Tar removal from low-temperature gasifiers

Partners:

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- Dahlman (NL)
- Dall Energy (DK)
- Danish Technical University (DK)
- Danish Fluid Bed Technology (DK)
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Abstract from the report

Biomass is considered an important source of renewable energy needed to realise national and European renewable energy goals and goals for CO2 reduction. Biomass gasification as a technology is recognized generally as highly desirable because of its high efficiency towards all kind of energy products. Biomass can be gasified using many different technologies ranging from high-temperature processes as high as 1500°C to low-temperature processes as low as 500°C. The project “tar removal from low-temperature gasifiers” focuses at gasification processes below 800°C. These so-called low-temperature biomass gasification processes have certain advantages, i.e. they are suitable for fuels with low ash melting points, have a high cold gas efficiency and low tar dew point, require easier gas cooling and cleaning, provide longer residence times, and are associated with less heat transfer limitations within gasifier compared to gasifiers operated at 800 to 900°C.

For some applications the main disadvantage of low-temperature gasification is the relatively high tar level in the gas. This is why these processes generally are not considered being suitable for connection to gas engines, gas turbines, fuel cells or catalytic synthesis reactors. All the advantages mentioned above however, urge researchers to develop gas cleaning systems that can extend the application of low-temperature gasifiers from simple co-firing to also the mentioned applications. Being able to handle tars in the 700-800°C interval would be very attractive. This temperature is high enough to have limited tar yield and low enough to have an acceptable tar dew point.

In the project, two gas cleaning technologies are adapted and tested in connection to low-temperature gasification, i.e. (i) the OLGA tar removal technology developed by the Dutch partners in the project and (ii) the cooling, filtration and partial oxidation developed by the Danish partners in the project. The project aims at judging technical and economical suitability of these up-scalable tar removal methods connected to high-efficiency low-temperature gasification. Suitability opens the way to high efficient and high fuel flexible biomass gasification systems for the connection to gas engines, gas turbines, fuel cells or catalytic synthesis gas reactors.

It is concluded that lowering the gasification temperature will require some modifications of the OLGA technology, though it is expected OLGA can remove also tars from the product gas of a gasifier operated at temperatures below 650°C to low enough levels that a gas engine should run, based on tars. For dust removal, bag house filters are suitable when operated above the tar dew point of the gas. If this would require too high temperatures technically or economically feasible for filters, the OLGA could be applied in which dust can be removed at a temperature below the original tar dew point of the gas. The cooling of gasification is a challenge as long as dust and tars result in fouling in shell and tube heat exchangers. To overcome such problems so called “evaporative coolers” can be used where the evaporative energy of water (or some other liquid) is used to cool the gas.