Solutions for converting bamboo waste to solid biofuels based on transportable carbonization equipment

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Abstract：

To convert bamboo waste into solid biofuels, a transportable carbonization equipment was designed. The equipment had the characteristics of recovering bio-tar, waste heat utilization and high carbonization efficiency. The physical and mechanical properties, combustion characteristics and ash fusion characteristics of the molded charcoal were investigated. As the percentage of bio-tar in the composite binder increased, the compressive strength of the molded charcoal decreased, while the combustion characteristics changed slightly. The mass ratio of HPMC and bio-tar of 3:1 was selected as the optimized ratio, in which the HHV of MBC was 25.88 MJ/kg with a compressive strength of 143.38 N/cm. In addition, the MBC had the $R_{B/A}<1$, $0.6<F_u<40$, and S/A＞3, thus the MBC had a low risk of slagging. These findings will help provide scientific guidance for value-added utilization of bamboo waste.

1. Set-up and operation of equipment

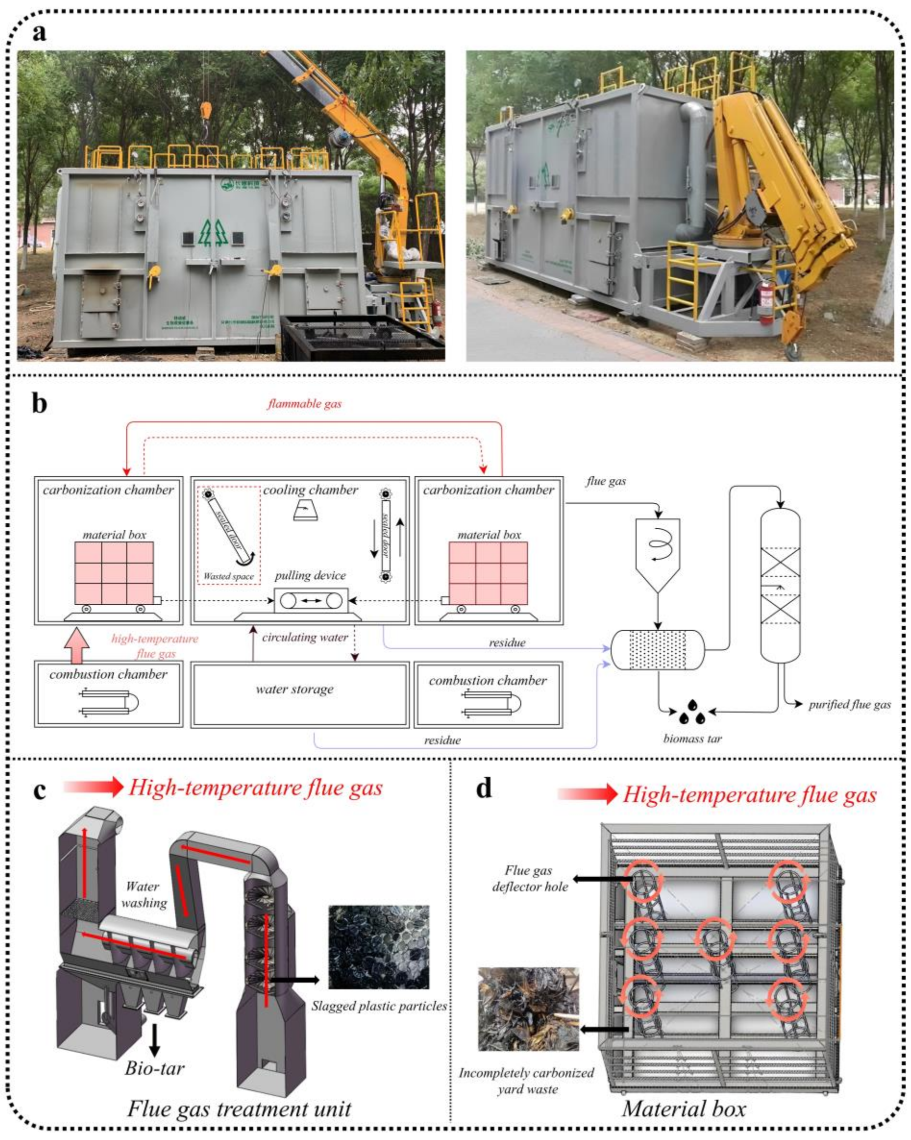

Fig. 1. Operation of transportable carbonization equipment

Fig. 1 *showed the transportable carbonization equipment in operation. The size of equipment was 7500 mm (length) ×2400 mm (width) ×2600 mm (height). The equipment included carbonization system, combustion system, cooling system, and flue gas treatment system.*

1.2. Physical and mechanical properties

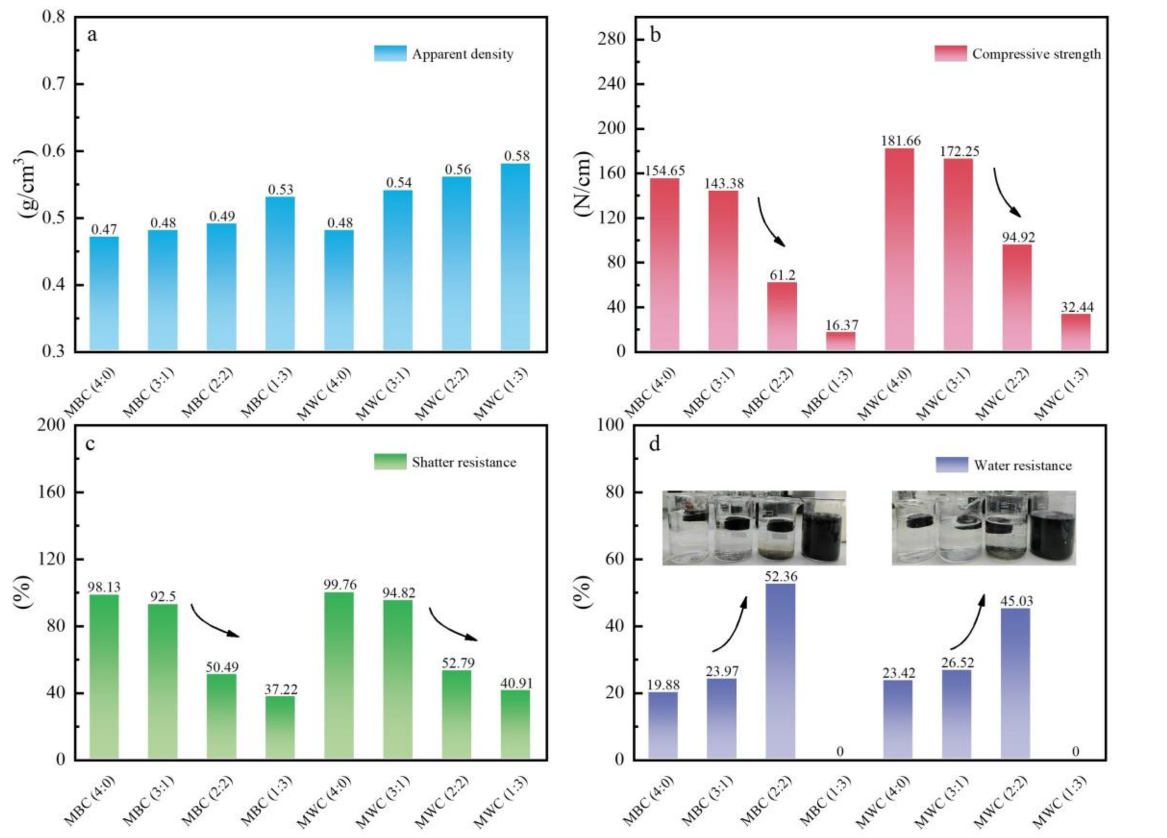

Fig. 2. *Physical and mechanical properties of molded charcoal*

Fig. 2 showed the physical and mechanical properties of the molded charcoal. The compressive strength, shatter resistance, and water resistance of molded charcoal changed significantly when the bio-tar addition was increased from 25% to 50%. Therefore, the percentage of bio-tar addition was selected at 25%, which had no significant influence on the physical and mechanical properties of the molded charcoal. This indicated that bio-tar could replace part of the binder, thus reducing the cost of molded charcoal production.

1.3. Ash fusion characteristics

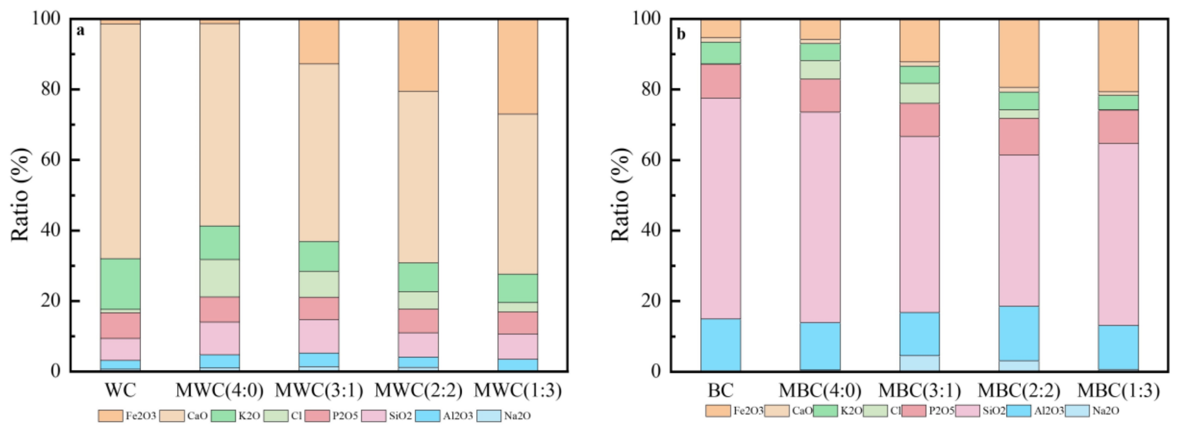

Fig. 3. *The oxide content in the ash samples.*

Fig. 3 *showed the oxide content in the ash samples. As the percentage of bio-tar in the binder increased, the content of Fe2O3 in the ash samples increased significantly. However, the ash fusion temperature decreased with the increase of Fe2O3 content, which could be related to that Fe2O3 promoted the conversion of high-melting-point mullite to low-melting-point cristobalite. Compared with MWC, MBC had lower CaO content.*

Conclusion

This research designed a transportable carbonization equipment that characterized by the recovery of bio-tar, waste heat utilization of pyrolysis gases and high carbonization efficiency. With the increased percentage of bio-tar in the composite binder, the compressive strength of the molded charcoal decreased, and the combustion characteristics and fundamental characteristics changed slightly. Tthe risk of slagging was lower for MBC.