Research Progress of Biochar and Pollution Control

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Abstract. In recent years, due to the impact of climate change caused by the emission of greenhouse gases such as carbon dioxide, nitrous oxide and methane, scientists have begun to pay attention to the use of biochar, because it helps to capture and remove greenhouse gases in the atmosphere by means of biochar storage, converting it into a very stable form and storing it in the soil for thousands of years. This paper focuses on the hazards of organic pollutants, the treatment of pollutants by biochar and the benefits of environmental remediation. Biochar is the product of biomass energy raw material after pyrolysis, and its main component is carbon molecule. In terms of pollution treatment, biochar has a strong adsorption capacity for organic pollutants such as phenol, and can also improve soil heavy metal pollution by increasing soil cation exchange capacity (CEC) and PH. In addition, biochar is also used in low-temperature NH_3-SCR denitrification catalysts to deal with nitrogen oxides in atmospheric pollutants and other aspects. Biochar is easy to ignite, non-polluting, smokeless and tasteless, less residue after combustion, light weight and high calorific value, the use of performance is better than most similar materials, known as the main force of human new energy and future fuel. The purpose of this paper is to provide the basis and reference for the development of biochar basic science and application technology.

Keywords: Biochar; organic pollutants; adsorption.

1. Introduction

Because methane emissions, a greenhouse gas, are still an impact of climate change. Biological and chemical weapons. It's a fairly stable store of greenhouse gases and greenhouse gases that have been in the soil for thousands of years. In addition, the use of biochar can also increase agricultural productivity by 20%, while purifying drinking water and reducing fertilizer consumption. In order to achieve this, it is also necessary to study the important role of biochar in curbing biological pollution and promoting energy storage.

The physical and chemical properties of biochar are the important basis for the development of biochar research and application, and are also the most critical link, which determines the efficacy of biochar and its application "export", and is the "source" of biochar to play a role [1]. At present, due to the differences in raw material sources, materials, carbonization process, preparation technology, and use methods, the basic science and application technology of biochar are characterized by "diversification, complexity and fragmentation", which are involved in different fields and disciplines, and the research results or conclusions are also greatly different.

The conversion of biomass energy into biochar through carbonization is now widely recognized globally as a technology that can mitigate the problem of climate change. This technology has obvious trends such as easy access to raw materials, safe and clean production. Biomass energy converted into biochar after carbonization can be promoted and used in ecology, environment and other fields, can fix carbon and reduce emissions, and integrate with agriculture and forestry, can alleviate a series of problems such as waste and greenhouse gas pollution generated by agriculture and forestry. The International Biochar Alliance has promoted the rapid and healthy development of the global biochar industry. In 2009, the Lausanne Experimental Station in the United Kingdom launched a long-term positioning test plan for biochar in Woburn Farm, and the biochar project carried out by the Brazilian Agricultural Research company EMBRAPA has entered the implementation and promotion stage. The goal is to create more "rich, high-carbon black soil." At present, many developed countries, including the United Kingdom and the United States, have begun to commit to biochar related

scientific research, and the United States and the United Kingdom have set up a special "biochar research center", which has obtained a series of achievements in theoretical system and technology development [2].

However, in many scientific research results, we also found some basic facts, that is, there are great differences between different research results and it is difficult to effectively compare the common, or even completely opposite or contrary, and the guiding significance and value of basic research and practical application is very limited [3]. It is found that the difference of the research results is mainly related to the source of raw materials, materials, carbonization process conditions, application objects, dosages and methods. In addition, due to the different research backgrounds, starting points and objectives of the research and users, the lack of systematic and accurate cognition of the concept, source, formation and characteristics of biochar also leads to subjective confusion or misunderstanding of the results of different biochar research and application. Therefore, it is very necessary to systematically sort out and summarize the concept, source, formation, structure, characteristics, function and regulation technology of biochar, so as to provide scientific reference for the research and application of biochar.

This paper will introduce a series of issues such as how biochar can control organic pollution and promote energy storage.

2. Biochar

2.1. Definition of Biochar

Unlike traditional fuels, traditional charcoal is used for land improvement, plant growth, agriculture, and carbon capture and storage. The thermal waste of biomass is mainly carbon.

2.2. Production Methods of Biochar

2.2.1 High temperature decomposition manufacturing

Charcoal has been used as fuel for thousands of years by a simple process: burn wood, straw or crop waste in the oxygen-deprived environment. The traditional method is to cover the ignited biomass with soil so that it burns for a long time without flame.

2.2.2 Turning waste into treasure

Charcoal can also be made from many other materials. There is a lot of waste from plants and animals used in agriculture, such as rice straw, seed shells, and feces. Manmade waste, sewage and other food waste can be used. Biochar production using waste also has a double carbon reduction effect. Waste fertilizer rots and produces methane. Methane is also a greenhouse gas and has a greenhouse effect more than 20 times that of carbon dioxide.

3. Organic Pollution

3.1. Definition of Organic Pollution

Pollutants are made up of naturally occurring organic compounds, including carbohydrates, fats, and mostly biodegradable organic matter.

3.2. Classification of Organic Pollution

Organic pollution can be divided into two categories according to the characteristics of natural organic pollutants and synthetic organic pollutants. Depending on their composition, they can be classified as persistent organic pollutants, organic halides, polycyclic aromatic hydrocarbons, surfactants, petroleum pollutants, etc. [4].

3.3. Hazards of Organic Pollution

The effects of biological contamination on the birth weight of children can affect the lives of individuals: lower birth weight, slower growth rates, stunted bone growth and metabolic disorders. It affects the nervous system. It can cause disturbances in attention, suppress immune system activity, and so on. There is also a potential threat to the endocrine system of the human body, resulting in testicular cancer in men, decreased sperm count, abnormalities in reproductive function, imbalance of sexual intercourse in newborns, breast cancer in women, early sexual puberty, etc. Not only harm the individual, but also have a permanent effect on the offspring. It increased incidence of cancer [5].

4. Applications of Biochar in Pollution Control

4.1. Water Pollution Control

Biochar has strong adsorption capacity for phenol, catechol, naphthalene, naphthol, trichloroethylene, antibiotics, endocrine disruptors and other organic compounds, and has received extensive attention.

The Powdered Activated Car-bon Treatment Process, first developed by DuPont, is one of the representatives of this new technology. Biochar method referred to as "PACT method ", or "PACSBR biochemical method ", is considered to be the most promising new biochemical wastewater treatment process abroad, in the biochemical influent (or in the aeration tank) added powdered activated carbon and backflow of carboniferous sludge mixed in the aeration tank, the remaining sludge discharged from the sludge thickening tank into the sludge dewatering device. In the aeration tank, activated sludge is attached to the surface of powdered activated carbon. Due to the huge specific surface area of powdered activated carbon and its strong adsorption capacity, the adsorption capacity of the sludge is improved, especially the concentration of dissolved oxygen and degradation matrix between the interface of activated sludge and powdered activated carbon is greatly increased, which also improves the degradation and removal rate of COD.

4.2. Soil Improvement and Restoration

Biochar affects the heavy metal migration ability of soil by increasing CEC, increasing soil PH, increasing soil organic matter and increasing soil microbial activity.

The application of biochar can effectively increase soil water holding capacity, increase pore space, strengthen soil erosion energy and reduce soil capacity weight, thus improving soil structure, enhancing soil water and fertilizer retention capacity and increasing crop yield. Because biochar has the characteristics of small specific gravity, many micropores, large surface area and strong adsorption capacity, it can adsorb soil colloid, promote the formation of soil aggregate structure, and the pores between the aggregates are large, which is conducive to keeping the soil loose and air circulation, and create good conditions for the coordination of soil water, fertilizer, gas and heat. Studies have shown that soil biochar application can significantly improve soil porosity, reduce soil bulk density, and improve soil compaction [6]. The application of biochar soil improvement agent reduced the soil microaggregates content < 0.25mm and promoted the transformation of small aggregates to large aggregates. The lifting amplitude of mechanically stable macroaggregates with diameter > 5 mm was the largest. It is 14.5% ~ 60.7% higher than the contrast. Soil total reservoir capacity, heavy water reservoir capacity and available water reservoir capacity were positively correlated with total porosity, capillary porosity and soil mass content, but negatively correlated with soil non-capillary porosity and soil mass content. Soil water storage capacity was closely correlated with soil mass composition and porosity. When 25 g/kg biochar was applied to silty soil, the soil weight decreased from 1.52 g/cm to 1.33 g/cm. Soil with pellet structure has good till ability, significantly reduced soil compaction degree and good crop root growth environment, which is an important guarantee for high and stable agricultural yield.

4.3. Air Pollution Control

Biochar is used as a low-temperature NH_3-SCR denitrification catalyst to. treat nitrogen oxides in atmospheric pollutants.

The climate change mitigation effect of biochar mainly comes from the inert characteristics of biochar itself, which can weaken the process of returning fixed carbon generated by photosynthesis to the atmosphere, and then reduce the content of carbon elements in the atmosphere, thereby alleviating the greenhouse effect generated by carbon dioxide. Biochar can also promote plant growth by improving soil fertility,

This in turn allows more plants to photosynthesize and consume more carbon dioxide. In the process of preparing biochar, energy will also be generated or excess energy will be stored and heat exchange, as a supplement to fossil fuels, used in other energy-intensive areas, thereby reducing the use of fossil fuels and reducing carbon dioxide emissions. The application of biochar to the soil also reduces the availability of soil nitrogen fertilizer, thereby reducing NO_x emissions. So, biochar plays a very important role in mitigating greenhouse gas emissions.

4.4. Disposal of Chemical and Teaching Experiment Wastes

Biochar based micro-electrolytic filler (Fig. 1) is used for the treatment of chemical wastewater (Fig. 2), which can effectively degrade the characteristic pollutants in chemical wastewater, such as pyridine, benzene, naphthalene and their derivatives, etc. It is a low-cost, environmentally friendly, high catalytic efficiency and stability of the material [6].

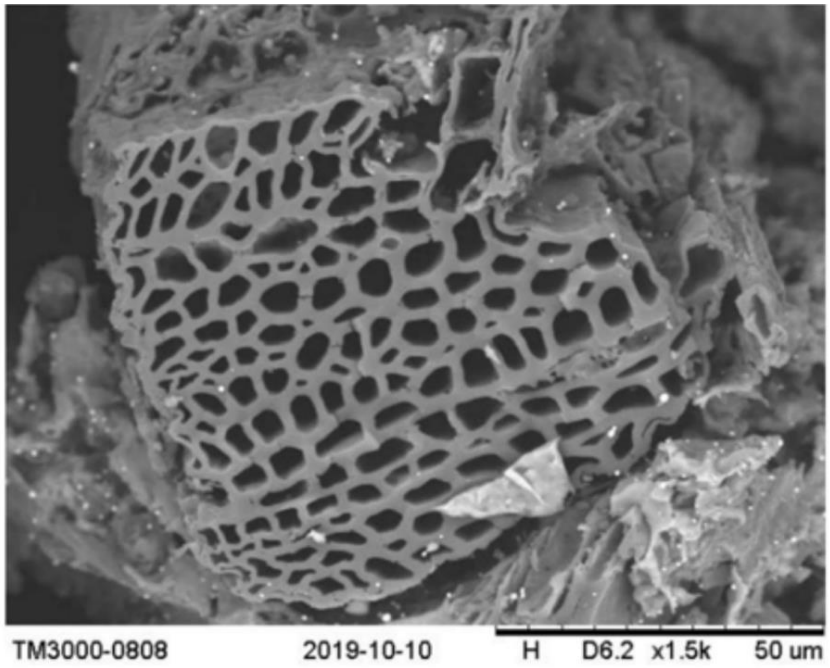

Fig. 1 A biochar based micro-electrolytic filler and its application in the treatment of chemical wastewater. https://wenku.baidu.com/view/60ebec16750bf78a6529647d27284b73f34236ec.html

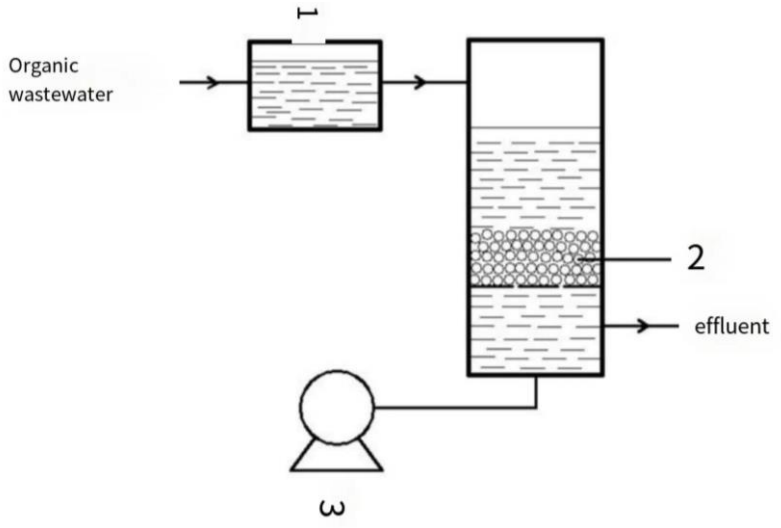

Fig. 2 A biochar based micro-electrolytic filler and its application in the treatment of chemical wastewater. https://wenku.baidu.com/view/60ebec16750bf78a6529647d27284b73f34236ec.html

4.5. Disposal of Waste

The raw materials for the preparation of biochar are often waste from agriculture, paper and other industries [7]. Biochar can be prepared from these wastes by a series of methods, which can effectively reduce the discharge of solid wastes, improve the utilization efficiency of resources, and protect the environment. Wheat straw and rice straw are used as raw materials to prepare biochar, so as to reduce the environmental pollution caused by waste wheat straw and rice straw, and realize the recycling of waste resources.

5. Other Applications of Biochar

5.1. Agricultural Field

When biochar is used as a soil conditioner and returned to farmland, it can effectively improve soil physical and chemical properties and micro-ecological environment, repair polluted soil, and improve soil productivity, crop yield and quality. Studies have shown that biochar combined with fertilizer can significantly improve crop fertilizer efficiency (Fig. 3) [7]. It was found that biochar can improve soil pore structure, increase soil moisture content, and increase soil nutrients [8]. Most of the biochar is alkaline, which can effectively improve the base saturation of the soil, consume the protons of the acidic soil to increase the pH value and improve the soil nutrients [8, 9].

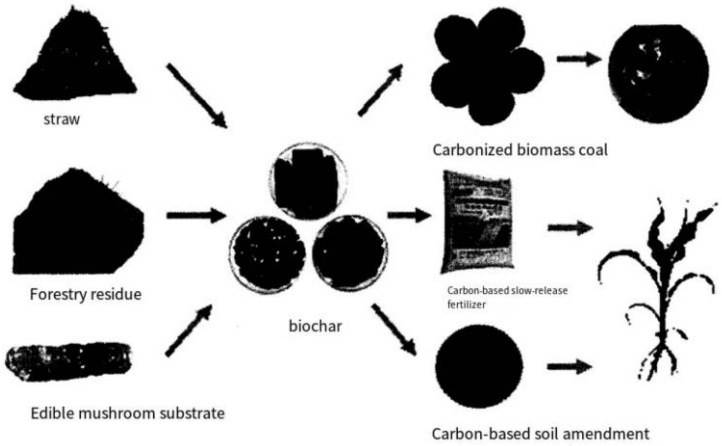

Fig. 3 The combination of biochar.
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5.2. New Energy Field

Biochar is easy to ignite, non-polluting, smokeless and tasteless, less residue after combustion, light weight and high calorific value, the use of performance is better than most similar materials, known as the main force of human new energy and future fuel [10].

Biochar is a kind of material with important value and potential, and its preparation of hard carbon anode is of great significance to lead the energy transition. By preparing a hard carbon anode, we can greatly improve the performance and energy storage capacity of the battery, providing more reliable support for the development of renewable energy. Biochar as a sustainable and environmentally friendly material, its preparation process also has the characteristics of low energy consumption and low emissions, in line with the current green development needs. Therefore, the use of biochar to prepare hard carbon anode can not only improve energy efficiency, but also help to reduce the dependence on fossil fuels and promote the realization of energy transformation. In the future, the preparation of hard carbon anode by biochar will become an important technology in the energy field and lead the way of energy transformation.

6. outlook

Biomass raw materials and preparation methods can significantly affect the properties of biochar, and the properties of biochar determine its application field. The controllable preparation of biochar can be achieved through raw material selection and preparation methods, etc. In recent years, the research has mainly focused on laboratory simulated sewage, and the application research in actual pollution treatment is still lacking. The actual polluted water and soil usually contain a variety of pollutants, so it is of great significance to remove some pollutants synergistically or selectively, and to recycle the adsorbed pollutants [11]. In addition, over the years, research has mainly focused on the preparation of biochar and the study on the mechanism of pollutant removal, and there are few reports on the desorption of pollutants and the reuse of adsorbents [12]. It is necessary to further strengthen research and systematically evaluate the technical and economic feasibility of biochar, so as to provide strong support for the engineering application of biochar [13, 14].

7. Conclusion

Biochar research is closely related to human life. Biochar has good comprehensive benefits and important role potential, value and contribution in the application of agriculture, environment and other fields. Its unique source, structure, characteristics and efficacy are not available to other materials, and it has also been widely concerned and recognized by scientists all over the world. Studies have shown that organic pollutants can cause irreversible damage to human systems and increase the incidence of cancer. With its unique functional and structural advantages, biochar can adsorb and reprocess contaminated water, soil, atmosphere and chemical waste. Biochar has also become the main force of new energy and future fuels with its easy-to-burn, pollution-free, smokeless, tasteless, and less residue properties. In addition, over the years, research has mainly focused on the preparation of biochar and the study on the mechanism of pollutant removal, and there are few reports on the desorption of pollutants and the reuse of adsorbents. It is necessary to further strengthen research and systematically evaluate the technical and economic feasibility of biochar, so as to provide strong support for the engineering application of biochar.

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