EXCELLENCE IN WATER TECHNOLOGY AQUA-RENOVATE

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Abstract

Problem identified: Water scarcity is a global problem in urban, peri urban and rural areas due to climate change its effects an unavailability of clean and safe water. Treated wastewater has become globally the main water source for water-reuse/reclaimed water in agriculture, replenish ground water and for different industrial applications. It is a resource that cannot be denied meeting the global challenge of water shortage.

Despite the introduction of different advanced membrane technologies, the main source of contamination (biological & pharmaceutical residues) remains unnoticed in reclaimed water. The wastewater is purified but insufficiently purified, both from municipal, industrial, and small-scale private sewage discharge.

It pollutes rivers, lakes, water bodies, and coastal waters and creates potential risk of microbial & pharmaceutical contaminants in treated reclaimed water that are used for irrigation and washing of vegetables and other industrial applications and can pose severe threat to human health and even death. Ref. EU report www.r3Water.eu, page 10-16.

This threat must be addressed, the emerging environmental problem associated with the treated wastewater is drug residues, personal care products, bacteria, parasites, and micro plastics/debris in purified and insufficiently purified wastewater both from municipalities and industries. All these substances are commonly grouped as micropollutants and can present a risk of disease spreading during irrigation and other applications.

Traditional water quality measurements like pH, DO, EC, ORP, Turbidity, temp, colour, COD, BOD can give extraordinarily little or no information at all about real-time micropollutants variations and its effect in water and to our water environment, these parameters are designed by authorities to gather statistical information only.

Different pharmaceutical residues like anti-depressive, neuroleptics, sedatives, heart medicines, and cytostatic etc that humans consume, these residues go out as human urine & faeces. Pathogens like bacteria, parasites and viruses comes from human faeces too. Different heavy metals, microplastics, pesticides and many other organic & inorganic chemical compounds comes from industry which are difficult to disintegrate and not easy to treat due to its complexity and need other technologies to treat and monitor the efficacy of treatment. These pollutants are very tiny, not visible to human naked eyes and need tiny host micro particles to stick to, to move forward in water. These are commonly called as micro-pollutants. To add to that infected Covid-19 virus particles originating from human faeces are the latest micro-pollutants in wastewater effluent which are of global concern. These emerging micro-pollutants needs to be acknowledged by the scientific researchers and farmers that it prevails in reclaimed and treated wastewater and find a market changing cost effective safe solution for reuse of water.

Methods used to address, according to United Nations' International Strategy for Disaster Reduction (ISDR) as defined a treatment process must contain the following components to verify the safety & security: Monitoring and warning service, Risk knowledge, Dissemination and Communication, and Response capability.

In recent years, several advanced wastewater treatment technologies have been developed like MBR, MBBR, SBR and STP treatment process and implemented to treat wastewater so that it can be reused as reclaimed water.

Aqua-Q, a Swedish applied research SME, addresses these global challenges with the development of two separate novel standalone innovative technologies AQUATRACK® & Ozone polishing = AQUA-RENOVATE. In the EU R3Water project for online monitoring the effluent quality from MBR process or treated wastewater, eliminating online both pharmaceutical residues and pathogens for safe reuse in irrigation for product and farmers safety. The treated water can be used for various industrial applications, irrigation and for aquifer recharge. The technologies are patented and demonstrated successfully in Sweden and Spain, without additional process step of GAC (granulated active carbon).

AQUA-RENOVATE process is patented, TRL7, fulfils the requirements of ISDR and novel monitoring, real-time automatic sampling of water at the time of contamination and removal of micro-pollutants recognised by IWA (International Water Association) as the best market changing innovation and was awarded Gold prize 2018 at Tokyo. AQUA-RENOVATE project needs EU funding to manufacture, demonstrate**,** development research under realistic use case scenario for future water safety plan for reuse/reclaimed water.

Wastewater effluent always contains pathogens & pharmaceutical residues. The tables below illustrate some outstanding efficiency **results** obtained without GAC filter.

		Before ozone	After ozone
Substance	Mode of action	ng/L	ng/L
Diclofenac	Anti-inflammatories	601	<14
Furosemide	Diuretics	957	<11
Hydrochlorothiazide	Antihypertensives	1660	<2.8
Ibuprofen	Anti-inflammatories	71	<10
Naproxen	Anti-inflammatories	37	<4.6
Ramipril	Antihypertensives	<5.6	<5.6
Warfarin	Anticoagulants	6,9	<4.9
Atenolol	Antihypertensives	120	<3.7
Amlodipine	Antihypertensives	<3.6	<3.6
Bisoprolol	Antihypertensives	32	<5.2
Caffeine	Stimulant	17	<15
Carbamazepine	Sedatives	265	<2.1
Citalopram	Antidepressants	216	<6.5
Fluoxetine	Antidepressants	8,8	<6.0
Ketoprofen	Anti-inflammatories	68	<7.2
Metoprolol	Antihypertensives	585	<6.6
Oxazepam	Sedatives	402	6,6
Paracetamol	Anti-inflammatories	28	<11
Propranolol	Antihypertensives	68	<4.4
Ranitidine	Antiulcers	72	<21
Risperidone	Antipsychotic	<22	<22
Sertralin	Antidepressants	<6.5	<6.5
Simvastatin	Lipid-regulating	<8.3	<8.3
Terbutaline	Asthma medication	13	<2.4
	Analysed at IVL Stockholm	(<) lowest quantifiable limit (LOQ, S/N=10)	

Samples	RT	30°C	37°C	Organic carbon (mg/l)	Color at 410nm
Control	13*10^2	16*10^2	15*10^2	12.5	0.008
Treated 1	0	0	0	10	0.005
Treated 2	0	0	0	10.5	0.004
Treated 3	0	0	0	10	0.005

Relevant conclusion is treated wastewater contains pathogens & pharmaceutical residues which must be removed before reuse of water and real-time monitoring & sampling will provide process safety & farmers security.

Key words: Pathogens, Pharmaceutical residues, Dynamic sampling, on-line monitoring & sampling, Irrigation.