STUDY OF WOOD AND BAMBOO CELLULOSE CARBONIZATION PROCESS USING γ -IRRADIATION AND PARTIAL OXIDATION METHOD IN AIR.

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Introduction.

Previous studies [1, 2, 3, 4] have shown that γ -irradiated almond shell, olive stone, wood, and bamboo undergo an alteration in carbonization process, carbon yield, and pore distribution.

In the present paper, the carbonization process and carbonized materials of Japanese cypress, γ -irradiated Japanese cypress, bamboo cellulose and coconut shell were studied.

Experimental

Materials: Japanese cypress, bamboo cellulose and coconut shell

A thermal analysis was carried out using a Shimadzu DTG-30 up to 800 ℃ with flowing nitrogen (99.9995%, 2.4 l/h), a heating rate of 300 ℃/h and 0.5 hour soaking time.

Apparent surface areas were obtained with a Micromeritics Shimadzu Flowsorb II 2300 by the single point BET method at liquid nitrogen temperature. (the flowed gas composition: nitrogen 30% and helium 70%) The Japanese cypress was irradiated by the 4.1 PBq Co-60 unit of the JEARI in air, and total dose was 2.5×10^{3}, 2.5×10^{4} and 7.5×10^{4} C/kg.

Results and Discussion

1) Japanese cypress, bamboo cellulose and coconut shell.

Using elemental analysis data of the material, and it's chars heated at 600, 800, and 1000 ℃, a atomic ratio of hydrogen and oxygen to carbon was calculated and normalized as carbon atom is 6. And the results are summarized in Table 1. In the Table 1, hydrogen remained about 2.2 at 600 ℃ and decreased to 1.0-1.1 at 800 ℃, and 0.8-0.9 at 1000 ℃. The ratio difference at same temperature among the chars are small. Oxygen ratio show 0.5 0.6 at 600 ℃ and no more decrease observed to 1000 ℃.

In TG curves of the materials, rapid weight loss observed 307 to 376 ℃ for Japanese cypress, 289 to 364 ℃ for bamboo, and 254 to 364 ℃ for coconut shell.

Table 1. Atomic ratio of hydrogen and oxygen to carbon (normalized as carbon is 6) for the materials and charcoal heated at 600, 800, and 1000 ℃.

	raw	600	800	1000
J. cypress *	9.15	2.26	0.99	0.79
	4.11	0.51	0.52	0.42
bamboo *	9.28	2.23	1.04	0.94
	4.32	0.59	0.55	0.58
coconut shell *	9.10	2.19	1.10	0.90
	4.16	0.56	0.55	0.55

* upper row: Hydrogen, lower row: Oxygen

Table 2. Carbon yields of the materials heated at 600, 800, and 1000 ℃.

	600	800	1000
J. cypress	25.6	23.8	23.4
bamboo	25.5	24.8	24.3
coconut shell	31.6	29.7	29.6

Carbon yields of the materials at 600, 800, and 1000 ℃ were calculated and the results are summarized in Table 2. Carbon yields at 800 ℃ varied in ranges of 23.8 % for Japanese cypress to 29.8 % for coconut shell. Carbon yields differences between 800 ℃ and 900 ℃ are less than

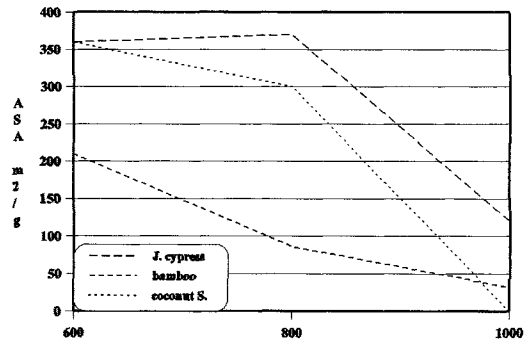

Figure 1. Apparent surface area for chars of Japanese cypress, bamboo, and coconut shell heated at 600, 800, and 1000 ℃.

1%. Apparent surface areas of the material chars which carbonized at 600, 800 and 1000 ℃ were obtained and results summarized in Figure 1. Chars of Japanese cypress and coconut shell show around 350 m^2/g at 800 ℃, but decreased to 100 and 1 m^2/g at 1000 ℃. Also bamboo char at 900 ℃ shows small surface area, because of the shrinkage of produced carbon

These results on the materials chars suggest that carbon yields are coconut > bamboo> Japanese cypress, and apparent surface area of char at 800 ℃ show Japanese cypress > coconut shell > bamboo.

Coconut char is the most hard. bamboo char is fragile.

2) γ -irradiated Japanese cypress.

After the γ -irradiation the following changes were observed: color went from brown to more dark color, oxygen content increased.

Usually, in the FT-IR spectra, peak appear around 1730 cm^{-1} and the peak become stronger with γ -irradiation. Japanese cypress have original peaks around 1730 cm^{-1}, and can not recognized new peak clearly.

Table 3. Carbon yields of γ -irradiated Japanese cypress chars heated at 600, 800, and 900 ℃. %

	600	800	900 ℃
raw	25.6	23.8	23.4
$2.5x10^3$	31.4	29.2	27.9
$2.5x10^4$	34.4	30.7	28.4
$7.5x10^4$	34.7	32.8	29.7

Carbon yields of Japanese cypress at 600, 800, and 900℃ was calculated and the results are summarized in Table 3. By γ -irradiation carbon yields at 800 ℃ increased from 23.8 % for non-irradiated to 32.7 % for $7.5x10^4$ irradiated.

Apparent surface area of char at 600, 800, and 900 ℃ were obtained and the results are summarized in Table 4.

Table 4. Apparent surface area of γ -irradiated Japanese cypress chars heated at 600, 800, and 1000 ℃. m^2/g

	600	800	900 ℃
raw	360	370	120
$2.5x10^3$	305	360	450
$2.5x10^4$	280	380	430
$7.5x10^4$	345	390	436

The areas for chars at 800 ℃ has no clear differences with γ -irradiation, for chars at 900 ℃ increased 3.5 times with γ -irradiation. By γ -irradiation, structure of Japanese cypress come to rigid and the shrinkage of produced carbon decreased.

Conclusions

1. Carbon yields at 800 ℃: coconut shell > bamboo > Japanese cypress. apparent surface area for 800 ℃ chars : Japanese cypress > Coconut shel > bamboo.
2. Higher γ -ray doses caused higher carbon yields on Japanese cypress.
3. Apparent surface areas of γ -irradiated Japanese cypress chars show maximum values at 900 ℃,

References

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