

The shape of coals and pigment adsorption degree

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1. Purpose

Wood becomes coal by maintaining the organizational structure of wood to a certain extent, so there are many holes on the surface, this has the effect of absorbing impurities in water. But environmental destruction such as deforestation is progressing to make charcoal. So, we decided to focus on corn raised all over the world and examine whether corn-coal made by roasting the corn's core can absorb impurities in water. In addition, we compared charcoal, corn-coal, bamboo-coal, and bincho-coal to see which type of coal has the highest adsorption.

2. Method

Definition: water impurity=pigment of methylene blue
Process of making the corn-coal

We used commercially available corn.

- i) Cut the dried corn kernel about 1 cm square.
- ii) Fill a can and burn it in a pizza kiln. (Figure1)
- iii) One day later, take out of the can. (Figure2)

Adsorption experiment

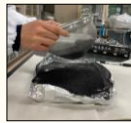
- ① Wash the each coal with distilled water.
- ② Burn the coals with gas burners for seven minutes in order to dry them.
- ③ Crush the coals.
- ④ Strain with tea strainers in order to match the size of coals. (Figure3)
- ⑤ Adjust methylene blue solution to 16.0, 8.0, 4.0, 2.0, 1.0, 0.5 mg/ℓ.
- ⑥ Place 5 ml of coal in plastic containers for 40 ml of methylene blue solution at each concentration, shake for 10 minutes and let stand for 45 minutes. (Figure4)
- ⑦ Apply 10 ml of ⑥ supernatant to 2500 rpm×8 min centrifuge and measure absorbance by spectrophotometer.



(Figure1)



(Figure2)



(Figure3)



(Figure4)

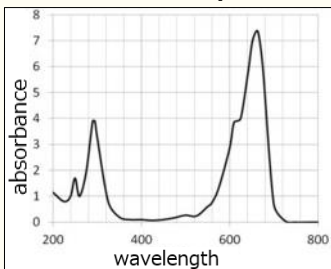
3. Results

Adsorption spectrum of methylene blue

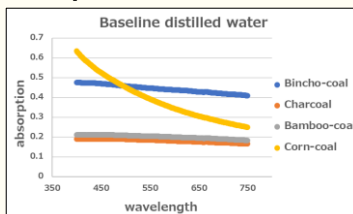
Methylene blue's maximum absorption wavelength is 650nm. (Figure5) Also, it doesn't absorb in 750nm.

Definition of adsorption degree

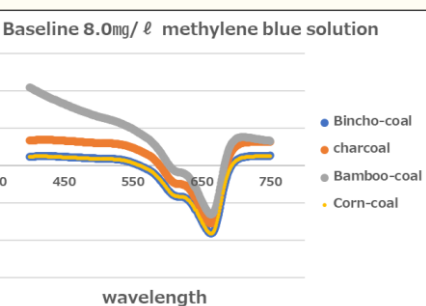
From (Figure6), there are some charcoal particles in the top clear layer after centrifuge, and the color of black can absorb all wavelengths. Then, to remove the influence of charcoal's absorption degree, we subtract the absorbance value of 750nm from the absorbance value of 650nm that is methylene blue's maximum absorption wavelength. (※) This value is the absorption in this experiment.



(Figure5)



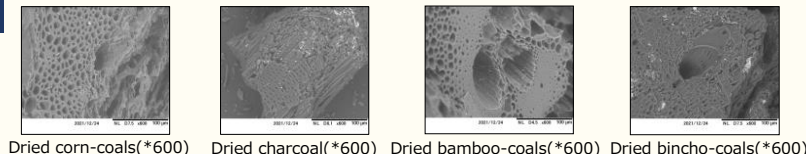
(Figure6) Absorption influenced by charcoal



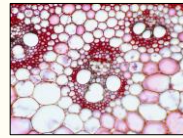
(※)

Influenced by charcoal, there is an absorption at 750 nm.

Coal shape



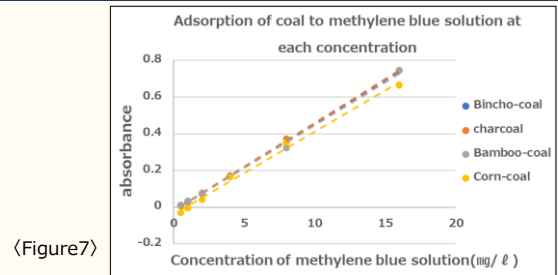
From the pictures above, we can see holes of 10 μm in many kinds of coal.



Vascular bundle of corn

As the left figure shows, absorbed pigments are the structure of the raw materials for coals vascular bundle. As the electron microscope image shows, we could also see the same structures even in corn-coal, bamboo-coal and bincho-coal.

4. Consideration



(Figure7)

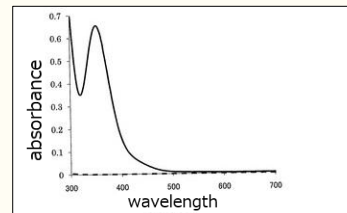
To define the experiment result we made the graph subtract the absorbance value of 750 nm from the absorbance value of 650 nm. (Figure7)

This graph shows that each type of coal has enough adsorption for the methylene blue solution at concentrations used in this experiment.

Also, in comparison with the adsorption degrees of bincho-coal, charcoal and bamboo-coal, corn-coal's adsorption degree is a bit low.

	Na	K	Ca	Mg
Corn(center of the core)	<LOQ	2	47	2
Sweet corn/Immature seed/Raw	0	290	3	37
	P	Fe	Zn	Cu
Corn(center of the core)	9	0.1	0.2	0.01
Sweet corn/Immature seed/Raw	100	0.8	1	0.1
<LOQ: below the detection limit				(Unit:mg/100g)

(Figure8) ingredient contained corn-coal



(Figure9) absorption spectrum of phosphorus ion

The reason for the extremely high absorption value of 350 nm to 450 nm in the corn-coal graph (Figure6) is thought to be from the influence of phosphorus contained in the corn core. It is unknown what influence it has in the purified water.

5. Outlook

We found that corn-coal which we can be made easily has similar adsorption rate to other coals. Corn is referred to as the world's third grain and produces 1.19 billion annually(2021). However, the core of corn is still thrown away as it is. So, making corn-coal will lead to reducing the amount of food waste.

As a future outlook, comparing CO₂ emissions of various kinds in coal's creation process, confirming reproducibility of data, investigating time for adsorption, and the limit of coal's adsorption. In addition, finding out more about the hole density for each type of corn.

Reference

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Words of thanks

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