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Effect of Magnetic Field on the Physical Properties of Water

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Changes in physical properties of water on being subjected to a magnetic field are reported. The properties invesigated are surface tension, pH, and dielectric constant. The changes brought about by a magnetic field are permanent. The pH of neutral water is found to increase when water is allowed to flow in a magnetic field.

A method for the prevention of boiler scales and corrosion has been reported.[1-4] This consists of passing ordinary water between the poles of permanent magnets before being fed to the boiler The strength of the magnetic field employed is not very high. It is reported that the boiler deposit[5-7] does not adhere to the walls and the mud remains suspended in the water. Corrosion of the iron has also been shown to be affected and claims have been made regarding the removal of corroded iron surface by such treated water leaving uncorroded metal exposed to this water for a long time without corrosion taking place. It was therefore thought useful to study this phenomenon of the change brought about by magnetic field on the properties of water from purely physico-chemical aspect.

EXPERIMENTAL

The experimental procedure for the magnetisation of water was simply to pass water through a pyrex tube of 12 mm diameter between the poles of two ferrite magnets, kept as close as possible, the direction of magnetic field being transverse to the flow of water. Later, in this work an electromagnet was utilised for studying the effect of field strength on the properties of treated water. pH measurements were made on an "Elico pH meter" with Beckman glass electrode, type 41262.

Water was distilled in all-pyrex glass system. Triple-distilled water with a specific conductance of 0.85×10^{-6} ohms^{-1} cm^{-1}, thus obtained was used.

It was observed that the pH of water changed when it was allowed to flow in the magnetic field. Table I shows the dependence of ΔpH on the rate of flow.

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TABLE I

Flow rate (ml/min)	..	50.00	1.40	0.25
ΔpH	..	+0.36	+0.36	+0.40

In all the experiments, identical measurements were made with water without subjecting it to magnetic field. The change in the property examined is reported with reference to this untreated water.

Table II records the effects of repeating the flow cycles, the rate of flow being 0.25 ml/min.

TABLE II

Original pH	pH after 1st cycle	pH after 2nd cycle	pH after 3rd cycle
6.82	7.22	7.22	7.22

Thus it is clear there is no change with repeated cycle.

Our experiments to find out whether such treated water will gradually get back to the original pH showed that even after ten days there was no change in the pH. The 'magnetised' water was heated to boiling, cooled and pH measured. Pure water was similarly treated and its pH was measured after cooling under identical condition. The difference in pH of the two types of water was the same as observed previously having a value of 0.4. The same experiment was performed by freezing the water and remelting. The value of Δ pH remained unaltered.

Experiments done with water at 30°, 45°, 60°. provided value of Δ pH of 0.40, 0.45, 0.47 respectively showing a slight temperature dependence.

The dependence of Δ pH on the pH is shown graphically in Fig. 1. The water used being in equilibrium with atmospheric carbon dioxide has a pH of 6.82. It is interesting to note that the effect is dependent on the pH, being maximum at the neutral pH value; sign of Δ pH changing on either side of neutral pH.

Table III summarises the effect of magnetic field on the values of Δ pH, $\Delta\gamma$, (γ=surface tension), and $\Delta\epsilon$ (ϵ = dielectric constant).

TABLE III

Temp.—30°

Field strength	ΔpH	$\Delta\gamma$ (dynes cm^{-1})	$\Delta\epsilon$
1900 gauss	0.35	1.6	1.5
3500	0.44	3.7	1.4
4800	0.62	4.7	1.4
5700	0.62	5.3	1.4

The Δ pH value shows a saturation trend with field strength, but the decrease in surface tension shows a linear rise in the beginning, tending towards saturation at high field strength. There is an increase in the dielectric constant which is not appreciably affected by higher field strength.

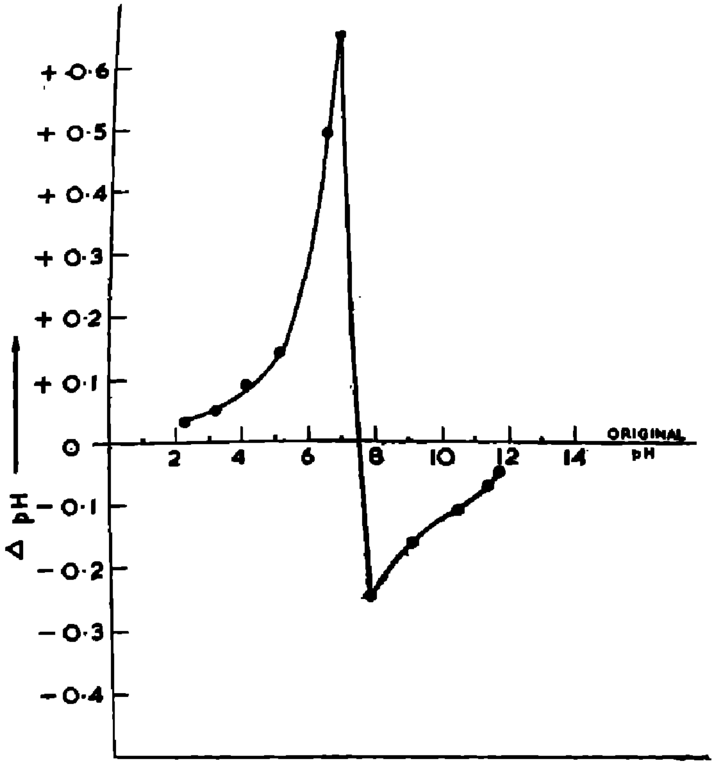

FIG. 1

DISCUSSION

The results presented above show that a permanent change in the physical properties of water is brought about by 'magnetisation'. Neutral water is seen to become more alkaline by this treatment. A possible reason for this may be the change in the ionisation constant of water under the influence of magnetic field resulting in decrease in the concentration of H_3O^+ ions. Though the reason for this observed effect at this stage can be only speculative, the explanation given by Friedel[4] that the electrostatic and dynamic angle of the ions is altered seems to be far fetched. If it were so, the effect could not be a permanent one. The change in $[H_3^+O]$ concentration brought about by change in the ionisation constant of water seems to be a more plausible hypothesis since the change to 'normal' water could be slow process.

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