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Biochar: the Solution to the Next Green Revolution

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Abstract

1. Purpose of research

To investigate the feasibility of using municipal cellulosic wastes as feedstock for production of biochar in pyrolysis, the effects of metal catalysts in pyrolysis, and the applicability of the produced biochar as a fertilizer

2. Procedures

A. Investigation into the characteristics of (metal catalyzed) pyrolysis of various cellulosic wastes

1. The cellulosic waste (and catalyst) was weighed and put into a boiling tube. The tube was stopped with a plastic bung with holes. A plastic tube and a thermocouple were inserted through the holes. The other end of the plastic tube was submerged.

2. A Bunsen flame was used to pyrolyse cellulosic waste. Temperature and time of reaction were recorded. Gas produced was collected underwater. Biochar and bio-oil were obtained and weighed.

B. Evaluation of adsorptive capabilities of different materials

1. Blue light absorbances of KH_2PO_4 solutions (mixed with vanadate-molybdate reagent to form yellow solutions) at different concentrations were found and an absorbance-concentration curve was established.

2. 5g of each material being evaluated was sandwiched between two pieces of filter paper before being put into a suction funnel. KH_2PO_4 solution was

poured into the funnels. The setups were left overnight and filtrates were collected.

3. Collected filtrates were mixed with vanadate-molybdate reagent. Concentration of phosphates in each filtrate was found by the curve.

3. Data

I. Highest **percentage conversion** from waste to biochar: 94.1% (paper towel, iron wool)

II. Highest **sequestration rate** of carbon: 98.6% (paper towel, zinc)

III. Lowest pyrolysis **temperature**: 162℃ (paper towel, copper)

IV. Best **catalyst** in terms of speed of biochar production: copper (+47.7%)

V. Highest **speeds of biochar production** (w/ and w/o catalyst): 46.4g/hr (paper towel, copper) and 27.7g/hr (sawdust)

VI. **Adsorptions** of KH_2PO_4: 14.4% (biochar from sawdust)/ 9.02% (sawdust)

4. Conclusions

The pyrolysis of cellulosic waste to biochar was achievable at school laboratory conditions, with satisfactory results in carbon sequestration, production speed and percentage conversion.

Under catalysis by various metals, the production of either biochar or pyrolytic gas and oil can be optimized, providing a low-cost way to derive **fuel and sequestration-ready carbon**, both crucial as answers to looming crises. The use of copper greatly speeds up pyrolysis and lowers the pyrolysis temperature, further increasing the **economic potential** of the process.

Biochar is also an **effective means to soil management**, as shown in field and laboratory experiments. Its adsorption capability far exceeds that of untreated cellulosic waste, retaining nutrients to be taken by plants instead of leaching away. It was also shown to improve fruit yield and induce ripeness in tomato, making it obvious that biochar is also a **viable fertilizer**.

All in all, **metal-catalyzed biochar production** from **municipal cellulosic waste** and the subsequent use of biochar as **fertilizer** have the benefits of: low feedstock cost, low energy cost, fast production, carbon sequestration, soil management and waste recycling. It is a remedy to some of the most persistent and serious global problems: food and energy crisis, water pollution, excessive greenhouse effect alongside waste treatment.

評語

本研究嘗試將廢料轉化為土壤改良劑，頗具創意。整個研究由轉化程序之操作到實際植物成長之驗證比較，也相當完整。未來若能對金屬片催化作用再作改進，當更理想。