



Plasma method for producing hydrogen from wastewater

We offer a fundamentally new and effective up-to-date technology for the treatment of very polluted wastewater, contaminated with pathogen organic agents and infectious, bacteria, viruses, antibiotics, drugs containing many organic and also inorganic impurities, dyes, liquid waste of military factories, etc. This is a plasma-oxidising vortex technology, which ensures high efficiency of water purification and disinfection.



As part of this approach to wastewater treatment, we get hydrogen as a by-product, that is, we get hydrogen for free. Our approach makes it possible to halve the cost of wastewater treatment at landfills, dairies, livestock farms and other facilities with a high concentration of organic compounds (for example, today the purification of wastewater from a landfill costs about \$10 per cubic metre; in Scotland, the treatment of drinking water taken from some dirty lakes reaches 70 pounds per 1 cubic m).

One module of our equipment (depending on the design) is able to treat 1 to 10 cubic metres/hour of wastewater. The use of 10 modules will allow cleaning around 2,000 cubic meters of wastewater a day (such amount of wastewater is produced by an average dairy plant in Ukraine). When purifying 10 cubic metres of wastewater, we get 1 kg of hydrogen for free, although currently the lowest cost of production of 1 kg of green hydrogen, estimated in the equivalent of consumed electricity, is about 35 kWh.

In our approach, hydrogen production occurs with the help of *plasmolysis* of water. For the processing of 10 cu. m of wastewater, we have to consume about 50 kW in hour of electric power.

For the production of 1 kg of hydrogen we have to consume 10 kg of crushed aluminium, which works as a consumable catalyst. Aluminium can scraps are available in large quantities at a price around 1\$/kg, though the price of waste aluminium cans is 2-3 times cheaper and we may crush aluminium cans ourselves.

We can treat even the most polluted wastewater, primarily landfill wastewater concentrate, which is obtained after applying the reverse osmosis method for wastewater treatment. There is still no technology in the world capable of cleaning such awful concentrate. We are the first who suggest our original technology. Cost of purifying 10 cu. m of such wastewater can be estimated at \$100. Our technology purifying 10 cu. m of the wastewater concentrate will consume 50 kWh and spent less than \$20, and at the same time we produce 1 kg of hydrogen for free.

Such a price estimate shows that the plasmolysis water purification technology offered by us is out of competition. Indeed, we can offer a price twice as low as available for wastewater treatment and obtain hydrogen as a by-product for free.

Putting the net profit from cleaning 1 cu. m of wastewater at the nearest level of \$3, the daily purification of 2,000 cu. m will result in \$6,000. Then the total net income could be \$2 million a year.

At the same time we will produce at least 60 tonnes of hydrogen a year, (200 kg of hydrogen a day).

Advantages of the Technology

- practically any types of wastewater can be purified;
- it can purify the most difficult types of wastewater, which is unattainable for other technologies;
- in the process of purification, two by-products are produced: 1) hydrogen and 2) nano powder of aluminum oxide Al_2O_3 , which in turn is widely used for the fine purification of drinking water (or can be used as raw material for melting aluminum);
- the net annual profit can be expected in the amount of several million dollars already from one treatment facility;
- the number of places with very polluted water is very large;
- return on investment is 1-2 years.

ANNEX

Our plasma method of purification unifies:

Quasi-stationary plasma, which purifying wastewater, triggers the following processes:

- creation of oxidizing agents (including OH^- and H^+ radicals, ozone);
- formation of a shock wave, which destroys biological elements and xenobiotic compounds;
- formation of ultraviolet radiation UV-C, which further contributes to synthesis of OH radicals and destruction of biological and chemical substances.

The technology implements a combination of deep vortex aeration with a hydrocyclone together with the microbubble ozonation effect. Besides, a special cavitator unit underlies the process of hydrocavitation, which initiates the appearance and destruction of microbubbles. This further leads to various physical and chemical effects, partial dissociation of water, vortices, pressure pulsations, shock waves at a microscale and nonlinear hydroacoustic effects.

Highly effective destruction of organic pollutants in water and their intense oxidation occurs as a result of these multifactorial effects. The finally plasma-treated water is characterised by a COD (Chemical oxygen demand) at the level of approx. 50 mg /L.

The purification also results in the appearance of a by-product – hydrogen.



The technology of plasma treatment of wastewater is:

- environmentally friendly – from carbon neutral to slightly negative
- emissions are extremely low
- no pathogens, fliers, rodents
- no air and surface water contamination
- good public relation