

Producer gas contains tars, particles and other contaminants that generally need to be removed, since they can seriously jeopardize the feasibility of a plant. The removal of tars is a particularly challenging issue. Therefore, gas cleaning and conditioning is a crucial step in biomass gasification facilities.

The dew point is the main property of tars. It is defined as the temperature below which tars can condense. It depends on tar composition and content.

## CONTAMINANTS IN PRODUCER GAS



*Fouling and plugging caused by biomass tars: heat exchanger, gas engine, pipes.*

Besides its main components ( $\text{CO}$ ,  $\text{H}_2$ ,  $\text{CH}_4$ ,  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ ...), product gas contains undesirable compounds which can cause operational problems in downstream equipment. The main contaminants of product gas are:

- Tars and particles: cause condensation, clogging, fouling and catalyst deactivation.
- Sulfur- and nitrogen compounds: lead to corrosion problems,  $\text{SO}_x$  and  $\text{NO}_x$  emissions and catalyst deactivation.

**Tars: All organic compounds present in the gasification product gas larger than benzene.**

## CLASSIFICATION OF TARS

Temperature	<ul style="list-style-type: none"> <li>• Low-T: Complex composition, fraction of polar compounds. Formed in updraft fixed bed gasifiers.</li> <li>• High-T: Mainly non-polar aromatic compounds. Formed in downdraft fixed beds, and fluidized beds.</li> </ul>
Reactivity (Evans and Milne)	<ul style="list-style-type: none"> <li>• Primary tars, e.g. levoglucosan, furfurals.</li> <li>• Secondary tars, e.g. phenols and olefins.</li> <li>• Alkyl tertiary tars, e.g. toluene, indene.</li> <li>• Condensed tertiary tars, e.g. benzene, PAHs.</li> </ul>
Water solubility/condensation (ECN)	<ul style="list-style-type: none"> <li>• Class 1: "gravimetric tars", not GC-detectable.</li> <li>• Class 2: heterocyclic (high solubility), e.g. cresol, phenol, pyridine.</li> <li>• Class 3: light aromatic, e.g. xylene, toluene.</li> <li>• Class 4: light PAHs (2-3 rings), e.g. naphthalene, phenanthrene.</li> <li>• Class 5: heavy PAHs (4-5 rings), e.g. fluoranthene, pyrene.</li> </ul>

## PROCESSES FOR TAR REMOVAL

1. **Primary methods:** gasifier design, adjustment of operating conditions (p, T, gasifying agent, residence time...), in-bed catalysts/additives.
2. **Secondary methods:** physical processes (cyclones, filters, electrostatic precipitators, scrubbers), thermal-catalytic processes (thermal cracking, partial oxidation, catalytic reforming, plasma processes).

### MORE INFO

TarWeb: the Tar Measurement Protocol site

<http://www.eeci.net/>