

POSTER

STUDY OF WOOD CARBONIZATION AND GRAPHITIZATION PROCESS USING CHEMICALS AND HIGH PRESSURE

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INTRODUCTION

Wood is used as a raw material for charcoal, but few studies have been done on the effects of chemicals and pressure on the characteristics of charcoal and its graphitization. In the present paper, we studied the effects of chemicals and high pressure on the wood carbonization procedure, carbon yield and apparent surface area. The carbonized materials were heated up to 2500°C and graphitization was studied.

EXPERIMENTAL

Materials; Japanese cypress (Jpn cyp), pine wood, bamboo and giant-ipil.

Standard procedures; Wood specimens were immersed in a chemical solution (10% ammonium phosphate, FeCl₃, K₂CO₃) for one night (16 hrs). After aeration at 160 °C for one night (16 hrs), the specimens (15 - 20 grams) were placed in the pit of a specially designed autoclave and evacuated for 30 min. The autoclave was then filled with nitrogen until the pressure reached 100 kg/cm². The pit was heated up in stages to 600 °C. (Safety valves of the autoclave were set at 300 kg/cm²).

Carbon residues were taken out after the autoclave returned to room temperature. (It took about 3 days)

A part of the carbon residues were heated up to 2500 °C in flowing argon.

The X-ray diffraction pattern, SEM picture and apparent surface area of the residues were studied.

RESULTS AND DISCUSSION

Table 1 shows chemicals and pressure combinations of the experiments. The other conditions of aeration, heating rate and maximum temperature were fixed at the same values.

run	Chemicals	aeration 160,16h in air	beginning pressure kg/cm ²	final Pressure kg-cm ²
W600	none	none	0	0
A600	none	○	0	0
AUP600	none	○	100	300
AC600	10%FeCl ₃	○	0	0
AUPC600	10%FeCl ₃	○	100	300

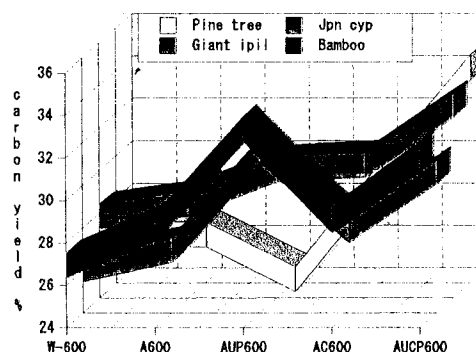


Figure 1. Carbon yields of wood carbonized at 600 °C under high pressure and/or impregnated with chemicals. (%)

Figure 1 shows the carbon yields of the experiments. Use of pressure increased carbon yields at 600 °C of giant-ipil and bamboo by 4.7 and 4.6 %, respectively. Carbon yields for Jpn cyp increased 1.6%.

Use of chemicals increased carbon yields at 600°C of pinewood by 2.9% but the other woods only increased about 1%. This would be due to the fact that giant-ipil and bamboo resist impregnation by chemicals.

Use of both chemicals and pressure increased carbon yields at 600 °C of all woods: pinewood 7.9%, Jpn cyp 4.6%, giant-ipil 3.7%, bamboo 3.3%.

Residues of the high pressure experiments were fragile, and correct values of carbon yields could not be obtained. Weights of the residues suggest that the carbon yields would increase in all woods.

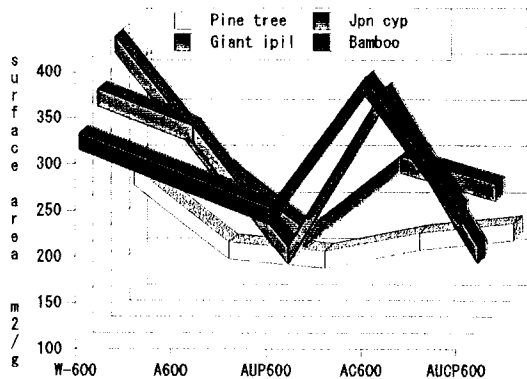


Figure 2. Apparent surface area of wood chars carbonized at 600 °C. (m²/g)

Figure 2 summarizes apparent surface area of the carbons. Surface area decreased with the use of pressure. These results suggest that under high pressure the tars do not evaporate and carbonization took place. Thus carbon yields increased. The tar carbon blocked the pores of the wood structure carbon. This resulted in smaller surface area values.

Figure 3 summarizes apparent surface area of 2500 °C heated carbon. The surface area was reduced more by chemicals than by pressure.

run	pine wood	Jpn cyp.	giant-ipil	bamboo
W600	91	92	86	86
A600	89	90	85	84
AUP600	92	92	89	88
AC600	87	88	83	81
AUCP600	87	88	84	88

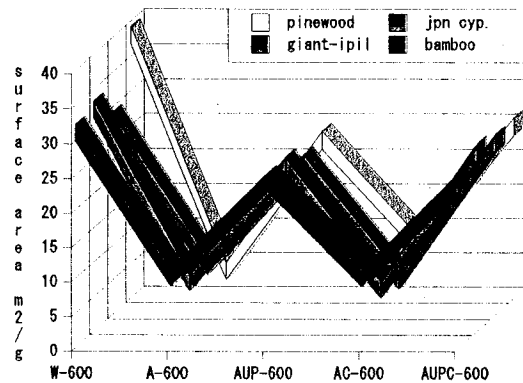


Figure 3. Apparent surface area of wood chars heated at 2500 °C. (m²/g)

CONCLUSION

- 1) Carbon yields of Japan cypress and pine wood increased when impregnated with chemicals. Carbon yields of giant-ipil and bamboo increased when carbonized under high pressure. Carbon yields of all wood samples increased 3 to 8 % when impregnated with chemicals and carbonized under high pressure.
- 2) Apparent surface area of the chars tend to decrease when carbonized under high pressure.
- 3) After heated at 2500 °C, carbon residues become fragile and the surface area decreased below 50 m²/g.
- 4) SEM pictures of the fragile chars show a deformation of the wood structures.