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Research of Physical Alterations in Water Treated with Evodrop Turbine Technology

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Abstract

Experiments with Evodrop turbine treated water show alterations in its structuring in terms of a lower number of clusters and increased average number of molecules per cluster compared to control water, also corresponding to increased average energy of hydrogen bonds. Local maxima in the distribution of numbers of molecules with respect to energy were observed at -0.1112, - 0.1212 and-0.1387 eV. The biggest stable clusters were observed at hydrogen bonds energy equal to

- 0.1387 eV. They were modeled with dodecahedral structures consisting of 20 water molecules having a diameter of circumscribed spheres equal to 0,822 nm. Obtained values of pH and ORP showed closer similarity of Evodrop turbine water to neutral Catholyte in comparison with tap water.

Keywords: Evodrop turbine water, NES, DNES, number of water molecules, hydrogen bonds, clusters

1. Introduction

EVODROP water treatment technologies have been invented by Fabio Huether. It is based on ultra-nano membrane water filtration, turbine rotation treatment and electrochemical activation. Corresponding patents were filed with the Swiss Patent Office (IGE) on 04.03.2019 [1]. In addition, his partner Eng. Markus Wantscha and his PhD Advisory Board work on new methods and promote continuous improvement of these three different innovations. Our previous research has shown significant and favorable changes in water treated with EVODROP electrochemical activation [2]. The present work was dedicated to investigation of physical changes in water treated with Evodrop turbine Technology.

2. Materials and Methods

2.1. Evodrop turbine water purifier

The proprietary operating principle and developed geometry of Evodrop turbine (Fig. 1) allow for highly efficient treatment. Incoming water passes through rotating turbine, driving them with its pressure, whereby it passes through the device rotating at approx. 2,000 rpm. Specific outcomes of such treatment are based with and magnetohydrodynamic forces [3].

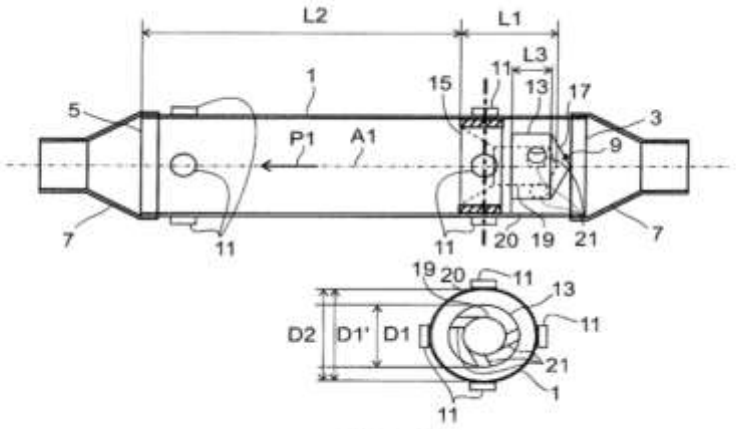

Fig. 1. Evodrop turbine operation principle

A water purifier comprising a nozzle (9) in a jacket tube (1). At least one inlet bore (21) connects an inlet-side section of the jacket tube (1) to a turbulence chamber (19) which is open in the direction toward an outlet-side section of the jacket tube (1). A water stream is deflected and swirled in the turbulence chamber (19) when flowing through the inlet bore (21). Subsequently, the rotating water stream passes the magnetic field of at least one magnet (11).

2.2. NES and DNES Spectral Analysis

NES and DNES spectral analysis was performed with an optical device invented by Antonov [4, 5]. Evaporation of water drops took place on a mylar foil pad supported by a glass plate in a hermetic chamber.

Its characteristics were:
1. Monochromatic light with wavelength $\lambda = 580\pm7$ nm (yellow color in the visible spectrum);
2. Angle of evaporation of water drops: from 72.3^0 to 0^0;
3. Temperature range: (+22–24 ^{0}C);
4. Energy range of hydrogen bonds between water molecules: E=-0.08– -0.1387 eV (corresponding to $\lambda = 8.9–13.8$ μm of electromagnetic radiation).

2.3. Parameters of NES and DNES water spectra

The energy ($E_{H...O}$) of hydrogen O...H-bonds between H_2O molecules in water samples was measured in eV. The function f(E) is called *energy distribution spectrum*. It was determined with the non-equilibrium process of water droplets evaporation. That is why the method is called Non-equilibrium energy spectrum (NES)[4, 5].
Figure 2 shows the schematics of the method for measurement of wetting angle of liquid drops on a hard surface.

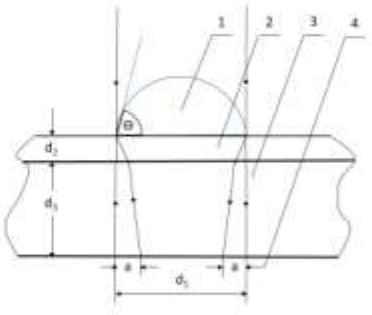

Fig. 2. Operation principle of the method for measurement of wetting angle of liquid drops on a hard surface: 1-drop, 2 – thin maylar foil, 3 –glass plate, 4 – refraction ring width (a). The wetting angle θ is a function of a and d3

The relation between f(θ) and the energy of hydrogen bonds between water molecules is expressed as:

$$f(E) = \frac{14{,}33 f(\theta)}{[1-(1+bE)^2]^2} \quad (1)$$

where E is the energy measured in electron volts (eV) and the dimension of f(E) is eV^{-1}.

In addition, the difference:

$$\Delta f(E) = f(sample) - f(control) \quad (2)$$

is called Differential non-equilibrium energy spectrum (DNES) [4,5]. DNES is a measure of modification of water structure as a result of a certain varied experimental factor. The overall effect of all other uncontrolled factors is the same for the control and the sample.
The dimension of DNES is eV^{-1}.

2.4. Electrical Measurements

A HANNA Instruments HI221 meter equipped with Sensorex sensors was used for the measurement of Oxidation Reduction Potential (ORP) and pH.
The range of HANNA Instruments HI221 meter is: pH - (2.00-16.00 ±0.01)
And ORP (±699.9±0.01 – ±2000±0.1) mV

3. Results and Discussion

3.1. Parameters of water molecules and hydrogen bonds

The water molecule has a size of 0.27 nm. Hydrogen bond length is 1.5-2.6 Å or 0.24-0.26 nm [6]. The covalent bond length is 0.096 nm. Hydrogen bond strength between two water molecules is 5-6 kcal/mol or 0.22-0.26 eV [7].
In spectral analyses using NES and DNES methods the range of research is (-0.0912)-(-0.1387) eV. For energy among the electromagnetic hydrogen bonds of (-0.0912) eV evaporates the top layer of water drops. For energy among the electromagnetic hydrogen bonds of (-0.1387) eV evaporate the last water molecules [8].

We adopt Saykally's model according to which the total number of available hydrogen bonds is maximum for 100 water molecules (Fig. 3) [9, 10].

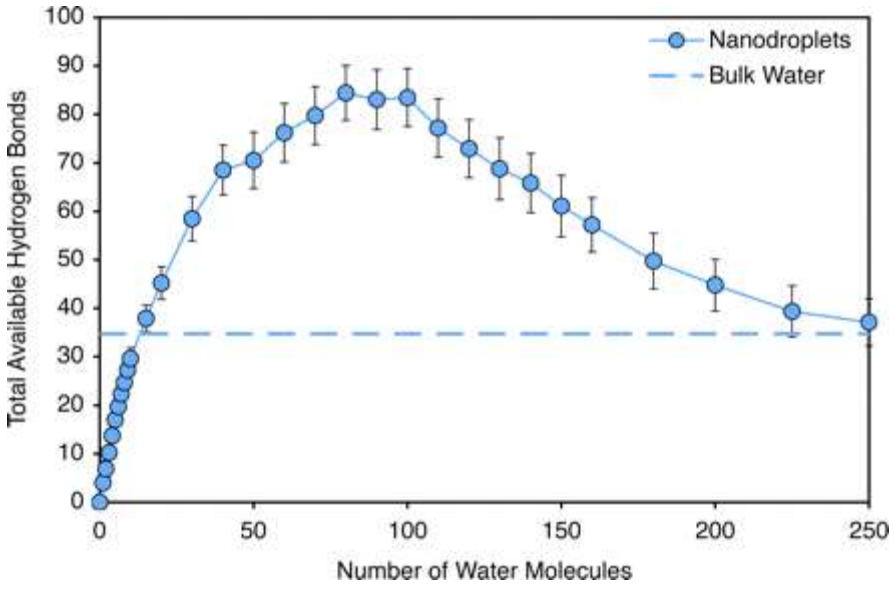

Fig. 3. Saykally's model of total available hydrogen bond numbers

Table 1 and Fig. 4 show the distribution of numbers of water molecules according to the energy of hydrogen bonds per each 100 water molecules in the bulk volume of Evodrop turbine and control water.

Table 1: Distribution of numbers of water molecules according to the energy of hydrogen bonds per each 100 water molecules in the bulk volume of Evodrop turbine water

-E[eV]	Evodrop turbine Water	Control Water	-E [eV]	Evodrop turbine Water	Control Water
0.0912	0	8	0.1162	0	0
0.0937	0	0	0.1187	3	8
0.0962	5	8	0.1212	15	4
0.0987	4	0	0.1237	0	5
0.1012	0	8	0.1262	0	0
0.1037	0	6	0.1287	10	8
0.1062	10	8	0.1312	3	4
0.1087	0	8	0.1337	10	5
0.1112	12	0	0.1362	10	8
0.1137	0	5	0.1387	18	7

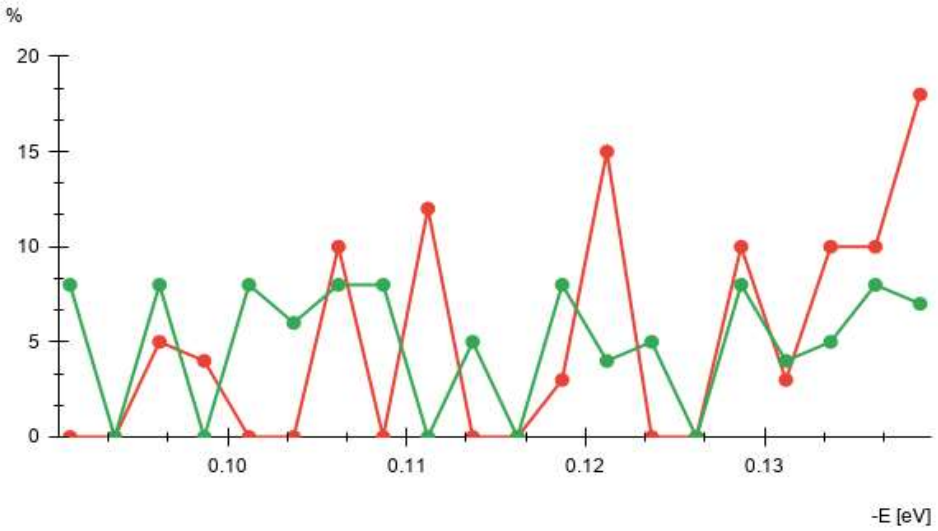

Figure 4. Graphic representation of the numbers of water molecules at different measured values of hydrogen bonds energy per each 100 water molecules in the bulk volume of Evodrop turbine (red line) and control water (green line)

These distributions are basically connected with spatial arrangement of H_2O molecules with equal energies of hydrogen bonds. This is a useful mathematical model for explaining the behavior of Evodrop turbine water, also describing structuring of H_2O molecules in clusters [11, 12].
In particular, at hydrogen bonds energy E=-0.1387 eV in Evodrop turbine water, we have estimated that the biggest stable clusters can consist of 18 water molecules. Their hydrogen bonds are measured last during evaporation of water according to the wetting angle. Such preliminary considerations lead to a realistic model of stable clusters with 20 water molecules arranged in dodecahedral structures shown in Fig. 5. Their size can be estimated using the diameter of circumscribed spheres, provided that nuclei of oxygen atoms are located at dodecahedron vertices [13,14].

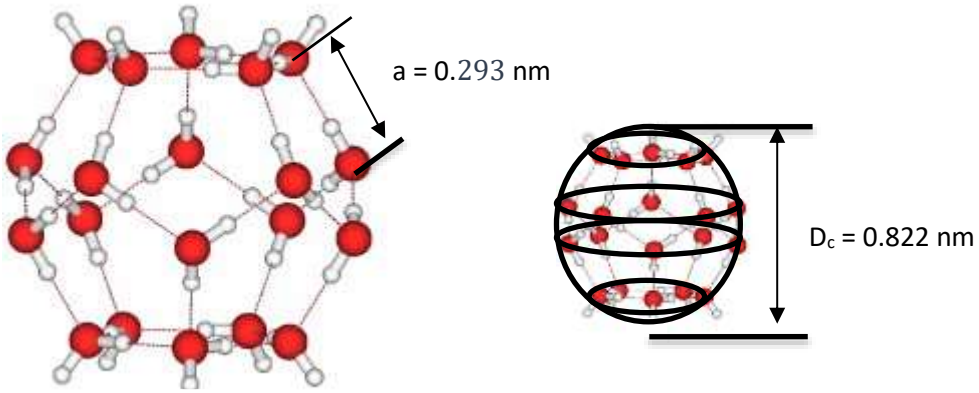

Fig. 5. Dodecahedral cluster structure with 20 water molecules and the diameter of its circumscribed sphere

Observed local maxima at -0.1112, - 0.1212 and -0.1387 eV are in line with previous results published by Antonov, Ignatov and al. [4, 5, 11, 12]. According to Antonov and Galabova, -0.1112 eV hydrogen bonds energy is related to stimulating effects on the nerve system and nerve conductivity with calcium ions [3, 4]. In addition, according to Ignatov, -0.1212 eV is related to anti-inflammatory effects [15] and Antonov has shown that -0.1387 eV is related to inhibition of tumor cells development on molecular level [3]. That is why, similar favorable health effects could be expected from Evodrop turbine water.

3.2. pH and ORP measurements, Number of clusters, Average Number of Molecules per Cluster and Average energy of Hydrogen Bonds

Measured values of pH and ORP [16, 17] as well as derived values of cluster numbers and average energy of hydrogen bonds for Evodrop turbine and control water are shown in Table 2.

Average energy <-E> of hydrogen bonds was calculated as [14]:

$$< -\mathrm{E} >= \sum_{i=1}^{n} \boldsymbol{n_i E_i}$$

where n is the total number of molecules according to the adopted model, k is the number of clusters, n_i is the number of molecules in the i-th cluster, and E_i is the energy of hydrogen bonds corresponding to the i-th cluster.

Table 2. Values of pH, ORP, number of clusters per 100 molecules and average energy of hydrogen bonds for Evodrop turbine and control water.

Parameter	Evodrop turbine	Control	Difference
pH	6.54	7.78	- 1.24
ORP [mV]	80	320	-240
Number of clusters per each 100 water molecules	10	14	-4
Average number of molecules per cluster	10	7	3
Average energy <E> [eV]	-0.1219	-0.1123	-0.0096

Decreased pH value of Evodrop turbine water points to increased number of hydrogen ions, i.e. to possibility of more hydrogen bonds. In such a case, the number of clusters will be decreased and the average number of molecules per cluster will be increased compared to control water. All this will result in increased average energy of hydrogen bonds as shown in the above table. Decreased value of ORP points to increased number of electrons which enhances the antioxidant ability of Evodrop turbine water.

4. Conclusion

Evodrop turbine technology is capable of inducing significant physical changes in treated tap water, without external power supply. Their overall consideration points to possible favorable health effects of its everyday use as drinking water.

References

[1] Patent: WO2020178200A1 Water Purifier; Applicants: Fabio and Markus Turbine Eng GmbH [CH]Inventors: Hüther Fabio [CH] Date of patent application: 01.03.2019.

[3] O.V. Mosin and I. Ignatov Basic concept of magnetic water treatment, *European Journal of Molecular Biotechnology*, **4** (2) (2014) , 72-85. https://doi.org/10.13187/ejmb.2014.4.72

[2] I. Ignatov, G. Gluhchev and F. Huether Dynamic nano clusters of water on EVODROP water, *Physical Science International Journal*, **24** (7) (2020), 47-53. https://doi.org/10.9734/psij/2020/v24i730202

[4] A. Antonov, Research of the non-equilibrium processes in the area in allocated systems, Dissertation thesis for degree “Doctor of physical sciences”, Blagoevgrad, Sofia, 1995, 258p.

[5] S. Todorov, A. Damianova, I. Sivriev, A. Antonov and T. Galabova, Water energy spectrum method and investigation of the variations of the H-bond structure of natural waters, *Comptes Rendus de L'Academie Bulgare des Sciences*, **61** (7) (2008), 857–862. https://doi.org/10.1016/s0764-4442(01)01925-5

[6] Sh. Zhou and L. Wang, Unraveling the structural and chemical features of biological short hydrogen bonds, *Chemical Science*, **33** (2019), 7734-7745. https://doi.org/10.1039/c9sc01496a

[7] B.E. Rocher-Casterline, L. C. Ch'ng, A. K. Mollner and H. Reisler, Communication: Determination of the bond dissociation energy (D_0)$(H_2O)_2$ by velocity map imaging, *Journal of Chemical Physics*, **134** (21) (2011), 211101. https://doi.org/10.1063/1.3598339

[8] P. Gramatikov, A. Antonov and M. Gramatikova, Study of the properties and structure variations of water systems under the stimulus of outside Influences, *Fresenius Journal of Analytical Chemistry*, **343** (1) (1992), 134. https://doi.org/10.1007/bf00332070

[9] J.R. Smith, Ch. D. Cappa, K. R. Wilson, R.C. Cohen, Ph. L. Geisler and R. Saykally, Unified description of temperature-dependent hydrogen bond rearrangements in liquid water, *PNAS*, **102** (40) (2005), 14171. https://doi.org/10.1073/pnas.0506899102

[10] Keutsch, F. and Saykally, R., Water clusters untangling the mysteries of the liquid - one molecule at a time, *PNAS*, **98** (19) (2011), 10530-40. https://doi.org/10.1073/pnas.191266498

[11] I. Ignatov and O. V. Mosin, Structural mathematical models describing water clusters, *Journal of Mathematical Theory and Modeling*, **3** (11) (2013), 72-87.

[12] I. Ignatov, G. Gluhchev, S. Karadzhov, I. Yaneva, N. Valcheva, G., Dinkov, T. Popova, T. Petrova, , D. Mehandjiev and I. Akszionovich, Dynamic nano clusters of water on waters Catholyte and Anolyte: Electrolysis with nano membranes, *Physical Science International Journal*, **24** (1) (2020), 46-54. https://doi.org/10.9734/psij/2020/v24i130173

[13] Ignatov, I. and Mosin,O.V. Mathematical models of distribution of water molecules regarding energies of hydrogen bonds, *Journal of Medicine, Physiology and Biophysics*, **2** (2014), 71-94.

[14] I. Ignatov, G. Gluhchev. G., N. Neshev and D. Mehandjiev, Structuring of water clusters depending on the energy of hydrogen bonds in electrochemically activated waters Anolyte and Catholyte, *Bulgarian Chemical Communications*, **53** (2) (2021).

[15] F. Huether, I. Ignatov, N. Valcheva, G. Gluhchev, Applications of EVODROP Water as Drinking Water of Highest Quality. Antibacterial and Antiviral Effects of EVOhygiene Colloidal Silver and Cooper Nano Water, *European Journal of Molecular Biotechnology*, **8** (1) (2020), 14-23. https://doi.org/10.13187/ejmb.2020.1.14

[16] Ignatov, I. Origin of life and living matter in hot mineral water and properties of polar molecules in the primary hydrosphere and hydrothermal ponds, *Uttar Pradesh Journal of Zoology*, **42** (6) (2021), 37-52.

[17] I. Ignatov, S. Karadzhov, A. Atanasov, E. Ivanova and O. V. Mosin, Electrochemical aqueous sodium chloride solution (Anolyte and Catholyte) as types of water. Mathematical models. Study of effects of anolyte on the virus of classical swine fever virus, *Journal of Health, Medicine and Nursing*, **8** (2014), 1-28.

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