ABSTRACT

Contaminants in producer gas constitute the main difficulty in the use of the gas for power generation in a gas engine or gas turbine. The main contaminants are: tar mist, acids, hydrogen chloride, sulfur gases, ammonia and nitrogen compounds, solid dust particles, alkali metals and heavy metals. These contaminants must be removed to acceptable levels before the gas can be utilized. Tar will impose serious limitations in the use of producer gas due to fouling of downstream process equipment, engine wear and high maintenance costs. There are still many questions related to tar and the problems they may cause. Tar, itself is a complex mixture of condensable hydrocarbons, which still requires to be satisfactorily defined. It is also necessary to understand its composition and formation in order to design systems for its optimum removal or conversion and for minimizing its formation in the gasifier and interactions downstream to the end use device.

To get a better insight in these problems ECN and BTG conducted a study with the aim to address the main problems, and to generate possible solutions for different gasifier configurations and the gas cleaning section in particular. In order to link the identified problems and possible solution with the practice, a workshop was organized where the findings were presented to an audience of experts in the field of gasification.

The study showed that relatively little information is available on the characteristics of tar that can cause problems, such as formation and characteristics of tar aerosols, soot formation when burning tars or tar aerosols, and polymerisation of tars. Furthermore, relatively few data have been published on the actual composition of biomass tars. Moreover, comparison of tars from different gasifiers is very difficult because of the various definitions and tar measuring methods that are being used. So there is a strong need to identify the tar fraction or the individual tar compounds that cause the direct problems in biomass gasification systems. This identification will lead to clear tolerances for tar in prime movers (*e.g.* compressors, internal combustion engines and gas turbines).

Condensation is one of the main tar-related problems both for the gas cleaning and for prime movers. These problems occur when tars condense on cool surfaces or form tar aerosols. Even soot formation from tars can indirectly be ascribed to condensation of tars to aerosols, because only tar aerosols (and not gaseous tar molecules) are expected to form soot when being combusted. It is therefore recommended to investigate the formation, existence and/or consequences of condensation, polymerisation and the interaction of tar compounds with other impurities in producer gas in relation to the performance of the prime mover for different biomass feedstock and gasifier configurations. Also the size distribution of aerosols should be investigated.

The study also showed that little operational experience exists for the tar destruction and removal techniques. For pressurised gasifiers, this problem might be relatively small but for atmospheric gasifiers there is lack of information on all conventional techniques. The potential of alternative techniques (plasma reactors, condi-cyclone, electrostatic filter, rotating particle separator) is unknown because of the absence of technical and economical data. It is therefore recommended to acquire data on tar removal or conversion efficiency, including tar compositions before and after the gas cleaning technique. Such information, including cost data, can be obtained from several European gasification research, development and demonstration projects.