LCM 2015
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LCM - LIFE CYCLE MANAGEMENT

TOPICS

- Role of chemicals and materials in enhancing the sustainability of product systems
- Application of LCA for eco-design and sustainable manufacturing
- Regional approaches for integrating Life Cycle Thinking
- Mainstreaming of sophisticated LC approaches towards applications and tools
- Managing uncertainty in decision making
- Additional key topics and the overall headline to be defined closer to the conference date

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BioRobur

LCM 2015

A SYSTEMATIC EVALUATION METHODOLOGY OF DIFFERENT INNOVATIVE DECENTRALIZED CONCEPTS FOR TECHNOLOGY BASED DECISION-MAKING PROCESSES – A CASE STUDY IN THE SYNTHESIS GAS PRODUCTION

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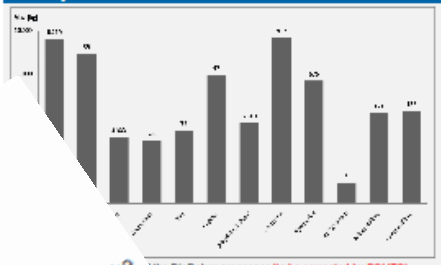
Motivation of the Case Study

- Aim of the project **BioRobur** (Biogas robust processing with combined catalytic reformer and trap) is to develop a robust and efficient biogas reformer for decentralized hydrogen generation in a scale of 50 Nm³/h.
- Major novelties:
  - *Use of autothermal or oxidative steam reforming*
  - *Soot retention from generated syngas with catalytically coated soot trap*
  - *Syngas purification with water gas shift reactors and PSA unit*
- The project involves an energetic and ecological assessment in order to show the energy-efficiency and climate compatibility of this innovative synthesis gas production.
- Methodology:
  - *Life Cycle Assessment (LCA) of techno-environmental performance*
  - *Identification of most efficient, economical and climate-friendly process type of reforming*
  - *Case study in field of hydrogen production of biogas that supports analysis*

LCA Aspects: LCA Results of the BioRobur Processor



the BioRobur processor (to be corrected by POLITO)

To be completed by POLITO

LCA Aspects: Optimization of the Process Efficiency

Fig. 1: Maximum plant efficiency (for biogas)

- Simulation results on the basis of ASPEN PLUS® mass and energy flow modeling have shown the positive effect of heat integration on plant efficiencies.
- The results on the comparison of plant efficiencies obtained for autothermal reforming (ATR), steam reforming (SR) and catalytic partial oxidation (CPOX) are summarized in Fig. 2.
- A detailed parametric study for the autothermal reforming route identified the S/C- (steam-to-carbon) and O/C- (oxygen-to-carbon) ratio as the most influential parameters:

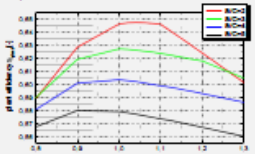


Fig. 2a: Efficiency analysis without using PSA off-gas (600°C ATR inlet temperature)

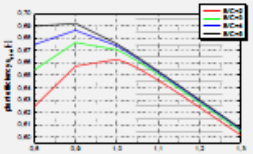


Fig. 2b: Efficiency analysis with using PSA off-gas (600°C ATR inlet temperature)

Modified Technology Portfolio (TPF) Analysis

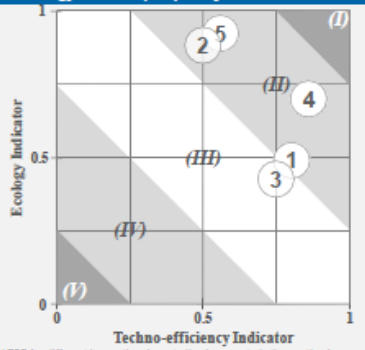


Fig. 3: Modified TPF for different innovative decentralized concepts in the synthesis gas production with (1) SR with NG, (2) Alkaline electrolysis with renewable energy, (3) ATR with NG, (4) ATR with biogas and (5) PEM electrolysis with renewable electricity) within the five technology-based recommendations for action: (I) Perfection, (II) R&D Intensification, (III) Selection (techno-efficient or ecological), (IV) R&D Reduction, (V) Leaving.

Conclusions and Outlook

- Different innovative decentralized concepts in the synthesis gas production are existing and competitive with existing concepts (e.g. with Steam Reforming)
- Results (with the ASPEN process model, LCA calculation, ...) show that the ATR concept is more efficient compared to other types of reforming processes (SR, CPOX).
- ... POLITO ...

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