Miodrag Prokic

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Newsletter and Technical Publications

<Sourcebook of Alternative Technologies for Freshwater Augumentation in East and Central Europe>

3. WASTEWATER TREATMENT TECHNOLOGIES AND REUSE

3.1 Ozone (Electro-plasma) Wastewater Treatment

Technical Description

Ozonation, or electro-plasma wastewater treatment, is designed to disinfect and purify natural waters and wastewater. Electro-plasma treatment removes radionuclides, oil, surfactants, fats, dyes, heavy metals, and other compounds, both of organic and inorganic origin, from the treated waters. Plants currently in operation in Ukraine have a through-put of 500 m3/day, and are designed to be expanded by the addition of further 500 m3/day units. The units currently in use have an areal requirement of 8 m2 for the wastewater treatment unit, and an additional 4 m2 for the drinking water unit. The wastewater treatment units have a power demand of 0.4 to 1.0 kW/m3, and a mass of 1 000 kg. The drinking water module has a mass of 500 kg.

The electro-plasma wastewater treatment systems used in Ukraine comprise an impulse electromagnetic activator; an counter-turbine ejector; an electro-hydro-gas-impulse reactor; an electro-gas-ionic stabilizer; and, a control station. Water (or wastewater) undergoes primary mechanical treatment and comes to the impulse electromagnetic activator (EMA), where it undergoes further treatment by pulse electromagnetic field. This treatment increases the solubility of gases, reduces the scaling capacity, and increases the sorption capacity of suspended matter, increasing coagulation rates by up to 45%. The effluent then flows into the counter-turbine ejector, where, rotating around its axis, the flow pattern changes from laminar to turbulent flow. Simultaneously, the effluent is injected, through the ejector, with ozone, which oxidizes organic compounds and bacteria. The gas-liquid effluent is in a state of slow cavitation (about 7 W/cm2 intensity) when it enters the electro-hydro-gas-impulse reactor (EHGIR). There, the effluent undergoes treatment with pulsed electric discharges which, as a result of the impact of short shock waves (1 to 50 ms at pulse pressure about 20 000 kgf/cm2), increases the solubility of ozone-enriched air by more than 30 times, forming a suspended matter flocculant that is not less than 0.2 m in diameter. The effluent is also subjected to UV-irradiation to remove bacteria and other pathogens. The flocculants are removed by electro-coagulation and flotation in the electro-gas-ionic stabilizer (EGIS), decreasing the COD, and removing oil and grease. Chloride ions are transformed into chlorine during this stage of the treatment process, providing a further element of pathogen protection prior to the discharge of the treated effluent.

Extent of Use

Electro-plasma treatment, which produces and effluent that complies with international quality standards, has been implemented in industrial facilities in Finland, Germany, Czech and Slovak Republics, Cyprus, Sweden, Israel, and other countries. In these various applications, the technology has been used to produce water for drinking water supply (by removing radionuclides, hardness, iron, hydrogen sulfide, and bacteria), industrial wastewater treatment (by removing detergents, surfactants, oil, dissolved iron, chromium [Cr6+], and radionuclides), agricultural wastewater treatment, and specialized treatment of water for medical purposes.

Operations and Maintence

Operation and maintenance of these units requires skilled labour. Typically, both an engineer-technologist and control operator are required.

Level of Involvement

This technology is usually implemented at the local administration or industrial levels.

Costs

The cost of a 500 m^3/day unit is $250 000. Increased capacity is achieved through combinations of these unit. There are various versions of this technology; the EPOS® system, used in Ukraine, is proprietary in nature (International Patent No. WO92-12933 of 06.08.1992).

Effectiveness of the Technology

This technology has proven effective in a range of treatment situations.

Suitability

Electro-plasma treatment technologies are suitable for numerous operations, and can be easily added onto existing treatment systems. The technology is well-suited to producing a product water that may be recycled on-site or to produce additional final product waters. Ozonation has a further advantage in that it does not require the effluent to be treated with alum, polyacrylamide flocculant aids, lime, chlorination, or other reagents which require replenishment, preparation, and additional treatment water consumption.

Advantages

Ozonation is a reagent-free purification method that is up to 100% effective in removing bacteria and other contaminants, including radionuclides, heavy metals, nitrites, and nitrates, with relatively low power consumption rates (0.4 to 1.0 kWh/m^3 of wastewater, depending on concentration of contaminants). The technology is well-suited to providing process water for reuse. The process can be highly automated, and outputs can be tailored to specific requirements.

Disadvantages

The technology is complicated, requiring specialized staff and services.

Cultural Acceptability

This technology is generally considered to be a very innovative technology, relative to the more traditional technologies used in the region, and is not yet widely accepted as an alternative to the traditional methods. However, the product water is culturally acceptable.

Further Development of the Technology

The technology is fully developed.

Information Sources

Dr ***Vladimir Demkin***, Ministry for Environmental Protection and Nuclear Safety of Ukraine, 5 Khreschatyk St., Kyiv-1, Ukraine, Tel./fax: (380-44) 228 0786, fax: (380-44) 229 8050, e-mail: demkin@mep.freenet.kiev.ua.

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