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MOLECULAR MECHANISMS OF MAGNETIC WATER TREATMENT

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ABSTRACT

It has been reported that magnetic and electromagnetic water treatment can inhibit the scaling of metal surfaces or even help in removal of scale deposits from metal surfaces. The mechanisms of magnetic water treatment have been unknown. It was recently found that magnetic and electromagnetic water treatment can perturb gas/liquid interfaces and consequently modify the interactions of water molecules with ions and suspended colloids. Certain magnetic and electromagnetic fields also produce small amounts of free radicals and reactive oxygen and hydrogen species such as ozone, superoxide ion, hydroxyl radicals, hydrogen peroxide or atomic hydrogen. Such species are either oxidants or antioxidants. In this work we explain on a molecular level how perturbations of water structure influence the reactivity of water towards ions and colloids involved in scale formation. The observed results suggest that magnetic and electromagnetic water treatments modify the chemical reactivity of water and the solubility of suspended colloids. Another possible explanation that magnetic water treatment results in very thick hydration layers at the interface does not seem likely.

1. Introduction

For many decades, magnetic and electromagnetic fields have been used to inhibit scaling of metal surfaces and to help in descaling cooling towers and boilers. The molecular mechanisms of action of such devices were unknown and quite controversial. The fact that magnetic and electromagnetic fields indeed influence the behavior of water, aqueous solutions and colloidal suspensions has been well documented in the last ten years. [1,2]. The review papers of Judd and Baker [1] and Colic and Morse [2] described the progress in that area. However, the mechanisms of the "magnetic memory of water" effects were still a mystery and indeed a very controversial issue. It was shown through industrial observations as well as through the laboratory results reported in at least 30 publications referenced in refs. 1 and 2, that the "magnetic memory of water" is indeed a real and reproducible phenomenon. It is common knowledge among physical chemists that the relaxation phenomena in water occur on femtosecond to second timescale. This discrepancy motivated our group to design models for such long term effects of magnetic and electromagnetic water treatment. [3]

The most common components of scale deposits in California are calcium carbonate and silica. Most magnetic treatment devices are installed in cooling towers where the metal used is zinc (galvanized iron). Therefore, we studied the effects of magnetic and electromagnetic fields on calcium carbonate precipitation and silica deposition, removal and dissolution to/from zinc surface.