Proceedings of the 17th Annual North American Waste-to-Energy Conference
NAWTEC17
May 18-20, 2009, Chantilly, Virginia, USA

NAWTEC17-2315

DESIGN OF A HIGH TEMPERATURE CHAMBER FED BY A PLASMA TORCH FOR THERMAL REMOVAL OF TARS

Alice Fourcault, Europlasma, www.europlasma.com, 21 rue Daugère, 33520 Bordeaux , France. +33 559 407 816, alice.fourcault@etud.univ-pau.fr

Frédéric Marias, Laboratoire Thermique Energétique et Procédés, ENSGTI, Université de Pau et des Pays de l'Adour, rue Jules Ferry, BP 7511, 64075 Pau Cedex, France. +33 559 407 809, frederic.marias@univ-pau.fr

Ulysse Michon, Europlasma, www.europlasma.com, 21 rue Daugère, 33520 Bordeaux , France. +33 556 497 000, +33 687 603 663, umichon@europlasma.com

Abstract
Biomass is one of the most important sources of renewable energy. One aim of Biomass gasification is to convert a solid feedstock into a valuable syngas for electricity or liquid fuel production. Actual industrial auto-thermal gasification processes achieve a production of syngas mainly polluted by products such as dust, nitrogen oxides, sulfur dioxide and tars. Tars remain, one of the main drawbacks in using the gasification process since they are capable of condensing at low temperature. This could lead to fouling, corrosion, attrition and abrasion of downstream devices such as gas turbines or engines. Tars are often removed from the syngas, decreasing the internal energy of the syngas itself. These tars are heavy aromatic hydrocarbons whose treatment remains difficult by thermal, catalytic or even physical methods. They can condense or polymerize into more complex structures, and the mechanisms responsible for their degradation are not completely identified and understood.
Turboplasma© is a thermal process, proposed by Europlasma. The main principle of operation relies on the use of thermal plasma for the cracking of tars inside a syngas produced in an auto-thermal gasification step. Basically, it consists of a degradation chamber where the syngas is heated by a plasma torch. The plasma plume provides a high temperature gas (around 5000K) to the system and enables heating of the incoming stream (above 1300K) and also generates high temperature zones (above 1600 K) inside the device. Due to both high temperature and long residence times of the syngas in the vessel, cracking of the tars occurs. Finally, the species released are mainly CO and H_2, leading to an increase in the Lower Heating Value of the syngas. The work presented here describes the design of a high temperature gasification system assisted by thermal plasma. It was performed using a CFD computation implemented with a full chemical model for the thermal degradation of tars. The objectives were to understand the aerodynamic behavior of the vessel and to propose enhancement in its design. We present here some results of this study.
Keywords : tars cracking, plasma torch, CFD, modeling, gasification