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TURNING BIOCHAR INTO A HIGH-TECH MATERIAL THROUGH EFFICIENT GRINDING

Biochar is gaining increasing importance in agriculture, environmental engineering, and industry. It can store nutrients, bind contaminants, and contribute to soil improvement. For successful use across these various applications, precise adjustment of particle size is crucial, as it significantly influences both technical handling and effectiveness. This requires efficient comminution technologies that enable uniform and reproducible processing. At Offenburg University of Applied Sciences, the Retsch Hammer Mill HM 200 is used for this purpose, allowing biochar from various raw materials to be processed efficiently. This report provides insight into the applied grinding process and presents several practical application examples, demonstrating how efficient comminution turns biochar into a high-tech material.

Milling technology

The Retsch Hammer Mill HM 200 (Fig. 1) is a powerful device designed for the grinding of hard, brittle, and fibrous materials. It operates with a robust impact mechanism that enables efficient size reduction down to fine particle sizes. The mill is designed for continuous operation and offers a high throughput rate while maintaining consistent grinding quality. Thanks to its user-friendly operation and durable construction, it is suitable for use in both laboratory and industrial environments.



Fig. 1: Hammer Mill HM 200



Fig. 2: Coal before and after grinding

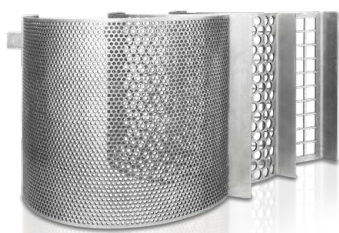


Fig. 3: Sieves for HM 200 with various aperture sizes



Fig. 4: left: Injection of Biochar suspension with GeolInjector (Vogt GmbH, Weidenberg, Germany)
right: Unground biochar and ground biochar processed with HM 200 to particle sizes <2 mm.

Further environmental applications of biochar

Biochar is also used for the immobilization of contaminants such as nitrates, pharmaceutical residues, and PFAS from wastewater and surface water. Here too, fine grinding - similar to powdered activated carbon - is advantageous, as the increased surface area of the ground biochar enhances its adsorption capacity for pollutants.



Fig. 5: left: HM 200 equipped with cyclone
right: Biochar-based fertilizer granules



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Innovative applications of biochar

The potential uses of biochar are virtually limitless. It is added to animal feed to improve digestibility, incorporated into cosmetics to cleanse the skin, and used in household appliances to neutralize odors (Schmidt and Wilson, 2014). Biochar is also being applied in material technologies such as concrete, asphalt, and plastics. For example, the Ithaka Institute, in collaboration with the manufacturer Oxess, has produced a snowboard that is used in World Cup races (<https://www.c-sinksports.net>). In this case, biochar improves power transmission and reduces the conversion of kinetic energy into heat during motion (Schmidt, 2025). For such applications, ultra-fine biochar is beneficial and can be produced using ball milling.



Fig. 6: Snowboard with charcoal admixture of the manufacturer Oxess.
Source: <https://www.c-sinksports.net/en/ct/17-NanoCarbon-Materials>

Conclusion

The grinding of biochar at Offenburg University of Applied Sciences using the Retsch Hammer Mill HM 200 aims primarily to explore the diverse potential applications of this material. The versatile use of biochar in agriculture, industry, and environmental technology demonstrates its great potential and adaptability across different fields of application.

References:

Schmidt, H.-P., 2025. Biochar wins World Cup. *Biochar J.* <https://www.biochar-journal.org/en/ct/113>
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