Moisture adsorption of wood at temperatures above 100℃

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Recently, wood working such as production of compressed wood, fixation of bent wood, or the dimensional stabilization of boards has been carried out using high temperature steam. In relation to this, we have been studying some physical properties of wood under high temperature steam and found that they were conspicuously different at different moisture contents. However, because it is difficult to measure the moisture content of wood under high temperature steam, we have used the relative humidity in the measuring atmosphere instead. In this paper, we will describe the equilibrium moisture content of wood under steam at relative humidity of 20 to 90% above 100℃, and clarify its effect on some physical properties of wood above 100℃.

The Figure below shows a schematic diagram of the measuring system. A HPLC pump and a Mass flow controller (MFC) are respectively used to control high pressure water and high pressure nitrogen. Water and nitrogen are mixed together in the vaporizer. Then the mixture is applied at an adjusted flow rate to achieve the desired partial steam pressure at a fixed temperature in the vicinity of a sample holder. The pressure of the system is controlled with BPR and the sample weights are measured with a magnetic suspension balance (RUBOTHERM Co.) .

As is shown in the figure, the balance at the top is separated from the sample portion at the bottom and the two parts are connected through magnetic force. This structure enables us to measure the sample weight accurately under high temperature and high pressure steam. The samples used in our experiments were sugi (*Cryptomeria japonica* D.Don) wood.

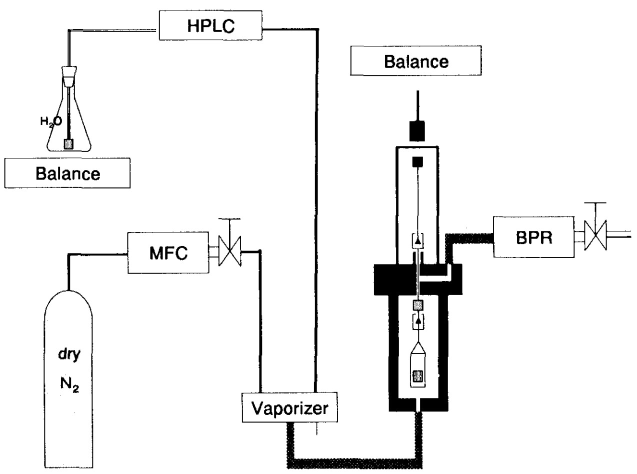

Figure: Schematic diagram of the measuring system

From the measurements above, we observed a linear relationship between the moisture content of the wood and temperature in the temperature range between 40 and 180℃ at a fixed relative humidity of 20 to 90%. From this we could estimate the moisture content at any temperature and at any relative humidity. With increasing temperature, the shape of adsorption isotherm changed from type II to type III in BDDT classification[1]. Adsorption water was separated into hydrated water and dissolved water on the basis of the Hailwood-Horrobin theory[2]. It was found that with increasing temperature the decreasing rate of hydrated water was large compared to that of dissolved water, and at 180□ only dissolved water was observed.

REFERENCES
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[2] A.J. Hailwood, S. Horrobin: Trans. Faraday Soc. **42B**, 84-92 (1949)