

OxTube Water Clarification

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Abstract

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 industrial and agricultural processes. Water gets rid of the load by evaporation powered by the sun, and leaves it 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 and algae, and low oxygen.

The natural water cycle is the largest transportation and climate cooling system in the globe powered by the sun. A lot of evaporation cool has lost by extension of civilization, open area building and construction, and underground sewerage systems. Wastewater is pumped underground thousands of kilometers to concentrated waste water plants and further to waters. The natural water cycle as well as photosynthesis is shrunk significantly.

OxTube water clarification separates the load from the water such a way that the most of it can be removed and recycled. The clarification is hermetic and consists of four seamless phases; (1) separation of dissolved ingredients, (2) molecular activation, (3) clarification reactions, and (4) replacement dissolving of air or other gases. It separates dissolved gases like radon, carbon dioxide, hydrogen sulfide and hydrocarbon, and dissolved solids like iron, manganese, calcium, fluorine and phosphorus. The molecules are activated and clarification reactions happen immediately by suction of clean air, oxygen or ozone. The clarified water is aerated or oxygenated right after the clarification. All this happens within a second or few seconds depending on water volumes to be clarified. Disinfection of 100 percent microbe reduction can be completed and microbe growth eliminated by ozone feed in the tube combined with the clarification. OxTube can be integrated in various water systems like fountains, flotation, hydro power generation, ships, boats and rivers.

Keywords: Wastewater Treatment; Water Clarification; Water Disinfection; Water Recycling; Particle Separation; Pharmaceuticals Removal; Radon Removal

Introduction

Present wastewater treatment needs a new perspective and environmental respect. In the present water cycle the seas and oceans can be seen as rubbish dumps. Rain, snow and waste waters with their load are led as fast as possible in to these rubbish dumps through the huge underground sewer network, and snow by dumpers. Climate cooling by water evaporation is reduced significantly. Water and ingredients recycling is little. In spite of power consumption increase in waste water treatment results unsatisfied outcome.

Further, the sewer network causes serious floods and additional load. Many serious problems, disasters and serious microbe growth can be avoided by the OxTube water clarification and wide area water buffers with solar evaporation. Further, capacity of photosynthesis can be increased together with restoration of the natural water cycle.

OxTube water clarification process, design criteria, related devices and some practical case studies are presented here. The clarification consists of four seamless treatment phases as follows:

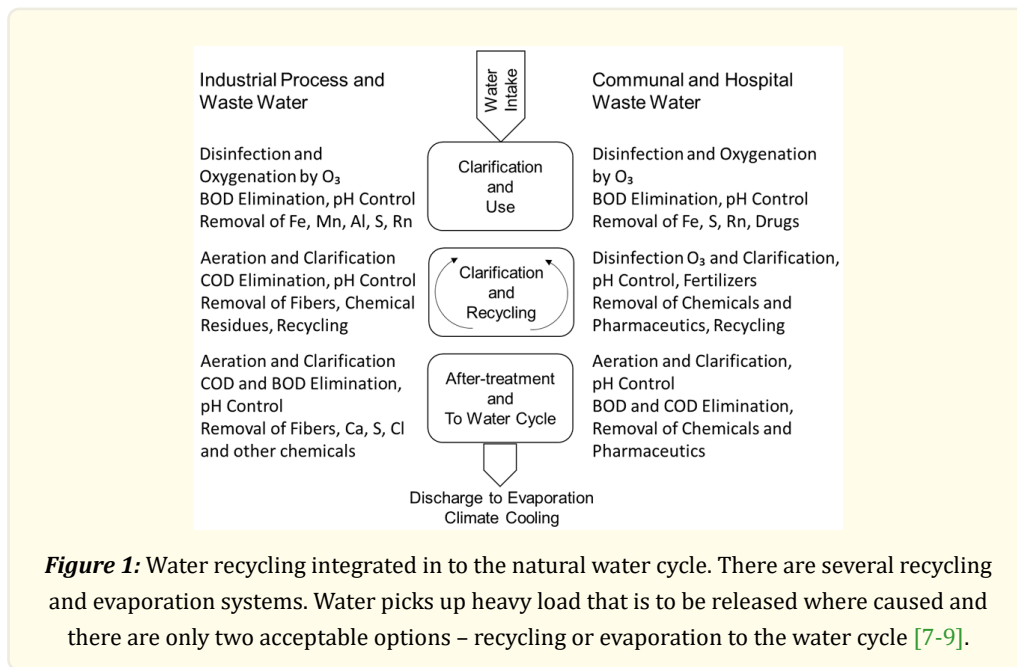
1. Separation of dissolved ingredients.
2. Activation of molecules.
3. Clarification reactions and disinfection.
4. Replacement dissolving.

Bubble generation is identified to be great and evenly contributed in water flow in the tube as shown in Figures 3 and 4. Particle attachment can be initiated in the tube and completed in a flotation cell. In case of refreshing natural waters the water in concern functions as flotation cell as shown in Figure 16. Bio mass attached on bubbles rises on to the surface.

There have been and are still the following main guiding principles on the product and application development, and related research:

- Water itself is a pure substance that picks up easily heavy load and it can be purified by releasing the load.
- Water is present everywhere and it performs the largest transportation system in the world.
- The clarification is to be well controlled and hermetic.
- The water purification is to be combined with other water processes like together with a hydro power, fountain and cruising ship.
- The treated waste water is to be discharged in to the natural water cycle in the way of climate and nature wellness
- Water recycling is to be maximized in use with the lowest energy consumption and heat generation.
- The treated waste water is to be reused for climate cooling like solar evaporation.
- The solution is to be economically competitive and its life cycle concerned.
- Natural energy, e.g. potential and direct solar energy is to be utilized.

Figure 1 summarizes the development principles [7-9]. The OxTube Clarification fulfils these development and design principles in several areas but it needs further development and research in many challenging applications. Separation of dissolved ingredients functions well but to remove these is challenging in certain substances like chlorine and salt.



OxTube Machine

In order to optimize the total solution according to challenging customer needs and concerns of various water matrices a modular structure of the system is applied. The same modules are applied in various contexts and customer satisfaction with nature respect.

OxTube Machine is the key module in the integrated clarification with low power consumption. The treatment doesn't need any additional energy, but side processes like ozone generation, chemicals dosing and instrumentation might need power. Some solutions installed in pressurized piping might need compressed air. However, this is possible to avoid by the system design.

OxTube Machine performs seamlessly the following clarification phases:

- Separation of dissolved ingredients (Figure 2).
- Activation of molecules (Figure 2).
- Suction of clarification gases like clean air, and possible chemicals (Figure 3 and 4).
- Performance of clarification reactions (Figure 2 right).
- Replacement or post dissolving of desirable gases and substances.
- Generation of gas bubbles for flotation improvement (Figure 4).

Separation of dissolved ingredients and molecular activation can be seen in Figure 2 left when the water is led through OxTube without air suction. Separated gases causes smell and solids are seen white fine particles. Molecular activation generates light bubbling and gaseous smell. Immediate clarification can be seen by air suction in to the activated water. The combined clarification with air suction is completed within less than a second in Figure 2 right. The fine TDS can be removed by simple filtering just after the separation and activation.

Upper photo of Figure 3 shows visually the even mixture of water, separated ingredients and air in the Tube. The even mixture is seen foggy in white. Its gravity is much lower than the intake water matrix. Gravity reduction in the nozzle zone could be 1/10 of water.

Collision probability of molecules, particles and bubbles is extreme high. Lower photo of Figure 3 shows the water flow when the air channel is closed. No turbulences nor cavitation are seen.

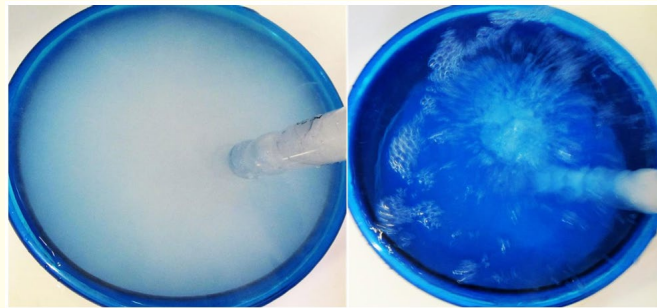


Figure 2: Efficiency of OxTube Clarification with air suction; Left Fine TDS separation and molecular activation of Swiss Alpen household water of 24°C, right the combined clarification with air suction at the same condition within less than a second. Fine particles stick in bubbles. The white separated TDS can be removed by a simple filtering just after the fine TDS separation.

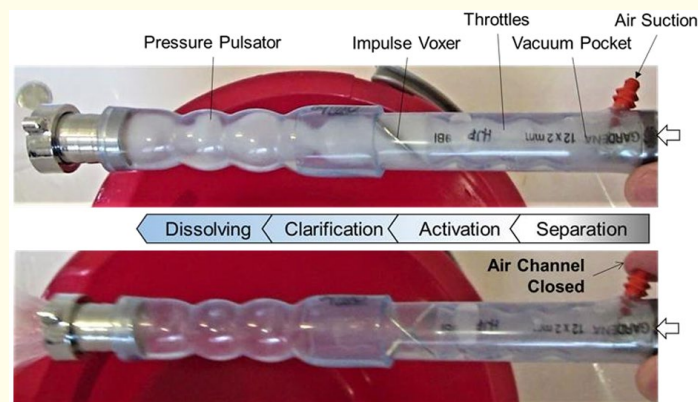


Figure 3: OxTube Integrated Water Clarification illustrated visually with air suction. The clarification is performed within less than a second [4, 7-9].

Bubble generation and mixing with the water is visualized in Figure 4. Height of the outtake spray increases nine times when the air channel is open. Gravity of the mixture turns respectively light in the nozzle. The spray of the mixture stays coherent all the way up which is an essential feature of OxTube Machine.

Figure 5 shows the oxygenation efficiency of OxTube at early stage development [1]. Since 2016 separation of dissolved ingredients has improved and gas suction increased by factor of 5. Losses are measured today in terms of mass flow due to huge gravity drop and change from incompressible to compressible liquid in the nozzle zone. The mass flow losses are measured to be less than 2 percent.

OxTube Machine is presented in Figure 6. It consists of DuOx Nozzle, air suction nipple, suspension chamber, outer tube and flanges. In the small sizes the flanges are replaced by standard thread fittings. All the fittings are metal-to-metal tight fits, there are no individual seals. Welding is minimized, only the flanges have to be welded to the outer tube. The structure is very compact and easy to keep in good condition.

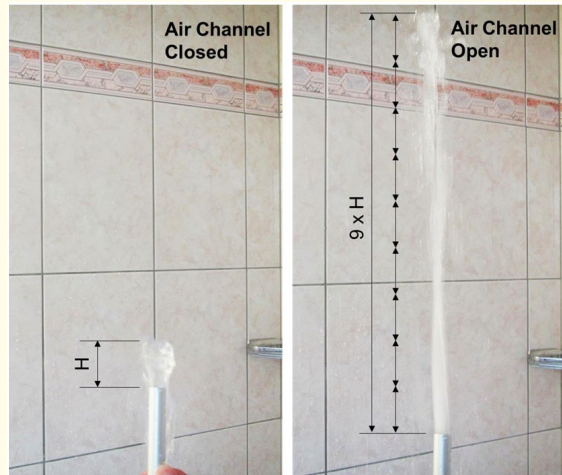


Figure 4: Performance of OxTube Machine in gas suction and mixing as well in clarification and replacement dissolving is great and efficient. No additional energy is needed in the clarification. Height of the mixture is nine times higher than the plain water has in the exact same condition of water intake [7-9].

OxTube Machine is easy to modify and optimize for various water matrices and treatments. Figure 7 shows the Machine modified to realize heavy gas removal and water clarification in one. There is a booster nipple for pressured air feed that removes separated heavy gases like radon and carbon oxide.

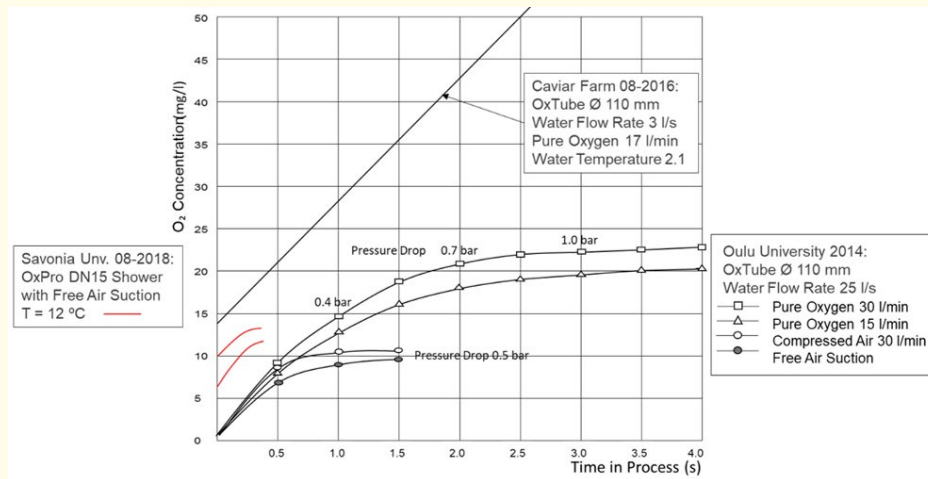


Figure 5: Oxygenation efficiency of OxTube in early stage development [1].

There are many other possibilities to figure various combinations of the modules in order to create the best solution to meet environmental and economical requirements.

Clarification, disinfection and oxygenation of a water matrix can be combined in one OxTube by ozone or mixture of ozone and air feed. The growing environmental problems, microbe variation and growth, and drug residues, are eliminated at the same time with water clarification.

Details of DuOx Nozzle is not presented here due to its dedicated structure that is to keep in secrecy. It's the active element of the integrated clarification. Its functional features are presented above in this chapter.

OxTube Machine separates dissolved ingredients but to remove them from the mixture needs further attention. As said OxTube Machine generates huge amount of overdosed bubbles by gas suction which can be used for flotation (Figure 11). 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, it's like a build-in feature. Particle attachment happens in OxTube and Fitting Modules before the flotation cell, and efficiency is improved all over [2, 3, 6]. Compressed air and diffusers can be eliminated when OxTube Machine is applied.

Of course, all the filtering methods can be applied in particle removal after the integrated clarification.

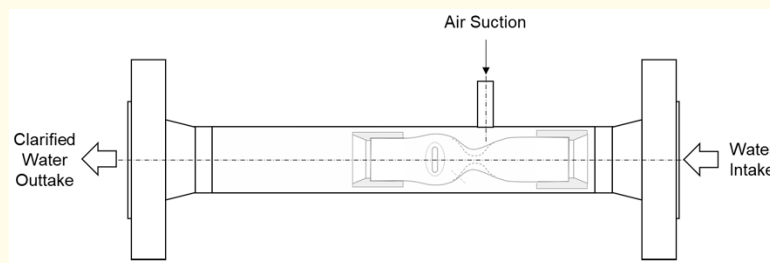


Figure 6: OxTube Machine with gas and chemicals suction is compact including standard fittings. It can be installed in various water treatment systems. Pressure norm is up to PN40 [7-9].

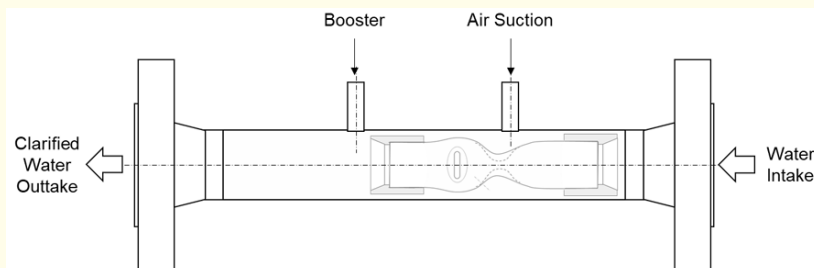
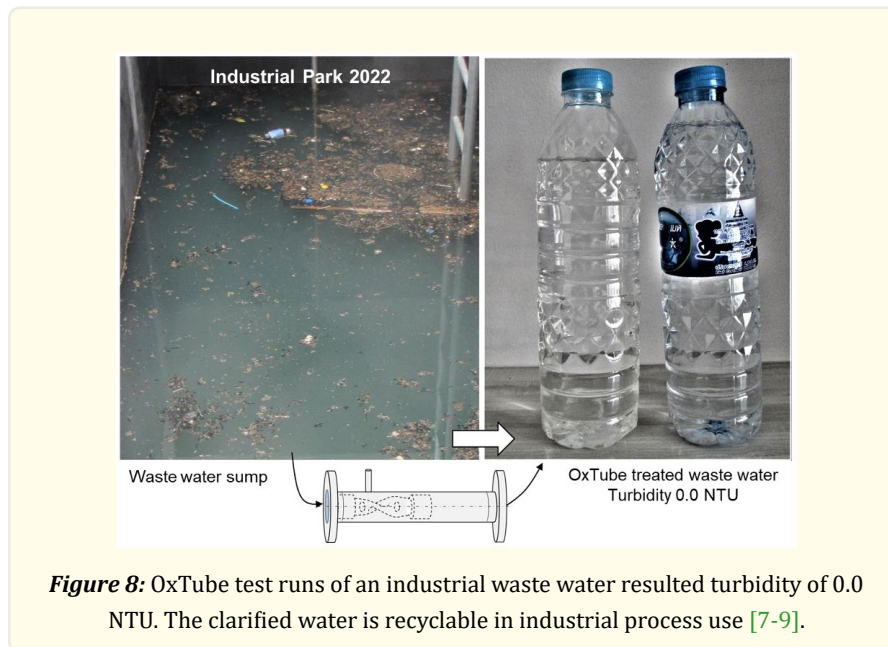


Figure 7: OxTube Machine with suction and booster nipple. The module is the same as in Figure 6 added by Booster nipple [7-9].

Figure 8 shows the efficiency of the OxTube clarification according to a hundred real test runs completed with an industrial waste water. Turbidity of the clarified waste water turned to 0.0 NTU within retention of 30 minute. 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 needs further investigations and verifications. For sure, potential to fulfil all the water quality issues exists. Disinfection would be performed with ozone and pH control with CO₂ easily.

Chemical residues can be removed by the OxTube clarification as verified already or by additional filtering.



Water Treatment Unit

There are many ways and combinations to apply the OxTube water clarification technology and removal of the separated water load. The basic Water Treatment Unit called WTU is presented in Figure 9. It consists of OxTube Machine, Gas Removal GasRemox and Fitting Module. It is developed for industrial process waters, intake water from lakes and groundwater wells, and pre-treated communal waste waters as post clarification. All kinds of OxTube Machines and modular combinations can be applied in WTU. Only the most challenging water clarification cases are presented here.

Disinfection of various water matrices including communal and hospital waste water can be disinfected by feeding ozone instead of air. Table 1 presents results in the case of disinfection of a hospital waste water. Microbe reduction of 100 percent was achieved together with clarification and oxygenation of over 20 mgO₂/l. Further, pharmaceutical residues can be eliminated by two through runs.

OxTube efficiency in removal of residues of pharmaceuticals and some chemicals from a city waste water is presented in Table 2 including comparison to two present systems. Pharmaceutical residues are a fast growing disaster in natural waters and ground. 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. Two runs result 99 percent reduction. The city waste water was disinfected, clarified and oxygenated at the same time with removal of the drug residues. The present waste water purification systems separate only 1/4 of OxTube performance. Removal of drug by the present systems and filtering leads residues to ground or back to waters which is not acceptable. There are many chemicals used decades and led in to the nature and food chains like DDT, aldrin, chlordane, chloroform, bromoform and hexachlorobenzene. The present treatment systems in use are not able to eliminate these chemicals similar to drug residues.

Heavy gas removal facility is presented in Figure 10. It is applied in radon gas removal in intake of ground water. Performance of the Rn removal can be seen in Table 3. Two WTU facilities with a compressor were installed in the present ground water intake after the pump. The intake water is clarified and aerated at the same time with Rn removal.

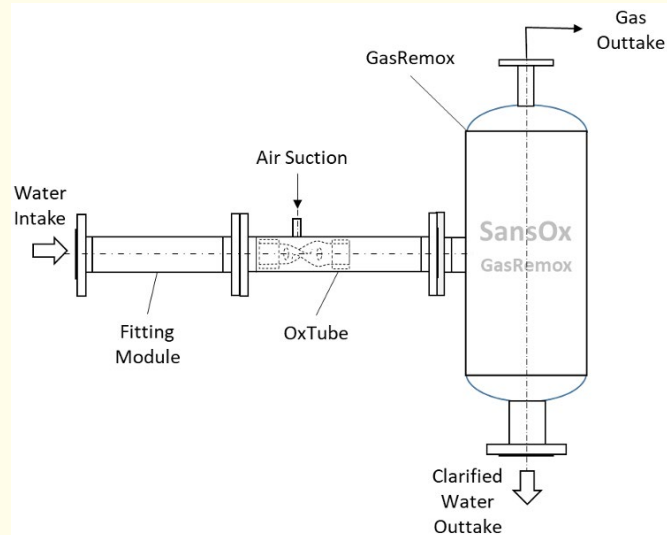


Figure 9: Water Treatment Unit for the most of water integrated clarification cases. It consists of OxTube Machine, Gas Removal GasRemox and Fitting Module. Microbe reduction of 60 percent was achieved with air suction and reduction of 100 percent with ozone feed [7-9].

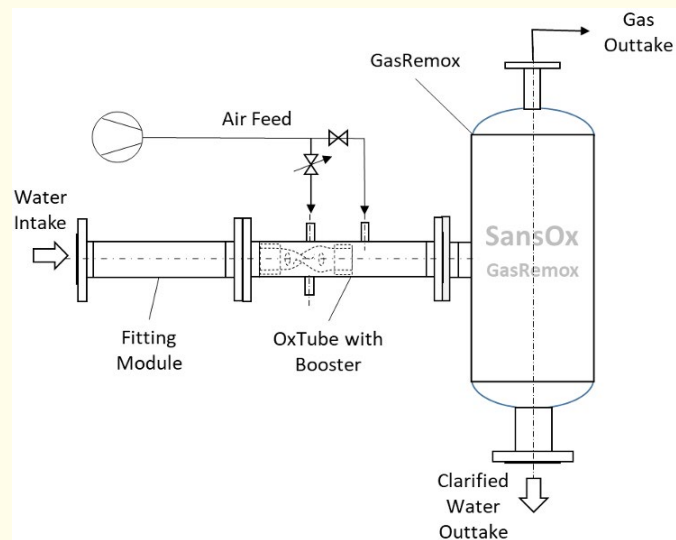


Figure 10: Water Treatment Unit of heavy gas like Rn and CO₂ removal. It consists of OxTube Machine with Booster, Gas Removal GasRemox and Fitting Module. Compressed air is used in separation, heavy gas blow-up and water clarification [7-9].

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	Turbidity 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

Table 1: Disinfection efficiency of the Combined Water Clarification of OxTube: 100 % Reduction of E.coli and MS2 achieved with O₃ feed of 2 l/min within 0.7 second, oxygen concentration raised over MR 20 mgO₂/l, no significant ozone residues / Savonia University of Applied Sciences in Kuopio [5].

Pharmaceutics and other substances	OxTube Ozone Treatment			Present Method 1		Present Method 2	
	Initial µg/l	Residue µg/l	Reduction %	Residue µg/l	Reduction %	Residue µg/l	Reduction %
Cetirizine	5,8	0,006	99,9	4	<20	4	<20
Benzotriazole	2,8	0,896	68	1	63	2	<20
Furosemide	1,8	0,054	97	1,4	<20	1,4	<20
Hydrochloricazide	1,8	0,162	91	1,4	<20	1,4	<20
Diclofenac	1,5	0,004	99,7	1,2	<20	1,2	<20
Lamotrigine	1,4	0,756	46	1,1	<20	1,1	<20
Losartan	1,2	0,005	99,6	1	<20	1	<20
Losartan	1,2	0,246	79,5	0,7	<20	0,7	<20
5-methylbenzotriazole	0,83	0,191	77	1,4	<20	1,4	<20
Diatrizoate	0,70	0,147	79	0,6	20	0,5	<20
Atenolol	0,56	0,118	79	0,42	<20	0,35	22
Carbamazepine	0,53	0,048	91	0,4	<20	0,4	<20
Clozapine	0,53	0,053	90	0,4	<20	0,4	<20
Bisoprolol	0,50	0,105	79	0,1	77	0,4	<20
Tramadol	0,43	0,043	90	0,3	<20	0,3	<20
Citalopram	0,42	0,013	97	0,2	<20	0,2	<20
Piperacillin	0,29	0,009	97	0,32	48	0,2	<20
4-acetamidoantipyrine	0,29	0,015	95	0,15	21	0,15	<20
Azithromycin	0,20	0,012	94	0,14	<20	0,14	<20
Mirtazapine	0,17	0,006	96,4	0,08	31	0,11	<20
Atorvastatin	0,14	0,013	91	0,09	55	0,09	66
Propranolol	0,11	0,010	91	0,09	<20	0,09	<20
Quetiapine	0,11	0,006	95	0,08	<20	0,08	<20
Naproxen	0,10	0,020	80	0,07	<20	0,07	<20
Desloratadine	0,081	0,022	73	0,1	25	0,09	33
4-formylaminoantipyrine	0,077	0,022	71	0,04	52	0,06	<20
Bezafibrate	0,069	0,014	79	0,01	78	0,05	<20
Fluvastatin	0,068	0,011	84	0,07	26	0,08	<20
Metronidazole	0,064	0,035	45	0,04	23	0,05	<20
Sotalol	0,064	0,010	84	0,06	<20	0,06	33
Sulfamethoxazole	0,063	0,011	83	0,05	<20	0,05	<20
Ketoprofen	0,059	0,042	28	0,03	62	0,02	80
Sertraline	0,05	0,011	79	0,03	<20	0,03	<20
Sulfadiazine	0,042	0,013	70	0,03	<20	0,03	<20
Clarithromycin	0,033	0,011	68	0,03	<20	0,03	24
Ramipril	0,031	0,008	74	0,02	<20	0,02	<20
Amiloride	0,023	0,014	38	0,01	<20	0,01	<20
Roxithromycin	0,008	0,003	62	0,01	<20	0,01	<20
Xylometazoline	0,013	0,002	86	0,006	<20	0,006	<20
Warfarin	0,007	0,020	<20	0,02	24	0,02	<20
Caffeine		0,018	<20	0,018	<20	0,011	52
Verapamil		0,010	<20	0,01	<20	0,01	24
Total Drug Emission Load Reduction	24,162	3,202	86,75	17,194	28,83	18,317	24,18

Table 2: Removal of pharmaceutics and some other substances from the purified city waste water of Kuopio Finland with OxTube Ozone. Microbe reduction of 100 percent, removal of pharmaceutics of 90 percent and oxygen concentration of over 20 mgO₂/l were achieved within a second [4].

Water Flow	Date of Sample	Monitoring Data					Raw Water	Treated Water	Rn Removal Bq/l		
		Pressure psi							Reduction Bq/l	Reduction %	Acceptance
		Pump out	OxTube 1	OxTube 2	Distr. Line	Δ					
62.5 m ³ /h	1809-19	60	52	48	60	0	55	9	46	83.6	Passed
	1909-19	60	52	48	60	0	50	8	42	84.0	Passed
	2309-19	60	52	48	60	0	53	4	49	92.5	Passed
	2409-19	60	52	48	60	0	52	5	47	90.4	Passed
	2509-19	60	52	48	60	0	51	4	47	92.2	Passed
	2609-19	60	52	48	60	0	47	5	42	89.4	Passed
	3009-19	60	52	48	60	0	43	8	35	81.4	Passed
	0110-19	60	52	48	60	0	52	7	45	86.5	Passed
	0210-19	60	52	48	60	0	45	6	39	86.7	Passed
	0310-19	60	52	48	60	0	47	6	41	87.2	Passed
	0710-19	60	52	48	60	0	57	8	49	86.0	Passed
	0810-19	60	52	48	60	0	56	6	50	89.3	Passed
	0910-19	60	52	48	60	0	50	5	45	90.0	Passed
	1410-19	60	52	48	60	0	42	6	36	85.7	Passed
	1510-19	60	52	48	60	0	52	6	46	88.5	Passed
2810-19	60	52	48	60	0	50	7	43	86.0	Passed	
Requirement							52	11		79.0	

Table 3: Radon gas removal by two WTUs with compressed air and Boosters from a ground water intake [7-9]. The WTU concept is presented in Figure 10.

Combined Water Clarification, Disinfection and Particle Removal by Flotation

OxTube Machine generates a lot of bubbles and even mixture of water and bubbles in the hermetic tube condition as illustrated in Figure 11. It can be integrated in to VoxFlot flotation as shown in Figure 12. Meeting probability of particles and bubbles is high, and particle attachment happens already in OxTube and the following tubes before the flotation cell [3, 4, 6]. Two head vortex flow of water and bubble mixture is generated in VoxFlot flotation cell that improves particle attachment and extends bubbles path to surface. The Bubble Trap speeds the vortex flow and push out a foam with particles on to the water surface. The clarified water is taken out behind the bubble trap where no bubbles nor particles exist.

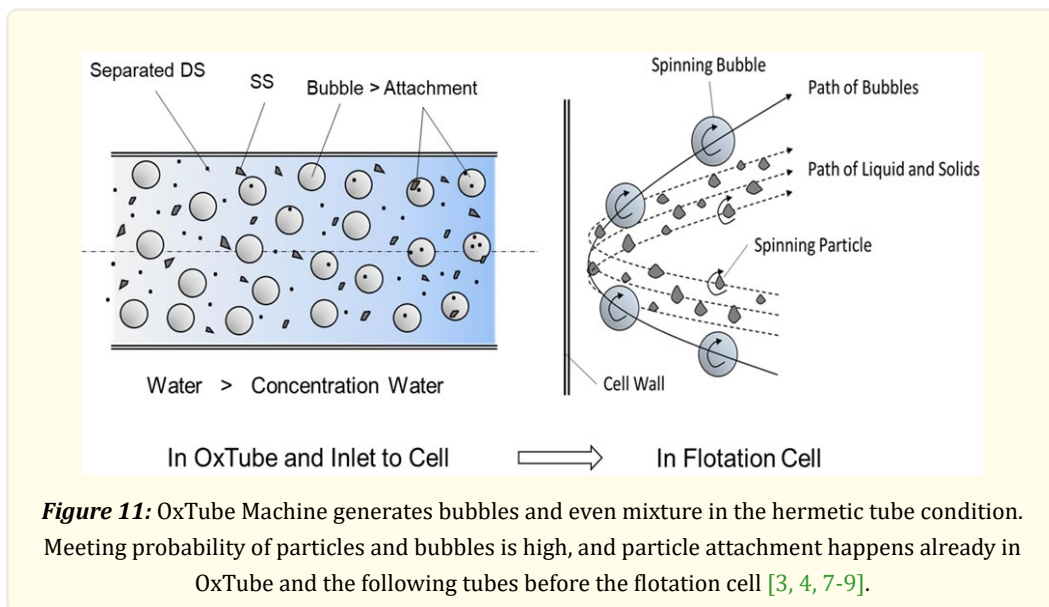
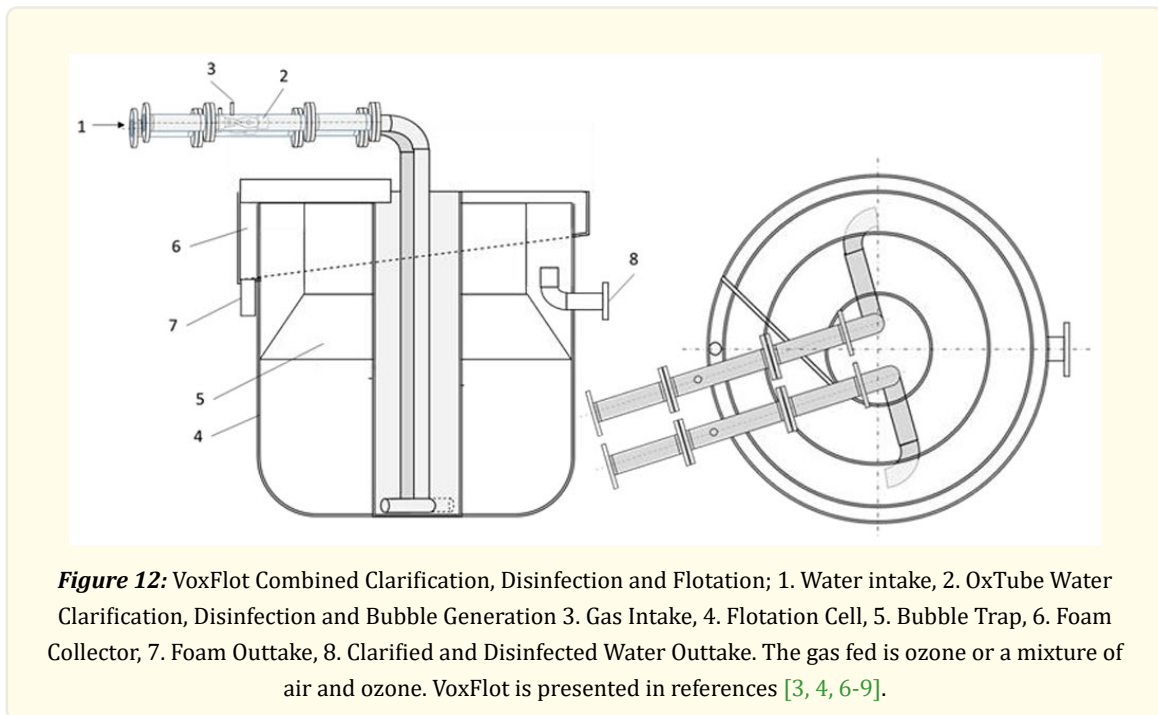


Figure 11: OxTube Machine generates bubbles and even mixture in the hermetic tube condition. Meeting probability of particles and bubbles is high, and particle attachment happens already in OxTube and the following tubes before the flotation cell [3, 4, 7-9].



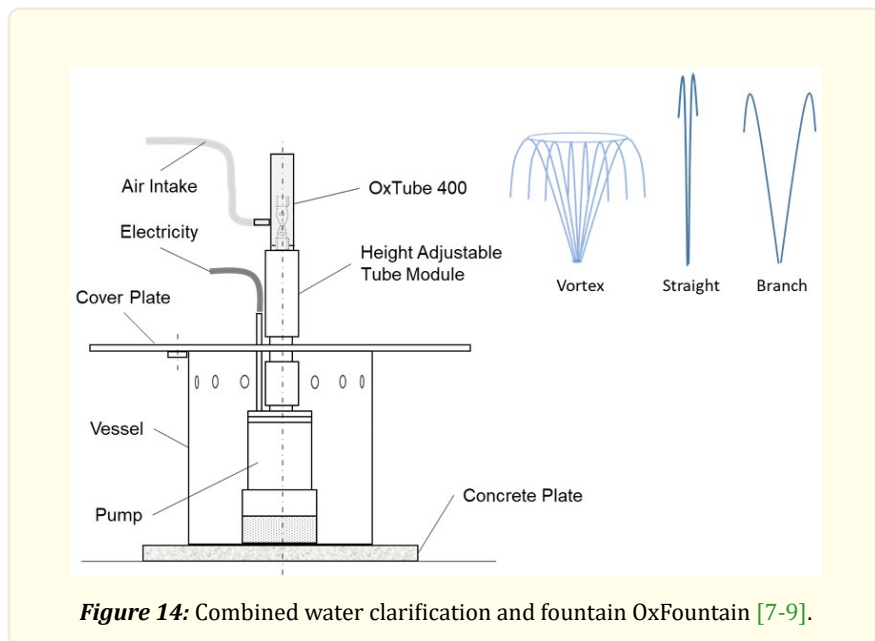
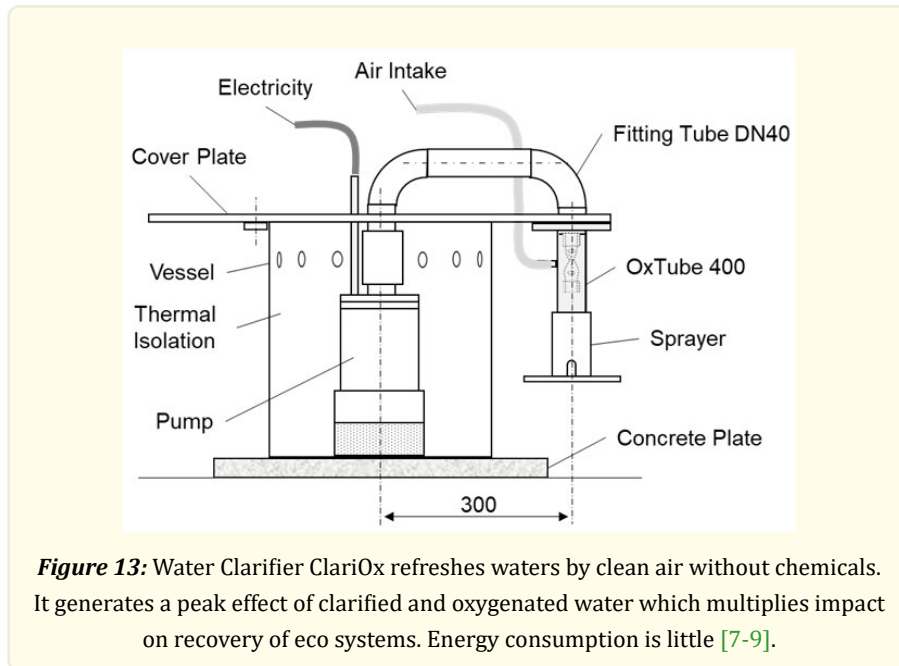
Water clarification, disinfection, oxygenation and particle removal by flotation can be combined by feeding ozone or mixture of ozone and air through the OxTube.

The bubble flow through OxTube Machine and two head vortex flow decrease the unit size significantly compared to a straight flow flotation with diffusers. Chemicals feed if necessary is completed directly in OxTube. Further, there are no rotational components involved. These features means reduced capital and operational costs [6].

Refreshing of Natural Waters

Natural waters are more or less waste water sumps already today. Rivers, channels, dikes and drainpipes function as drains of the nature water cycle. Ponds, lakes and seas function as sewage basins. Pollution load of waters has increased and became more hazardous particularly in population centers where the water and rain are led fast to drains and sewage basins of the water cycle. Energy consumption of waste water treatment has increased significantly but it is deficient. Evaporation area is reduced tragically and concentrated in seas and oceans which means significant loss of climate cooling power, more floods, increased desert area and extreme weather phenomena. It's urgent to refresh waters and food chains, and eliminate new waste load and enhance evaporation area and photosynthesis capacity.

The OxTube Machine and its integrated water clarification presented in Chapter 2 can be utilized easily many ways and positions of the water cycle. Two examples are presented in Figures 13 and 14 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 OxTube water clarification and landscaping by water spray. Both of the examples generate a peak effect of clarified and oxygenated water which multiplies impact on recovery of eco systems. Their energy consumption is found negligible. Figure 15 shows clarification of a lake of 2.3 km² with a smaller clarifier ClariOx than shown in Figure 13 during 2018 and 2020. Fishes and gray fishes are identified to grow bigger and turn brighter in color.



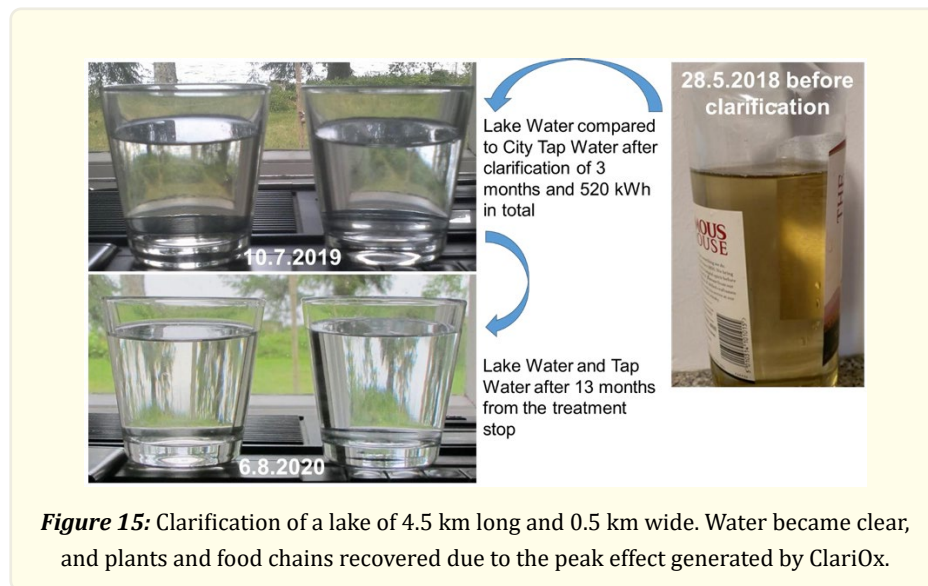
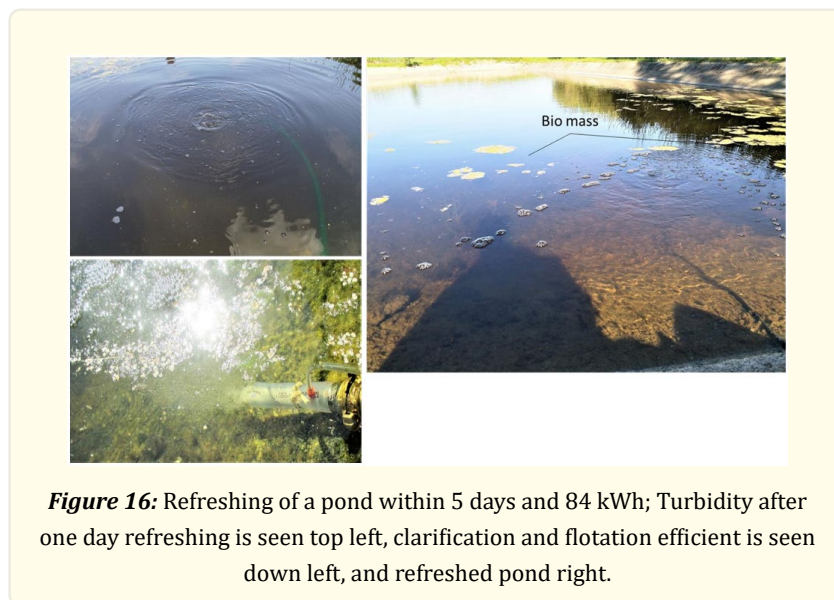
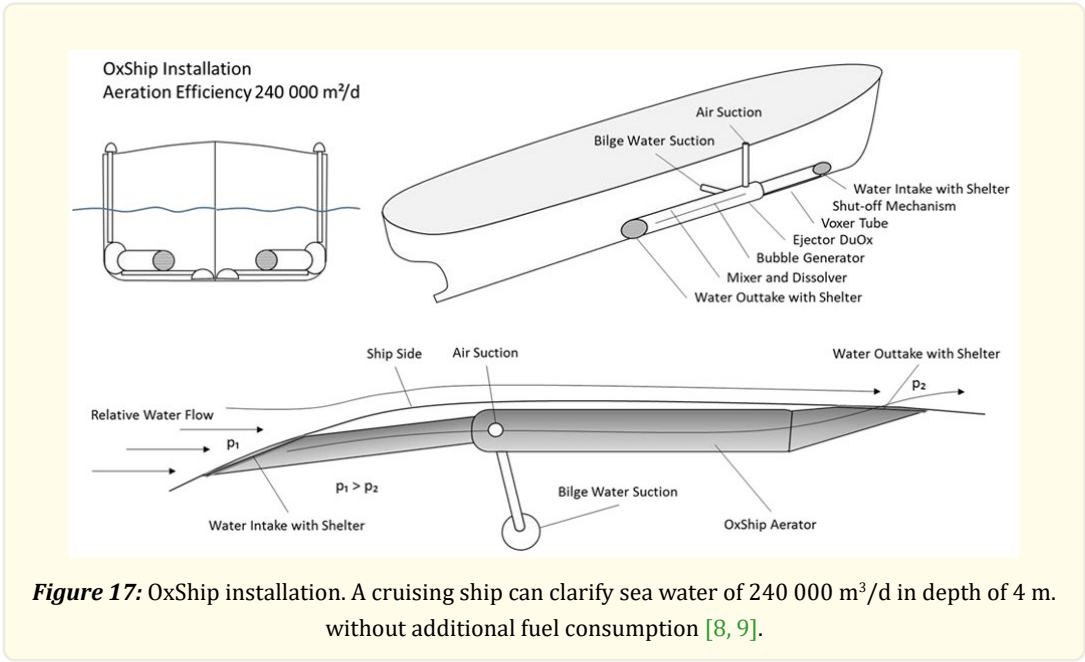


Figure 16 shows fast and low energy consumption recovery of a pond. It illustrates the combined clarification mechanism visually. Bio mass and particles attach on bubbles, rise on to the surface, and water become clean.

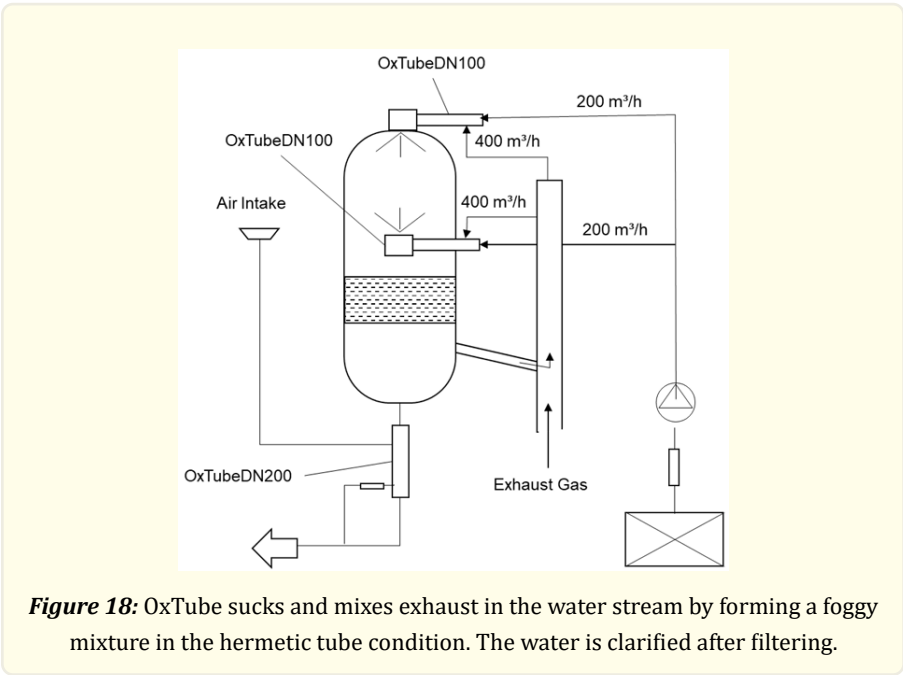


Further, the combined water clarification can be applied in all kinds of water transport vehicles without any additional energy consumption. Kinetic energy of the vehicles in motion can be used for the clarification. Flow resistance can be kept the same or even reduced by proper design and integration. A cruising ship would clarify sea water in depth of 4 meter 240 000 cubic meter a day. Figure 17 shows an integrated ship installation. The combined water clarification can be installed easily in rivers and power plants, too. In this case water flows and the OxTube clarifier stays in place.



Exhaust Collection and Recycling

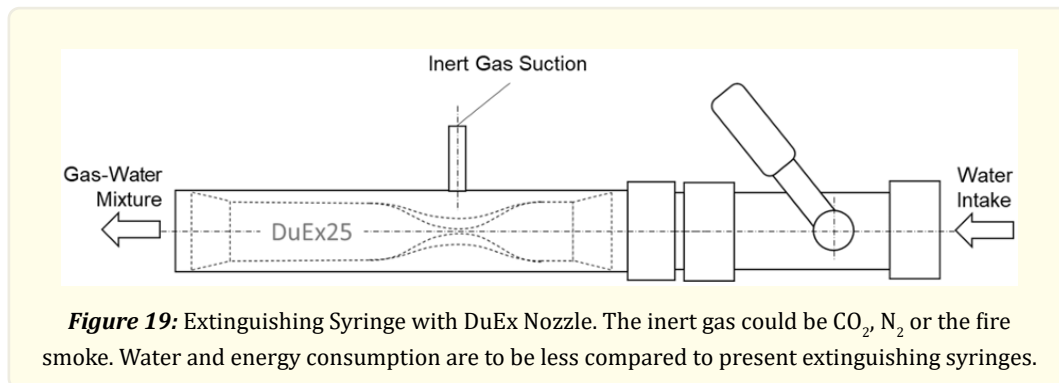
OxTube Machine can suck and mix gases in the water stream over ten times of water in volume NTP. Exhaust gases can be sucked and mixed in water of flowing tube condition, and sprayed for collection and recycling. Figure 18 presents an exhaust gas washing and collection system for ships that can be engine based. The system can be scaled down to small ships and boats, and even to trucks and cars. The water can be clarified and recycled back to the washer or to the sea water clarification by OxShip presented in Figure 17.



Extinguishing Syringe DuEx Nozzle

DuEx Nozzle is modified from DuOx of Oxtube for fire hydrants, and it can be integrated in extinguishing syringes as shown in Figure 19. It sucks and mixes gases over ten times of water in volume. Gases could be air, or an inert gas like nitrogen, CO₂ or the fire smoke.

DuEx Nozzle generates a coherent mixture of gas and water as shown in Figure 4. Energy and water consumption can be reduced significantly with gas suction, and further, extinguishing efficiency improved with an inert gas suction or feed. Suction of the fire smoke can be utilized.



Brief Summary

OxTube Water Clarification is found to meet the environmental and economic guiding principles and criteria listed in Chapter 1. It has been applied successfully in removal of pharmaceuticals, radon gas, calcium, manganese and iron from various water matrices, and in disinfection with ozone of a hospital waste water. More than 40 different pharmaceutical residues in total over 24 µg/l were removed 90 percent by OxTube Machine within a second in one through run without filtering [5]. Two through runs result 99 percent removal. Radon removal from 57 to 8 Bq/l is achieved continuously in five installations of ground water intakes at Water Plants. Disinfection of a hospital waste water with ozone resulted 100 percent microbe reduction, and clarification and oxygenation of the waste water in one through run within a second. Reduction of viruses of 60 percent was achieved just by air suction without any other gas and chemicals feed. Two runs with air might result about 80 percent reduction. Microbe growth and variation is reduced with just clean air suction and eliminated with ozone feed.

OxTube Machine and Water Treatment Unit can be installed in various positions in present treatment processes and facilities of various water matrices. It can be applied in pre- treatment, removal of the water load, clarification and oxygenation and disinfection of various waste water matrices. Further, discharge water can be treated with the environment respect.

The four phase clarification and bubble generation of OxTube Machine can be applied in all the areas of water purification and recycling described in Figure 1. Volumes of 0.1 to 6000 m³/h with one Tube can be clarified and returned to the natural water cycle with full environment respect. OxTube Machine can be integrated in and combined with present water systems. The DuOx nozzle can be integrated in hydro turbines for combined power and water treatment. Combined fountain and water clarification by integration of DuOx Nozzle reduces energy consumption in to half or more, and the nature loves it according to fountain tests completed. DuOx Nozzle improves fire extinguishing, saves water and reduces damages by feed of an inert gas like nitrogen and carbon oxide, or smoke from the fire (see Figure 4 and 19). Irrigation and fertilizing can be combined by means of exact spot farming. The integrated 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 treat sea water of 240'000 cubic meter a day without additional fuel consumption. There are more opportunities

to be solved by water treatment in respect of the nature.

OxTube clarified water has positive impacts on bio tissues and metabolism. Pure air and water have certain health features, and dissolving these deeply together the healthy impacts and transfer speed are multiplied in wet contact. The subject is discussed in reference [9].

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