

SAFETY AND SUSTAINABILITY DRIVERS FOR PROCESS DESIGN AND OPTIMIZATION OF SUPPLY CHAINS

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The main determinants of the impact and safety of process plants are defined in the design stage, in particular in the early phases where a higher number of degrees of freedom is present. Furthermore, the production of goods causes impacts that extend beyond the actual production facility and involve up-stream and downstream processes: a holistic perspective is required in the technological optimization of such life-cycle.

The research activity on this topic focused on the development of Key Performance Indicators (KPIs), applicable as sustainability drivers in the design activities and in the supply chain optimization. The use of quantitative indicators provides auditable support in design choices and allows for selection of the production and treatment technologies which more effectively reduce environmental burdens, maximize yields and minimize costs.

The main outcomes of the research activity included:

1. Tools for the identification of sustainability KPIs through a structured approach accounting for the specific factors and constraints of design activities (e.g. limited availability of data). System analysis ranged from Life Cycle Assessment (LCA), to detailed process simulation. Experimental activity supported the collection of relevant performance data for emerging processes (e.g. biomass densification).
2. Advanced approaches for the interpretation, normalization and aggregation of indicators. The use of site-specific factors introduces a sound reference for the interpretation of the indicator values.
3. Indicators for inherent safety assessment. The methodology was developed to provide both a flexible procedure for the identification of the hazards, and a sound consequence-based quantification of the safety performance of a process scheme.
4. Specific optimization studies. Examples of studies include: alternative fuel supply chains based on biomass, production of bulk and fine chemicals, envisaged hydrogen chain for automotive applications, hazardous wastes.

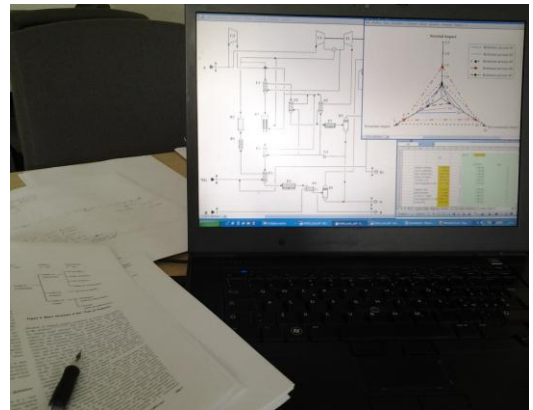


Fig.1 Sustainability study of alternative design options for a process plant.

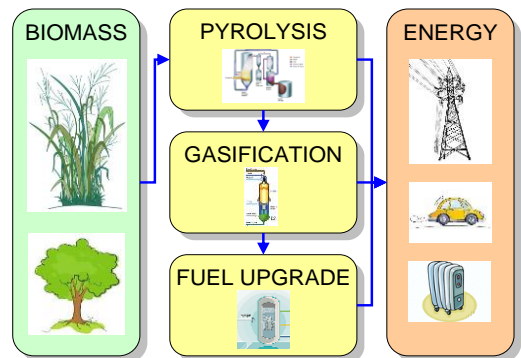


Fig.2 A product chain study: alternative fuels from biomass pyrolysis.

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