LIFETIME OF FREEZING - ACTIVATED WATER

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Abstract. *Special properties of the "activated" water have been reported in numerous papers. Water activation can be achieved either through applying electromagnetic field, through consequential freezing-melting of the water or using some other methods. Freezing-melting activation is the simplest yet still effective method of activation. Activated water ensures better growing of some plants and can be helpful in order to prevent negative effects of unsatisfactory environment conditions.*
On the other hand, mention should be made that the activation effect is limited by some time frames, which depend on many factors. Activated water can lose its special properties during quite short period of time and then it turns into regular water, which does not reveal any special characteristics.
This work reports the results of investigation of the activated water lifetime, which has been determined through measurements of the activated water electroconductivity in comparison to conductivity of the regular one. This method assumes that some nano-sized clusters can keep the ice crystal structure in the freshly melted state for some period of time, which should influence electro conductivity of the melted water.
The approximated lifetime of the activated water was found equal to about 3,5 hours at the temperature of 18^0C, 2 hours – at 23 ^{0}C and immeasurably short at 28 ^{0}C. This result proves that any special properties of the activated water can be expected only within rather very short time after melting. Then the activated water loses its special features and turns into regular one.

Keywords*:* *ice nano-associates; melted water; electro conductivity measurements*

Introduction

There are many publications reporting specific properties of water after so-called "activation" [1-3]. This water exhibits anomalous electro conductivity, different viscosity value and other specific differences. There is reference on the weak but still detectable sound generation, which occurs in the process of water activation [4]. Activated water also exhibits special biological activity. There are references reporting its stimulating effect on the growth of some agricultural cultures, antimicrobial activity and others [5-7].
Specific properties and action of the activated water is caused by its specific composition and structure. It is considered that this water can have nano-sized structures, which bond together some amount of the water molecules and form relatively strictly associated structural components. These components can save the structure of solid ice and represent the elements of the ice preserved in liquid water.
There are many available methods of water activation: freezing-melting, electrochemical activation, activation by ultrasound and others [6, 8, 9]. The freezing-melting method is the simplest one but the most effective is the water activation method. The application of the melted water ensured better growth of some plants and faster rehabilitation of the injured animal tissues. There are also some reports on the wholesome effect of the melted water in the human organism [6, 7].

However, there is also a question of duration of the above mentioned effects. The ice-like complexes existing in water can not stay forever and should have some life time. Since they cause specific properties of the activated water, destruction of the complexes should result in transformation of the activated water into a normal liquid and gradual disappearance of its specific properties.

The aim of this work was to investigate the life time of ice-like complexes formed in melted water and to estimate possible duration of its specific properties [10]. The presence of these complexes should influence the water electroconductivity. In other words, detection of the anomalous electroconductivity would indicate presence of the nanocomplexes and gradual return back to the normal conductivity would indicate decomposition of the complexes and transformation of the activated water into normal one. The complexes should change electroconductivity of the water since the well known Grotgus mechanism of electrons or ions movement in water assumes some gain in the distance covered by the travelling charged particle because of its “jumps” between molecules (relay-race ions movement). The larger the size of a particle is or the complex charge is jumping between, the higher the distance gain is and, consequently t the changes in electroconductivity. Thus, the conductivity of melted water should be higher than the conductivity of the regular one. Therefore, by studying temporal changes in water electroconductivity we can determine the life time of ice-like complexes existing in the freezing-meeting activated water.

Experimental results and discussion

A regular alternating current electroconductivity measurer R-5066 together with a temperature-controlled cell has been used for the conductivity measurements. The device measured the electric resistance of water, which has been transformed into specific conductivity using the formula

$$\kappa = \frac{1}{R}, \qquad (1)$$

where R is the electric resistance (Ohm) and κ is the specific electroconductivity (Si).

Table 1

Measured values of electric resistance and calculation of electroconductivity for melted and regular water samples

Sample	Electric resistance (Melted water), Ohm	Electroconductivity (Melted water), Si	Electric resistance (Regular water), Ohm	Electroconductivity (Regular water), Si
1	$4.35 \cdot 10^{4}$	$2.30 \cdot 10^{-5}$	$1.34 \cdot 10^{5}$	$7.46 \cdot 10^{-6}$
2	$4.31 \cdot 10^{4}$	$2.32 \cdot 10^{-5}$	$1.32 \cdot 10^{5}$	$7.58 \cdot 10^{-6}$
3	$4.28 \cdot 10^{4}$	$2.34 \cdot 10^{-5}$	$1.28 \cdot 10^{5}$	$7.81 \cdot 10^{-6}$
4	$4.43 \cdot 10^{4}$	$2.26 \cdot 10^{-5}$	$1.23 \cdot 10^{5}$	$8.13 \cdot 10^{-6}$
5	$4.21 \cdot 10^{4}$	$2.38 \cdot 10^{-5}$	$1.25 \cdot 10^{5}$	$8.00 \cdot 10^{-6}$
6	$1.49 \cdot 10^{4}$	$6.71 \cdot 10^{-5}$	$1.43 \cdot 10^{5}$	$6.99 \cdot 10^{-6}$
7	$1.87 \cdot 10^{4}$	$5.35 \cdot 10^{-5}$	$1.37 \cdot 10^{5}$	$7.30 \cdot 10^{-6}$
8	$1.81 \cdot 10^{4}$	$5.52 \cdot 10^{-5}$	$1.33 \cdot 10^{5}$	$7.52 \cdot 10^{-6}$
9	$1.79 \cdot 10^{4}$	$5.59 \cdot 10^{-5}$	$1.52 \cdot 10^{5}$	$6.58 \cdot 10^{-6}$
10	$1.95 \cdot 10^{4}$	$5.13 \cdot 10^{-5}$	$1.72 \cdot 10^{5}$	$5.81 \cdot 10^{-6}$
11	$1.89 \cdot 10^{4}$	$5.29 \cdot 10^{-5}$	$1.68 \cdot 10^{5}$	$5.95 \cdot 10^{-6}$
12	$2.65 \cdot 10^{4}$	$3.77 \cdot 10^{-5}$	$1.68 \cdot 10^{5}$	$5.95 \cdot 10^{-6}$

13	$3.66 \cdot 10^4$	$2.73 \cdot 10^{-5}$	$1.49 \cdot 10^5$	$6.71 \cdot 10^{-6}$
14	$3.48 \cdot 10^4$	$2.87 \cdot 10^{-5}$	$1.51 \cdot 10^5$	$6.62 \cdot 10^{-6}$
15	$4.44 \cdot 10^4$	$2.25 \cdot 10^{-5}$	$1.54 \cdot 10^5$	$6.49 \cdot 10^{-6}$
Averaged	$\mathbf{3.11 \cdot 10^4}$	$\mathbf{3.79 \cdot 10^{-5}}$	$\mathbf{1.45 \cdot 10^5}$	$\mathbf{6.99 \cdot 10^{-6}}$
Average deviation	$1.11 \cdot 10^4$	$1.45 \cdot 10^{-5}$	$1.36 \cdot 10^4$	$6.45 \cdot 10^{-7}$

Freshly distilled water and the same cell were used throughout all experiments. Some part of the water has been frozen and another part left liquid. Then some pieces of ice were spilled off, melted, placed into a thermo controlled cell until the temperature stabilized and then the electroconductivity values have been measured. Similar procedure has been applied to determine the electroconductivity of the regular water sample. All the experiments have been carried out at 18 ^{0}C.

Table 1 shows the results of a series of electroconductivity measurements.

The data in Table 1 clearly outlines that electroconductivity of the melted water was about 5 times higher as compared to the value of the regular one.

It is needful to emphasize that there are several processes, which contribute to electroconductivity of water.

The first one is the dissociation of water:

$$2H_2O \leftrightarrow H_3O^+ + OH^-, \ (2)$$

which takes place even in distilled water and results in the formation of some amount of hydroxonium and hydroxide ions. They can travel between the water molecules according to the relay-race mechanism and contribute to the total conductivity.

The second one is the presence of some dissolved admixtures, for example carbon dioxide, which can form dissociable molecules. This compound can be absorbed from the air and also contribute to total conductivity:

$$2H_2O + 2CO_2 \leftrightarrow 3H^+ + HCO_3^- + CO_3^{2-} \ (3)$$

The dissolution of air oxygen also can influence total electroconductivity.

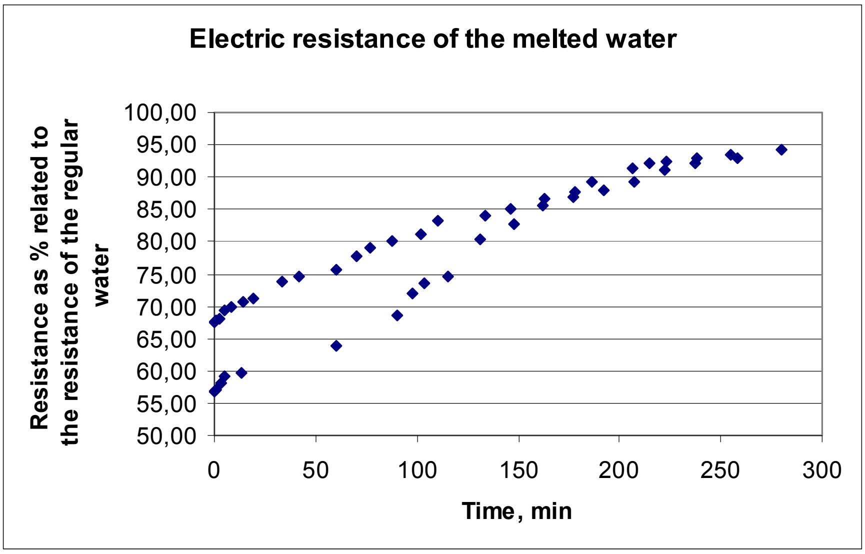

Figure 1. Temporal changes in electric resistance of the melted water as against the regular water resistance at the temperature 18 ^{0}C.

The concentration of the above mentioned compounds in freshly distilled water is very low, almost negligible but it gradually increases as water takes contact with air. Different water examples had different contacting time and this is the reason for some scattering in the values of electroconductivity from Table 1. On the other hand, both examples, frozen-melted and regular one had similar contacting time for every experimental series, which ensured similar concentration of the dissolved compounds. Therefore, only various conditions for the relay-race charges transfer can explain the difference in frozen-melted and regular electroconductivity values.

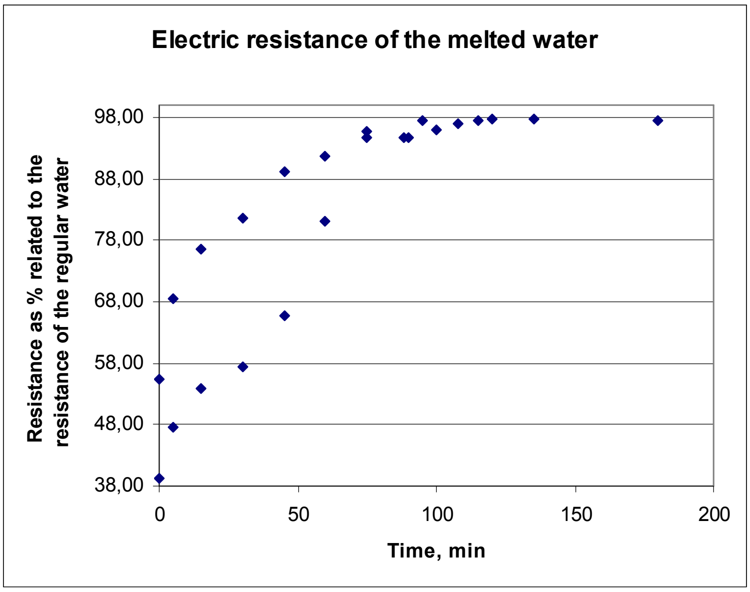

Figure 2. The same as in Figure 1 but at the temperature 23 ^{0}C

Figures 1 and 2 prove that the resistance of melted water is increasing with time and becomes almost equal to the resistance of the regular one in about 3.5 hours at 18 ^{0}C and in about 1.5-2 hours at 23 ^{0}C. The electric resistance of melted water has become practically equal to the resistance of the regular one during the time of thermostabilization of the sample at 28 ^{0}C (~ 15-20 min). That is why data for 28 ^{0}C are not graphically presented here.

The above data can be another confirmation for the assumption of influence of ice-like nano-clusters presence in the melted water on its resistance (or electroconductivity). The higher the temperature is, the faster these clusters are being decomposed because of the Brownian movement, which brings the resistance back to the level of regular water.

Taking into account the very fast decomposition of ice-like clusters at 28 ^{0}C we can suppose that at higher temperatures such structures do not survive at all and decompose just after the melting process.

Conclusions

The electroconductivity of melted water samples significantly differs from the values of those ones which have not been frozen and melted. Taking into account the Grotgus model of relay-race charges movement in water these results can be explained by remainders of solid ice-like associated with structural clusters, which can be found even in liquid water some time after its melting.

Gradual decrease in electroconductivity values of the melted and regular water in the course of time occurred after melting. The higher the water temperature is, the faster these values equalize. This fact indicates the role of the Brownian thermal movement of molecules, which destabilizes and destroys the ice-like clusters.

Therefore, there are quite distinct lifetime frames for the activated water, which can be used to recover biological objects after ecological stresses. Activated water loses almost all special ice-like clusters within 3.5 hours at the temperature of 18 ^{0}C and within 1.5-2 hours at 23 ^{0}C. Higher temperature leads to a very fast deactivation of the melted water, which transforms into a regular liquid.

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