Trial of continuous measurement of micro-nano bubbles in water

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Micro-nano-bubbles (MNBs) are tiny bubbles with diameters ranging from tens of nanometers to several tens of micrometers. Owing to their small diameter, MNBs have lower rising velocity and persist for long periods in the liquid phase. MNBs technology is proposed to use for various areas such as groundwater remediation, aquaculture, mass transfer. Although MNB generation methods and applied to problems are attracted, the continuous in-situ measurement technique has not researched well. An easy, continuous, and inexpensive method is desired for more efficiently using MNBs. In previous research, the dielectric constant of MNBs water was different from that of water. Therefore we hypothesized that continuous measurement of dielectric constant could be used to estimate MNBs in the water. The purpose of this study is to investigate the attempt to continuous measurement for MNBs. To measure dielectric constant, we used time domain reflectometry (TDR). A TDR probe (0.15 m long) was used with a cable tester (Model 1502C, Tektronix Inc.) in this study. We also used GS3 sensor (METER Group, Inc.) for water temperature measurement because the dielectric constant and water temperature were measured every 1 min during before and after MNBs generation. We conducted experiments with several MNBs generators. Measured dielectric constant changed before and after MNBs generation. Although estimated dielectric constant from water temperature differed from measured dielectric constant, both agreed about half day. It was suggested that simultaneous measurement of temperature and dielectric constant can estimate the amount of MNB in water.