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Numerical Investigation on Feasibility of Electromagnetic Wave as Water Hardness Detection in Water Cooling System Industrial

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Abstract : Numerical and experimental of using novel electromagnetic wave technique to detect water hardness concentration has been presented in this paper. Simulation is powerful and efficient engineering methods which allow for a quick and accurate prediction of various engineering problems. The RF module is used in this research to predict and design electromagnetic wave propagation and resonance effect of a guided wave to detect water hardness concentration in term of frequency domain, eigenfrequency, and mode analysis. A cylindrical cavity resonator is simulated and designed in the electric field of fundamental mode (TM010). With the finite volume method, the three-dimensional governing equations were discretized. Boundary conditions for the simulation were the cavity materials like aluminum, two ports which include transmitting and receiving port, and assumption of vacuum inside the cavity. The design model was success to simulate a fundamental mode and extract S21 transmission signal within 2.1 – 2.8 GHz regions. The signal spectrum under effect of port selection technique and dielectric properties of different water concentration were studied. It is observed that the linear increment of magnitude in frequency domain when concentration increase. The numerical results were validated closely by the experimentally available data. Hence, conclusion for the available COMSOL simulation package is capable of providing acceptable data for microwave research.

Keywords : electromagnetic wave technique, frequency domain, signal spectrum, water hardness concentration
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