Energy & Agricultural Carbon Utilization
SUSTAINABLE ALTERNATIVES TO SEQUESTRATION
JUNE 10-11, 2004
THE UNIVERSITY OF GEORGIA • CENTER FOR CONTINUING EDUCATION • ATHENS, GEORGIA • USA

SESSION THREE
ORAL PRESENTATION B

Reactivity of wood charcoal with ozone

Kunio Kawamoto[1]*, Kengo Ishimaru[2], Yuji Imamura[2] and Makoto Ogawa[3] (*: correspondent)

[1] General Affairs Department Kansai Environmental Engineering Center Co., Ltd. Azuchimachi 1-3-5, Chuo-ku, Osaka 541-0052, Japan Tel. +81-6-6263-7302; Fax +81-6-6263-7301 E-mail:kawamoto_kunio@kanso.co.jp

[2] Research Institute for Sustainable Humanosphere Kyoto University Uji, Kyoto 611-0011, Japan Tel. +81-774-38-3670; Fax +81-774-38-3678 E-mail: ishimaru@rish.kyoto-u.ac.jp

[3] Biological Environment Institute Kansai Environmental Engineering Center Co., Ltd. Uji-Matafuri 8-4, Uji, Kyoto 611-0021, Japan Tel. +81-774-21-5001; Fax +81-774-21-5005 E-mail: ogawa_makoto@kanso.co.jp

Abstract:

It has been reported that charcoal is useful for soil amendment, waste-water purification, deodorization etc. These utilizations are based on charcoal's high stability. There are, however, few reports regarding the chemical degradation of wood charcoal. Many groups have investigated the reactivity of carbon to ozone, especially activated carbon. Most of these papers, however, focus on removal of ozone. Few reports show the degradation of non-activated wood charcoal in the presence of ozone. Quantitative assessment of the stability of wood charcoal is indispensable to count carbon in the charcoal when the charcoal is utilized as the carbon storage. Carbon credit under the Kyoto Protocol or the other Emissions Trading markets would be derived from charcoal by the sufficient estimation of its degradation characteristic and its ability of carbon storage.

In this study, we investigated the effect of ozone on the surface property of carbonized wood, estimated a half-life of wood charcoal by ozone in air and clarified a carbonization temperature to produce wood charcoal appropriate for the carbon storage.

Two kinds of wood charcoal were prepared from sawdust of *Fagus crenata*. The sawdust was heated to 400°C (C-400) and 1000°C (C-1000) in a muffle furnace. As a reference, a commercial activated carbon (AC) and graphite (GR) were used. Various concentrations of ozone were generated by an ozone generator with oxygen gas. The ozone gas was supplied to a separable glass flask in which the samples were settled in a small glass flask. After the ozone exposure treatments, weights of the samples were measured, and the decrease ratios of the sample's weight by ozone exposure were determined. The surface morphology of the samples was investigated by scanning electron microscopy. Carbon, hydrogen and oxygen of the samples were analyzed to clarify the interaction of these elements with ozone. X-ray photoelectron spectroscopy (XPS) was used to analyze the surface chemical structure of the charcoal. The rate constant of the weight decrease was calculated on the basis of hypothesis that the decrease was caused by one order exponentially with the ozone treatment.

The weight of C-1000 and AC was largely decreased by ozone treatment although no decrease of that was observed in C-400 and GR. Change of the surface morphology was observed in the ozone-treated C-1000 and AC. There was no correlation between the weight decrease of the samples and the contents of carbon, hydrogen and oxygen. Stability of the samples against ozone depended on the development of hexagonal carbon layers. The half life of C-1000 by ozone in air was estimated to be 5.1×10^4 years.

The charcoal made by carbonization at a lower temperature has an economic advantage in that it is less costly than the charcoal made at higher temperatures Thus, the charcoal made at lower temperatures is more suitable for carbon sequestration by its utilization as a soil amendment and for forestation and carbonization projects in developing countries as proposed by Okimori et al.

This study will be published from the Japan Wood Research Society in 2004.