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Depollution Using Gasification Process of Biomass

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Abstract: Energy recovery from biomass gasification is the most economically and ecologically. This energy recovery will contribute to protecting the environment. States, industry and we as individual consumers, have long neglected the energy course offered by the planet in favor of energy immediately more profitable but also more costly to the environment. We have chosen the first time thermochemical conversions are: combustion, pyrolysis and gasification. Gasification is to decompose in the presence of a reactive gas (air, 0_2 CO_2, H_2O, etc ...) the starting material for gas products. The gaseous products obtained are mainly composed of H_2, CO, CO_2 and CH_4. Gasification is a technique more interesting than it attaches great importance to the problems of pollution and environment. Indeed, beyond the striking aspect, with these processes it is possible to better control emissions. Not forgetting of course the gas obtained can be used and valued.

Key words: Biomass · Gasification · Pyrolysis · Hydrogen

INTRODUCTION

Under normal conditions, without limiting factor in the availability of light, water, carbon dioxide (and minerals), a cell will develop a set of substances forming what is generally called biomass. Knowing these substances is essential for any study on the energy recovery.

Since the Conference of Parties to the UNFCCC held in Kyoto [1], bioenergy is seen as a privileged way to fight against the greenhouse effect. Besides a positive effect on the environment, increased use of bioenergy can reduce dependence on fossil fuels. Thermochemical processing provides today probably more than 95% energy recovery from biomass [2].

The three main thermochemical conversion of biomass are commonly developed in the combustion, pyrolysis and gasification.

These three channels are grouped under the term of thermochemical conversion, which refers to a set of processes involved in the action of heat and producing changes in chemical constituents of compounds derived products.

Gasification: Gasification can convert solid fuel into a heterogeneous homogeneous gaseous fuel that contains a large proportion of hydrogen. 11 should be noted that gasification technology is simple and widely proven particularly from coal.

The overall reaction is very complex, it seems important to clarify the mechanisms of how a little more fundamental, this approach will understand where the barriers tonight development in the field of biomass energy.

The Chemical Reactions of Gasification [3]: Gasification, pyrolysis, homogeneous and heterogeneous oxidation are four basic mechanisms that determine the gasification. These thermochemical mechanisms, coupled phenomena of heat transfer and mass of these reactors are a very complex reaction whose understanding and mastery is now essential to the emergence of new methods adapted to the gasification of biomass.

The pyrolysis reaction slightly endothermic, produces gas and solid matrix residual concentration of carbon, called carbon .. Figure 1 shows the gas obtained after pyrolysis. The coal will be transformed in the next steps will see it in the reactions [1-5].

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$C + H_2 O CO + H_2$ (1)
$C + CO_{22} CO$ (2)
$C + O_2 CO_2$ (3)
$C + ½ O_2 CO$ (4)
$CO + H_2O CO_2 + H_2$ (5)

Fig. 1: Gasification [4].

The homogeneous oxidation between volatile matter and oxygen from the air will help produce energy on the one hand and water vapor and carbon dioxide necessary for the gasification of the other. It should also be noted that water vapor also comes from the initial moisture of the raw biomass. The kinetics of homogeneous oxidation for hydrocarbons. Hydrogen and carbon monoxide are very fast (a few tenths of seconds) and well known.

The heterogeneous oxidation of coal can provide additional energy to proceed, where the share due to the homogeneous oxidation may prove insufficient. This reaction must be reduced to be minimal, since it consumes coal, which will therefore no longer available for the gasification reaction. Moreover, the problem of ash described above also appears here as a strong constraint associated with this reaction.

Heat transfer and mass play an important role in controlling such processes and essential chemical reactions described above. In particular, the dissemination of pyrolysis gases, fumes from oxidations still air, which will allow drinks mixed reactant / reagent needed for the various chemical reactions involved This is an undeniable weakness of fixed bed reactors, compared to those in fluidized beds.

Gases Produced: During gasification, the organic fuel is converted mainly into carbon monoxide CO and hydrogen H_2 and smaller proportions of methane CH_4depending on the type of reactor, but especially gas reaction the sum $H_2 + CO$ varies in large proportions and may represent up to 80% in the case of synthesis gas obtained by gasification with oxygen.

These gases also contain various inert gases: water vapor H2O nitrogen N_2 and carbon dioxide ($C0_2$ in varying proportions depending on the processes and raw material and various compounds at trace levels. Whose proportions are directly related to the nature of the fuel HCl HF, $_{NH3}$ HCN volatile heavy metals at low temperatures, etc.. .... Finally, a more or less of hydrocarbon compounds, tars resulting from the pyrolysis may be present in gases, depending on the type of reactor used and, once again, the quality of the raw material.

The gasification gas are generally responsible for many annoying elements (dust, tars, alkali, ash, etc. ...) It is necessary to remove before energy recovery.

The Separation of Particles or Dust: The particles come from the vast majority of fine coal and a small portion of ashes.

Elimination of Tars: Several treatment methods are used tar or under development. They were all based on the following processes:

- Heat treatment
- Catalytic cracking
- The wet scrubber
- Condensation forced

The Removal of Alkali: The alkali metals are responsible for corrosion on turbine blades causing damage to the surfacing.

The Applications of Gasification: The gas produced by gasification of biomass is a mixture of CO, $H_{2,}$ CH_4 and heavier hydrocarbons, more or less diluted with water vapor and nitrogen. Its calorific value (NCV) varies from 3.5 to 6 MJ / Nm^3 depending on the process and used gasification agents (air, oxygen, water vapor ,...).

Direct Combustion: The gas can be burned in a boiler producing steam and high temperature high pressure recovered in a turbine-generator to produce electricity.

Combustion Engines: If one has a clean producer gas, it is quite possible to use in internal combustion engines. Should recall that a gas of charged impurities (tar, oxides, water ....) can cause serious deterioration of engine components (corrosion of the flue gas. Sticking valves, piston seizures ...).

Gas Turbines: A gas turbine (TAG) consists of an air compressor, a combustion chamber and turbine. A variety of fuel can be used in the TAG: methane, landfill gas, diesel, ...

The fuels are mixed with combustion air and burned under pressure to deliver gas at high temperature. These are expanded in the turbine generator that drives the compressor. The return of a TAG is very sensitive to temperature.

Fuel cells [5]: The fuel cell is a system of power generation based on the principle of reverse electrolysis. Given its interest in future we decided to recall the features, even if the quality of the gasification gas is still far from meeting the quality criteria still poorly defined in a fuel cell.

Finally the fuel cell has a higher electrical efficiency at part load than full load, which allows very flexible operation and a considerable reduction of effluent into the environment. These qualities, combined with very low noise and vibration due to the absence of large rotating machinery, promote decentralization of facilities.

Their high performance makes them particularly attractive in a whole generation of electricity with gasifier.

However, the works are in their infancy and it is likely that the coupling gasifier / fuel cell faces the same constraints as before: the quality of gas.

Advantages of Gasification: Gasification technology offers the opportunity to use modern equipment to produce electricity as gas turbines for cogeneration of heat and electricity infinitely more efficient than traditional solutions ineffective after steam cycles. Its main advantages can be summarized as

With high electrical efficiency gas turbines and engines, even small powers This improvement can yield an increase in plant biomass size without increasing the radius of which supply a significant impact on investment costs and d supply.

Significant reduction in costs of reducing emissions because of low volumes of gas put into play in relation to combustion. Gasification is a technique more interesting than it attaches great importance to the problems of pollution and environment. Indeed, beyond the striking aspect, with these processes it is possible to better control emissions.

CONCLUSION

Hydrogen production by thermochemical processing of biomass is an attractive way a priori that should benefit from ongoing technological developments. Two technologies make it possible to convert biomass into hydrogen flash pyrolysis followed by steam reforming of oil produced and gasification under atmospheric pressure. The flash pyrolysis is to be quickly fine particles of biomass at 600 ° C; oils are produced and subsequently reformed with steam in the presence of a catalyst. The second way, gasification, this particular interest produce synthesis gas CO + H_2 which can be used either to produce electricity or to produce hydrogen. This technology has already led to some achievements across the industrial demonstration, but it remains limited mainly because of difficulties in the purification of gases, including the elimination of tars. The cost of hydrogen produced is burdened by the high cost of raw materials (compared to fossil fuels).

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