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Opinion Article

Applications of Hydrothermal Carbonization

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DESCRIPTION

Hydrothermal Carbonization (HTC) is an efficient and valuable pre-treatment technique for converting waste biomass into high density carbonaceous materials that can be used for a variety of energy, environmental, soil improvement and nutrient recovery applications. HTC converts residual organic materials into high energy density solid materials (hydrochars) and liquid residues. This liquid residue concentrates the most volatile and oxygenated compounds (mainly furan and organic acids) during the reaction. The original hydrochar is mainly used for direct combustion, heat or electricity generation, but at the stage of further activation it can also produce a highly porous carbonaceous medium for energy storage or contaminant adsorption. The HTC process can be used specifically to improve the recovery of nutrients such as nitrogen and phosphorus, and can be used as a soil conditioner to promote plant growth and mitigate soil desertification. The current examination offers perspectives on the various potential uses of hydrochars produced from all types of waste biomass sources. Suggested applications, key operating parameters that have the greatest impact on hydrochars, are highlighted to meet the requirements of the particular application.

With the growing need to find new renewable energies to replace fossil fuels and the need to safely dispose of organic waste, in recent years it has become more efficient for energy recovery and conversion of waste biomass into valuable materials. The search for reliable technology is progressing. In fact, the constant increase in global energy consumption and the consequent decline in fossil fuel supply have led the scientific community to seek more sustainable resources. Waste biomass, especially the Organic Fraction of Municipal Solid Waste (OFMSW), as well as industrial and sewage sludge, is one of the most studied residual raw materials for the production of energy and valuable carbonaceous materials.

One of the main drawbacks of choosing waste biomass for energy production is that it requires one or more pre-treatments before use. Due to the high water content of the waste biomass, the energy density is low, which is often not suitable for direct energy transformation by incineration or gasification. The high water content of the residual biomass significantly increases the operating costs of transportation and the energy consumption of drying. But because of its abundance, global availability, carbon neutrality, and the need to find efficient and valuable technologies to process it into sustainable energy sources and usable materials, waste biomass is receiving more and more attention and study.

In addition to various valuable alternative treatments for waste biomass, wet thermochemical techniques have gained increasing attention in recent years due to their flexibility and inherently low investment and operating costs. In particular, Hydrothermal Carbonization (HTC), also called wet pyrolysis, is a thermochemical process usually carried out in the presence of subcritical water at temperatures of 180°C -280°C and naturally saturated steam conditions (10-80 bars). The times vary from minutes to hours. At high temperatures and pressures, even under subcritical conditions, water dramatically changes its properties and functions as an organic solvent. The increase in its ionic products usually favors acid or base-catalyzed reactions and increases biomass degradation through hydrolysis, dehydration, and decarboxylation reactions. These reactions can be increase the carbon content of the raw material by removing most of the highly volatile oxygenated compounds (furan and low molecular weight fatty acids) that are normally carried over to the aqueous phase. Also, it is well documented in the works that some of the minerals move to the liquid phase during the HTC, which one of the hand reduces the formation of minerals and ash in solid residues (hydrochar) and on the other hand is high in calories. This behavior reduces the risk of impact and fouling phenomena during combustion of hydrochars in the boiler compared to the use of pyrochars.

CONCLUSION

Hydrochar can be used in a variety of applications as a biofuel for power generation, as a source of carbon and nutrients for soil applications, and as a raw material for further use in super capsules and porous matrices for adsorbing contaminants. In addition, process scalability to the industrial level and relatively mild process conditions make HTC an effective solution in the near future for converting a wide range of raw biomass into valuable materials. It reports a flow chart of hydrochar

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production from waste biomass and its potential energy and environmental applications.