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Green Indicator

In this issue of Green Indicator we are looking at the possibilities of integrating biomass gasification in different current industries, such as chemical pulp mills, oil refineries, steel plants etc. And in today's CatScan alternative production of ammonia by circumventing the equilibrium with the use of cold plasma is discussed.

/Andreas Leveau

Industrially integrated biomass gasification

Over the last decade, a large number of studies on industrially integrated gasifiers for production of biofuels have been published. These studies comprise different types of gasifiers (fluidized bed, indirect and entrained flow) integrated in different industries for the production of various types of chemicals and transportation fuels such as SNG, FT-products, methanol and DME.

Integrating biofuel production processes in existing industries may result in a number of technical, energy-related and economic benefits. For instance, large feedstock handling and logistical advantages can be obtained by integrating biofuel production processes in existing forest industries. Gasification of black liquor can be applied in chemical pulp mills, where it can also be possible to replace the bark boiler with a biomass gasifier for syngas production. Biofuel production processes can also be co-located with other process industries with a steam or hot water demand, such as sawmills or biomass-based combined heat and power plants. In those plants, biomass handling and logistical benefits may also be obtained. Oil refineries and steel plants are also interesting from the point of view of integration. The former due to already existing downstream processes (distillation columns, cracking processes,

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Cold Plasma

In the production of bulk chemicals, the thermodynamic equilibrium is often a limiting factor. This is true for instance in the production of hydrogen, methanol and ammonia. In circumventing the equilibrium there have been several methods proposed and one of these is the use of cold plasma. Researchers at University of Minnesota have showed that by passing hydrogen and nitrogen through a cold plasma in the presence of a catalyst, ammonia can be synthesized in amounts that significantly exceed the equilibrium composition. This also at low pressure conditions such as ambient pressure.

The question is if there are any advantages to reap with operating the ammonia process at lower temperature and pressure. The initial reaction is that yes off course there are, but when digging deeper into the question the answer is not as obvious as one may think. The energy consumption (including feedstock) of the process is about 20 GJ/tonne and state-of-the-art technology is about 24-25 GJ/tonne. The savings with respect to energy is thus quite small due to good internal energy recovery. This means that the major excess off-gases from steel making, which can be used for co-synthesis with biomass based syngas.

However, it is difficult to compare the results of these studies systematically since they most often have different system boundaries, production capacities etc., and since for example efficiencies are often calculated using different methodologies and standards. This makes comparisons of system efficiencies between different integrated biorefinery concepts and studies difficult (or unfair), even for studies that are very similar to each other. Despite this, the results from various techno-economic studies made on the subject of industrially integrated biomass gasification indicate that this could be a promising opportunity for different industries to increase their overall system efficiency.

requirements of reactor materials. There are thus not as large benefits as one may initially expect and the plasma electricity consumption will have to be small. However, the technology is quite suitable when looking at alternative, small scale production of ammonia such as fertilizer production from wind power.

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