

COMSYN

Compact gasification and synthesis for flexible production of transport fuels and heat

Concepts for distributed primary biomass conversion and central refining *S. Tuomi, VTT*

An important aspect for alternative fuel processes is their integration into the existing infrastructure. The FLEXCHX and COMSYN process both employ the double integration principle: The fuel process is in close proximity to a source of forest residue or agricultural waste and is integrated to a local district heating network. This way, process off-heat can be utilized. In addition, the decentralized plants form a supply network for the existing centralized refineries.

The FLEXCHX process adds another connection to the existing energy system: By sourcing electricity from the grid when cheap, renewable electricity is available, the product output of the process shifts towards a higher hydrocarbon production thereby decreasing the heat production. This way the process can react to seasonally fluctuating heat demand.

Gasification technologies for small-to-medium scale syngas plants *E. Kurkela, VTT*

Gasifier technologies, developed with VTT's know-how, were presented: The staged fixed-bed (SXB) gasifier (TLR5) studied in FLEXCHX is designed to a size of up to 50 MWth. The DFB gasifier (TRL5-6) is used at scales of 50 – 150 MWth. This gasifier type is studied in the COMSYN project.

Hot filtration *H. Balzer, GKN*

GKN helped to improve the gas cleaning process within the COMSYN process. GKN has developed a novel production process for a FeCrAlSi-Alloy hot gas filter for the removal of fly ash from the gasifier syngas. With the laser-welded filter candles a stable operation was shown during the COMSYN experiments. Filter clogging was found to occur at high tar content in the raw gas. Long-term tests showed no deposition of corrosive species in the filter material.

Catalytic reforming *B. Rollins, Johnson Matthey*

Johnson Matthey (JM) contributed to the FLEXCHX project with their advances in catalytic tar reforming. Reformation of tars from the gasifier is a crucial process step as the tars lead to fouling in subsequent equipment. Newly developed reformer catalyst types have been tested during the experimental campaigns. Their effectiveness in removing tars from gasifier syngas was demonstrated. The effect of temperature and poisons on the durability of different nickel and platinum group metal catalysts was studied. This allowed Johnson Matthey to prove the viability of tar reforming within the FLEXCHX concept and refine their catalyst cost models.

Sorbent-based final gas clean-up*C. Frilund, VTT*

During the COMSYN and FLEXCHX campaigns at VTT's piloting Centre Bioruukki, a new gas cleaning concept successfully removes gas contaminants according to the requirements of the FT-catalysts. Conventional wet scrubbing solutions are not cost efficient at lower scales. The sorbent based cleaning process under investigation promises a 20% cost reduction compared to the conventional methods. The test runs with woody-residue and agro-residue biomass showed a complete removal of all gas contaminants.

Compact Fischer-Tropsch synthesis*T. Boeltken, INERATEC*

INERATEC offers a solution for the production of renewable fuels and materials with their innovative chemical reactor design. Their



micro-structured Fischer-Tropsch reactor matches perfectly with the decentralized production concept pursued in the COMSYN as well as the FLEXCHX project.

Use of FT product at oil refineries*M. Wuokko, NESTE Engineering Solutions & J. Jenčík, ORLEN UniCRE*

NESTE summarizes three co-processing pathways for the Fischer-Tropsch product in existing refining infrastructure in Finland. The addition of a hydroprocessing unit in an oil refinery allows for the production of base oils from the FT wax. Whereas, a hydrocracking unit shifts the product yield towards the shorter chained products gasoline, diesel and jet fuel. A third option is the integration of the distillate fraction to an HVO plant. Thereby, 100 % renewable jet fuel and diesel can be produced.

ORLEN UniCRE has conducted an analysis of the Fischer-Tropsch product from the COMSYN test campaigns. For the analyzed sample the diesel fraction meets the EU standards of a drop-in fuel. Further, it was found that the product can be integrated into the existing refining plant in Litvinov.

Techno-economic study for the COMSYN process *V. Tota, Wood*

With their techno-economic study of the COMSYN process Wood could identify the economically most efficient process configuration. Here, Wood estimates a bio-crude production cost of 1.22 €/l. For the study CAPEX and OPEX are estimated based on a heat-integrated process flowsheet for a 100 MWth plant. Different plant configurations are compared for this study: CO₂ removal in the gas cleaning section doesn't improve the economic outcome compared to a case with no CO₂ removal.

Techno-economic studies for FLEXCHX process *R.-U. Dietrich, DLR*

The SXB gasification pilot plant at VTT

DLR's applied its standardized methodology for techno-economic and ecological assessment to the FLEXCHX and the COMSYN process concepts. For the FLEXCHX process two operation modes were analyzed, one with electrolyzer, and the other without electrolyzer operation. The winter mode was found to have production costs of 0.7 €/l for Fischer-Tropsch intermediate. With an electricity price

lower than 20 €/MWh the summer mode reaches lower production costs than the winter mode.

EU funded FLEXCHX and COMSYN projects organized a webinar on "Compact Gasification and Synthesis for Flexible Production of Transport Fuels and Heat" on 19 January 2021. Detailed webinar presentations are available at the project's websites. ●

COMSYN PROJECT

COMSYN develops a new BTL production concept by means of a compact gasification and synthesis process. Biofuel production costs will be reduced by up to 35% compared to alternative routes, which translates to less than 0.80 €/l production cost for diesel. The production concept is based on the distributed primary conversion of various kinds of biomass residues to intermediate liquid products at small-to-medium scale units located close to biomass resources. The Fischer-Tropsch products will be upgraded to fuels.

CONSORTIUM: VTT (coordinator), DLR, ORLEN UniCRE, INERATEC, Wood, GKN Sinter Metals Filters GmbH & AFRY.

Website: <https://www.comsynproject.eu/>

FLEXCHX PROJECT

FLEXCHX-process is a flexible and integrated hybrid process that combines electrolysis of water with gasification of biomass and catalytic liquefaction. The process produces heat, power, and FT-wax, which can be refined to transportation fuels. The vision is to realise a process for optimal use of the seasonal solar energy supply and available biomass resources.

CONSORTIUM: VTT (coordinator), Lithuanian Energy Institute, DLR, Enerstena, Johnson Matthey, Neste Engineering Solution, Kauno Energija, Helen, INERATEC & Grönmark.

Website: <http://www.flexchx.eu/index.htm>

FT liquid product and FT wax



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