Sustainable Hydrogen Production For Green Technology

Abstract

Hydrogen tops as one among the sustainable alternatives of fossil fuels. The purpose of this paper is to consider various technologies for hydrogen production. The paper also explores various fields of hydrogen usage and their current and future scope. Also it briefs the recovery of hydrogen from the PSA and its advantages

INTRODUCTION

Since the last 20 years, reducing dependence on fossil fuels has become a huge matter of concern. Techniques like photobiological water splitting, solar driven electrolysis promises clean production of hydrogen. But these technologies are still not commercialized due to the need for advancement.

Nowadays generating of hydrogen from Biomass became more economical, practical, renewable and potentially carbon neutral means. According to task 16 of International Energy agency, a program was held on 2004 collecting International experts to investigate production of hydrogen with less environmental impacts. Public access hydrogen as an energy carrier for transportation and power generation, if and only if they are confident enough in safety of vehicles and power systems and storage infrastructure. This paper is brought up with the idea of production of hydrogen from Biomass with least environmental and economic impacts.

BIOMASS AND HYDROGEN

Biomass are sustainable components that produce high value end products from its Laboratories or through proper and adequate biochemical conversion. Byproducts from food Industries, plants and waste from Agriculture constitute the Biomass, which can be converted to energy, Chemicals materials ,food and animal feed. Here we discuss about gasification technology for sustainable production of hydrogen via Biomass

First thing that must be brought into attention is the availability of feedstock and deployment which matches to the local markets. A hydrogen containing gas is produced in Biomass conversion process similar to gasification of coal. Gasification of supercritical water, application of thermo-chemical cycle, steam gasification etc are methods of production of hydrogen from Biomass. But ,these Technologies never reached its demonstration phase.

BIOMASS GASIFICATION

Biomass gasification is defined as a process which in the presence of high temperature and controlled Oxygen and steam converts fossil based carbonaceous materials or organic materials into carbon dioxide, carbon monoxide and hydrogen. Carbon monoxide reacts with water producing carbon dioxide and more hydrogen with the help of water gas shift reaction. Adsorber separates hydrogen from gas stream .

The methods vary depending on crop type, location and climatic conditions. Low quality and less homogeneous fuels need more conversion interfaces. Need for rationalization for production and preparation of fuel is essential for high quality and more consistent fuels. Large-scale systems produce poor quality and cheaper fuels and small scale production unit produce better quality costly and good fuel with homogeneity.

THE THREE TECHNOLOGIIES

Here we discuss three gasification technologies .In the first technology there are basically two units, gasification unit and char combustion unit. Hot sand circulating between gasification and char combustion unit provide the required endothermic reaction. This method is named ‘indirectly heated’ because the heat is supplied by a circulating hot sand. Followed by the heating and clean up, the syngas is cchooled for pressure swing adsorption(PSA).Cooling is done for the gas to get compressed at pressure that is required by the PSA.

The product gas of gasifier is steam reformed after combustion to go through two water gas shift reaction to produce highly concentrated carbon dioxide and hydrogen. The purification of produced hydrogen gas is also done in PSA prior to its storage and distribution this gasifier is named as low pressure indirectly heated gasifier(fig 2).

The second gasification technology developed is IGT(integrated gas Technologies) gasifier (fig 3) which also operate under high pressure in the presence of direct heating. The steps involved in this technology are Biomass handling, drying, gasification in the presence of air separation unit, cleaning up of hot gas, reformation, shift conversion and purification of product gas that is hydrogen.

Third method is dual fluidized bed gasification technology(fig 4). Here olivin is used as bed material. Gasification reactor is separated from the combustion reactor. The gasification of steam, without oxygen takes place in the gasification chamber. The required endothermic reaction takes place in the combustion reactor. From the gasification reactor, char and bed are transported together to reach the combustion reactors, where it burns exothermically to produce heat. Gasification reactor is a bubbling fluidized bed ,fluidized with steam whereas combustion reactor is a fast fluidized bed. Heat required for combustion is transferred from gasification to combustion reactor, through circulation loop of bed material which also ensures the separation between the wood gas and flue gas of gasification and combustion reactor respectively.

Using olivin as bed material in the presence of woody biomass, hydrogen content of about 40 percentage is obtained as byproduct. The product gas leaving the gasification reactor is cooled below 200 degree Celsius and filtered . Fly char is separated from the stream of gas. The condensation of water takes place in the scrubber where the products gas enters, following filtration. Succeeding water gas shift reaction the resultant product is hydrogen.

PSA IN BRIEF

PSA (pressure swing adsorption) technique, gives the product gas hydrogen with maximum purity of 99 to 99.99%. Impurities gets absorbed more at high partial pressure in an adsorber. Multiple adsorbers are used to get constant feed, product and tail gas flows. swinging of the adsorber pressure from feet pressure to tail gas pressure lowers the partial pressure. Driving

force for adsorption and separation is stimulated by the partial pressure difference of impurity between feed gas and tail gas. PSA is similar to chromatography as the lighter the impurities will be first separated first followed by heavier.

Advantages of this technology is high purity hydrogen is produced in the process(99 to 99.99%). This system cause moderate cost and good scale economy. requirement of compressor, ascertain most economical process.

HYDROGEN IN VARIOUS FIELDS OF USE

Fuel cell vehicles which uses hydrogen as carbon dioxide neutral alternative is a promising technology for sustainability. But its implementation has still many barriers. Refueling for hydrogen is still not established fully and the cost for the fuel cell vehicles needs to be reduced for it to enter the field of marketing. This comes under small scale usage of hydrogen .

Refineries come under medium scale usage of hydrogen. At present about 30 percentage of market share of hydrogen is dependent on the refinery sector. Hydrogen is mainly used for hydrogenation process example desulfurization ,where heavier crudes are cracked to produce lighter crudes. Need for purity is high in those Refineries. Chemical Industries constitutes 63 % of global hydrogen demand which come under large scale usage of hydrogen.

CONCLUSION

Therefore we can conclude that today's hydrogen market is headed up by chemical industries and Refineries. Even now most of the hydrogen demand are met by fossil fuels. The need of the hour is to depend on renewable Sources of energy to meet the rapidly increasing demand, so as to reduce Greenhouse gas emissions and environmental hazards. Hydrogen generation from Biomass gasification can play a significant role for providing hydrogen from Renewable Sources.

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