Air Quality and Energy Analysis of Bagasse Charcoal
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Introduction
An enormous percentage of the world’s population relies on charcoal to cook food and sterilize water. To make charcoal, wood or other plant material is ignited and then covered to induce pyrolyzation.

The harvesting of wood for charcoal production is a cause of deforestation in developing countries. Bagasse, the fibrous byproduct of sugarcane, is abundant in much of the world, and can be processed into charcoal briquettes for cooking in homes.

The objective of this research is to determine the energy value and emissions quality of charcoal produced over a range of temperatures, and to discern if there is an optimal production temperature.

Producing Charcoal
Bagasse is placed into a canister designed to exclude oxygen and heated in an oven. Once pyrolyzed, it is crushed and made into briquettes using cassava starch as a binder.

Analysis
Energy
Bomb calorimetry is used to determine the energy value per mass of charcoal produced. The charcoal’s energy “return on investment,” or Energy ROI, is determined by dividing the energy in the charcoal by the energy used during its production.

Air Quality
For air quality testing, the briquettes are lit and the combustion fumes are sampled for particulates using a modular impactor. The impactor distinguishes between particles larger and smaller than 2.5 microns in diameter. The latter, known as fine particulate matter, is most harmful.

Results and Conclusions
As charcoal production temperature increases, the amount of energy ROI decreases. But the amount of particulates emitted during charcoal combustion decreases with higher charcoal production temperatures.

Below 600 °F, little pyrolysis happens. The mass of particulates emitted during combustion decreases by approximately 70% with charcoal produced at 700 °F compared to that produced at 600 °F. There is no significant decrease in particulate emissions with charcoal production temperatures above 700 °F.

From an air quality perspective, higher pyrolyzation temperatures generate fewer particulates, but the gains are diminishing after 700 °F.

Pyrolyzing the charcoal at a lower temperatures results in a higher energy ROI. So long as satisfactory emissions quality is achieved (i.e., low particulates), Charcoal production at low a temperature decreases net energy use (and cost).

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