



Review Article

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Water Clarification Combined with Other Water Systems

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Abstract

The natural water cycle is the largest transportation as well as bio system and climate cooling element in the globe. Water is a pure substance that picks up a huge load during its cycles on the earth, bio systems, in washing and cleaning, as well as in industrial and agricultural processes. It gets rid of the load by evaporation powered by the sun, and leaves the waste in the ponds, lakes and seas. In spite of modern waste water treatment these dumps of the water cycle become worse, and energy and chemicals consumption of the treatment has increased steadily. The waters and eco systems suffer increasing amount of drug and pharmaceutical residues, nutrients, various poisons, many other chemicals, micro plastics, microbe growth, algae, temperature growth, and low oxygen. Evaporation area as well as photosynthesis and related cooling capacity have been shrunk significantly by extension of the civilization. It's urgent to have a new perspective in water treatment and use. Combined water systems with proper clarification and related water resource management save nature and money, and could reduce environmental energy tensions, climate warming and floods. Even health and wellness impacts can be improved by the proper water clarification.

Keywords: Water Clarification, Water Treatment, Water Oxygenation, Water Purification, Water Recycling, Particle Separation, Flotation, Pharmaceuticals Removal, Radon Removal, Water Disinfection, Natural Water Refreshing, Exhaust Gas Collection

Introduction

Hybrid and decentralized waste water treatment should be carefully considered instead of centralized one with good reason [1]. Waste waters with their load are pumped thousands of kilometers to the centralized treatment plants and further, poorly processed in to the waters through the huge underground sewer network. Rain water is led through various ways mostly underground to the waters, too. Climate cooling by water evaporation is reduced significantly, and the sewer network causes serious floods with microbe growth and spread. Temperature of the nature waters increases steadily mostly by general consumption, cooling water of nuclear power plants and data centers, and waste water treatment and discharge in the waters instead of evaporation and local reuse. Water and ingredients recycling is little. Many serious problems, disasters, awful smell and serious microbe growth can be avoided by the water clarification by consideration of full nature respect and wide area clarified water buffers with solar evaporation. Water and natural water cycle are necessary for the bio systems and food chains as well as the climate balance. Water clarification in tube

condition could be a desirable new perspective in combined water clarification and water resource management. OxTube Water Clarification and some examples are presented briefly here.

OxTube Water Clarification in Tube Condition

OxTube Machine presented in Figure 1 is a basic module of water clarification in tube condition [2,3]. It clarifies various water matrices within seconds with air suction in continuous flow. It consists of four seamless treatment phases and as the fifth step a firm gas bubble generation in the flow as follows:

1. Separation of dissolved substances
2. Activation of molecules
3. Clarification reactions
4. Replacement dissolving
5. Bubble generation in water flow for combined flotation and clarification

Water itself is a pure substance that picks up easily heavy load and it can be purified by releasing the load. It is present everywhere, and it performs the largest transportation and cooling system in the globe powered by the sun. Water is spoiled within seconds by civilization, OxTube provides solution to clarify it within seconds, and it can be combined with other water processes like together with a hydro power, fountain, water vehicles, exhaust gas washing, cooling systems, flotation and removal of pharmaceutical residues, radon gas and solid particles. The clarified waste water

can be discharged in to the natural water cycle in the way of climate cooling and nature wellness

In the most cases the load of water can be separated and gases removed in one shot through OxTube Machine but the removal of solid particles needs filtering or flotation. Removal of heavy gases like Rn and CO₂ can be removed by air blow. Separation efficiency of OxTube is illustrated in Figure 2. The basic research is completed 2013 – 14 at Oulu University [4] (Figures 1,2).

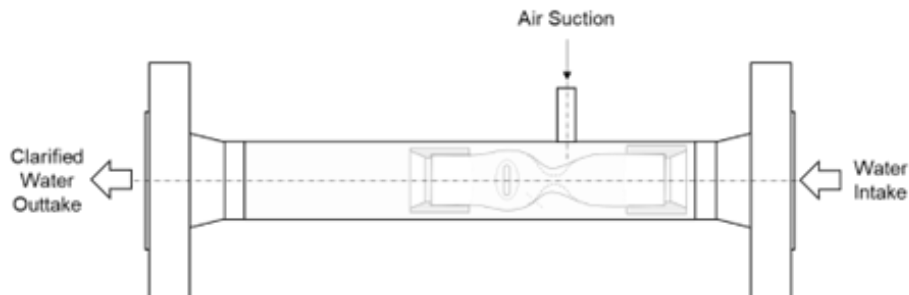


Figure 1: OxTube Machine with gas and chemicals suction is compact including standard fittings. It can be installed in various water systems [2, 3].

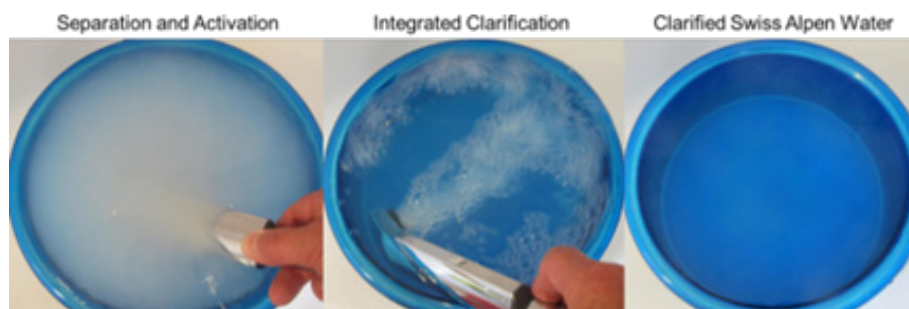


Figure 2: Efficiency of OxTube Clarification in Tube Condition with air; Left Separation of soluble ingredients and molecular activation without air, middle Integrated Clarification with air, and right the clarified Swiss Alpen household water. The separation, activation, clarification and replacement dissolving are performed seamlessly within a second in OxTube as shown in the middle.

Figure 3 shows visibly the clarification efficiency of OxTube Machine. Turbidity of an industrial water tuned to 0.0 NTU by one run through OxTube Machine. The water can be disinfected by ozone feed at the same time, and solid particles removed by a sand filter. The water is recyclable for industrial use [5]. Separated and reac-

tion gases are removed by Water Treatment Unit WTU that consists of OxTube Machine, gas removal GasRemox and Fittings, Figure 4. Removal of heavy gases out of the system might need additional air compressed in the tube (Figures 3, 4).

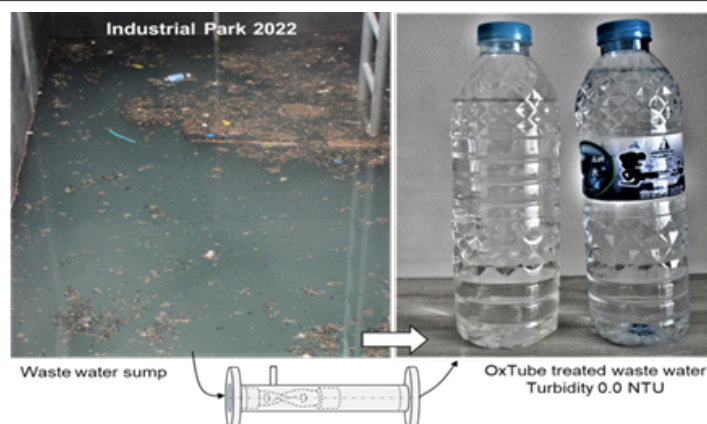


Figure 3: OxTube test runs of an industrial waste water resulted turbidity of 0.0 NTU. The clarified water is recyclable in industrial process use [5].

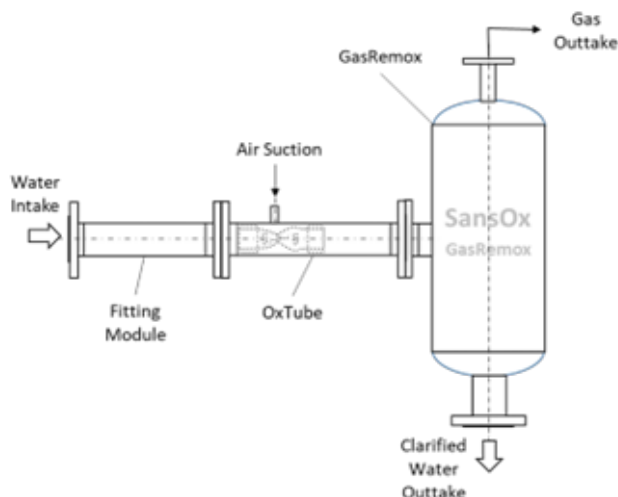


Figure 4: Water Treatment Unit for the most of water clarification cases. It consists of OxTube Machine, Gas Removal GasRemox and Fitting Module. Microbe reduction of 100 percent combined with clarification and after oxygenation was achieved within a second by ozone feed [2, 3].

Combined Water Clarification and Hydropower Generation

DuOx nozzle can suck and mix air in to flowing water over ten times of water flow volume at the normal pressure. The spray of the mixture is coherent, and functions well in high efficient Pelton

turbines. Flow speed of the air and water mixture increases respectively with air suction which means a bit higher impulse on the turbine pocket. The water is clarified and aerated in the nozzle, and it can be disinfected by ozone feed and filtered by a sand filter before household or fish farm use (Figure 5).

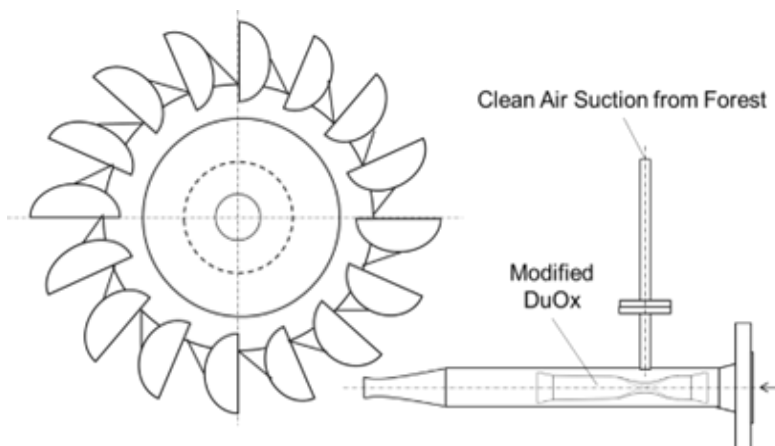


Figure 5: Combined Clarification, Aeration and Hydro Power Generation.

Combined Clarification, Disinfection and Pharmaceuticals Removal

Combined clarification, disinfection and oxygenation of various water matrices including communal and hospital waste water can be executed by feeding ozone instead of air. Table 1 presents a comparison of disinfection of a hospital waste water by OxTube and various present technologies. Bacteria and virus reduction of 100 percent was achieved together with clarification and oxygenation of over 20mgO₂/L by OxTube Machine. Ozone residues were measured negligible [6].

OxTube efficiency in removal of pharmaceutical residues from a city waste water is presented in Table 2 including comparison to two present modern systems. About 90 percent of these residues

were split, clarified and removed only by one run through OxTube Machine to an open vessel without any filters [6]. Two runs result 99 percent reduction. The city waste water was clarified, disinfected and oxygenated at the same time with removal of the drug residues. There are many chemicals used decades and led in to the nature and food chains like DDT, aldrin, chlordane, chloroform, bromoform and hexachlorobenzene. OxTube clarification in tube condition might be able to remove these hazardous chemical residues due to the chemical similarity to pharmaceuticals (Tables 1, 2).

Combined Clarification, Radon Removal and Aeration

According to common understanding the best ways to remove radon from water are with granular activated carbon, various aer-

ation methods and in many cases water distilling [7]. However, only OxTube Machine was able to remove Rn out of ground water in an invitational competition in The Philippines. Water Treatment Unit in Figure 4 facilitated with compressed air blow are applied in ground water intake at four water plants. Performance of the Rn

removal can be seen in Table 3 [8, 9, 10]. The intake water is clarified and aerated at the same time with Rn removal. In principle other radioactive residues could be removed from cooling water of a nuclear power plant (Table 3).

Table 1: Comparison in disinfection efficiency / Savonia University of Applied Sciences in Kuopio.

Disinfection Comparison of OxTube Ozone and UV based on THL Reports 2017 - 2019									
Disinfection Method	Q L/h	E.coli Initial PMY/ml	E.coli Finish PMY/ml	Reduction %	MS2 Intial PFU/ml	MS2 Finish PFU/ml	Reduction %	O ₃ Res mg/l	O ₂ mg/l
OxTu-beDN25 Ozone	900	2500000	<0,001 (ML)	100	870 000	<2 (ML)	100	0,07	>20
UV 19mJ/cm ²	900	3 100 000	17 000	99,452	430 000	130 000	69,767		
UV - 29 mJ/cm ²	500	3 100 000	93	99,997	430 000	35000	91,860		
LED-UV	900	2 800 000	400 000	85,714	3 600 000	2 100 000	41,667		
LED-UV	500	2 100 000	210 000	90,000	3745455	1800000	55,605		
UV +PAA	500	2400000	1700	99,929	3 000 000	730 000	75,667		
LED-UV + PAA	500	2400000	1	100	3 000 000	120 000	96,000		
OYA 1 mg/l		2 100 000	<0,12	100	750 000	30 000	96,000		
OYA 0,3 mg/l		2 100 000	2900	99,862	750 000	45 000	94,000		
OxTu-beDN25 Air Suction	900	2500000	1700000	32,000	870 000	340 000	60,920	0,02	11,65

Table 2: Removal of pharmaceuics of 35 from the purified city waste water of Kuopio Finland by OxTube Machine within a second including comparison to two present method [6,2,3].

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

Table 3: Radon gas removal by two WTUs with compressed air and Boosters from a ground water intake [8,9,10].

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 %	Acceptance
		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	

Combined Water Clarification, Disinfection and Particle Removal by Flotation

OxTube Machine functions well in flotation systems. OxTube generates a lot of bubbles and even mixture of water and bubbles in the tube condition as illustrated in Figure 6. Collision probability of particles and bubbles is high following with great particle attachment in the tube condition before the flotation cell [11,3]. Two head vortex flow of water with even bubble mixture is generated in flotation cell that improves particle attachment and extents bubbles path to surface [11,2,3].

Water clarification, disinfection, oxygenation and particle removal by flotation can be combined by feeding mixture of ozone and air through the OxTube Machine. Calcium removal and pH control are completed successfully by CO₂ feed and lamella attachment [12,13]. Consumption of CO₂ has reduced in to 1/5 and Ca removal improved significantly in the best case. The flotation cell size is reduced significantly compared to a straight flow flotation with diffusers. Chemicals can be fed directly in OxTube Machine which is a superior mixer, too. Capital and operational costs are reasonable low [11] (Figure 6).

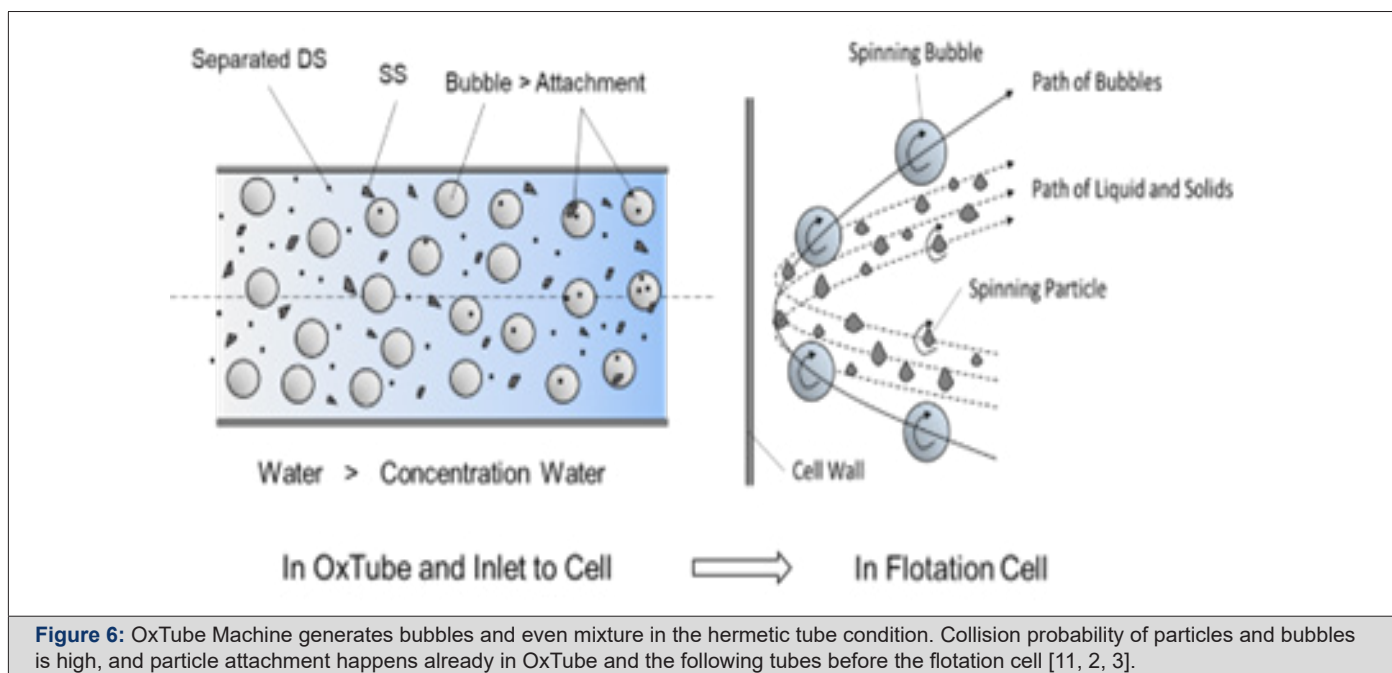


Figure 6: OxTube Machine generates bubbles and even mixture in the hermetic tube condition. Collision probability of particles and bubbles is high, and particle attachment happens already in OxTube and the following tubes before the flotation cell [11, 2, 3].

Natural Waters

The present waste water treatment systems are centralized. Used water is pumped hundreds of kilometers to the treatment site underground, and further to lakes and seas. Pollution load of waters has increased and became more hazardous particularly in population centers. Energy consumption of waste water treatment has increased but it is deficient. Evaporation is reduced tragically which means significant loss of climate cooling capacity in the globe. Further, the waters are warmed by various process cooling systems, e.g. nuclear power plants, data centers, foundries and steel factories. It's urgent to refresh waters and food chains as well as to

improve waste water treatment so that it can be returned to the nature by spraying it on ground, plants and solar panels for evaporation and local cooling.

Two examples are presented in Figures 7 and 8 just giving an idea how easy it could be. Water clarifier ClariOx has all the functions of OxTube Machine. The combined water clarifier and fountain performs water clarification, landscaping and cooling by coherent water-air spray. Both of the examples are easy to install and movable. Their energy consumption is found negligible. Fast recovery of lake waters and related food chains is identified and convinced in real installations and trials [14,15,16] (Figures 7, 8).

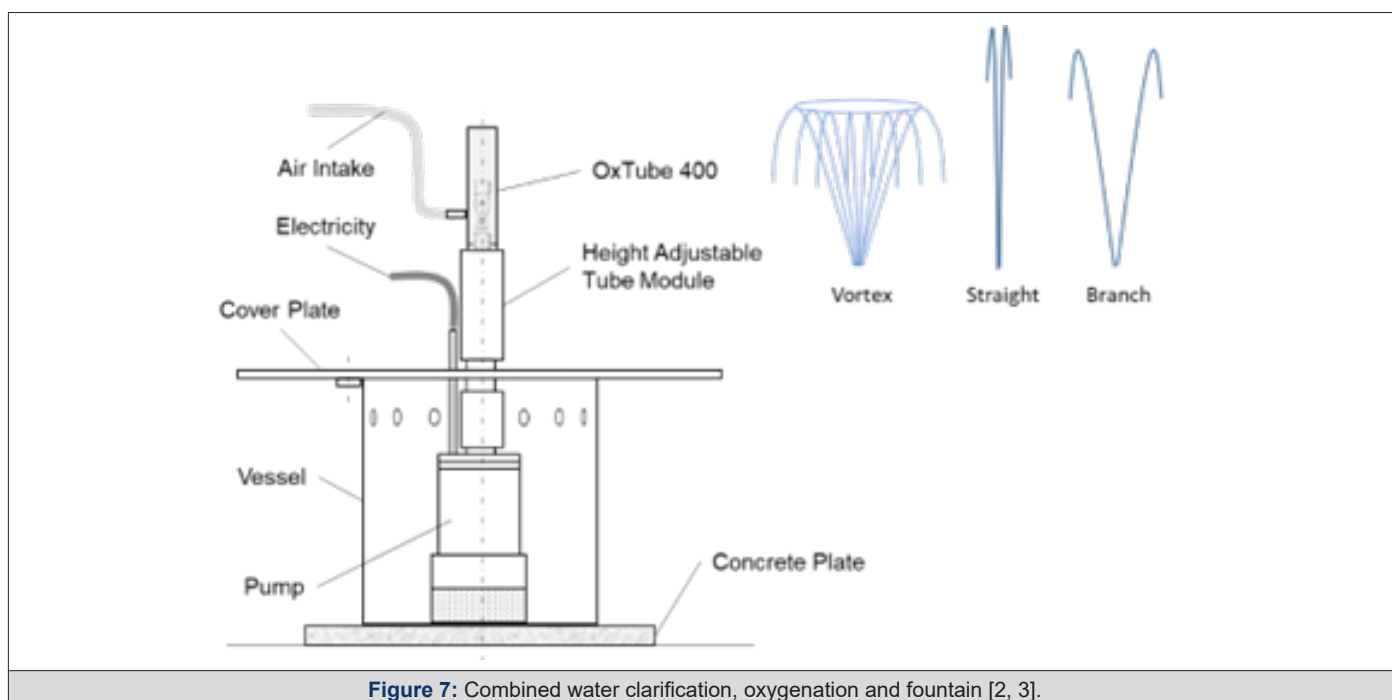


Figure 7: Combined water clarification, oxygenation and fountain [2, 3].

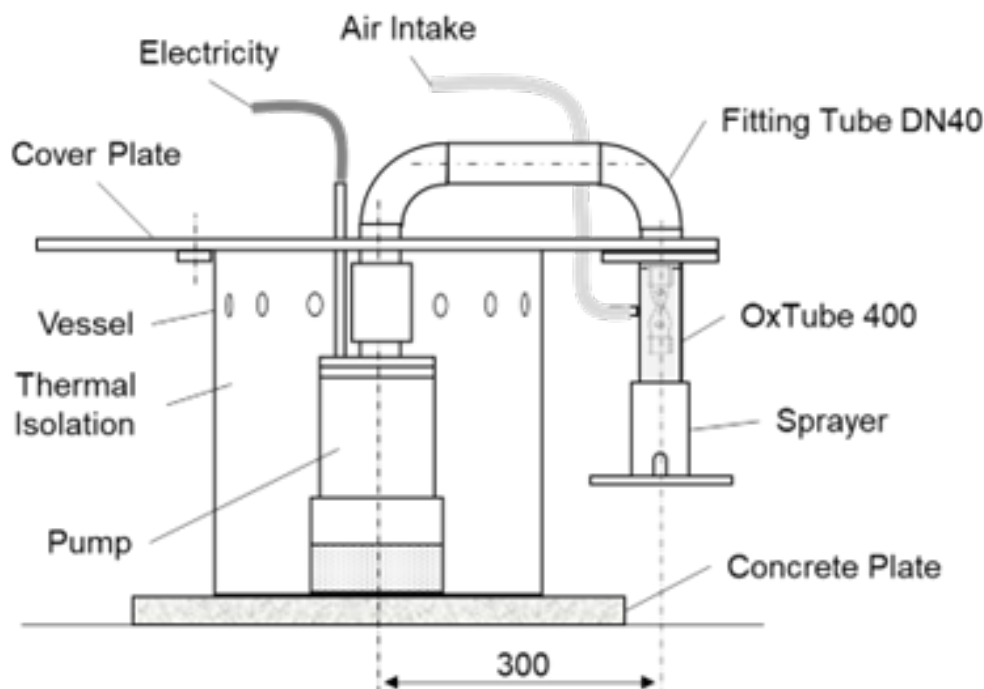


Figure 8: ClariOx clarifies and refreshes waters by clean air without chemicals. Energy consumption is little [2, 3]. It consists of the same main parts as the fountain in Figure 7.

Further, the tube water clarification can be applied in all kinds of water transport vehicles without any additional energy consumption. Kinetic energy of the vehicles in motion can be used for the treatment. Flow resistance can be kept the same or even reduced by proper design. A ship would clarify sea water in depth of 4 meter over 200 000 cubic meter a day when cruising [2,3].

Air Impacts Transfer on Tissues in Wet Contact

OxPro down scaled from OxTube treats the water in flowing condition in its hermetic tube. It splits molecular and ionic structures, activates and separates soluble ingredients in the water, and replaces these by air gases that are sucked by vacuum in the nozzle

zone. The water is clarified and air gas dissolved as seen in (Figures 2, 9).

Health and wellness impacts of the OxPro treated water are discussed briefly in reference [3]. Over 500 individuals and professionals have been used so far OxPro treated Water for various tissue diseases and orally in order to improve metabolism. The treated Water transfers impacts of clean air immediately in to tissues like skin, nails and hair, and orally to metabolism in the wet contact, Figure 10. Further, surface tension of the water treated is reduced which enhances the interaction between the water and bio tissues (Figures 9, 10).



Figure 9: Demonstration of OxPro Tap with Swiss household water. Separation of dissolved ingredients and molecular activation without air suction on the right, and integrated clarification on the left. OxPro Tap is shown in the middle [3].

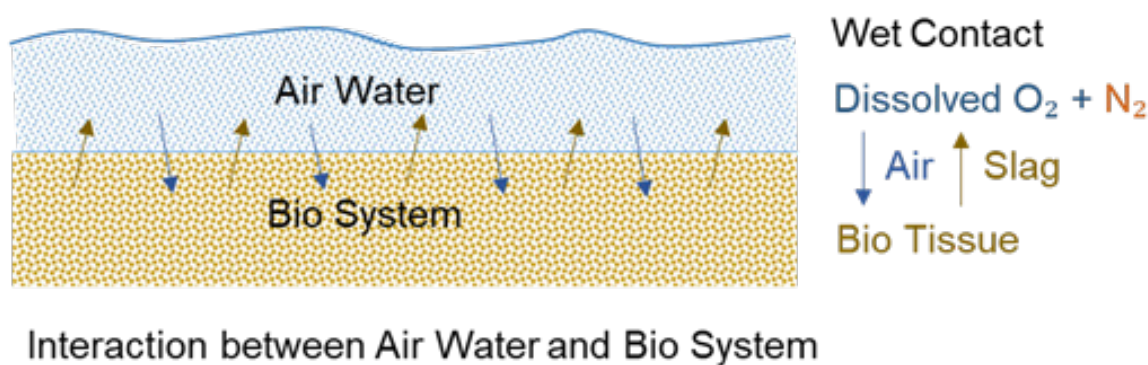


Figure 10: Transfer of Air Impact in to bio tissues in wet contact.

The cat in Figure 11 enjoys every day OxTube clarified test water. She finds and drinks always only clarified test water although it is hard to reach (Figure 11).



Figure 11: Cats involved select always the OxTube Clarified water even it is hard to catch.

Summary

OxTube Water Clarification in tube condition has been applied successfully in removal of pharmaceuticals, radon, calcium, manganese and iron from various water matrices, and disinfection with ozone of a hospital waste water. Pharmaceutical residues in total over 20µg/l were removed 90 percent by OxTube Machine with Clarification and Disinfection within a second in one through run [6]. Two through runs result 99 percent reduction. Radon removal from 57 to 8Bq/l is achieved continuously in five installations of ground water intakes at four Water Plants. Disinfection of a hospital waste water with ozone resulted 100 percent microbe reduction, and clarification and oxygenation of the waste water at the same time. Microbe growth and variation is reduced with just clean air suction and eliminated with ozone feed. Combined disinfection and drug removal in tube condition doesn't cultivate resistance of viruses.

Hybrid and decentralized waste water treatment should be

carefully considered instead of centralized one with good reason [1]. In principle the wastewater can be clarified by OxTube in sewage drain on the way back to the nature. However, it's definitely a better way to clarify waste water combined with other water systems promoting recycling and evaporation cooling.

The tube clarification should be started at all the water intakes already due to fact that waters content already too much waste, drug residues, radon and micro plastics. Seas and oceans - refuse dumps of the water cycle - can be refreshed by integrating OxTube Machines in ship structures. A cruising ship can clarify sea water of 200 000 cubic meter a day without additional fuel consumption. OxTube can be integrated in hydro power generation as shown in Figure 5. It's urgent to refresh waters and food chains as well as to improve waste water treatment so that it can be sprayed on ground, plants and solar panels for evaporation and local cooling. Combined water clarification with other water systems saves nature and money.

During the research and test runs in product development the clarified water was found a bit slippery and its surface tension reduced. Significant impact on skin, hair and nails, and taste and mouth hygiene as well was identified. Further, eczemas and various wounds recovered fast without additional medical care, and signs of metabolism improvement was reported by people and professionals. Pure air and water have certain health features, and mixing and dissolving these deeply together the healthy impacts and transfer speed are multiplied in wet contact.

Conflicts of Interest

None.

Acknowledgements

None.

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