled with cement and sealed in one operation.

The system boundaries for the paper cement sack covers the production of sack kraft paper, production of paper sacks in a sack plant, distribution to a filler and finally the filling process with cement.

The impact of the cement production is excluded from the analysis, as its goal is to compare the environmental impacts of the two alternative packaging solutions.

In a second step, the study also extended the system boundaries to include three different end-of-life scenarios for both packaging alternatives; landfill, incineration and recycling. For the recycling scenario the cut-off method has been applied in both cases.

In order to investigate the potential influence of this approach, for the polyethylene ffs sack a scenario has also been modelled with extended boundaries, in which the emissions associated with recycling and a credit for offset virgin polyethylene production are included in the system boundaries, thereby reducing the overall footprint of the polyethylene ffs sacks.

Data sources

The figures used for evaluating the paper sack production are mainly primary data. They are taken from representative European paper mills, paper converters and machinery manufacturers. Secondary data is also used from GaBi and Ecoinvent databases to enable an analysis of other important emissions than greenhouse gases.

Figures used for evaluating the plastic sack (production of LDPE and LLDPE granulates and film production) are taken from PlasticsEurope.

RESULTS

Climate change

Paper cement sacks have significantly lower fossil GHG emissions (71 g CO_2e) than polyethylene ffs cement sacks (192 g CO_2e). The emissions are 2.5 times smaller and therefore have a lower climate change impact.

Fossil energy consumption

The paper sack production is more energy efficient and climate-friendly:

- 5 times less fossil resources are used as fuel input (0.97 MJ fossil energy/paper sack versus 4.72 MJ fossil energy/plastic sack).
- 18 times less fossil resources are used as raw material within the sack (0.18 MJ fossil energy/paper sack versus 3.19 MJ fossil energy/plastic sack).

Renewable energy consumption

The paper sack system uses more renewable energy sources (0.19 MJ renewable energy/paper sack compared to 0 MJ renewable energy/plastic sack), reflecting the high degree of renewable energy utilization in the pulp and paper industry.

Other emissions into air

During the production process, polyethylene ffs cement sacks produce higher nitrogen oxides (NOx) and sulphur oxides (SOx) emissions (due to the higher consumption of fossil fuels) and higher emissions of the heavy metals lead (Pb) and mercury (Hg) into air.

In contrast, paper cement sacks produce higher emissions of ammonia (NH_3), non-methane volatile organic compounds (VOCs) and particulates into air.

Emissions into freshwater

The polyethylene ffs sack production emits more heavy metals into freshwater, while the paper sack production emits more organic substances into freshwater.

Paper sacks and polyethylene ffs sacks have different emission profiles because they use different raw materials, processes, energy requirements and mixes. That is the reason why the results cannot be directly compared in all aspects.

Extending the system boundaries to include three different end-of-life scenarios

The results show that the relative standing of emissions for the two different packaging alternatives remains unchanged.

Considering fossil resources consumed as raw material for the two packaging alternatives, the polyethylene ffs sack has a significantly higher consumption and therefore also higher GHG emissions.

This remains true also for the recycling scenario, even when a credit for offset virgin polyethylene production are included in the system boundaries.