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A Review Of Researches On Biochar Adsorbing Organic Contaminants And Its Mechanism And Influence Factors

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Abstract. Biochar is a product in the anoxic conditions to the biomass pyrolysis. Because of its exquisite unique pore structure and surface chemical properties, the organic pollutants in environmental media have strong adsorption capacity, and thus affect the migration of pollutants and end-result. In recent years the biochar research on adsorption characteristics and mechanism of organic pollutants has become one of the research hotspots in the field of environmental science. This article mainly explains the mechanism of biochar adsorption to organic pollutants and the influence factors.

1. Introduction

It is of great guiding significance and application value to study the adsorption mechanism and law of biochar to organic pollutants. Adsorption mechanism mainly includes distribution, surface adsorption and pore intercept three, and in the complex pollution of the environment and the diversity of biochar type under the condition of a variety of adsorption mechanism work together to fully explain the adsorption process of organic pollutants.

2. Mechanism of biochar adsorption to organic pollutants

2.1. Distribution function

Distribution function is ion organic compounds in the soil adsorption process when first proposed a simple linear adsorption process, is the weak intermolecular interaction, is organic matter can be allocated to the soil organic matter, instead of adsorption on the surface adsorption sites[1]. Pollutants in the distribution coefficient of organic matter (K_{oc}) instead of octanol - water partition coefficient, present the obvious linear relationship between, therefore, distribution function is organic pollutants according to the principle of "similar miscibility between hydrophilic and hydrophobic phase distribution, the process mainly depends on the soil organic matter content, has nothing to do with the soil particle surface area[2-5]. Distribution function is mainly by biochar and organic pollutants "matching" and "effectiveness", both polarity, high matching, distribution is mainly process; And effectiveness on the one hand, refers to the amorphous organic carbon to organic pollutants effectively "dissolved", on the other hand refers to the high concentration of organic matter in the biological carbon surface adsorption effectiveness is reduced, the main distribution non-competitive [6].

2.2. The surface adsorption

Surface adsorption is the organic pollutants and molecular structure of biological carbon surface interaction is an important mechanism of adsorption, adsorption is qualitative in biochar the polar



functional groups with rich surface and huge specific surface area of relatively special material surface adsorption sites on the phenomenon of enrichment, biochar is part of the main contribution of the strong adsorption ability.

2.3. Pore intercept

Pore intercept is a kind of important biological carbon adsorption fixed the micromechanism of organic pollutants, the aperture size, porosity, functional group composition and the morphology and properties of the organic pollutants in all can affect the pore intercept adsorption process. Biochar is a kind of give priority to with microporous structure, the non uniformity of porous level special porous solid materials[7]

2.4. Combined action

Separate distribution, and the roles of the surface adsorption or pore intercept explain biochar the adsorption process of organic pollutants have limitations. For biochar characteristics, the nature of the organic pollutants, and the environment, such as adsorption, biological differences between carbon adsorption process of organic pollutants, usually is given priority to with some kind of adsorption mechanism. Zhu [8] such as quantitative analysis on nitrophenol in organic bentonite on the adsorption, distribution and surface adsorption work together to complete the interpretation of the adsorption process.

3. The influence factors of the adsorption to organic pollutants by biochar

Biological carbon adsorption mechanism of the strength of the organic pollutants and affected by many factors, biological carbon materials, the polarity of the organic pollutants, molecular size and adsorption conditions such as pH coexist, environmental medium and material and so on all can influence the whole adsorption process

3.1. The raw material of biochar

Different kinds of raw materials and pyrolysis conditions are the main reasons for the formation of biochar with different properties. General common raw material for biochar preparation include wood, pine wood, peanut shells, straw, tobacco poles, reeds, coconut shells, bamboo or other plant wastes, animal excrement and sludge, etc[9]. Studies have shown that the aging cryogenic pyrolysis biochar decreases compared to the new carbon aromatic carbon content, the alkyl carbon content increases, and the polarity increases. In addition, with the dissociation of surface functional groups, there is an increase in alkalinity and an increase in CEC. This will affect the adsorption process of biochar. The changes in the physical and chemical properties of the biological carbon aging process with different pyrolysis temperatures and raw materials.

The specific surface area, aromaticity, pH and C/N ratio of wood sawdust were higher than those of dry cow dung, and the composition of ash was less than that of dry cow dung, which would increase the water holding capacity of soil and increase the adsorption capacity of on the surface of raw carbon. The physical and chemical properties of biological carbon are also influenced by the content of lignin in the raw materials. The aroma, stability and carbon content of the maize straw bio carbon are higher than that of the wheat straw biological carbon, but the polarity and ash content of the biomass carbon is lower than that of the wheat straw biological carbon. The carbon composition of different biological charcoal was compared by element analysis and accelerated aging method. The results showed that the stability of biological carbon has a positive correlation with the ratio of O/C atoms, which is mainly related to the efficiency of carbon conversion in the preparation of. The results show that the aging low temperature pyrolytic carbon has the characteristics of small aromatic carbon content, large alkyl carbon content, strong polarity and so on. With the dissociation of the functional groups on the surface of the biological carbon, the alkaline enhancement and CEC increase, which will affect the adsorption process of biological carbon, and the physicochemical properties of the biological carbon will also

follow the heat during the aging process. The difference between temperature and raw material changes.

3.2. The properties of organic pollutants

The adsorption of organic pollutants on biochar is influenced by polarity, hydrophobicity, aromaticity and molecular size. Due to the steric hindrance of different molecular sizes, there are differences in the effective contact and interception effects on biological carbon, so the adsorption mechanism and adsorption effect are also different[10].

In addition, the biological carbon has aromatic structure, which can interact with the organic matter with the benzene ring structure, produce the π - π , and strongly adsorb the organic matter on the surface of the biological carbon. The adsorption mechanism and adsorption effect also change, due to the difference in the effective contact and retention effect on the biological carbon, with the effect of the space hindrance. Therefore, for organic pollutants with different molecular volume and polarity, the adsorption mechanism of biological carbon will change. For hydrophobic organic pollutants, hydrophobic distribution is the main adsorption mechanism, and for the strong polar small molecule organic matter, it can be adsorbed by the surface polar functional groups of biological carbon, and the molecular size of organic pollutants is different. The filling effect of their micropores is different, so that the amount of adsorption changes.

3.3. Adsorption environment

The adsorption environment will affect the adsorption of organic pollutants. The main adsorption environment is environmental pH, environmental medium and coexisting ions. The adsorption of sulfadiazine (SMT) on the biological carbon under different pH conditions is studied. The main existence of SMT⁺ in the acidic environment is the interaction between the pi electron and the body receptor on the surface of the biological carbon, while the basic environment is mainly SMT⁻, and the OH⁻ produces SMT⁰. The hydrogen bond is the main mechanism of hydrogen bonding. The actual soil pollution is mostly compound pollution [11]. The study shows that in the compound pollution, the adsorption strength of each organic matter will decrease under the CO adsorption of several organic compounds. It shows that there is a competitive relationship between organic carbon adsorption and organic carbon adsorption on the adsorption process of organic pollutants.

4. The research prospect

Biochar can improve soil fertility, mitigate climate change and restore polluted environment. But at the same time, biological charcoal will cause some pollution. The study shows that the amount of heavy metals ($0.301 \sim 129 \text{ mg kg}^{-1}$) and PAHs ($1.48 \sim 5.48 \text{ mg kg}^{-1}$) in the biological carbon prepared by organic waste will increase the content of PAHs in the soil, and can reach a moderate degree. Or serious pollution will cause serious environmental problems to the soil. At the present stage, the research on the remediation of organic contaminated soil by biological carbon is in the initial stage. The research is less and the idea and system are not mature enough, so it cannot be popularized to the public.

In the future period of study, we should pay attention to the following problems: (1) A large number of experiments are carried out under the conditions of different preparation materials and different preparation processes, and the data parameters of biochar can be analyzed. The optimal method of biological carbon preparation can be obtained, the performance of biological charcoal is improved, and the ecological environment of biological charcoal can be increased as much as possible. In order to reduce the harm to the ecological environment and increase its application scope, the adsorption process of biological charcoal is deeply studied to determine the adsorption mechanism of various substances in the soil, and the factors affecting the adsorption of organic pollutants on biological charcoal can be deeply understood. After applying the best amount of biological carbon, the biological carbon can be used to make organisms. Carbon showed the best adsorption capacity; (3) The effects of biological charcoal on soil physical and chemical properties, microbial community and soil reuse

value after adding soil to soil; (4) Biological carbon added into soil accelerated soil nutrient cycling and biological migration of, indicating the biological carbon and soil endogenous growth. The combination of biochar and other animals, plants and microbes can jointly repair the biochar to achieve efficient remediation of organic contaminated soil.

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