

High quality water production: analysis and perspective

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Ecology and the industry of Russia, Moscow, 2008, p. 4-7.

Nowadays there are a number of methods of drinking water quality determination. The main water characteristics are its chemical composition and purity. However it turns out that even pure water has very complex structure and properties. Drinking water standards do not reflect the most essential water property-its biological beneficial effect. That is why regular water we drink is not good enough.

During the last decades scientists are getting more interested in water, as water is a unique liquid. Numerous experiments results show that existing methods of water properties investigation do not satisfy requirements. They do not include a number of water parameters that actually characterize water beneficial properties and biological activity. Physiological water properties are determined not only by its chemical composition and the process of its purification, but also by a number of interrelated physical parameters which characterize water as a complex structured system in a non-equilibrium thermo-dynamic state. This system has a microcluster structure and become a source of emission (Figure 1) [1].

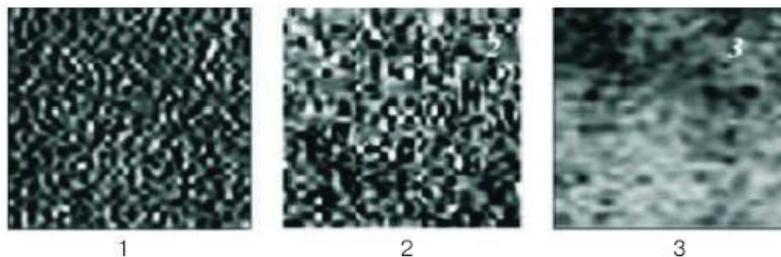


Figure 1. Microclusters (0.01-0.1 mm) in water solutions: 1 - distilled water, 2 - natural mineral water, 3 - 70% alcohol solution.

Water activation is the process of water transfer into a non-equilibrium thermo-dynamic state, accompanied by change of water structure. Water acquires resonant microcluster structure. There are number of methods of water activation (physical, chemical, biological, ets) -Figure 2. 1-3 solutions were activated by means of the device "Izumrud-SI" (mod.03). The solutions 1 and 2 were received by means of flow-through devices for anolyte and catholyte production (1:1). The solutions 4-5 were activated by means of the device "Izumrud-SI" (mod.04). The solution 4 was contact activated by means of electrolysis, the solution 5 was non-contact activated by means of electrolysis. The solution 6 was non-contact activated by means of ultrasonic scanning. The solution 7 was activated by means of ultraviolet radiation. The solution 8 was activated by means of gaseous fractions formed in the result of a reaction between Al and HCl solution. Activated water has a high physicochemical and biological activity.

One of the most essential drinking water parameters is water "charge", that is water RedOx. Silver-chlorine electrode was used as an auxiliary electrode for RedOx measurement. RedOx water in these conditions should be negative and pH should be neutral, since RedOx of human body cells is ≈ 70 mV. When RedOx of cells is different from the norm, people contract diseases. Investigation data (Invention application RU 2007127132, RU 2007127133; Patents RU 2299859, RU 2316374) show that RedOx is a general parameter reflecting drinking water structure and biological activity. RedOx can vary even if pH remains unchanged. RedOx and pH anomalies [2.3] do not contradict Nernst equation. It actually reflects the fact that Nerst equation is not universal and can not be applied to every case. It also reflects peculiarities of non-equilibrium environment parameters measurement (Figure 3, during our experiments electromotive voltage of signal - E was changed by the method described in Invention application RU 2007127132).

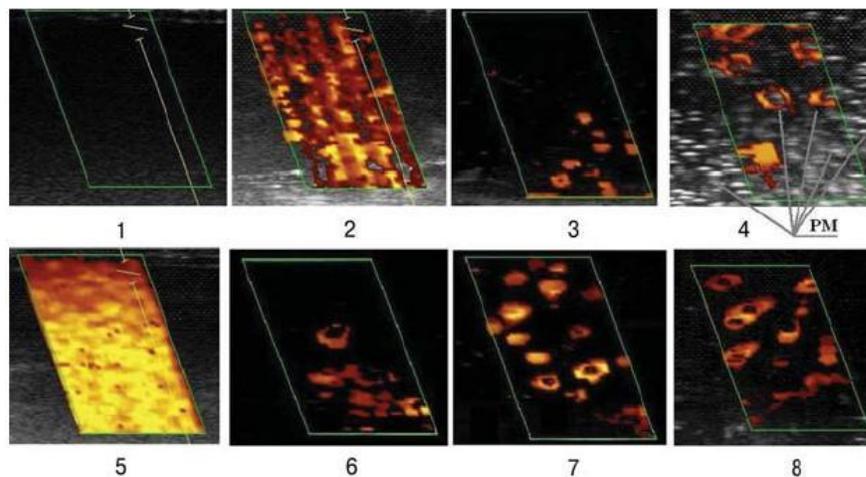


Figure 2. Microclusters (5-25 nm) in water solutions: 1 - anolyte acid solution; 2 - catholyte alkaline solution; 3 - anolyte neutral cathodic; 4 - 0.3% Na_2CO_3 water solution; 5 - distilled water; 6 - vodka "Sarapulskaya"; 7, 8 - distilled water.

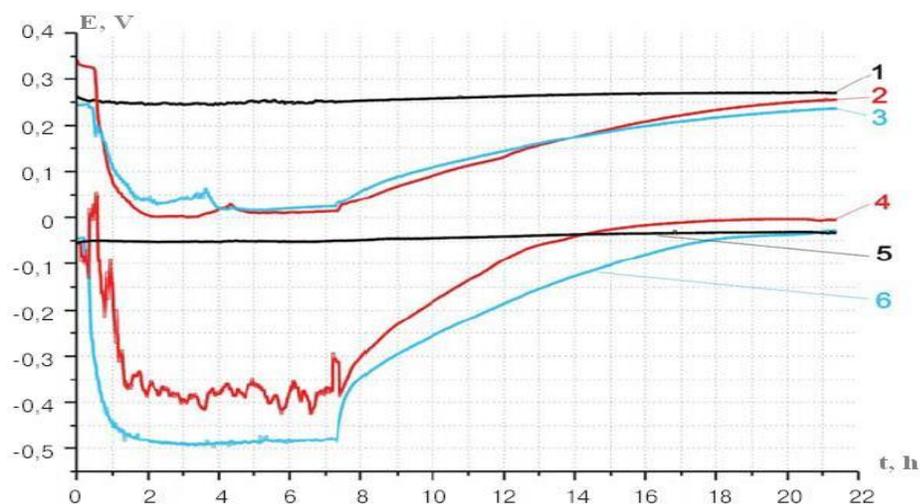


Figure 3. Dynamics RedOx (1-3) and E (4-6) samples of distilled water (1, 2, 4, 5) and of infusion solution (3, 6): 1, 5 - control samples; 2, 3, 5, 6 - activated non-contact by electrolysis without diaphragm in an interval $t=0-6,7$ h.

Anomalies of pH and RedOx of non-contact and contact activated water can easily be explained by the fact, that stable high-energy resonant microclusters form on the base of covibrating dipoles (water molecules, OH) near anode and cathode [2-4]. In a static state such dipole systems are not stable (collapse effect), but in a dynamic state there is a stabilization effect. Alternating field formed on the base of two covibrating in antiphase dipoles has a narrow frequency range (resonance effect) and becomes narrower at the rate of $1/r^4$.

The anomalous properties of activated water solutions (such as relaxation period, non-contact activation effect, cluster structure existence period- Figures 1 and 2, opportunity to predetermine and control mineralization degree, homeopathy) can be explained by high-quality microcluster structures ("molecular tuning forks")- $Q \sim 10^{13-23}$. Regular drinking water ($\text{RedOx} > 0$) penetrates into human body tissues and takes electrons from cells that consist of water by 80-90%. In the result of that biological structures of the human body (cell membranes, organoids, nucleic acids, etc) are destroyed by oxidation processes. That is how body gets older, essential organs cease to perform their functions, immunity decreases.

Melt water in mountains have microcluster structure and a negative charge due to triboelectricity, transconformation and phase transition. Drinking water with a negative RedOx is easily assimilated by human body. It gives its charge to human blood and compensates a negative cell charge. For example, we found out that if mice that if mice are treated with a lethal dose of X-rays and then given water with $\text{RedOx} = -450$ mv, their death rate decreases from 96% to 10% (in comparison with the control group of mice, that

was given regular de-activated tap water with a positive RedOx.

As a rule, a negative water RedOx lasts not longer than 24 hours, that is why it is recommended to prepare such water or live near mountain springs with 'alive' water.

In 1990 Kiselev B.I. discovered a method of water solutions non-contact activation by means of laser, magnetic or sonic field (Patent 1827274 USSR). He proved for the first time that it is possible to make water biologically active for some period of time by means of physical methods. Clinical tests show that activated water solutions can be used as immunostimulant remedies, therapeutic and prophylactic agents, since they do not have any side effects. Oral introduction of activated water solution (during 60 days) is less effective than infusion introduction (10 days).

In 2000 microhydrin (nanocarbon) was discovered. They called it "longevity tablets". One tablet per a glass of water, milk or coke shift liquid RedOx from +300 mV to -300 mV which is much more than fresh carrot juice RedOx (-70 mV). Microhydrin is one of the most effective antioxidants, but unfortunately, 1 liter of such water is rather expensive \$4. Later Dvornikov V.M. created a beverage "Vashe Zdorovye" (Patent RU 2234945) which can retain negative RedOx during 6-12 months. As test had shown, the beverage has marked immunostimulating properties and can be used as effective therapeutic and prophylactic agent, but is quite expensive- \$6/liter.

One of the important water parameters is its mineral composition. Ca^{++} , Mg^{++} , J, Se bulk ions deficiency in water cause a number of diseases. There are few springs which have water with microelement and ion content which comply with Russian Healthcare Organization standards. Some of these springs are situated in Sarovo area.

Calcium and magnesium deficiency can lead to hypertension, heart ischemia, osteochondrosis (even in 1.5 year old children), osteoporosis, incorrect posture, intelligence and memory decrease, quicker bilestone formation and stone formation in urinary tracts, tooth decay, alopecia etc. Ca and Mg ions are essential for normal development and health. They are especially important for children, women during pregnancy and breastfeeding, aged people.

The tests show that there are just a number of unique springs with water with such properties and composition that this water comply with the demands for healthy life. As a rule, these springs are situated in mountains. So what can people do if they mostly drink regular tap or bottled water?

In the course of history, two methods of water production were created.

The first method is more widely-spread and cheap. It is based on water purification and decontamination up to standards of the particular region. This method allows to preserve necessary mineral substances and to produce cheap water - \$0.0001-0.001 per liter.

The second method was considered to be affordable only for some people. It allows to produce high quality clear water by means of reversed osmose or electro dialysis and the following mineralization (addition of mineral compositions, substances and gases). Now the reversed osmose technology is getting less expensive and more widely-spread. It will allow producing cheaper and more affordable water.

Reversed osmose devices are usually advertised as next-generation devices for high-quality water production. But it is proved that because of the reversed osmose devices water becomes:
-distilled (demineralized);
- deionized (oxidated), since water RedOx is positive in comparison with silverchlorine electrode (200-400 mV);
- water structure retain information about pipes covered with slime and dirt; it is especially dangerous for people with low immunity.
Such water is not good enough for drinking.

New unique Russian technologies, patented devices and methods allowed creating next-generation devices for production of high quality water (on the base of FTR-3 (Flow-Through Reactor, Figure 4) and extra-high quality water (by mens of Faraday screen) with resonant microcluster structure (Figure 5). Such

devices can also control water parameters during water production.

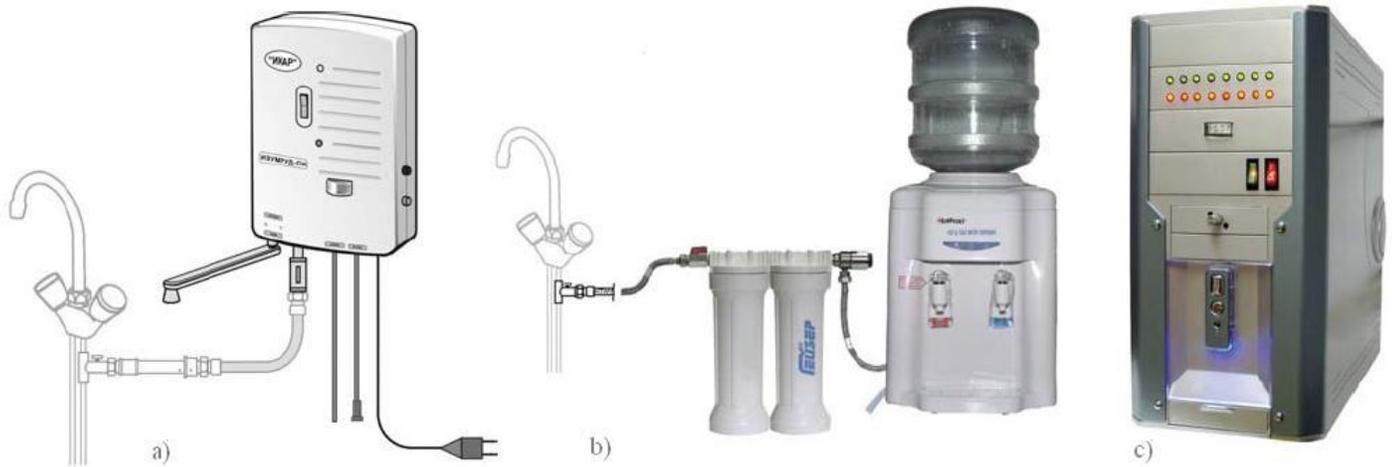


Figure 4. Device "Emerald - SI" (mod. 01) for reception of the drinking activated high quality water with the given mineral structure and antioxidant properties properties: a - household, b - office, c - industrial.

Now the device "Izumrud-SI" (mod.01 os) has no analogues (Figure 5).

The new approach is based on three main stages: pure water activation, the following mineralization and properties control. The offered device (Faraday screen, Patent 2299859) allowed to boost efficiency of water activation and electrical safety and to lower power inputs. Water mineralization was performed by means of unique Russian mineral composition "Severyanka++" containing Ca^{++} , Mg^{++} , J, Se ions.

The device has integrated controller, flow-type sensors with two-level indication system - reversed osmose processes monitoring (purification), activation monitoring (water ionizing), water mineralization (mineral composition optimization). The integrated controller and twin indicator lamps (green and red) perform sensors monitoring and signal if any disrepairs happen. Three light indicators regimes: 1) green, 2) flashing (green/ red), 3) red, which tells that filters or mineral additive should be changed.



Figure 5. Device "Emerald-SI" (мод.01 os) for production of extra-high quality water with the set mineral composition and antioxidant properties.

Water and water solutions cost depending on "Izumrud- SI" devices performance: \$0.004-0.008/liter (mod. 01), \$0.008-0.08/liter (mod. 01 os).

The devices can be used in different spheres of science and engineering when intensification of the processes is needed by means of activated high-quality water solution production with predetermined composition and properties.

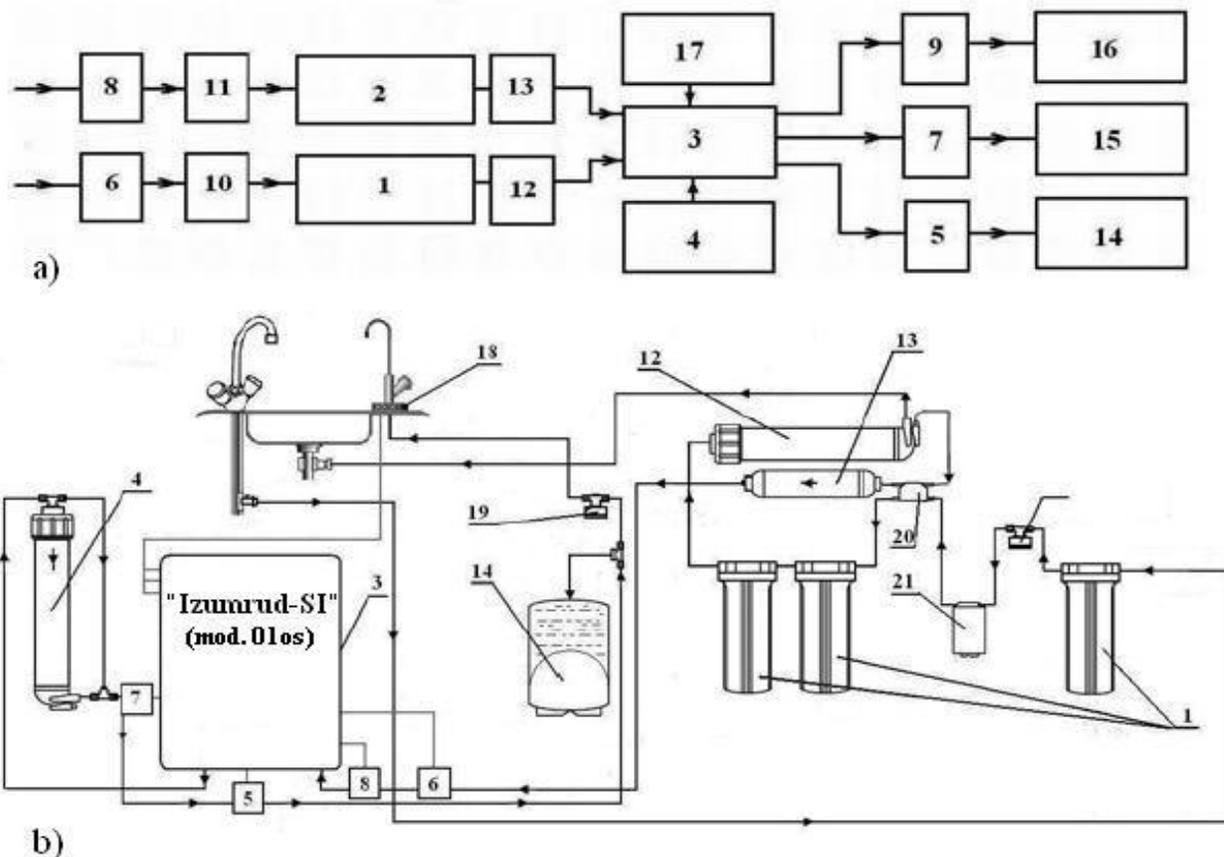


Figure 6. Block scheme (a) and principle scheme (b) device "Emerald-SI" (mod.01 os).

The device can be applied for creation of new class of condensed substances (solid substances, activated solutions and beverages). Block scheme of the device "Izumrud-SI" (mod. 01 os- Figure 6a) includes purification subassemblies 1, 2, electroactivation subassemblies 3, mineral composition controller 4, sensors 5, 6, 9 for control of water properties (activation degree, pH, RedOx, temperature, dielectric capacitivy , conductivity etc), sensors 7 and 8 for liquid composition control (mineral elements, substances). The sensors 5, 7, 9 are on the system output, sensors 6 and 8 are installed in front of the purification subassemblies. If necessary, one can also install water disinfection subassemblies 10 and 11 (Figure 6a), fine filter 12, degasifier 13, tank for activated liquids 14, liquid heater 15, liquid cooler 16, one or several ultrasonic activators, high-pressure switch 19, low-pressure switch 22, automated cut-off valve 20 and pump 21. Fine filters 12 and degasifiers 13 can be standard membrane devices- on the base of osmotic, track, selective or hollow fibers membranes, on the base of vacuum or ultrasonic deaerators or on the base of both. Tank for activated liquids 14 can also have pressure and temperature maintenance system.

This technology is aimed at liquid quality and treatment efficiency increase, at water parameters control, at preventing electrode overgrowing with cathode depositions. It prevents diaphragms from clogging. The technology allows to expand operational options and to make the device user-friendlier and easier to maintain.

Tap water always was and will remain process water, unless the offered technology is used. This is said in new State Standard. Low water quality is explained by water treating facilities condition and water chlorination technology that is widely used and other factors. Now there are two ways out: first, to produce bottled water, second, to treat tap water by means of regular water purifiers or purifying installations.

The "Izumrud" electroactivation devices can produce 100-2000 tons of water depending on tap water quality. The main advantage of this technology over bottled water production consists in the quality of produced water- it is ionized and has RedOx and pH close to that of melt water and human body. The project creators hope that if one distinguishes drinking water and process water it will help to solve numerous problems of water supply and to increase average life expectancy.

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