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烘焙对生物质热解产物特性的影响

Effect of torrefaction on characteristics of pyrolytic products of biomass

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中文摘要:

烘焙可有效地降低生物质中的水分和氧，对其热解过程有显著的影响。该文主要研究了烘焙温度（200，230，260，290℃）对生物质热解过程及产物特性的影响行为及影响机制；研究发现烘焙能改善热解产物的品质，随着烘焙温度的升高，热解合成气中CO含量由48%逐渐减少到34%，CH4和H2增加，其中H2含量最大增加了77.4%，而液体产物中，乙酸和水分含量逐渐减小，水分含量最大减少了42.8%，而酚类产物的含量明显增加，有利于生物油品质的提高。该研究为烘焙技术的发展和生物质高效热化学转化提供科学参考。

英文摘要:

Abstract: The pyrolysis of biomass is one of the promising methods for obtaining bio-energy, and is discussed widely. Bio-oil obtained from pyrolysis is easy to store and transport, and can be used directly and indirectly as a fuel. However, bio-oils have high acid content, high water content, and low heating value. These drawbacks have limited the broad application of bio-oils. Torrefaction is a low temperature pyrolysis process carried out at temperatures ranging from 200 to 300℃ for liberating water and releasing volatile organic compounds, which may affect the subsequent pyrolysis process and related products. In this sense, there has been significant increase of interest in biomass torrefaction techniques.In this work, torrefaction of cotton stalk was conducted on a tube furnace at 200, 230, 260, 290℃ with a residence time of 30 min. Pyrolysis of torre?ed cotton stalk was also performed on a tube furnace reactor at 550℃ with a residence time of 30 min. The effect of torrefaction temperature on the yield, products composition, and physical properties of bio-oil were studied. In addition, the product distribution of torre?ed cotton stalk pyrolysis was also investigated. Torre?ed cotton stalk was chosen as the benchmark when calculate the yield .The gas products of pyrolysis were analyzed by chromatograph (GC), and liquid products were analyzed by gas chromatography mass spectrometry (GC-MS) and Karl Fischer moisture tester.The research results showed that increasing torrefaction temperature resulted in the increase of the carbon content of torre?ed biomass from 46.07% to 62.63%. However, the hydrogen and oxygen contents decreased from 7.06% to 5.26% and 41.26% to 24.84%, respectively. With the increase of torrefaction temperature, the cotton stalk gradually converted to charcoal. The highest calori?c value was 24.85 MJ/kg when torrefaction was performed at 290℃. The solid yield of pyrolysis was decrease sharply with elevated torrefaction temperature, which was in contrary to the liquid yield, while gas yield had no obvious change. As for pyrolysis of gases, the content of H2 and CH4 increased with elevated torrefaction temperature, and the yield of H2 increased by 77.4%, the content of CO decreased from 48% to 34%, the yield of CO2 had no obvious change. However, the total content of combustible gases increased. As for liquid production, with the increasing torrefaction temperature, the yield of liquid was decreased by 3.4%, 17.6%, 25.0%, 42.8% compared to the raw biomass. Water and acetic acid content in bio-oil decreased greatly while the quantity of polycyclic aromatic compounds increased, which indicated that torrefaction could improve the quality of bio-oil, and provide process optimization for subsequent fast pyrolysis.

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