Waste to Watts: Converting Locally Sourced Organic Waste Material Into Activated Carbon Based Supercapacitors

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The world's increasing demand for energy and concerns over the environmental impacts of current battery production methods highlight the need for more sustainable energy storage solutions. Supercapacitors (SCs) are one such energy storage solution as they store energy electrostatically, eliminating the need for environmentally harmful materials like those used in batteries. Thus, in this project, I created an activated carbon (AC) based SC out of AC processed from renewable waste material like brewer's spent grain (BSG), a common organic waste byproduct of the brewing process, and saltwater (SW). The BSG AC was produced as environmentally friendly as possible, through the activation of carbonized BSG via superheated steam during pyrolysis. An iodine absorbance test showed that the BSG AC absorbed 972.06 mg of iodine per gram, 870% more than regular carbon and only 4% less than commercial AC, confirming successful activation. The BSG AC was then used to create an SC with a SW electrolyte, chosen for its relatively low environmental impact compared to other popular electrolytes. This SC was tested against a supercapacitor of identical construction made using commercial AC. Testing revealed that the BSG AC SC could achieve a maximum voltage of 1.2V, capacitance of 158.64 F, specific capacitance of 453.26 F/g, energy density of 5.2 mWh/g, and a power density of 0.2654 W/g. Although the commercial AC SC showed a 20% increase in performance in most areas, the results were promising. They demonstrated the potential for supercapacitors made from low-value waste materials like BSG and SW to be viable, environmentally friendly, and renewable energy storage solutions that can pave the way for the future of clean energy storage devices the world desperately needs.