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Recent developments in pyrolysis technique – A review

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ABSTRACT

Pyrolysis is a thermochemical decomposition of organic material at very high temperature without the use of oxygen. It involves the generation of char which is nothing but the oil which is used or blended with the fuel. Pyrolysis finds applications in fields like heat and power, automotive fuels and bio refineries. Different type of materials are used for the pyrolysis in which the char is separated by different kinds of techniques. For example it is heated to the high elevated temperature and also it is separated from the raw material by the usage of special kinds of reactors etc. The various applications of pyrolysis are cooking, biofuel, chemical analysis, thermal cleaning etc. The intent of the article is to give a review of the materials used for the production of char. In this paper most recent developments in the pyrolysis process are discussed.

KEYWORDS Co-pyrolysis, Fast Pyrolysis, Solar pyrolysis, Catalytic pyrolysis

INTRODUCTION

Pyrolysis is the thermo chemical decomposition of the organic material at the very high temperature in the absence of the oxygen.Pyrolysis has been considered as a promising fuel for producing biofuels and bio chemicals to replace the fossil fuels. Pyrolysis is a type of thermolysis, and is most commonly observed in organic materials exposed to high temperatures. It is one of the processes involved in charring wood, starting at 200–300 °C (390–570 °F).][1] It also occurs in fires where solid fuels are burning or when vegetation comes into contact with lava in volcanic eruptions. In general, pyrolysis of organic substances produces gas and liquid products and leaves a solid residue richer in carbon content, char.Pyrolysis is also used in heavy industries which is used to produce activated carbon, charcoal, methanol and other chemicals.The main source of availabiltity of raw material is the wood in base of conventional techniques more reseaches are done by using a wood as aw material or feedstock for producing chat which is by the pyrolysis process,The different types of pyrolysis are catalytic pyrolysis.fastpyrolysis,gas pyrolysis etc.In this reviw article different type of material used as a raw material and the type of pyrolysis process involved is discussed.

MATERIALS AND METHODS

[1] Geert Haarlemmer et.al have presented analysis and comparision of bio oils obtained by hydrothermal liquefaction and fast pyrolysis of beech wood structures and reported that hydrothermal and pyrolysis oil suffer from a very high acidity.This leads to the adjustment in storage devices. So in this he discussed that while using beech wood as a raw material for pyrolysis it must br heated to the certain temperature and there is also need of the catalyst while during the process of pyrolysis which helps to maintain the viscosity of oil at the optimum level.

[2] AnkeKrutof and KellyHawboldt have presented a review of blends of pyrolysis oil.petroleum and other bio based fuel and reported that blending of bio based oil shows good result in which it has the optimum level of viscosity by blending along with the fish oils in which it contains triglycerides.

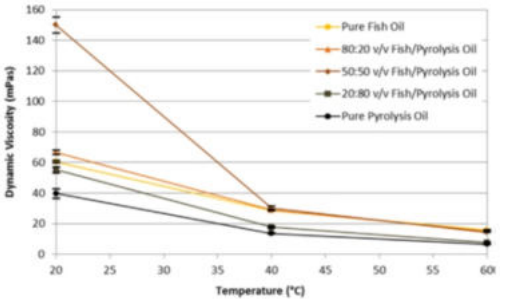

Fig 1 Dynamic Visoscity over the temperature for different blends

[3]Guangyi Liu et.al have presented about the catalytic pyrolysis of amino acids and he compared his views on aliphatic amino acidand cyclic amino acid and reported that the chemical structures of amino acids plays a significant role in product distribution of catalytic pyrolysis and amino acids are less favourable for production of hydrocarbons and ammonia via catalytic pyrolysis.In this leucine and proline were selected as a representatives of aliphatic amino acids and cyclic amino acids

[4]Andrés I. Casonia et.al have presented about the catalytic pyrolysis of using MCM- 41 type catalysts and reported that the use of MCM-type catalyst increase the production of liquid fraction and lowering the production of levoglucosanwhich formed from the pyrolysis of carbohydrates such as starch and cellulose and it also often often used as a tracer for biomass.

[5]J. Appelt, W. Heschel and B.Meyer have presented about catalytic pyrolysis of german lignite in a semi continuous rotory kiln apparatus and he found that by using kiln apparatus with a pulverized one way ZSM-5 catalyst he obtained low molecular hydrocarbons without need of hydrogenatiom process and the yield of low molecular hydrocarbons is around 5000C. So ZSM-5 Coated beats has also comparible effect to the ZSM-5 catalyst and the formation of hydrocarbons is compatible and obtained within 3-5 cycles.

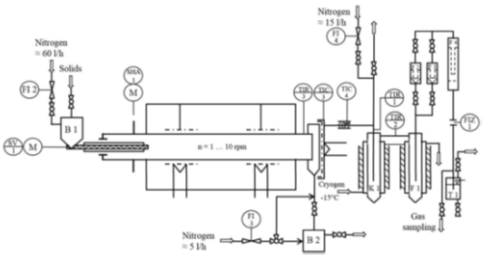

Figure 2 Process and instrumentation flow chart of the semi continuous rotary kiln for the catalytic pyrolysis

[6]Gurayyildiz et.al have presented about the design and operation process for the catalytic fast pyrolysis of woody biomass and he proposed about his schematic views for the production of biomass of different techniques of in situ and ex situ techniques and he suggests that the use of alkaline ash spoils the catalyst and therefore careful selection of biomass is must and the physical contact between the biomass and catalyst is prevented.

[7]Ann-Christine Johansson et.al have presented about the characterization of pyrolysis products produced from different Nordic biomass types in a cyclone pilot plant and suggested that by using of Nordic biomass type it can yield high aerosol value and it promotes high viscosity which can be effectively used for the combustion process.

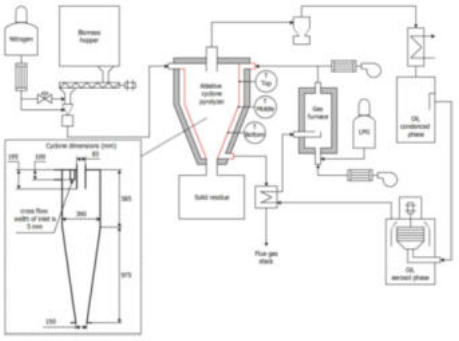

Figure 3 Schematic Sketch of the pyrolysis pilot plant

[8]Weimin Chen et.al have presented about the Co-pyrolysis of waste newspaper with high density polyethylene and discussed that around the temperature of 400-500o C synergic effect was occurred resulting in increase of oil phase which results in decrease in viscosity and obviously results in the increase of yield by co-pyrolysis.

[9]Chen Chen et.al haveinvestigated on chlorine and potassium release and migration in micro spatial distribution during rice straw pyrolysis and he concludes that he uses scanning electron microscope which is used to analyze the morphology and distribution of inorganic matters in raw rice straw and water washed rice straw as well as the char obtained from the raw rice straw pyrolysis and discussed that particles distributed on the cell walls in the ground tissue were proven to be inorganic salt rich in chlorine and potassium.

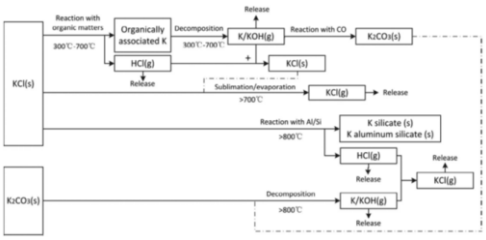

Figure 4 Possible release path of K and Cl

The epidermis is the main part that decomposes and losses weight during the pyrolysis.

[10]TaoKan et.al have investigated on lignocellulosic biomass pyrolysis and he summarized the properties of the pyrolytic products and their analysis methods and also the state of industrial pyrolysis techniques and he suggests that cellulose and hemicelluloses contribute to the bio oil production yield higher and resulrs in increase in molecular weight and viscosity which is efficient during the combustion process.

[11]Rui Li et.al have discussed about the product distribution from solar pyrolysis of agricultural and forestry biomass residues and he concludes by experimental results indicate that gas yield generally increases with the temperature and heating rate for the various biomass residues whereas the liquid yield progress oppositely. Gas generated during solar pyrolysis can be further utilized for power generation, heat or transportable fuel production.

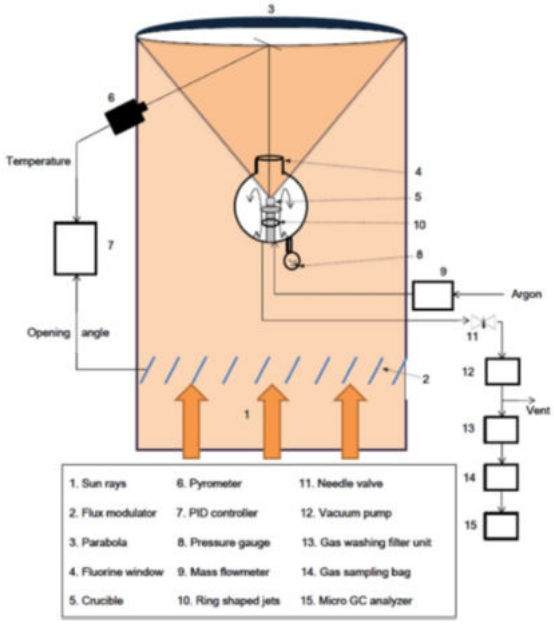

Figure 5 Schematic of Solar Pyrolysis setup

[12] Pinto et. al. have discussed about the production of liquid hydrocarbons from rice crop wastes mixtures by co-pyrolysis and co-hydropyrolysis. They have analyzed different pathways for improving the quality of liquids and concluded that the process of Co-pyrolyis followed by the hydropyrolysis was not favorable and led to the great increase of gases.Therefore Co-hydropyrolysis led to the highest conversion as both gas and liquid yield is higher.

[13] GurayYildiz et.al have discussed about the In situ performance of various metal doped catalysts in micro-pyrolysis and continuous fast pyrolysis of pine wood.They have analyzed that best performance was obtained with the lower redox metal containing acidic catalyst and freshly calcined metal doped basic mixed metal oxide catalyst.

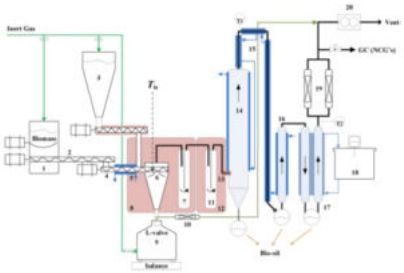

Figure 6 Schematic of pyrolysis mini plant

[14] Pike et.al discussed about the preparation of zinc sulphide thin films by ultrasonic spray pyrolysis from bis (diethyldithio carbamato) zinc (II).They have analyzed that formation of cubic hexagonal phase is achieved by using ultrasonic pyrolysis technique at a temperature of around and below 500^{0}C

[15] Xiangyu Li et.al discussed about the production of petrochemicals during catalytic fast pyrolysis of corn fermentation residual by-products generated during citric acid production.They analyzed that the corn fermentation is an attractive biomass feedstock for the production of higher added value petrochemicals by using catalyst fast purolysistechniques.The maximum yield of petrochemical by this technique is around (66.8-71.1%)

[16] ElianeLazzaria et.al discussed about production and chromatographic characterization of bio-oil from the pyrolysis of mango seed waste. They have finally concluded that the production of bio-oil from mango seed waste shows higher potential for the production of chemical and liquid fuels.

[17] Hui Zhou et.al discussed about Influence of process conditions on the formation of 2–4 ring polycyclic aromatic hydrocarbons from the pyrolysis of polyvinyl chloride. In this they have used two different type of process slow pyrolysis and fast pyrolysis.They have finally concluded that production of polycyclic aromatic hydrocarbon is lower from slow pyrolysis process compared to fast pyrolysis process.

CONCLUSION

A review of recent development in pyrolysis technique has been carried out. The various feedstock and the type of pyrolysis such as fast pyrolysis, slow pyrolysis ,hydro pyrolysis ,solar pyrolysis, catalytic fast pyrolysis have been discussed.

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