Study and Development of Microwave Irradiation Ports for Woody Biomass Pretreatment

**(Graduate School of Engineering,
Laboratory of Applied Radio Engineering for Humanosphere,
RISH, Kyoto University)**

Katsuyuki Yano

Pretreatment process is essential to produce bioethanol efficiency from woody biomass. We have been studying on a pretreatment system by microwave irradiation and have developed continuous-process type microwave pretreatment systems. The objective of the present thesis is development of highly efficient microwave irradiation ports for an effective woody biomass pretreatment.

Relative permittivity characteristics of solvents, which are mixed with the woody biomass, are important to design an efficient microwave irradiation port. The relative permittivity characteristics of water and ethylene glycol (EG) were measured as parameters of frequency and temperature, as shown in Fig.1 and Fig.2, respectively. We utilized the measured data to calculate reflection coefficient and design microwave irradiation ports.

In the continuous-process type microwave pretreatment systems, a glass plate was inserted into a microwave irradiation port in order to prevent microwave oscillator from high pressure. A dielectric cone was inserted on the glass plate in order to make the microwave reflection lower. We expressed the microwave irradiation port as equivalent circuit and we estimated reflection coefficient of the port. The calculation results were compared to 3D electromagnetic simulation results, as shown in Fig.3. The characteristic impedance of the dielectric cone can be expressed as equivalent relative permittivity.

We also developed a simple continuous-process type irradiation system, in which a magnetron is installed directly. The microwave irradiation port was designed as by the 3D electromagnetic simulator. We developed a prototype of the designed port and measured the temperature characteristics of reflection coefficient, when we assumed water as woody biomass mixture. From the measurement results, the reflection coefficient was lower than -9 dB at a frequency of 2.45 GHz when the water temperature was 15 C° to 70 C°. Finally, we succeeded to develop a simple and efficient microwave irradiation port.

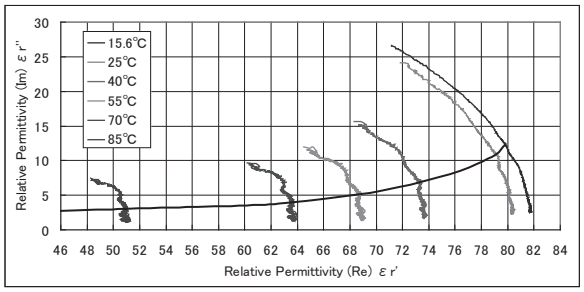

Fig.1 Characteristics of relative permittivity of water for the parameter of temperature.

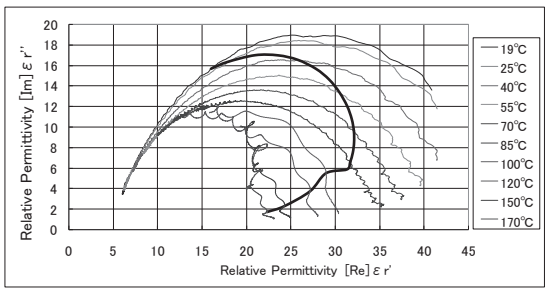

Fig.2 Characteristics of relative permittivity of EG for the parameter of temperature.

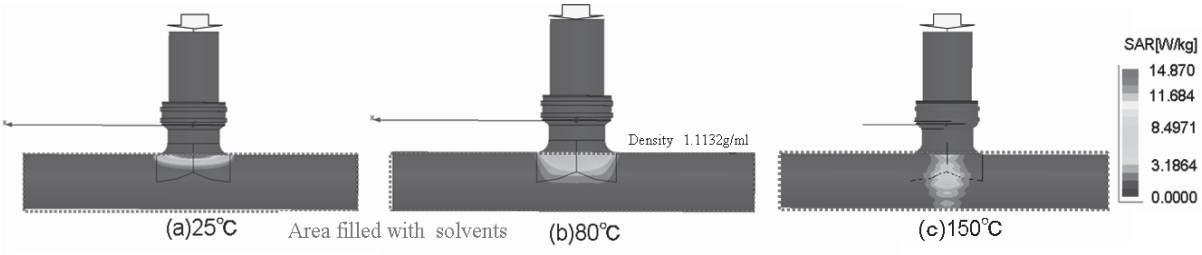

Fig.3 Simulation results of specific absorption rate.