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Combined Ship Cruising and Sea Water Clarification

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Abstract

OxTube, a new water treatment innovation clarifies water matrices in tube condition with nature respect within seconds. It can be integrated in ships and other watercrafts. The seas suffer low oxygen, algae, toxins and micro plastics. A cargo ship can clarify sea water 288 000 m^3 a day in depth of 4 to 5 meter when cruising without additional fuel consumption.

OxTube generates huge amount of air bubbles along with water clarification. Mixture of air bubbles and water is coherent and viscosity up to ten times lower than water. It can be led under the cruising ship in order to reduce flow resistance and fuel consumption. All kinds of combined processing is economically and environmentally beneficial. According to MIT Group combined energy and water system could provide for millions.

Keywords: Water Clarification; Water Treatment; Sea Water Refreshing; Water Oxygenation; Flow Resistance Reduction; Fuel Saving

Introduction

In the present water cycle the seas and oceans are rubbish dumps. Rain and waste waters with their load are led or pumped thousands kilometers as fast as possible in to the huge rubbish dumps through the underground sewer network. Present technologies and increasing power consumption in wastewater treatment result unsatisfied balance. Many serious problems, disasters, awful smell and serious microbe growth can be avoided by the combined water clarification and watercraft [5, 7, 9]. Water and natural water cycle are necessary for the bio systems as well as power generation and the climate balance.

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 [5, 6, 7]. 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. Present concentrated waste water treatment needs a new perspective [17]. Recovery of natural waters needs urgent actions and innovations. All kinds of combined systems are potential and economic beneficial.

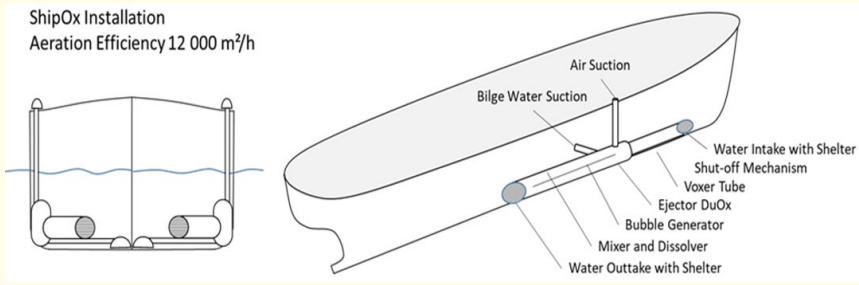

Figure 1: Sea water clarification system ShipOx of water treatment capacity of 288 000 m^3/d in depth of 4 to 6 m from sea surface without additional fuel consumption. Also the exhaust gases can be dissolved in to sea water for refreshing of green plants and natural food chains [6, 7, 8].

OxTube Water Clarification

The new innovation OxTube clarification in tube condition has shown in many applications 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 [4, 7, 9]:

1. Separation of dissolved ingredients.
2. Activation of molecules.
3. Immediate clarification reactions.
4. Aeration after clarification.
5. Bubble generation in water flow for particle removal by flotation.

Figure 2 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 installed 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 [3], and removal of radon from ground water [12, 13, 14] and pharmaceutics from wastewater [2, 3], and separation of iron, manganese and calcium from industrial waters. Figure 3 summarizes OxTube functions so far. Calcium has been removed with CO_2 feed in OxTube and a lamella [15, 16], and iron and manganese removed by air suction and sand filtering.

OxTube Machine presented in Figure 2 and 3 is the key module in the clarification in tube condition [6, 9, 10]. 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.

OxTube Machine generates huge amount of bubbles by air suction and clarification reactions which can be used for flotation [1, 4, 5] and reduction of flow resistance due to viscosity decline. Collision probability of particles and bubbles is high and attachment is identified to be great, so the flotation happens in natural waters. Particle attachment is initiated in OxTube Machine. Figure 4 illustrates visually efficiency of the air suction and coherent air-water mixture. Aeration efficiency of OxTube Machine is seen in Table 1. Oxygen

saturation is achieved in 0.4 second in tube size DN20 and within seconds in tube size DN400.

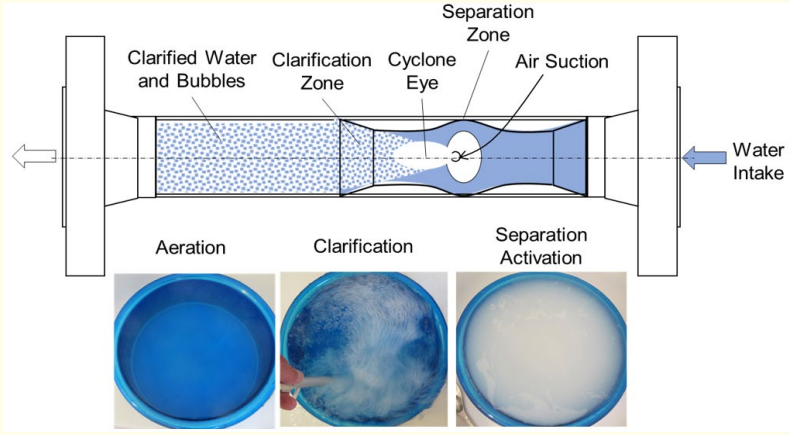

Figure 2: OxTube Clarification with air; Right Separation of dissolved substances and molecular activation, middle Integrated Clarification with air, and left the clarified Swiss Alpen household water. The entire process is performed seamlessly within a second [18].

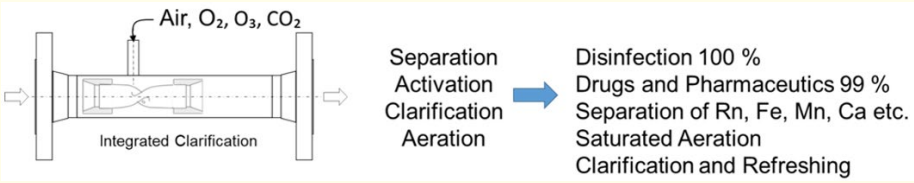

Figure 3: OxTube Machine and its functions in one in terms of seconds [18].

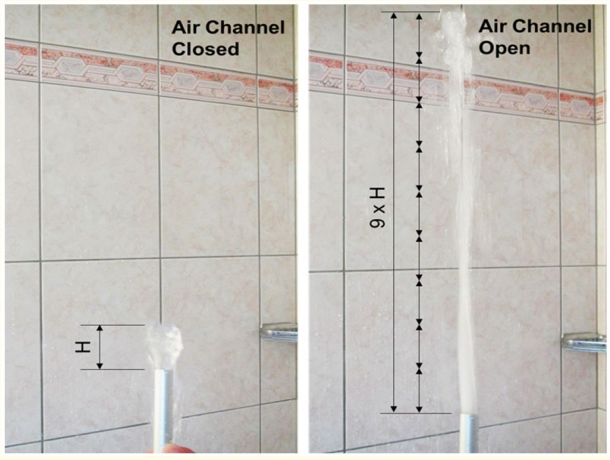

Figure 4: Performance of OxTube Machine in air suction and mixing as well in clarification and replacement dissolving is great and efficient. Height of the air-water mixture is nine times higher than the plain water has in the exact same condition of water intake. Air suction is 8 times of water in volume at NP, it could be over 10 times.

Figure 5 shows the efficiency of the tube clarification according to a hundred real test runs completed with an industrial waste water [11]. Turbidity of the clarified waste water turned to 0.0 NTU and smell disappeared 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 an ozone disinfection and sand filtering, and related verifications are needed.

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

Table 1: 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.

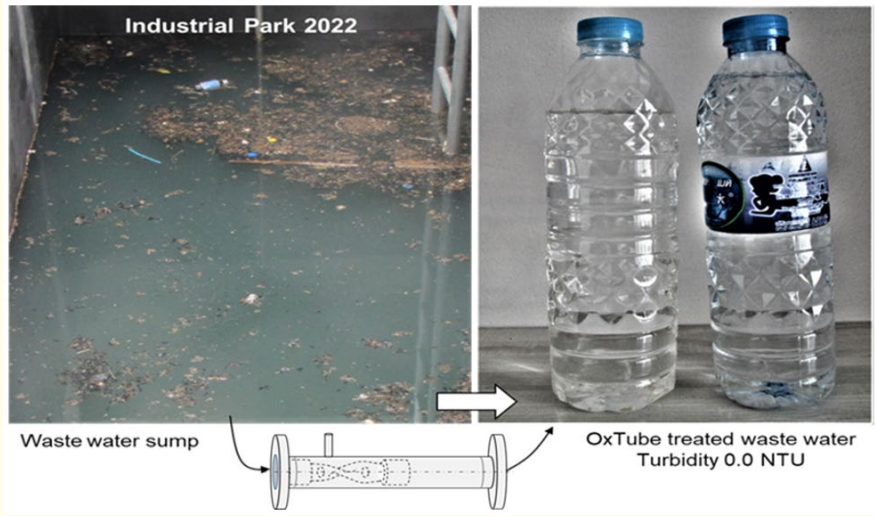

Figure 5: OxTube test runs of an industrial waste water resulted turbidity of 0.0 NTU. The clarified water is recyclable in industrial process use [11].

Combined Sea Water Clarification and Ship Cruising

OxTube Machine can be integrated in various watercrafts. Sea water is clarified under the surface when the vehicle is cruising without additional fuel consumption. OxTube Machine generates a huge amount of bubbles in water flow by suction. Viscosity, density and surface tension of the air-water mixture decline significantly. These features can be applied in ship building in order to reduce flow resistance and fuel consumption. OxTube integration in a ship is illustrated in Figure 6 and 7.

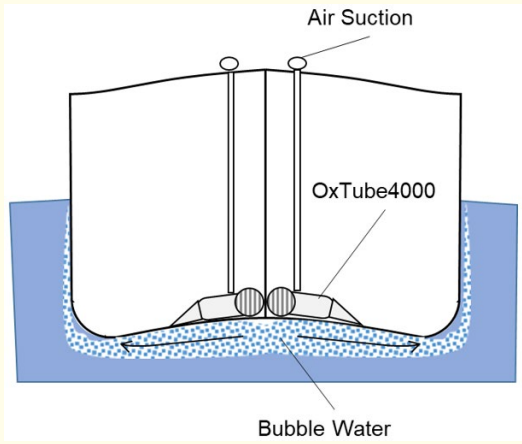

Figure 6: Installation of Combined Sea Water Clarification and Ship Cruising. The bubble water reduces flow resistance and fuel consumption.

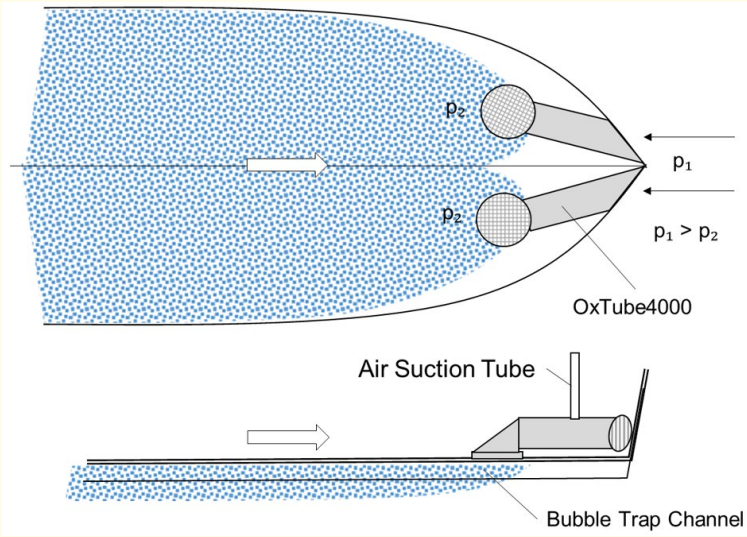

Figure 7: Combined Sea Water Clarification and Bubble Distribution on Hull.

Dynamic Pressure is described by the formula

$$q = ½ * \varrho * v^2$$

where ϱ is fluid density and v fluid velocity.

Kinetic energy is described as follows:

$$E_k = ½ * m * v^2 = ½ * \varrho * V * v^2$$

where m is mass that moves by velocity of v, and ϱ is density and V volume.

Viscosity is related to the liquid resistance in flowing condition. The resistance influences between liquid layers. Viscosities η of air and water are follows:

- Air: viscosity $\eta = 17.4*10^{-6}$ Pa*s.
- Water intake: viscosity $\eta = 1.002*10^{-3}$ Pa*s.

Regarding the losses, turbulences and clarification efficiency the optimal flow speed of the water in the intake tube is v = 2 m/s which results dynamic pressure q = 2 N/m^2. Velocity v increase of 50 percent to 3 m/s results dynamic pressure of 4.5 N/m^2.

When the mixture of air-water is 50/50, tube diameter 400 mm in water intake and outtake, hydro pressure 1.5 bar in depth of 5 m and pressure in OxTube outtake 1 bar due to suction caused by cruising speed of 2 m/s, the following conversion figures are resulted:

- Viscosity of the mixture $\eta = 0.502*10^{-3}$ Pa*s.
- Flow speed in OxTube outtake v = 4 m/s.
- Density of the mixture ϱ = 0.5 of water.
- Dynamic pressure q = 4 N/m^2, double of water intake.
- Spray head of OxTube4000 H = 0.8 m.
- Axial force of double OxTube4000 without air; $F_{a0} = 2*\pi*r^2*q = 2*\pi*0.2^2*2$ N = 0.50 N.
- Axial force of double OxTube4000 with air; $F_a = 2*\pi*r^2*q = 2*\pi*0.2^2*4$ N = 1.00 N.

Bubble water flow in double OxTube4000 outtake in cruising speed of 2 m/s is 3 619 m^3/h equal to 18 095 m^2/h of 0.2 m thick layer equal to 302 m^2/min. Air suction is higher than ratio of 50/50 air/water in practice. Theoretically the flow resistance is reduced in to a half of normal condition above air-water layer. Assuming the efficiency and coverage of 30 percent the flow resistance is reduced 15 percent.

OxTube sucks over 10 time of air related to water flow in optimal condition. The ratio of air/water could be 5/1 air/water in practice, and viscosity reduction is 82 percent. When the mixture of air-water is 5/1, tube diameter 400 mm in water intake and outtake, and pressure in outtake 1 bar due to suction caused by cruising speed of 2 m/s, the conversion figures are resulted as follows:

- Viscosity of the mixture $\eta = 0.1812*10^{-3}$ Pa*s.
- Flow speed of the mixture in outtake v = 11 m/s.
- Density of the mixture ϱ = 0.2 of water.
- Dynamic pressure q = 12.1 N/m^2.
- Spray head of OxTube4000 H = 6.2 m.
- Axial force of double OT4000 without air; $F_{a0} = 2*\pi*r^2*q = 2*\pi*0.2^2*2$ N = 0.50 N.
- Axial force of double OT4000 with air; $F_a = 2*\pi*r^2*q = 2*\pi*0.2^2*12.1$ N = 3.04 N.

Bubble water flow in double OxTube4000 outtake in cruising speed of 2 m/s is 9 953 m^3/h equal to 49 765 m^2/h of 0.2 m thick layer equal to 829 m^2/min. Assuming the efficiency and coverage of 50 percent the flow resistance is reduced 41 percent which can be seen as a potential objective.

Summary

According to MIT Group combined energy and water system could provide for millions. Refreshing the seas and lakes is urgent. Combined water clarification and ship cruising refreshes seas and lakes, and saves fuel. Further, exhaust gases can be washed and led in to the water for revitalizing water plants. In the present water cycle the seas and oceans are rubbish dumps. Rain and waste waters with their load are led or pumped thousands kilometers as fast as possible in to the huge rubbish dumps through the underground sewer network. Many serious problems, disasters, awful smell and serious microbe growth can be avoided by the combined water clarification and watercraft.

OxTube Machine can be integrated in watercrafts such a way that kinetic energy of cruising can be used for water clarification in depth of 4 to 5 m. OxTube Machine generates and mixes a lot of air bubbles in the clarified water as a coherent mixture of low gravity and viscosity. The low viscosity mixture can be spread as a layer under the watercraft, and flow resistance and fuel consumption are reduced. A cargo ship can clarify 288 000 m^3 a day when cruising.

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