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A Review on Utilization Biomass Pyrolysis Technology and Dusulfurized Ash

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Abstract

Coal resources play a significant role in China 's economic development. In recent years, the burning of a large amount of coal has caused serious environmental problems.Therefore, it is necessary to develop clean energy including biomass energy, improve the efficiency of biomass and clean conversion technology to reduce carbon emissions. This paper reviews the current research progress in the conversion and utilization of desulfurization ash. The development status of biomass pyrolysis technology is discussed. It is considered that biomass pyrolysis is the most suitable method to convert desulfurization ash into effective resources due to its poor hydrophilicity, difficult degradation and easy decomposition.

Keywords

Desulfurized ash; Biomass; Pyrolysis.

1. Introduction

In recent years, with the continuous improvement of environmental pollution control requirements, the emission of sulfur dioxide in coal flue gas has been effectively controlled.[1-3].China is currently generally treated with a semi-dry method, that is, a calcium compound such as CaSO3,Ca (OH)2, CaO such as a desulfurizer as a medium, which is delivered as a desulfurizer as a medium.The main components of the desulfurization ash are CaSO3, CaO, Ca(OH)2 and SiO2, so there is a certain degree of chemical instability. Desulfurulfurium granularity, low density, poor hydrophilicity, difficult to degrade, easy to solve[4].The pH of the elimination of the desulfurization ash is high, high alkali, and the heavy metal content is low[5].The main disposal measures of the current desulfurion are still simple stacking, which not only occupies a large amount of land, which dust and leach have secondary pollution to the atmosphere, land, water resources, etc[6-7].Therefore, it is necessary to find an efficient way to apply desulfurization ash.

Nowadays, solar energy, wind energy, hydropower, nuclear energy and hydrogen energy are the main force of new energy, helping the power industry to achieve low carbon emissions. "Green hydrogen" is a reserve force for new energy, which helps to further reduce carbon emissions in the industry and transportation [8]. Biomass energy is the only carbon-containing renewable energy. In addition to being directly used for power generation, it can also be converted into liquid fuels and chemicals to replace corresponding petroleum-based products. Taking advantage of biomass can effectively alleviate my country’s oil shortage. The current situation, the efficient development and utilization of biomass energy will play a very active role in solving energy and ecological environmental problems[9]. However, there are still many problems in the utilization technology of biomass pyrolysis oil andpyrolysis gas in our country, and how to improve the yield of meteorological products and oil quality obtained by biomass pyrolysis is the main existing problem. Most of the currently used technologies are catalytic hydrogenation, adding catalysts for deoxygenation and upgrading. A large number of studies have shown that calcium-based catalysts can promote the generation of small molecular free

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radicals in biomass during the pyrolysis process, thereby increasing the calorific value of gas phase products and methane yield.

2. Application of Desulfurized Ash

Some studies have found that desulfurized ash will harden like cement after compaction by water pressure, so desulfurized ash has the potential to replace lime powder as a composite cement and mortar substrate. Desulfurized ash was added in the preparation process of different proportions of cement, which can enhance and supplement he compressive an flexural properties of cement[9]. However, the desulfurized ash contains more than standard sulfate compounds. When these sulfate compounds enter the cement and are used to formulate concrete, they will further cause deliquescence and cause micro-expansion of cement products and concrete buildings due to the production of crystal water due to the hydration reaction. It reduces the stability of cement and concrete and brings hidden dangers to construction projects.

Desulfurized ash has a higher pH, and some studies address soil acidification in the South, the use of the desulfurization ash to alkaline soil conditoner,achieved good results in the experiment planted white clover Huiya , the amendment can effectively promote the alkaline hydrolysis of nitrogen, phosphorus, and potassium in the soil, and significantly promote the growth of plants[10]. Although the slight alkalinity of desulfurized ash is effective in improving acidic soil, it is difficult to control the amount of desulfurized ash. , and there is no experiment to prove whether the acid soil after the improvement of desulfurization ash has potential harm to the human body, and further analysis and research are needed.

Additionally, desulfurized ash has the characteristics of small particle size, large specific surface area and rich in CaO and SiO2, has the research potential of preparing sewage treatment. Some studies have found that desulfurization ash ceramsite fillers are prepared by mixing desulfurization ash with clay and dewatered sludge in appropriate proportions. the removal rate of COD and total phosphorus in municipal sewage can reach more than 80%, and the removal rate of ammonia can reach more than 90% [11]. Desulfurization ash has a significant effect on sewage treatment, but due to the complex physical and chemical properties of desulfurization ash, uncontrollable reactions are prone to occur in the process of sewage treatment.

3. Research on Biomass Pyrolysis

At present, there are two main types of methods for biomass pyrolysis, The first is to use the method of deashing and deoxygenation pretreatment to improve the quality. Deashing helps increase the yield of bio-oil, Can reduce the content of acids and phenols in bio-oil, The content of carbohydrates is significantly increased. Effectively reduce the content of cellulose and hemicellulose during deoxidation, So as to reduce the acid content formed by its decomposition. The second is to add calcium catalyst to improve the quality. During the pyrolysis of biomass pyrolysis oil. Adding calcium-based catalysts (such as calcium oxide) can effectively replace oxygen and oxygen-containing functional groups which increase the hydrogen to carbon ratio of the final liquid product. So as to increase the yield of bio-oil in the pyrolysis process, achieving the purpose of improving its quality. Generally speaking, different high-cost catalysts are mainly used for the catalytic pyrolysis of biomass, such as microporous zeolites, mesoporous M41S and mesoporous aluminosilicates. All these catalysts produce bio-oils with improved properties, which may be valuable products as feedstocks for bio-refineries. On the other hand, some other inexpensive catalysts, such as bulk metal oxides or supported sulfide/oxides and metal catalysts, mainly alumina, have also been tested for biomass catalytic pyrolysis. Although improved bio-oil has also been obtained, further bio-refining processing is required for practical applications.

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4. Desulfurized Ash and Biomass Pyrolysis

With the increasing of environmental protection in China,the utilization of desulfurization ash has become an urgent problem to be solved. As a building material, soil improvement and sewage treatment, desulfurization ash has a limited performance. Currently, most of the research was still kept in the laboratory stage. Therefore, it is difficult to carry out large-scale industrial implementation. The annual output of biomass waste in my country is huge, and calcium-based compounds in desulfurized ash have long been proven to have a significant catalytic effect on biomass gasification. If the desulfurized ash is use as additive in biomass pyrolysis process,it can not only achieve efficient conversion of biomass,but also complete resource utilization of desulfurization ash. Therefore, studying and regulating the reaction process of co-pyrolysis desulfurization ash and biomass to prepare high-quality gas and biomass semi-coke loaded with calcium compounds can achieve the multiple purposes of converting solid waste, protecting the environment and saving investment. The development and implementation of this research is in line with my country's long-term goal of "carbon neutrality" and has broad application prospects and social value.

5. Conclusion

As a building material, soil improvement and sewage treatment, desulfurization ash has a limited performance. Currently, most of the research was still kept in the laboratory stage. Therefore, it is difficult to carry out large-scale industrial implementation.

Most of the existing technologies require catalysts to catalytically upgrade biomass, thereby increasing the yield of gas phase products and oil phase products of biomass pyrolysis. However, these technologies have a problem, that is, the requirements for the equipment used in the experiment are relatively strict, and the cost of a large number of catalysts used in the experiment is also relatively high, which makes it difficult for these technologies to be popularized and applied.

Calcium-based compounds in desulfurized ash have long been proven to have a significant catalytic effect on biomass gasification. If the desulfurized ash is use as additive in biomass pyrolysis process, it can not only achieve efficient conversion of biomass, but also complete resource utilization of desulfurization ash.

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