

Deuterium removal: light water without heavy investments

V.S. Leontiev , K.V. Ladygin, S.I. Stompel

"Safe Technologies" Industrial Group

Let's talk of modern technologies for purifying water from heavy isotopes of hydrogen and oxygen, which, according to scientific data, are far from being harmless for the human body. And let's find out why we need light water, how it affects our health and how we can get it at the lowest cost using column equipment equipped with regular Chevron packing developed by "Safe Technologies" Industrial Group.

What qualities we ascribe to water? Such a question can be perplexing. Cold or hot, salty or fresh, dirty or clean - that basically exhaust the list of definitions. Anyone interested in thermonuclear reactions will remember heavy water. However, few would guess that along with heavy water, there is also light water. And this is correct, because light water not only exists, but increasingly passes from the realm of science to real life.

THE UNIQUE PROPERTIES OF LIGHT WATER AND ITS EFFECTS ON THE HUMAN BODY

What is the reason for the growing popularity of light water? The reason is that this substance has amazing properties. As the name suggests, light water, or protium¹ water, consists of $^1\text{H}_2^{16}\text{O}$ molecules, namely the lightest isotopes of hydrogen and oxygen.

But what does this have to do with humans? It has been found that there is a

direct link between the isotopic composition of the human body and the composition of the water and food consumed. For example, among other elements in the human body, deuterium (^2H), which has two protons in the nucleus, ranks right behind sodium in terms of prevalence. The deuterium content in blood plasma is 4 times higher than potassium, 6 times higher than calcium, 10 times higher than magnesium and much higher than the content of such essential elements as fluorine, iron, iodine, copper, manganese and cobalt. The human body 'prefers' light isotopes of the elements, so we are 99.4% built of the four light isotopes of ^{12}C , ^{16}O , ^1H , ^{14}N .

When the body's defences are weakened as a result of ageing, stress, prolonged illness or unfavourable conditions, the concentration of heavy isotopes of elements can exceed their optimum concentration in the body and thereby play a negative role, causing various malfunctions.

A unique experiment in studying chan-

¹ Protium water, from the word "protium," referring to the most common, lightest isotope of hydrogen, consisting of a single atom.



ges in the isotopic composition of biogenic chemical elements in the human body under conditions of prolonged isolation in a containment facility was carried out at the Institute for Medical and Biological Problems of the Russian Academy of Sciences. It turned out that under conditions of severe stress and adverse external influences, our organism primarily gets rid of heavy isotopes, including deuterium and heavy oxygen (^{18}O).

For example, the distribution of iron isotopes, one of the most important biogenic elements, in the urine of the experiment participants was as follows: ^{56}Fe - 34.23%, ^{57}Fe - 36.76%, ^{58}Fe - 13.15%. Meanwhile, the natural distribution is somewhat different: ^{56}Fe - 91.66%, ^{57}Fe - 2.19%, ^{58}Fe - 0.33%. Thus, the content of heavy isotopes of iron removed from the body exceeds the natural content: 18 times for ^{57}Fe and 40 times for ^{58}Fe .

The same pattern was observed for calcium, magnesium, copper and silicon. Scientists suggested that in order to increase vitality and mobilize it to fight adverse external influences, we need to clean our bodies from heavy isotopes of biogenic elements, including deuterium, just as we get rid of chemical toxins. It turns out that this purification occurs as a result of drinking light water, which is depleted of deuterium.

The immunomodulatory properties of light water have been scientifically proven. The fact that it also has antitumor properties was first discovered in 1993 by the Hungarian microbiologist G. Somlyai. Clinical trials between 1994 and 2001 in Hungary showed that:

- the survival rate of patients who drank light water in combination with or after traditional methods of treatment was significantly higher than that of patients who were treated by chemotherapy or radiation therapy only. According to G. Somlyai, the survival rate of patients with stage 4 breast cancer who used light water during standard treatment was three times higher after two years than in patients who used only traditional methods of treatment;

- the use of light water during or after chemotherapy sessions can partially or completely reverse the immunosuppressive effects of cytostatics, reduce or completely relieve the adverse side effects of chemotherapy drugs.

During light water research at the P.A. Herzen Cancer Research Institute in Moscow (*in vitro**) and at Russian Cancer Research Center named after N.N. Blokhin (*in vivo**) scientists confirmed the inhibitory effects of light water in tumor cell proliferation and tumor growth.

* *In vitro* - conducting an experiment "in vitro" - outside a living organism.

** *In vivo* - experiment on a living organism.

Table 1

Marketable light water brand	pH	Main ions content, mg/l										Deuterium content, (ppm)
		Cations					Anions					
		Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	Fe ^{2+/3+}	HCO ₃ ⁻	Cl ⁻	F ⁻	SO ₄ ²⁻	NO ₃ ⁻	
Langway	7,3	43	13,5	2,3	4,9	0,02	201,3	4,8	0,18	4,8	<0,1	50–125
Moskovia	7,2	77,2	24,4	6,3	10,4	<0,001	378	4,7	1,2	10,1	0,1	142
Evian	7,3	80	24,6	5,5	1	0,005	296	3	0,11	11,5	4,3	148
Perrier	5,1	142	3,7	15	0,66	0,015	326	30,5	0,1	76	27	149
VITTEL	7,2	202	36	3,8	2	0,006	402	7,2	0,28	306	6	149
VERA	7,4	33,7	13,1	2,3	0,5	0,001	144	2,1	0	15,3	3,2	148
VICHY	6,3	108	11,4	1240	70,8	0,065	3111	240	8,84	173	3,6	148
Highest category water (SanPiN)	6,5–8,5	25–80	5–50	≤ 20	2–20	≤ 0,3	30–400	≤ 150	0,6–1,2	≤ 150	≤ 5	No applicable regulation

Non the less interesting were radioprotective properties of light water first discovered by I.N. Varnavskiy in experiments on *Drosophila melanogaster*. In later work the radioprotective effect of light water was registered during testing exposure of mice with a cobalt gun. The survival rate of animals in the experimental group which received light water (30 ppm) for fifteen days before irradiation was 2.5 times higher than in the control group (at a dose of 850 R).

At the same time it was found that in the surviving mice of the experimental group the number of leucocytes and erythrocytes stayed within normal range, while in the control group the number of leukocytes and erythrocytes was considerably decreased.

The use of light water during or after radiation therapy sessions has been shown to improve patients' blood composition, stop hair loss and relieve attacks of nausea after the session.

LIGHT WATER PRODUCTION. EFFICIENCY OF THE "CHEVRON" PACKING

So where does one get light water, for example, for use as disease prevention? Drinking water with a low deuterium content (105 ppm) is registered and marketed in the USA and some European countries as a prophylactic agent against cancer.

In our country, the light water Langway is produced by MTK "Aisberg". Langway water has been tested and received positive conclusions and recommendations from the A.N. Sysin Research Institute of Human Ecology and Environmental Health of RAMS, the State Institute of Blood Substitutes and Medical Preparations, the Research Institute of Physical and Chemical Medicine and other organisations.

Table 1 shows the content of different ions and of deuterium in several drinking water market brands.



Fig. 1. Mesh packing "Chevron".
JSC "Intarex" production facility



Fig. 2. Column equipment equipped with "Chevron" series
mesh nozzles (JSC "Elektrogorsk Institute of Oil Refining")

Light water is produced in rectification columns with a bulk spiral-prism packing. High efficiency of this packing (up to 25 t.t./m) with increase of column diameter for more than 50 mm decreases sharply. At diameter of 100 mm the efficiency is 10 t.t./m, and at diameter of 150 mm about 6 t.t./m. Significant disadvantages of currently used packings are also their low flow capacity, high hydraulic resistance (3-5 mm Hg/t.t.) at the price up to 3000 rubles/liter. To produce 6000 l/month of light water (with heavy water content D_2O 50 ppm) on such equipment, 40 columns are required. The cost of spiral-prism packing alone would reach up to several million roubles.

There is equipment available in Russia which will make it possible to reduce the cost of the light water production process several times while improving the quality of the product at the same time. Columns equipped with regular packing "Chevron" (Fig.1) manufactured by "Intarex" ("Safe Technologies" IG) (TU 11002-73357951-2015) are easily scalable and ensure high capacity production facilities construction (Fig. 2). Thus to obtain 6000 l/month of light water (D_2O content less than 10 ppm) only one column with diameter 300 mm and height 15 m of the packing is needed.

At the same time, in the production of light water with a D_2O content of less than 50 ppm, this column will give a capacity of 12000 l/month. And all this is at half the energy input of the 80 spiral-prism packing columns with 100 mm diameter per column. The load factor of the spiral-prism packing is 3-5 times less than of the "Chevron" 10-3 packing.

The hydraulic resistance of the "Chevron" 10-3 regular packing is 0.2-0.3 mm Hg/t.t. (compared to 3-5 mm Hg/t.t. for the spiral-prism packing), which not only significantly reduces energy costs, but also results in a new light water quality with D2O content below 10 ppm.

COLUMNS WITH CHEVRON PACKING FOR TRITIUM REMOVAL FROM RADIOACTIVE EFFLUENTS

Absorption and rectification columns manufactured by "Safe Technologies" Group are well known in Russia. The company started with formaldehyde absorption and achieved the maximum required cube concentration in this industry. Now "Safe Technologies" expand the range of offered columns. The new packing series by Intarex include units designed for petroleum product rectification and other applications.

A project similar to the production of light water has already been implemented by "Safe Technologies": a detritization column (for removal of radioactive tritium, the third heaviest hydrogen isotope) from radioactive effluent (Fig. 3). The project took place as part of the Russian proposal to eliminate the Fukushima accident impact. The column was also equipped with a "Chevron" packing manufactured by Intarex ("Safe Technologies" Group).

The Eskimo language has more than 30 words to describe the various types of snow on which these northern people depend very much in their ordinary life. Likewise, the various modifications of



Fig. 3. Liquid effluent detritization plant commissioned by FSUE "RosRAO"

water that affect the health of all people deserve the special attention of humankind. The water in all its modes needs to be studied and used properly. The first steps towards this are already being taken in Russia today. ■