LIFE CYCLE ASSESSMENT AS A TOOL FOR RESOURCE OPTIMISATION OF CONTINUOUS BASALT FIBRE PRODUCTION IN ICELAND

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Key Words: sustainable manufacture, continuous basalt fibre, energy, production, resource management

Continuous Basalt Fibre (CBF) is a structural material formed from molten rocks and is analogous to glass fibre. The concept of using molten rock to form fibres dates back to the start of the last century. The inception of more comprehensive research took place in the 1970s, by former Soviet countries. The largest active mines today are located in Ukraine and Russia. The market is steadily developing as production becomes more economically viable, and CBF becomes more readily known and tested. Continuous basalt fibres are ideally suited for demanding applications that require high temperatures, chemical resistance, durability, mechanical strength and low water absorption. CBF therefore has a large potential within the construction industry.

Greenbas is a project led by Innovation Centre Iceland and funded by NORDMIN. It investigates the extraction of volcanic basalt, for the optimised, sustainable production of CBF in Iceland. Life cycle assessment (LCA) is a useful tool for the assessment of environmental impacts, including greenhouse gas (GHG) emissions. LCA has been used to address every step of the future production chain of CBF in Iceland; from the mining and crushing of rocks, to the fibre production of CBF using various energy mixes. This future production chain has been compared to current CBF production in Russia, in order to optimise production in terms of consistency, quality, cost and GHG emissions. This research is relevant to conference topics: ‘LCA and other assessment tools for waste and resource management and planning’ and ‘life cycle engineering and sustainable manufacturing.’

Data has been modified from existing mining and production systems to fit Icelandic conditions, in order to perform the LCA calculations. Current practice involves melting crushed basalt rocks with natural gas and non-renewable electricity mixes. In contrast, we investigate an advanced, all-electric production technology, which uses the Icelandic electricity mix. Resource optimisation, in terms of energy use during production is investigated through a furnace sensitivity analysis. Life cycle emissions from transport are also investigated.

It was found that an all-electric Icelandic production may result in 68% lower GHG emissions than Russian production, whereby in both cases furnace energy consumption is identified as the largest contributor to GHG emissions. The reduction of furnace energy consumption is dependent on numerous parameters, such as type of furnace, operation, basalt fracture composition and size, furnace size and CBF production rate.

Figure 1 – Comparison of emissions from CBF production in Russia and Iceland