

## Comparative Life Cycle Assessment of Three Insulation Materials

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Insulation of buildings in order to save heating energy is an important technology for promoting sustainable development. This paper summarises the results of a comparative LCA study of stone wool (HT Rockwool), flax and paper wool (shredded paper cellulose) applied for insulation of attics.

The three materials are very different with respect to their life cycles. Stone wool is a traditional industrial product based mainly on abundant inorganic raw materials; flax is an agricultural product being reinvented for new industrial purposes, and paper wool is based on recycled raw material, i.e. old newsprint. The study shows how to address the methodological problems associated with the different origin of the materials. System expansion is used where possible, e.g. by examining the combined paper cycles of newspapers, old newsprint and shredded paper cellulose. In the case of flax insulation, the agricultural system is expanded to include oil seeds and shives (for cattle fodder). Furthermore, a comparison is made between the environmental interventions when using system expansion and conventional economic allocation. Stone wool is examined by using information from one production site and comparing the results to earlier LCA's.

The study addresses a selection of global and regional environmental impacts for which the database and the impact assessment methods are believed to be satisfactory, e.g. global warming, acidification, nutrient enrichment and photochemical ozone formation, complemented with inventory information regarding consumption of different energy sources.

Of the three products investigated, paper wool has in general the lowest global and regional environmental impacts and flax insulation the highest, with stone wool falling in between. A somewhat surprising exception from this is that the total primary energy consumption is lower for stone wool than for flax and paper wool. The findings are considered as robust given the available database, but especially for flax insulation there may be large variations in the impacts, due to differences in yield as well as product design. The presentation will give a thorough overview of the critical elements in the comparison.

The study also addresses occupational health, using an approach similar to that used for risk assessment. Here, the modern less biopersistent stone wool products are seen as the safest alternatives, because of a low potential for exposure, sufficient animal testing and the absence of carcinogenic properties.

However, the differences between the investigated products are of minor environmental significance when keeping in mind that insulation of buildings saves up to 100 times the environmental impacts associated with the production of insulation materials. The main conclusion is that the quality and fitness for use of an insulation product throughout its useful life span is the most important aspect in the life cycle of insulation materials.