

## Evaluation of Acid-alkali-acid Pretreatment for Environmental Wood Samples at Dongguk University

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### 1. Introduction

Radiocarbon is produced by neutron collisions of cosmic rays with nitrogen in the atmosphere. Before 1850, the production of radiocarbon by cosmic rays was only influenced by universal effects. However, since 1850, carbon has been produced from fossil fuels for use by humans; thus, the concentration of radiocarbon has reduced compared with that in 1850. In addition, many nuclear weapon tests were conducted by humans at this time and the amount of radiocarbon became very high; this concentrated peak is called the bomb peak. The bomb peak occurred around 1960, after which the radiocarbon concentration ( $^{14}\text{C}/^{12}\text{C}$ ) decreased due to the emission of considerable amounts of carbon dioxide from fossil fuels, which were being used by humans [1]. The dilution of  $^{14}\text{C}$  by  $\text{CO}_2$  from fossil fuels is called the Suess effect [2]. Trees absorb carbon from air by photosynthesis, resulting in the creation of tree rings and leaves; hence, trees represent the amount of carbon in the air. Carbon isotopes of tree rings were measured to trace the local fossil fuel-derived  $\text{CO}_2$  using accelerator mass spectrometry (AMS) in China [3].

Chemical pretreatment of wood is required for the precise measurement of the radiocarbon concentration with AMS [4]. There are many chemical pretreatment methods for wood, and acid-alkali-acid (AAA) is the most simple method. Therefore, the AAA method was chosen to evaluate the precision. In this study, a standard wood sample (C5), a known sample, and charcoal were investigated and subjected to two AAA chemical pretreatments to improve the evaluation when the pretreated samples were analyzed using AMS.

### 2. Materials and methods

To evaluate the precision of measurement, two chemical pretreatments were performed on three samples: the acid-base-acid method was named by Method 1 [5] and the AAA method was named by Method 2 [6].

Table I: Methods of acid-alkali-acid (AAA) pretreatment for wood.

AAA	Type	Mole (mol)	Temp (°C)	Time (min)
Method 1	HCl	0.5	80	30
	NaOH	0.1	80	30
	HCl	0.5	80	15
Method 2	HCl	1	80	20
	NaOH	0.2	80	20

	HCl	1	80	60
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The three samples subjected to pretreatment included C5, which is a standard wood sample produced by the International Atomic Energy Agency (IAEA) [7]; a sample of known age (named by CAL), provided by the Carbon Analysis Lab, which is a radiocarbon dating service in Korea; and charcoal, for background level measurements by chemical pretreatments. The three samples were graphitized and analyzed with the graphitization system and AMS facility at Dongguk University [8].

### 3. Results and discussion

The measurement precision was examined for C7 and C8, produced by IAEA [9]. The results are summarized in Table II.

Table II: Measurement data of C7 and C8.

Name	Reference $F^{14}\text{C}$	Measured $F^{14}\text{C}$
C7	0.4953	0.4920
C8	0.1503	0.1506

The results in Table II indicate good precision.

Meanwhile, the results of C5, CAL, and charcoal are presented in Table III.

Table III: Measurement results of C5, CAL, and charcoal.

AAA	Name	Reference $F^{14}\text{C}$	Measured $F^{14}\text{C}$	Difference
Method 1	C5	0.2305	0.2288	0.0017
	CAL	0.8627	0.8561	0.0066
	Charcoal	0.0000	0.0035	0.0035
Method 2	C5	0.2305	0.2320	0.0015
	CAL	0.8627	0.8600	0.0027
	Charcoal	0.0000	0.0066	0.0066

The differences between the reference and measurement values from Method 1 were higher than those from Method 2. The precision of Method 2 should be higher than Method 1, as depicted by the measurement results. The background level of Method 2 (charcoal) was slightly higher due to contamination in the press process. However, this did not affect the other samples, as indicated by the higher measurement values of C5 compared with the references; though, the measured values for CAL were lower than the reference values.

#### **4. Conclusions**

Carbon dioxide is an important compound regarding the climate change. In particular, radiocarbon is used to trace fossil fuel consumption using wood samples. However, these samples require chemical pretreatment for accurate measurement. The AAA method is the most simple chemical pretreatment process. Two methods were tested with C5, CAL, and charcoal as test samples. The three samples were subjected to chemical pretreatment and measured using the AMS facility at Dongguk University. The data of Method 2 exhibited a higher accuracy than those of Method 1.

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