# ELF and stationary magnetic fields resonance influence on water electrical conductivity


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## Abstract


Influence of weal ELF magnetic fields on water in conductometric sensors was investigated. Studied frequencies were in the band 1-50Hz, alternative magnetic field inductance 0-2mT constant magnetic field inductance 0.07-3.5mT. Strong changes of water parameters at the frequencies 6.5Hz, 7.5Hz and less variations at the 12-14Hz were observed.


## 1. Introducrion

The influence of weak ELF magnetic field on water is an unusual phenomenon. Since the field energy is much less than hydrogen bond in water as well as natural environmental thermal energy. Up to date the acknowledged theory of this phenomenon does not exist and besides numerous experimental treatments were carried out in conditions which were not consistent with theory models [1,2] and so in our research (see also [3]) the changes of water electric conductivity parameters due to action of a weak ELF magnetic fields ($f \leq 50$Hz), weak consistent magnetic fields and their combined action were investigated.

## 2. The experimental techniques and measuring methods

The study of magnetic fields action has been carried out by two water conductometric sensors, which include 1ml of distillated water dielectric cells, two stainless steel or platinum electrodes and thermistor. The sensors are located inside an Al screen. One of the sensors has been under magnetic field action (near magnetic coils) and the second one (control sensors) has been located at 1.5-2 meters distance from magnetic coils. Magnetic system consists of two pairs of Helmholtz coils, which are located at small distance from each other. One pair coils forms a constant magnetic field of the inductance 0-3.5mT and other pair coils forms an alternative magnetic field of 0-6.6mT inductance. The vector of the electric field strength in sensors was perpendicular to the vector of magnetic fields inductance. The distillated water with $(3\text{-}5)*10^{-6}\ \Omega^{-1}*cm^{-1}$ specific conductivity has been used in experiments. The measuring method (procedure) includes the following steps:

- 1ml of distillated water is filled in sensors;
- The electric nichrom heaters are located on each sensor. The heater can heat the water in sensors by (2-3)ºC in 3 minutes. The electric conductivity is measured in heating period regularly;
- Water in sensors is cooled down to environmental temperature after previous heating;
- After cooling one of the two water sensors was put in magnetic field for 20 minutes. This period was determined by our experience [3]. The water parameters are changed to considerable extent in their period and after it water parameters had the small changes;
- After magnetic field action sensors water has been heated once again and specific conductivity vs temperature have been measured too.

The magnetic field influence on water has been estimated by both the water specific conductivity (s) and thermal coefficient of the water specific conductivity (k). If the water is heated by (2-3) ºC “s”, vs temperature can be approximated by linear function. “k” is determined by an angle between conductivity line and abscises axis. “k” is one of main parameters, which has been used for influence of magnetic field estimation , because it is more sensitive to magnetic field, than “s” parameter. The second one is specific conductivity value, which is determined before the beginning of water heating. Relative changes of these two parameters with taking into account their changes in the control sensor in the experimental time determine an magnetic field influence. k is more sensitive and stable parameter for estimation of water structure change under magnetic field action in comparison with s parameter.

Different factors such as small impurities which appear in sensors during experimental time due to solution of different gases and electrodes in water influence on “k” parameter less than on s parameter.

## 3. Experimental results

The ratio of the $k_2/k_1$ vs magnetic field frequency is shown in fig.1, where “$k_1$” – specific conductivity thermal coefficient in control sensor cell and “$k_2$” – specific conductivity thermal coefficient in sensor under magnetic field action. The results in fig.1 were received for inductance of the geomagnetic field only.

In time of experiments the thermal coefficient of specific conductivity without artificial magnetic field has been measured periodically. As a result 2-4% natural fluctuations of conductivity were determined and these fluctuations were chosen as noise level.

The fig.1 shows that strong decrease of “k” produced by the magnetic field is observed for 6.5Hz, 7.5Hz and 12-14Hz frequencies and smaller variations s and k are for other frequencies of research band. The specific electric conductivity “s” changes less in value than “k” (fig.2) and besides s increases for 6.5Hz and 7.5Hz where “k” decreases. Thus “k” is more sensitive to magnetic field in comparison with “s”.

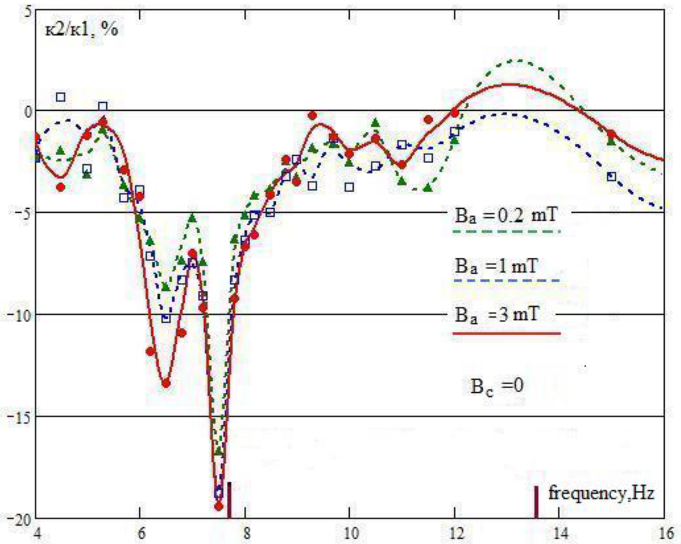


Fig.1

Some of theoretical models [1,2] demand the combined action both alternative and constant magnetic fields for water parameters changes. In our experiments the geomagnetic field (0.041mT) has been continually and its vector has coincided with inductance vector of magnetic coils. To estimate weak constant magnetic field action on water an experiments with applied artificial constant magnetic field have been carried out. Inductance of experimental magnetic field has varied from 0.07mT to 3mT. The fig.3 illustrates the constant magnetic field influence at “k” water parameter for 1mT alternative field inductance.

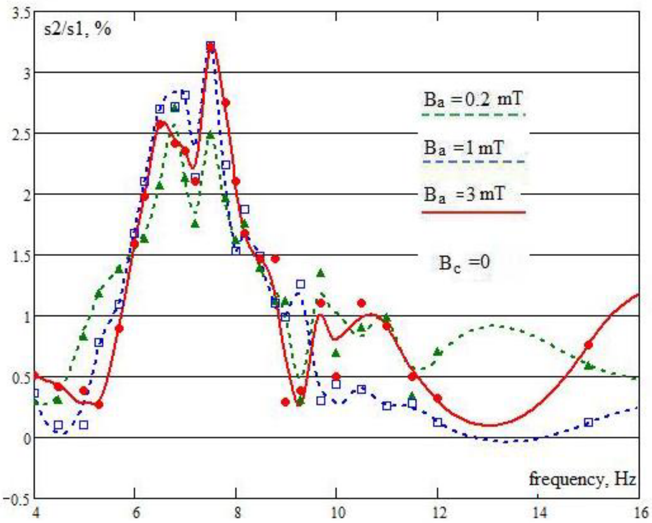


Fig. 2

Strong decrease (about 15%) of the specific conductivity thermal coefficient “k” for 7.5Hz frequency and for geomagnetic field action only disappears when the 0.3mT additional artificial constant field $B_0$ is switched on. “k” value for 6.5Hz magnetic field with inductance $B_0$ more than 0.1mT and for the same experimental conditions has been increased instead of decrease for $B_0 < 0.1$mT. However “k” maximum value position for 6.5Hz and all experimental parameters were not changed.

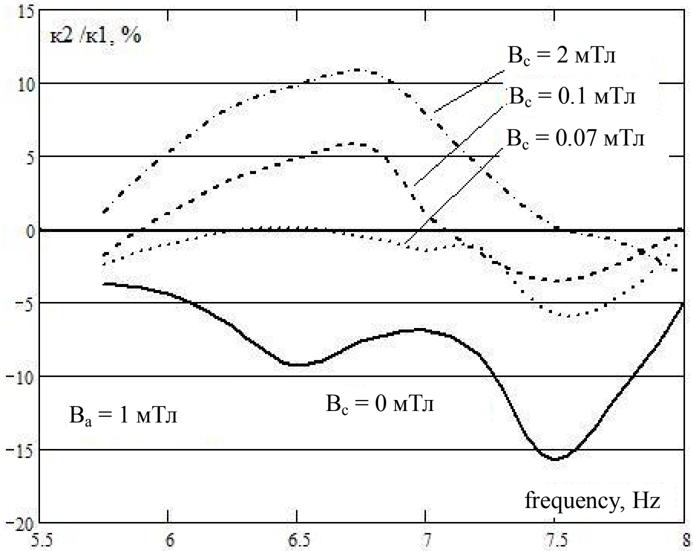


Fig.3

## 4. Discussion

Unfortunately we could not investigate and determine physical nature of research effects, i.e. mechanisms of magnetic field actions on water parameters. For the time being we cannot explain how changes of water structure and density or mobility of charge water components as well as how double near electrodes charge layers are modified or what are impurities roles and so on, however it is possible to draw physical parallels between our results and geophysical phenomena.

Theoretical predictions and experimental data of ref.[1,2] where combined action of alternative and constant magnetic fields leads to multimodal dependencies of biological effects in magnetic field function were not confirmed in our studies. This is confirmed two curves the temperature coefficients specific conductivity for 6.5Hz and 7.5Hz frequencies and 1mT inductance if alternative field ($B_a$) vs constant magnetic field inductance ($B_c$) are shown in the fig.4. Theoretical equations in ref.[1,2] for biological effects include Bessel’s functions in which have the ratio of $B_a/B_c$ as a part of the argument and feature of these functions is the reason of theoretical multimodality. However the theoretical prediction are given for biological object, but not for pure water/ So it is necessary to study reasons stated differences and to determine the role of water radiated by magnetic fields in biological objects.

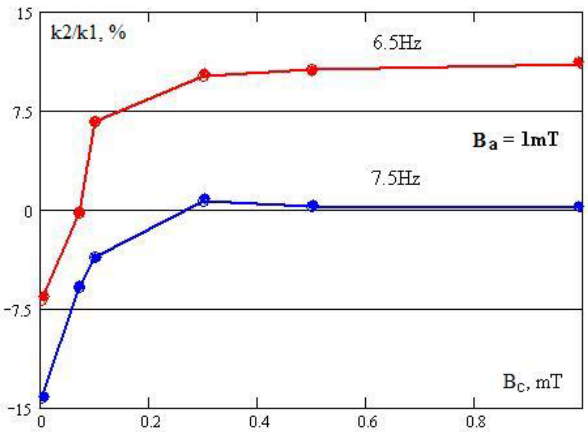


Fig.4

The coincidence of frequencies in experimental results with frequencies of Earth-ionosphere cavity modes (Schuman's resonances) is qwite noticeable.

The main frequencies of the first Schuman's mode are at 7-8 Hz and the second one – 13-15Hz [4]. The are any fluctuation of "k" parameter are in other frequencies of the 4-50Hz band, when are another Schuman's mode. However it is necessary to carry out more precise researches to find another frequency peculiarities.

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