Tar sampling and analysis methods

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Introduction

The research on gasification of biomass in fluidized beds has been an ongoing activity at KTH for more than 40 years. Tar in the product gas is a commonly encountered problem when gasifying biomass, especially in fluidized bed concepts. To achieve a understanding of issues related to tar, research on tar and tar analysis has also been ongoing for about the same time. In 1991, tar fractionation on SPE amino phase was first discussed by Brage and Sjöström and subsequent development efforts resulted in the so-called SPA method presented in 1997.

Tar definitions by KTH

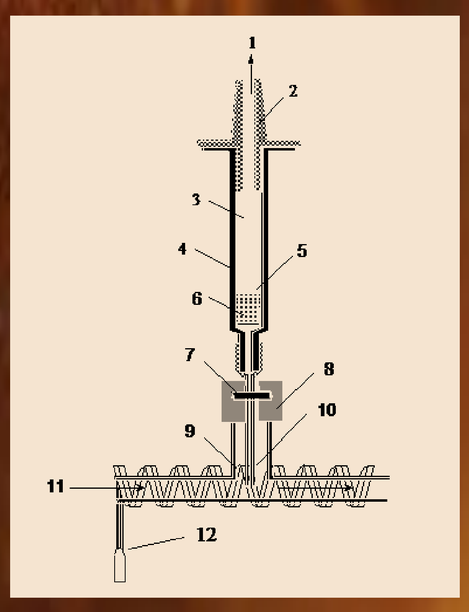
- Light tars: Organic compounds detectable with both GC and HPLC. (Mw 79-300).
- Heavy tars: High molecular weight (Mw≈>300) ”non-volatile” polar organic compounds with high bp. Mixture of oxygenated “non volatile’’ compounds that cannot pass through a GC column, but may be analysed by HPLC.

Sampling and analysis methods at KTH

Off-line:

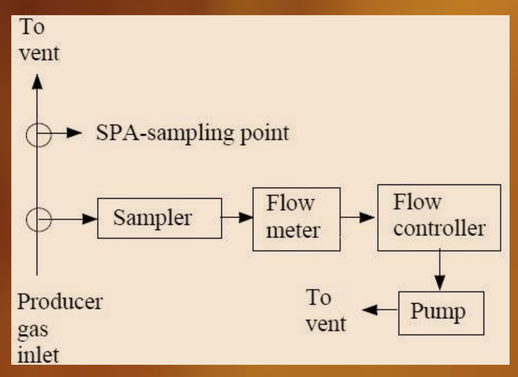
1. Solid-phase adsorption, SPA:

100 ml producer gas is passed through the SPA syringe (amino phase bonded to silica). After preparation, samples are analysed for individual compounds by GC. Fastest off-line method. Through traditional SPA may compounds ranging in molecular weight from 78 (benzene) to 300 (coronene) be determined.



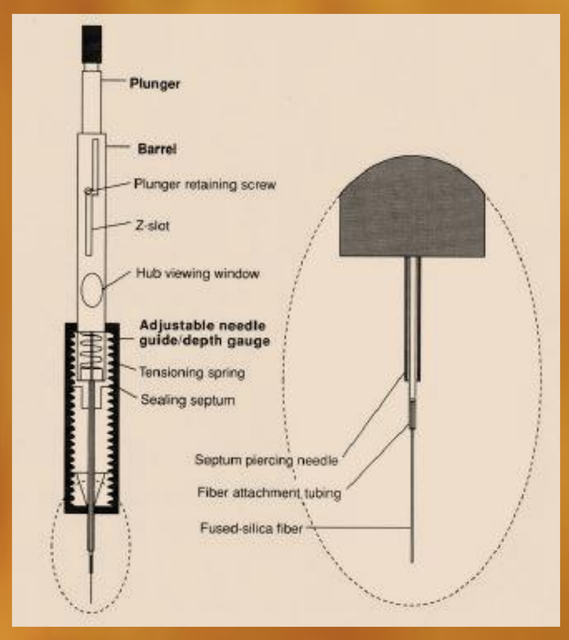
2. Sampling and analysis of total tar:

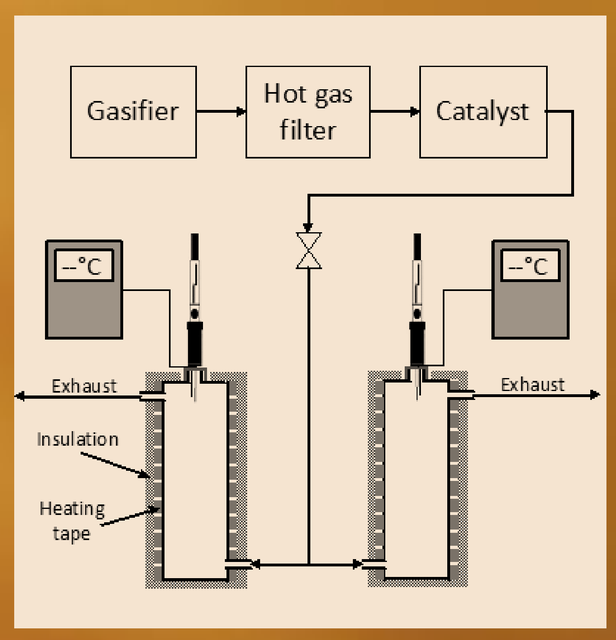
Method is being developed for the analysis of total tars. Samples are quantified by SPA analysis (light tar) and gravimetric analysis (heavy tar) in parallel.



3. Sampling with SPME (Solid Phase Micro Extraction):

Fast and accurate analysis method for low tar concentrations. Analysis of clean gas used for methane production, gas turbine and syngas applications which demand low level of tar. Method is based on extraction of analytes from a sample matrix onto a stationary phase (non polar: polydimethylsiloxane). Desorption of the analytes in an analytical instrument (GC). The method is solvent free and can be used for trace analysis. The detection limit is 0.1 mg/Nm^3. It is a good complement to SPA and other tar analysis methods with higher detection limits.





- **On-line tar sampling with PID (Photo Ionisation Detector)**

The ionization potential of the PID depends on the gas inside the lamp. The ionization potential of the xenon lamp is 8.4 eV. Hence may compounds with a ionization potential below 8.4 eV be detected by the this lamp. Naphthalene, acenaphthene, flourene, anthracene and pyrene are examples of compounds detected by the xenon lamp.

Set up of and example of real producer gas on-line PID tar analysis