Water Interacting With Magnetic Fields: Structures, Properties, And Functions

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There are many reports on magnetic field treatment (MT) of water, which may bring about crystal structure change of $CaCO_3$, inhibition of corrosion, changes in water properties. Thus, the MT water has been used to inhibit scale formation in pipes and boilers, promote growth of plants, dye strings, etc, and many kinds of MT devices for tap and industrial water are sold commercially worldwide.

A few papers showed that some properties of pure water changed very slightly when pure water stood in steady, homogeneous magnetic fields, e.g., 0.1 % increase in the refractive index of a pure water at 10 T, 5 mK rise in the melting point of ice at 5T, etc. Also our results, promotion in water adsorption and lower shift of the onset pressure of capillary condensation of water vapor onto cylindrical pores, suggest that the water/solid interaction should be enhanced by steady magnetic fields. These magnetic field effects were attributed to hydrogen bond development. Such conclusion seems to be consistent with the results in magnetic treatment of water, that the hydration layer around ions and colloids in aqueous solutions should be thickened by a magnetic field [1,2].

Our careful experiments using magnetic fields higher than 2 T showed remarkable MT effects on contact angle, decomposition voltage, and Raman and IR bands of pure water and on iron corrosion and calcium carbonate formation [3-6]. The “magnetic field-affecting water” (MFA water), which required dissolved O_2 and the relative motion of water against a magnetic flux, seemed to be accompanied with formation of clathrate-like hydrate of O_2 and promotion of hydrogen bonded networks [4].

We will review our experimental results that MFA water is a real entity. In-situ Raman spectra of MFA water developed during MT and relaxed slowly after stopping MT. The memory effect as well as induction period, which were reported in recrystallization of chlathrate hydrates, were observed in the MFA water showing decreases in both viscosity and contact angle and increase in Raman intensity. Also, the difference Raman spectrum of MFA water was very similar to that of clathrate hydrate or supercooled water. Therefore, it is inferred that MFA water forms a clathrate-like structure comprising water cages surrounding an O_2 molecule activated by varying magnetic fields to quasi-stabilize a MFA state. Corrosion inhibition property as a typical function of MFA water also was examined by using small pieces of iron and copper plates. MFA water depressed significantly their rust formation.

However, it is still an open question why such quasi-stable MFA water is formed by MT.

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