FISSAC

FOSTERING INDUSTRIAL SYMBIOSIS FOR A SUSTAINABLE RESOURCE INTENSIVE INDUSTRY ACROSS THE EXTENDED CONSTRUCTION VALUE CHAIN

Eco-design of cost-effective products: new cement-based products, new ceramic tiles, and innovative Rubber Wood Plastic Composites

Executive summary

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D3.3: New Cement based products eco-design
D3.4: New Ceramic Tiles eco-design
D3.5: Innovative Rubber Wood Plastic Composites (RWPC) eco-design
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What is eco-design?

According to the definition in the EU Eco-design directive 2009/125/EC:

"Eco-design means the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life cycle."

The definition puts the eco-design focus of a product on environmental aspects that cover raw material acquisition, manufacturing processes, distribution, maintenance, use and end-of-life. However, the FISSAC project applies a broader definition for eco-design. Not only environmental factors, but also technical, economic, and market factors will be identified to perform the overall analysis.

The FISSAC project defines seven drivers of industrial symbiosis:

- Sustainability
- Energy savings
- Technical innovation
- Regulation
- Economics
- Information
- Cooperation

The focus of EU directive 2009/125/EC is on the environmental aspects for energy-related products. With that, it coincides mainly with to two of the seven FISSAC drivers: sustainability and energy savings.

In comparison to the EU directive, eco-design in FISSAC will consider two additional aspects: technical innovation and economic factors. Technical innovation not only provides solutions to conquer the technical barriers while using secondary raw materials to improve the quality of the new products, but also sets requirements on energy efficiency, simplicity, flexibility and safety during the process. Regarding economic factors, the aspects costs and market demands will be considered and analysed. As eco-design is aligned with life-cycle assessment (LCA) methodology, upstream and downstream efficiency changes in the supply chain and the waste or reuse and recycling streams can be integrated. Eco-design of new and refined products can identify benefits from and contributions to industrial symbioses.

Figure 1– Relation between Eco-design in FISSAC, Eco-design in Directive 2009/125/EC, and Industrial Symbiosis drivers

From the perspective of the manufacturers, eco-design provides the following benefits:

1. Economic efficiency
   - Energy saving through energy efficient technologies
   - Reduced cost of the primary materials
   - Less need to purchase greenhouse gas allowances
2. Increase market competitiveness
   - Lead the market of green products
   - Improve user satisfaction

Eco-design methodology

The eco-design process varies from industry to industry, from company to company and from product to product. However, some main stages are always present: product information collecting, environmental performance evaluation, setting up redesign focuses & strategies, and implementing the strategies. Depending on which product life-cycle stage accumulates the highest environmental impact, the eco-design products can be classified into different basic types. Accordingly, the eco-design focus can be defined and corresponding redesign strategies can be applied to reduce the environmental footprint.

Eco-design in FISSAC

At the very beginning of the project, a general approach to eco-design was set up based on the EU eco-design directive (Directive 2009/125/EC). The approach was complemented with experience feedback from eco-design projects and was developed and refined to the aims and the scope of the FISSAC project. A common set of indicators was identified to enable communication of information across the tasks of the project. The manufacturers and innovators are to scrutinize that common list, to complement and to streamline it, while providing their perspective of priorities, preferences and constraints relating to their implementation of eco-design.

Quantitative and qualitative assessments were applied to evaluate the environmental and economic performance of the products. Based on the LCA and life-cycle cost (LCC) results and the evaluation of other eco-design indicators, preliminary redesign strategies were defined to drive improvement. In order to validate the design strategies, further assessments will be carried out based on the eco-design suggestions to optimize the products. The improvements will be quantitatively validated through new LCA & LCC assessment, which will be conducted in a later phase of the FISSAC project.

Figure 2 – Detailed eco-design process for an individual product

Conclusions of eco-design for the FISSAC products

Products analysed in the project are:

1. Cement-based products:
   - New Eco-Cements
   - New Green concrete:
     - Autoclaved aerated concrete (AAC) blocks/panels
     - Ready-mix concrete
2. Ceramic Tiles:
   - Porcelain tiles
   - Wall tiles
3. Innovative Rubber Wood Plastic Composites (RWPC)

The performance of the new design scenarios is compared to identified reference products and includes the results of LCA & LCC analysis and the technical testing. The direction of change associated with each of the selected eco-design parameters was derived from the detailed list of grouped indicators and summarized as a simplified display in Table 1.

Ecodesign Parameter	eco-cement										AAC Scenario 1	AAC Scenario 2	Green concrete (ready-mix) Scenario 1	Green concrete (ready-mix) Scenario 2	Porcelain tiles	Wall tiles	RWPC
	Case 1a	Case 1a (2)	Case 1b	Case 1c	Case 2a	Case 2b	Case 2c	Case 2d	Case 2e	Case 2f							
Cost-performance ratio	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
Innovation	→	→	→	→	→	→	→	→	→	→	↑	↑	↑	↑	↑	→	↑
Service Life	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
Functionality & performance of the product	↓	↓	→	→	→	→	→	→	→	→	↓	↓	↑	↑	→	→	↑
Environment	↓	→	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	→	→	→	↓	↑
Health and Safety	↓	↓	→	→	→	→	→	→	→	→	↓	↓	→	→	→	→	→
Quality	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	↑
Producibility & Availability of resources	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	→	→	↑	↑	→	→	→

Table 1 – Change directions of Eco-design parameters for FISSAC products

As a general trend, the results show that improvements could be achieved mainly in:

- Cost-performance ratio
- Innovation
- Environmental impact
- Producibility & availability of resources

In case of the studied products, the collection of eco-design aspects from a broad perspective shows that with few exceptions, achievable advantages are not counter-balanced or outweighed by disadvantages.

Often disputed however is that products designed to utilize secondary raw materials do not perform to the same level as products based on primary raw materials. Performance reduction should however be clearly discussed separately from quality aspects. In many applications, product performance by far exceeds the requirements. The comparison product versus product should be replaced with a direct matching of performance and requirements. Valuable resources could then be directed in an optimized way.

The report concludes with the presentation of comparative assessments – topic by topic – of the new proposed product in comparison to a reference product or scenario. With no weighting of the relative importance of these topics, a balanced scoring and recommendation is not obvious. The intention is rather to display fields of improvement, of equity or of disadvantage. Embedded in decision-making processes with clear design and performance targets, this approach can be refined and detailed, value judgments can be applied to identify and justify a ranking of available options. Taken to further design improvements, identified weaknesses should be detailed and mitigated, while compliance with functionality and performance requirements should be maintained. To enable such eco-design optimization, detailed knowledge about product-specific requirements and targets is a prerequisite.

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