The 6th International Conference on Life Cycle Management in Gothenburg 2013

LIFE CYCLE ASSESSMENT OF FIRE RETARDANT TREATED WOODEN CLADDINGS

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Keywords: Coatings, Fire retardants, LCA, Wooden claddings.

ABSTRACT

The aim of this work was to evaluate the environmental performance of fire retardant treated exterior wooden claddings using LCA as a tool. The study takes into account the wood, paint and fire retardant chemicals production, wood treatment processes, use phase and disposal life cycle stages. The assessment was done using a functional unit of 1 m^3 treated exterior wooden cladding with a reference life span of 50 years. The results show that the highest impact from raw material production stage which is mainly contributed from fire retardant chemicals.

INTRODUCTION

Fires occur in buildings have been a concern due to the increased risk of injuries, loss of life and properties. The type of materials selected in buildings play major role towards determining the risk of fire and its propagation through the structure or adjacent units. Wood, one of the well-used sustainable building materials, is combustible and treated with different fire retardant chemicals to reduce the combustibility of wood. Fire retardants (FRs) are used to reduce the temperature at which thermal degradation of wood occurs allowing people more time to evacuate the building and authorities to control the spread of fire. Although FRs including phosphorous, bromine, boron, magnesium hydroxide and their combinations have been used in order to renew wood's popularity by reducing the risk of fires, some of these treatments have been criticized due to their poor performance (Ostman *et al.*, 2001; White, 2009; Hakkarainen *et al.*, 2005). To the best of our knowledge, there are no open references that cover LCA of fire retardant treated wood products using the standard methodologies. This study addresses the life cycle assessment of fire retardant treated wood used for exterior claddings, using ISO 14040 series life cycle assessment methodologies.

GOAL AND SCOPE OF THE STUDY

The goal of this study is to provide a comprehensive understanding of environmental burdens associated with the raw material, impregnation; wood coating; use and end of life (EOL) life cycle stages of fire retardant treated wood based on LCA methodologies. The scope of the study is illustrated in Fig.1.

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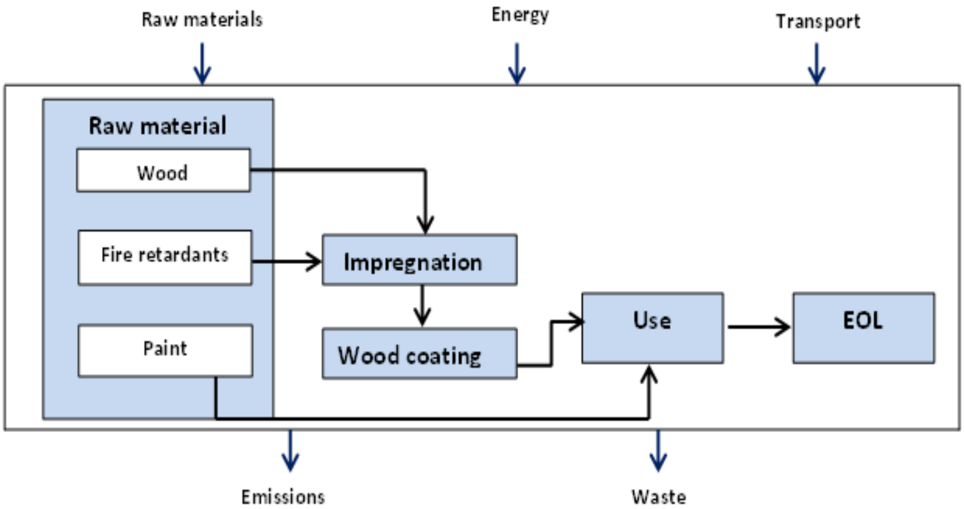

Fig.1. System description of fire retardant treated wood

LIFE CYCLE INVENTORY

The foreground information of the selected process in the wood production is based on the environmental product declaration. Primary input and output data for fire retardant fluid production and impregnation process were collected from Moelven wood. The coatings data was based on environmental data sheet and product technical data of Akzo Nobels products, Cetol BL 21 Plus and Cetol BL Opaque.

LIFE CYCLE IMPACT ASSESSMENT

The effects of resource used and emissions generated are quantified and grouped to limited number of indicators using the Europe ReCiPe midpoint and endpoint H/H LCIA method. The LCIA calculations have been performed by using Simapro 7.3 software.

RESULTS AND DISCUSSION

The percentage contribution values of impact indicator at each life cycle stages presented in Fig.2 shows the highest impact contribution of the raw material stage, predominantly on freshwater eutrophication impact category. From the raw materials, including wood, coating and FRs, the impact is mainly due to the FRs. The type of FR chemicals used and the requirement of higher FR retention in the impregnation process may be the cause of higher impact from FR. The energy consumption in the impregnation process; the fuel consumed during the transportation of the treated wood to construction site and the paint used for the maintenance of the cladding during its life time and finally the energy used as well as the emission generated in the end of life cycle stages may be the source of impacts from impregnation, use and end of life cycle stages, respectively. Relatively, the wood coating stage was with the lowest impact which may be due to the assumption of manual application of the paint on the surface of the cladding.

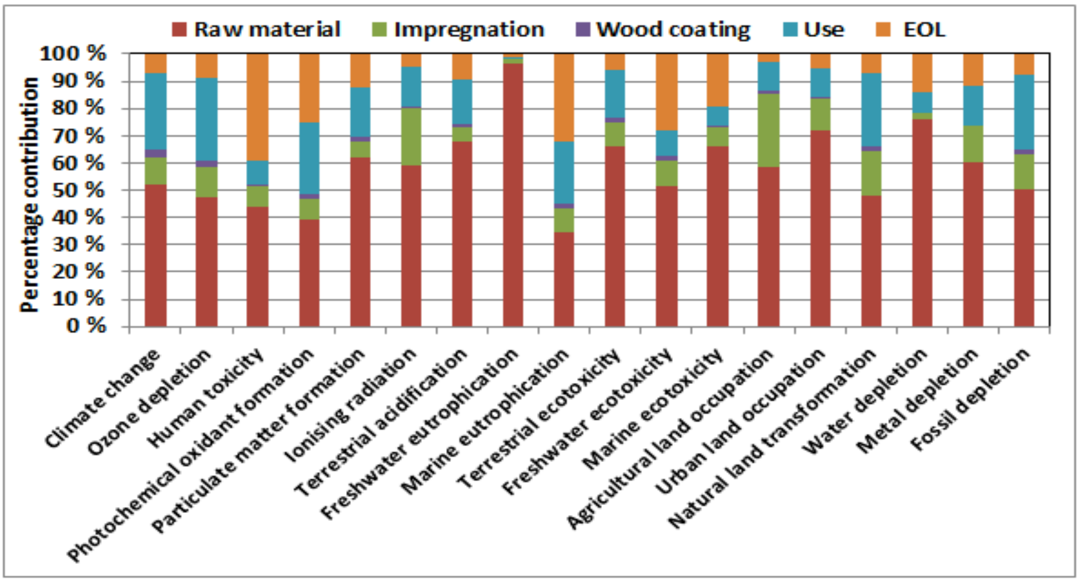

Fig.2. Impact indicator contributions for each life cycle stage

CONCLUSIONS

In this study, the findings illustrate the highest impact from the fire retardants used to improve the durability of fire retardant impregnated wood. Selecting durable and environmentally preferable FRs may reduce the impact of FR treated wood. Furthermore, utilization of durable paint may reduce the impact of the treated wood by reducing the frequency of maintenance required.

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