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Research Article

From Heat Sources to Climate Coolers

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Abstract

Water evaporation of the natural water cycle binds huge amount of heat energy. Heat sources can be switched to climate coolers by water evaporation. It's better to buffer and evaporate water on heat surfaces and plants for climate cooling than to lead it to seas via underground sewer networks. Every heat generator is a potential climate cooler. Clarified wastewater and rain water can be buffered and evaporated on heat sources powered by the heat generated, the sun and wind. Before releasing wastewater to water buffers and further, to evaporation it should be clarified with the full nature respect which is a big challenge for the present concentrated wastewater treatment practices. Global heat sources can be switched to climate coolers powered by direct solar energy and wind. A lot of wide area cooling capacity of evaporation and photosynthesis has been lost, huge heat sources have been built and serious energy tensions created by the civilization.

Water evaporation binds energy of 0.628 kWh per kg. Cautiously assessed water of 200kg per person every day is used without evaporating which means cooling losses of 126kWh per person a day. Today wastewater as well as rain water is pumped underground out of our sights to centralized treatment processes and further with toxin residues in to seas. A huge amount of power is consumed and free cooling capacity lost.

Some best practices and solutions that are easy to implement and provide economic benefits are presented here. The verified concept of Factory in Forest developed and applied since 1979 by Fanuc Company Japan can be applied widely at all kinds of industrial operations, data centers, power plants and urban areas. Capacity of carbon sinks and photosynthesis, and growth of trees can be multiplied and heat sources switched to climate coolers. Further, Factory in Forest has improved healthy and mentality of personnel as well as families. These impacts on people have been lately identified by therapy of walking in forest. Living and working in forest will multiply these positive impacts.

OxTube, a new water treatment innovation clarifies water matrices in tube condition with nature respect within seconds. It could be installed in water flowing positions for combined purposes with water clarification. All kinds of combined processing is economically and environmentally beneficial. According to MIT Group combined energy and water system could provide for millions.

Keywords: Climate cooling, Water clarification, Water treatment, Water oxygenation, Water purification, Water recycling, Pharmaceutics removal, Radon removal, Water disinfection

Introduction

Present concentrated water treatments need a new perspective and environmental respect [1]. In the present water cycle the seas and oceans are rubbish dumps. Rain and waste waters with their load are led or pumped thousands of kilometer's as fast as possible in to the huge rubbish dumps through the underground sewer network. Climate cooling by water evaporation is reduced significantly. Water and ingredients recycling is little. Present technologies and increasing power consumption in wastewater treatment result un-

satisfied balance. Further, the sewer network causes serious floods. Many serious problems, disasters, awful smell and serious microbe growth can be avoided by the combined water clarification and disinfection, and water buffers of wide surface area with solar and wind evaporation. Water and natural water cycle are necessary for the bio systems as well as power generation and the climate balance. The civilization has built heat sources all over that can be switched to climate coolers by evaporation of clarified waste water.

Water is a pure substance that carries a huge load during its natural cycle on the earth, in the bio systems, in washing and cleaning, as well as in agricultural an industrial processes [2-4]. Water gets rid of the load by evaporation caused by solar heat, and leaves it in the ponds, lakes and seas. In spite of modern waste water treatment these dumps of the water cycle become worse. The waters and eco systems suffer increasing amount of drug and pharmaceutical residues, nutrients, various poisons, many other chemicals, micro plastics, microbe growth and algae. The natural water cycle functions as a major climate cooling element together with the photosynthesis. A lot of water evaporation cool has lost and heat sources built by extension of civilization, open area building and construction, and underground sewer network. Water evaporation binds energy of 0.628 kWh per kg. Cautiously assessed water of 200kg per person is used a day without evaporating which means cooling losses of 126kWh per person a day.

Main Heat Sources

Civilization based heat sources are increased and natural ones are stayed more or less the same. Evaporation cool has been shrunk due to unsatisfied wastewater treatment, and underground sewage and rain water network. Further, photosynthesis cool could be higher due to fact that trees have been harvested where water and sun exist, and CO_2 is generated. Impact of the civilization to the natural water cycle and photosynthesis is illustrated in Figure 1. Increase in heat and power consumption warms the climate. Energy tensions caused by heat and temperature differences have become widespread. Heat transfers to cold in intermediate according to thermodynamics. Noxious load in the waters increases although advanced purification technologies are adapted.

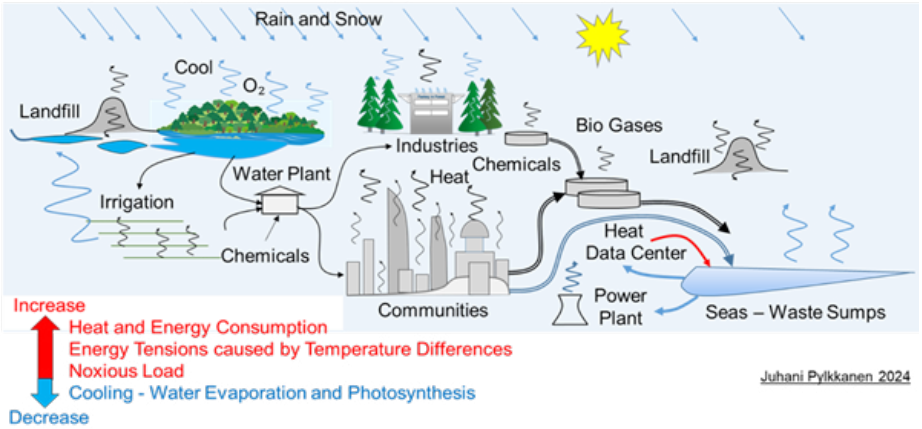

Figure 1: Growing Civilization and shrinking Nature Water Cycle [7].

Mega Cities collect and reflect sun heat, and generate additional heat by cooling and heating systems. Cool of evaporation and photosynthesis is little due to high buildings, no trees nor water buffers in practice. Water flows in underground sewers and channels. Heat transfer to air is unlimited high, Figure 2. Sites of factories, power plants and data centre's are harvested forestless. Heat flows in to waters and to air are unlimited. Data centre's consumed 1 to 2 percent of the global electric power 2019 [5]. Their coolers are efficient to transfer generated heat to waters and to air. In few installations the waste heat is used for district heating in cold seasons. Water evaporation cooling could switch data centre's from heaters to climate coolers.

Efficiency of PV solar cells is low in spite of huge development efforts. Traditional single-junction cells with an optimal band gap for the solar spectrum have a maximum theoretical efficiency of 33.16% [6]. In 2023 Chinese manufacturer LONGi Green Energy Technology Co. announced a tandem silicon/perovskite cell that achieved 33.9% efficiency [6]. PV Solar cell could generate in the optimal condition electricity of 300 W/m^3 and heat 700 W/m^2. However, in practice the electricity generation is less than 200 W/m^2. PV solar power plants need huge land area that could be used for evaporation and photosynthesis cool.

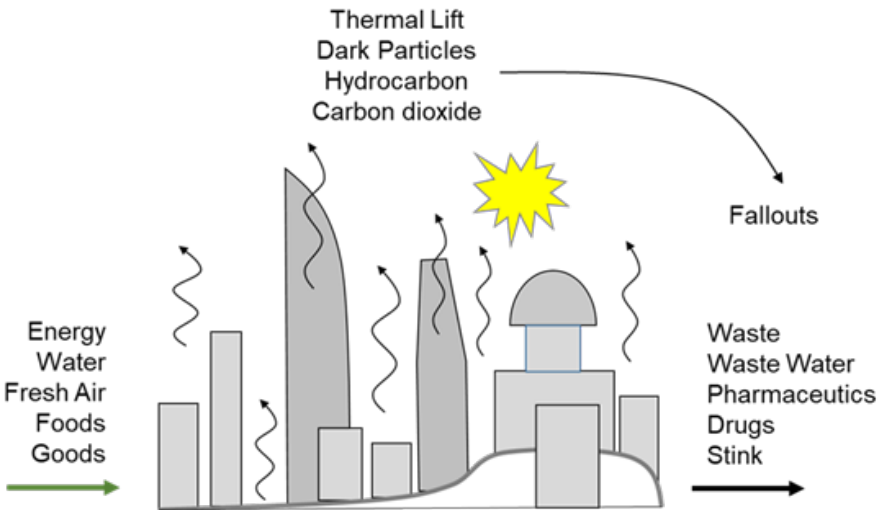

Figure 2: A Huge Heat Exchanger and Waste Producer by the growing civilization. Heat transfers to cold. In spite of high energy consumption in waste, water and heating/cooling processes the direct sun energy nor photosynthesis are not applied [7].

Regarding industries, energy generation and data centers it's said that waste heat is used for district heating. However, the district heating is needed in cold seasons, and top cooling positions in warm seasons. Precise balance of the heat and cool is difficult to achieve. Water evaporation cooling returns purified water to the nature water cycle continuously and precisely according to cooling needs. Further, water evaporation could be enhanced by the sun, wind, and of course clarified wastewater.

From Heat Sources to Climate Coolers

All kinds of combined processing are economically and environmentally beneficial. According to MIT group combined energy and water system could provide for millions. Figure 3 presents one of the best practices of combined processing with nature respect. The concept Factory in Forest of Fanuc Japan applies heat source reduction by shadow of trees, water buffering and evaporation, and maximized photosynthesis [7]. The buildings are lower than top height of the trees, the roofs function as water evaporation coolers, and ventilation air is circulated to and from the surrounding forest that is vibrant, grows well, sinks carbon with high capacity and produces oxygen, and provides large area for water evaporation. The company is top profitable, productivity high including innovations, energy consumption low, health condition of the personnel and their families perfect, and the nature around feels well. Further, Fanuc applies in every respect waste free operation which means no waste nor packing materials in their logistic chains. Figure 4 illustrates these environment friendly principles that can be applied easily in industrial operations and power generation as well as in urban areas

Figure 3: Waste Free Factories in Forest by Fanuc Japan. Roofs function as water buffers and evaporation coolers as well as the forest. Indoor air is stable by oxygen from forest and evaporation cool [7].

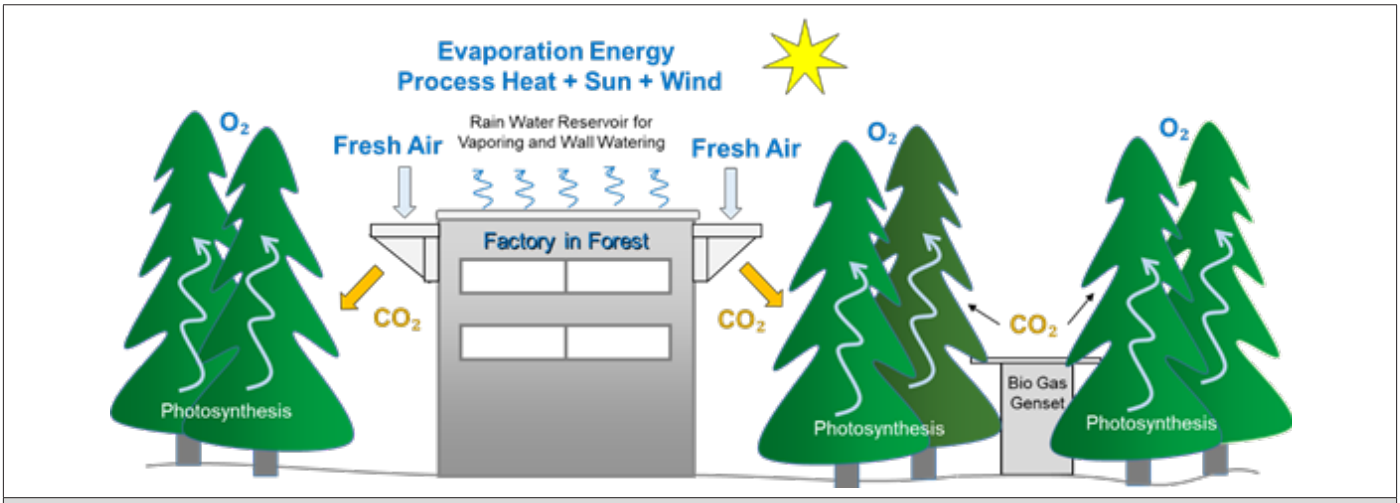

Figure 4: Waste Free Factory applies water evaporation and photosynthesis cooling. Trees grow faster than in average due to high carbon sink capacity and improved immunity.

Data centre's process bits with power up to 500MW, and present fast growing heat sources that can be switched to climate coolers as illustrated in Figure 5. Data processing could be streamlined and its efficiency improved many ways. Demanding clean room condition is appreciated in data processing. The concept of Data Centre in Forest provides air conditioning of low power consumption natural way, and functions as a combined data processor and climate cooler.

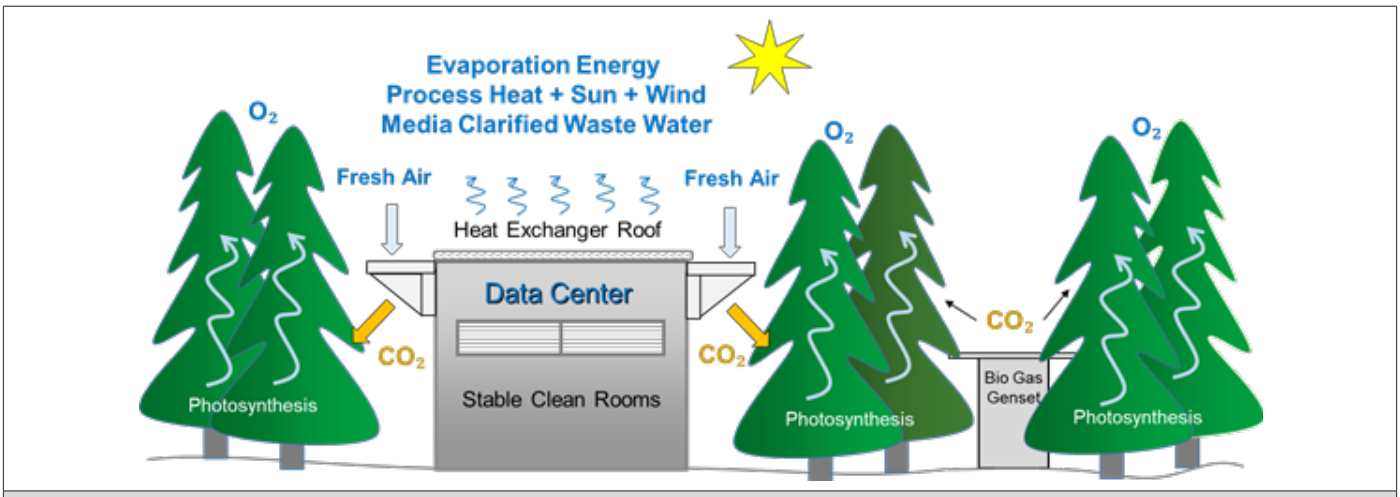

Figure 5: Electric power of over 100MW is becoming common in new water cooled data centre's which can be switched from water heaters to climate coolers.

Combined car park and tree planting of 400 cars is presented in Figure 6. Shadow of trees, photosynthesis and rain water evaporation cut efficiently and natural way heat generation on asphalt and cars, and heat transfer to air. All the open areas could be planted similar way.

Figure 7 illustrates heat flows on PV solar panels with and without water film. Water evaporation takes heat 2 260 kJ/kg equal to 0.628 kWh/kg. Water film of 1mm per m^2 weights 1kg. Intensity of sun energy varies by location on the globe. In this estimation the top sun energy of 1 kW/m^2 is used. An advanced PV solar panel generates electric power of 200 W/m^2 and heat of 800 W/m^2 in the peak condition in practice. Water of 1kg can be vaporized theoretically on PV solar panel of 1m^2 in 0.8 hour. Water of 1.25 kg/hm^2 can be vaporized and returned to the nature water cycle. In addition to the direct sun energy the evaporation capacity depends on air temperature and wind. However, the thin film water evaporation on PV solar cells can eliminate the climate warming impact by the efficiency of 80 percent [7].

Figure 6: Combined car park and tree planting switches off huge heat sources by nature respect.

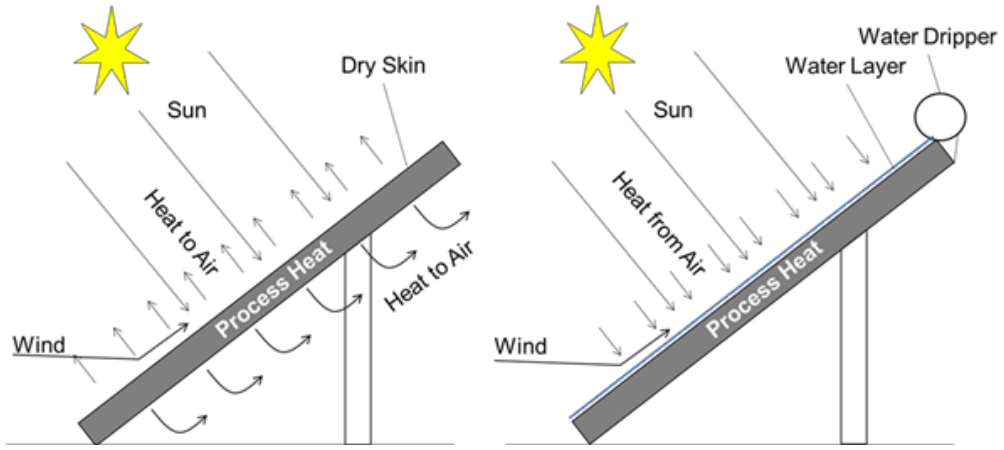

Figure 7: Heat flows of dry PV Panel and water evaporated PV panel on left and right respectively. Combined climate cooler by water evaporation and solar power generator on the right. Clarified waste water can be returned in the nature water cycle [7].

Combined Wastewater Clarification and Evaporation Cooler

In order to return wastewater in the natural water cycle the present concentrated waste water treatments together with huge sewer networks need a new perspective. The new innovation OxTube clarification in tube condition has shown in many application's superior performance and nature respect. It can be integrated in various water systems. Its performance is based on high collision probability of molecules by the seamless treatment process as follows [3,8,9]:

a) Separation of dissolved ingredients

b) Activation of molecules

c) Immediate clarification reactions

d) Aeration after clarification

e) Bubble generation in water flow for particle removal by flotation

Figure 7 illustrates the seamless process of the separation and activation as well as clarification with Swiss Alpen household water. In this case the water turns to milky and a bit effervescent when it is led through OxTube without the air suction, and it clarifies immediately after air suction is initiated. Color of the activated water differs from white to brown depending on dissolved substances. The cyclone eye sucks gases and possible chemicals, and mixes them effectively and evenly in the water flow with activated molecules. The mixture of water and air is evenly foggy in the tube after the nozzle. Spray of the mixture of water and air is coherent. Air suction is great, it can be over ten times higher in volume than the water flow, and the gravity decreases respectively. The foggy mixture of air and water has a great cooling capacity of climate. Normally pump energy available can be used depending on the case. OxTube can be in-

stalled in other water systems, in present concentrated wastewater treatments, too.

OxTube has been verified by laboratory tests and practical installations in aeration, oxygenation, disinfection and clarification of various water matrices, and removal of radon from ground water and pharmaceutics from wastewater, and separation of iron, manganese and calcium from industrial waters [4]. Figure 6 summarizes OxTube functions so far. Calcium has been removed with CO_2 feed in OxTube and a lamella [10,11], and iron and manganese removed by air suction and sand filtering.

OxTube Machine presented in Figure 8 and 9 is the key module in the clarification in tube condition [3,9,12]. The treatment doesn't need any additional energy, but side processes like ozone and chemicals feed might need power. The structure is compact and easy to keep clean.

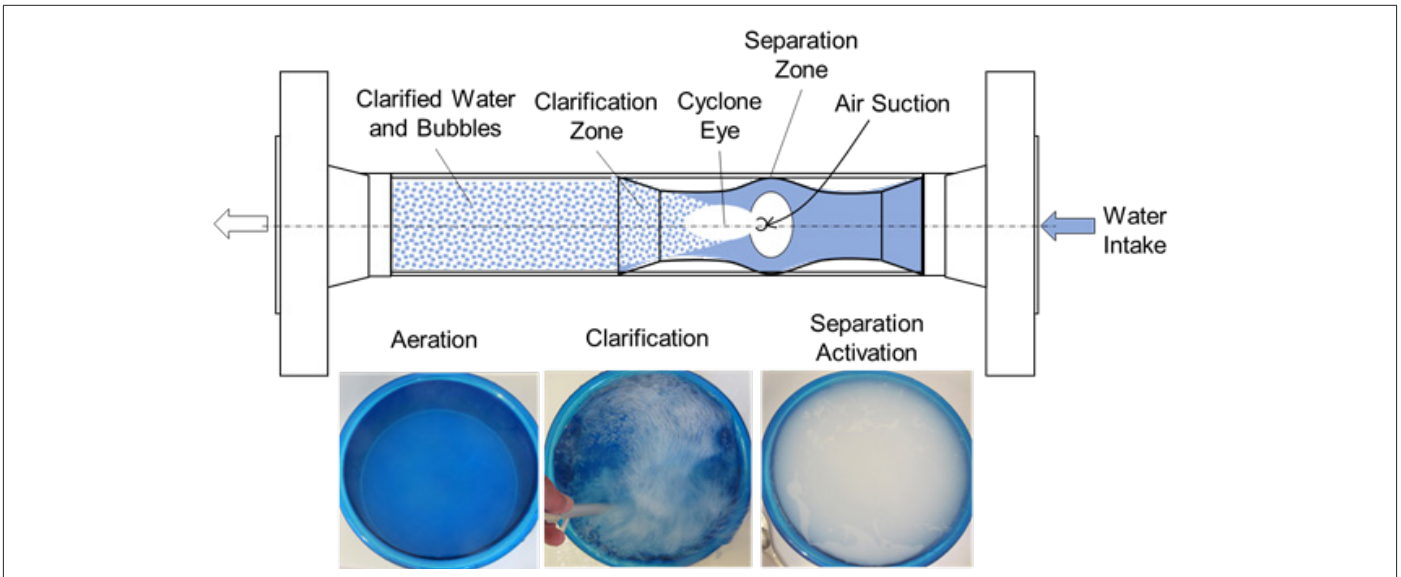

Figure 8: OxTube Clarification with air; Right Separation of dissolved substances and molecular activation, middle Integrated Clarification with air, and left the clarified Swiss Alpen household water. The entire process is performed seamlessly within a second [7].

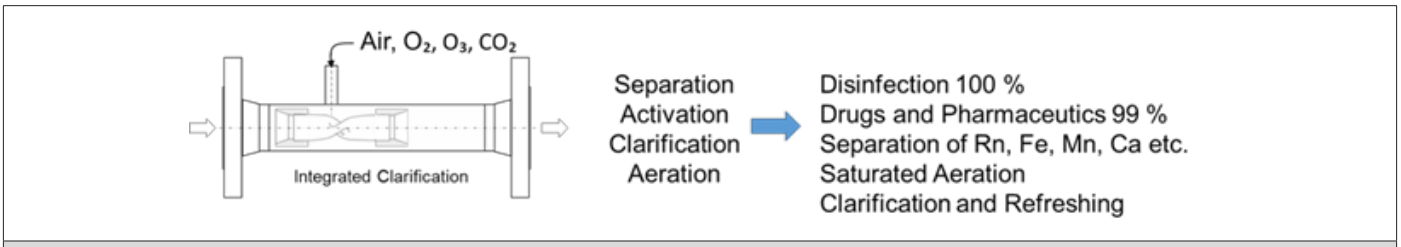

Figure 9: OxTube Machine and its functions in one in terms of seconds [7].

OxTube Machine separates dissolved ingredients but to remove them from the mixture needs further attention. As said OxTube Machine generates huge amount of bubbles by gas suction and clarification reactions which can be used for flotation [13,14,2]. Collision probability of particles and bubbles is high and attachment is identified to be great, so the flotation is a natural way of particle removal. Particle attachment happens in OxTube Machine. All the filtering methods can be applied in particle removal after the separation and clarification.

Figure 10 shows the efficiency of the tube clarification according to a hundred real test runs completed with an industrial waste water [15]. Turbidity of the clarified waste water turned to 0.0 NTU and smell disappeared within retention of 30minute. Only OxTube Machine, a pump and an open outtake vessel were used, no filters. The treated water was identified recyclable for industrial purposes. In order to recycle it for household purposes an ozone disinfection and sand filtering, and related verifications are needed.

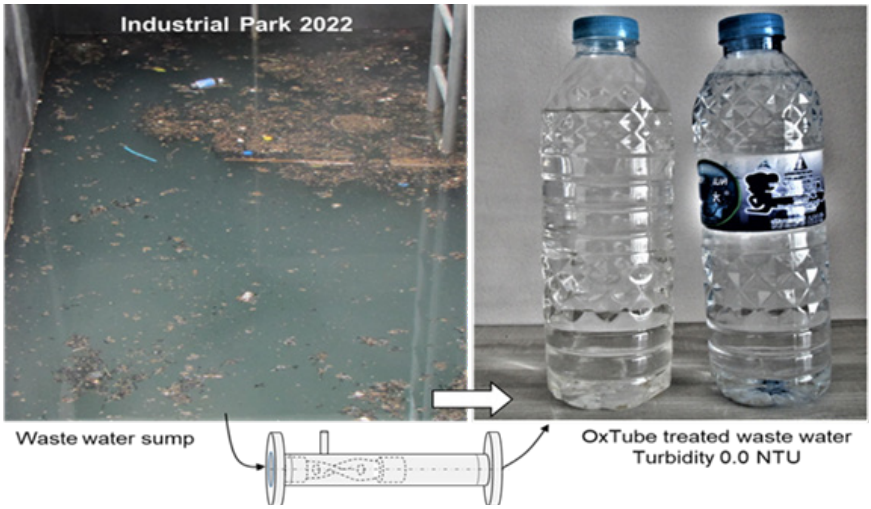

Figure 10: OxTube test runs of an industrial waste water resulted turbidity of 0.0 NTU. The clarified water is recyclable in industrial process use [15].

Disinfection of various water matrices can be performed by feeding ozone instead of air [2,3,16]. Table 1 presents results in the case of disinfection of a waste water. Microbe reduction of 100 percent was achieved together with clarification and oxygenation of over 20 mgO_2/l. Ozone residues were measured negligible.

Table 1: Disinfection efficiency of OxTube Water Clarification 100% Reduction of *E.coli* and MS2 achieved with O_3 feed of 2 l/min within 0.7 second, oxygen concentration raised over 20 mgO_2/l / Savonia University of Applied Sciences in Kuopio [16,2,3].

Disinfection of Hospital Waste Water / THL Summary April 3, 2018												
Sample	E.coli PMY/ml	Log-red	Reduction %	MS2 PFU/ml	Log-red	Reduction %	T °C	EC µS/cm	pH	Turbity NTU	O_3 Res mg/l	O_2 mg/l
Test Water	2			1			12,8	283	7,73	0,68	0,03	10,26
Inoculum	2 500 000			870 000								
0 mgO_3/l	1 700 000		32,00	340 000		60,92	12,4	285	7,88	0,46	0,02	11,65
1,43 mgO_3/l	<0,001 (MR.)	>9,23	99,99999994	<2 (MR.)	>5,27	>99,9995	13,2	285	7,81	0,31	0,10	> 20
1,27 mgO_3/l	<0,001 (MR.)	>9,23	99,99999994	<2 (MR.)	>5,27	>99,9995	12,6	294	7,83	0,27	0,14	> 20
1,11 mgO_3/l	<0,001 (MR.)	>9,23	99,99999994	<2 (MR.)	>5,27	>99,9995	12,9	288	7,73	0,44	0,10	> 20
0,95 mgO_3/l	<0,001 (MR.)	>9,23	99,99999994	<2 (MR.)	>5,27	>99,9995	14,3	279	7,84	0,37	0,10	> 20
0,79 mgO_3/l	<0,001 (MR.)	>9,23	99,99999994	<2 (MR.)	>5,27	>99,9995	14,0	289	7,85	0,44	0,08	> 20
0,61 mgO_3/l	<0,001 (MR.)	>9,23	99,99999994	<2 (MR.)	>5,27	>99,9995	14,0	287	7,74	0,40	0,07	> 20

Radon gas removal from a ground water intake by OxTube Clarification with air has been verified in five installations. OxTube separates Rn gas and it's removed by compressed air via gas remover GasRemox. Table 2 shows the results of an installation in Rn gas removal out of a ground water [17-19]. Combined with Rn removal the water is clarified and aerated. The system is applicable for any heavy gas, e.g. CO_2.

Table 2: Radon gas removal of two OxTube Installations with compressed air from a ground water intake [17,18,19].

Water Flow m^3/h	Date of 16 Samples 2019	Monitoring Data					Rn Concentration		Rn Removal Bq/l		
		Pressure psi					Raw Water	Treated Water	Reduction Bq/l	Reduction %	Aceptance
		Pump out	OxTube 1	OxTube 2	Distr. Line	Δ					
62,5	1809 - 2810	60	52	48	60	0	57 - 42	9 - 4	44	87,5	Passed
Requirement							52	11	41	79	

OxTube performance in removal of residues of pharmaceutics and some chemicals from a city waste water is presented in Table 3 including comparison to two present modern systems [20,16,8]. About 86 percent of these residues were split, clarified and removed only by one run through OxTube Machine to an open vessel without any filters. Two runs result 96 percent reduction. OxTube seems to be a potential solution for wastewater purification such a way the water can be recycled or sprayed on heat sources for evaporation.

Table 3: Removal of pharmaceutics of 35 from the purified city wastewater of Kuopio Finland by OxTube Machine within a second including comparison to two present methods [16,20,3].

Pharmaceutics	OxTube Ozone Treatment			Present UV Method 1		Present UV Method 2	
In Total 35 Residues	Initial µg/l	Residue µg/l	Reduction %	Resudue µg/l	Reduction %	Residue µg/l	Reduction %
Total Emisions Load Reduction	20,158	2,041	89,88	14,556	27,79	14,666	27,24

High efficient and immediate aeration of OxTube Machine has measured in clarification of several water matrices. Table 4 shows aeration and refreshing results in clarification of a mine water [16,20,3].

Table 4: Aeration Efficiency of OxTube20 based on vacuum air suction, even mixture and lowered surface tension. Aeration time is 0.4 second. / Savonia University of Applied Sciences 11/2019.

OxTube Aeration of Mine Water / Savonia University of Applied Scences 11/2019					
T °C	initiatal O_2 concentration mgO_2/L	DO by Air Suction mgO_2/l	Saturation mgO_2/L	DO/ Saturation %	Aeration Time s
3,2	<1	12,63	13,4	94,3	0,4
9,3	<2	13,31	11,5	115,7	0,4
9,7	<2	13,08	11,4	114,7	0,4
8	<1	13,63	11,8	115,5	0,4

Summary

The civilization has built several heat sources that can be switched to climate coolers by water evaporation powered by process heat, direct sun energy and wind. Clarified waste water can be used for evaporation media on the heat sources. In order to clarify wastewater by nature respect the present wastewater treatments need a new perspective. OxTube Water Clarification in tube condition is found to meet the environmental and economic requirements well. It has been applied successfully in removal of pharmaceutics, radon gas, calcium, manganese and iron from various water matrices, and disinfection with ozone of a waste water, and refreshing of various water matrices. During the research and test runs in product development the clarified water was found a bit slippery and its surface tension reduced. It has a significant impact on skin, hair and nails, and taste and mouth hygiene as well. OxTube clarified water is a very potential media for the transition from heat sources to climate coolers by water evaporation powered by heat generated, direct sun energy and wind.

Acknowledgement

None.

Conflict of Interest

None.

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