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Review Article

Combined Waste and Wastewater Management – A Future Approach

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Abstract

Waste and wastewater are treated mainly in concentrated manners separately. In spite of many good practices the waste is transferred as soon as possible out of our sights to landfills outside urban areas. The wastewater is transferred via underground sewer networks to concentrated treatment plants, and finally it is discharged into waters with noxious load, drug residues and micro plastics. Many land areas and waters are becoming worse and the natural food chains suffer due to unsatisfactory waste and wastewater management. The rainwater as well is led from roofs, streets and roads via huge underground networks into rivers and seas. Huge amount of water evaporation cool is lost and energy consumed by the present concentrated wastewater and rainwater treatment.

The clarified wastewater should be discharged into nature with full nature respect. The proper way treated wastewater can be led to the natural water cycle by spraying it on ground, landfills, plants, roofs and all kinds of heat sources for the evaporation and climate cooling by solar and process heat. The destructive load can be reduced in seas and oceans. Clarified and oxidized wastewater should and can be sprayed over a landfill that forms a trap for elimination of biogas leak and smell into air, and waste fermentation and biogas collection can be improved too. The water spray expels birds, bats and ratites away that eliminates spread of hazardous diseases. Biogas is collected by gas venting pipes This character pipes and CO2 are led to trees. The leachate and rainwater are directed into water buffers for further clarification and evaporation on earth and plants.

First of all, the key issue is to reduce waste and wastage as well as the related waste transportation into minimum. Regarding packing there are many good practices to be adopted. The concepts Zero Waste Shopping particularly applied in UK and Loop Bag applied in Japan eliminates disposable packing that presents a huge part of harmful waste globally. Composting bags applied in cities in Japan are recommended for treatment of household bio waste. Industries have applied zero waste concepts in supplies for decades already that could be easily applied in households, public sector, markets, hospitals and restaurants.

Keywords: Waste Management, Wastewater Management, Water Clarification, Water Purification, Water Treatment, Water Recycling, Combined Water Clarification, Wastewater Discharge, Climate Cooling

Introduction

Waste and wastewater are treated mainly in concentrated manners separately as illustrated in (Figure 1). Despite many good practices the waste is transferred as soon as possible out of our sights to landfills outside urban areas. The wastewater is transferred via underground sewer networks to concentrated treatment plants, and finally it is discharged into waters with noxious load, drug residues and micro plastics. Hybrid and decentralized wastewater treatment should be carefully considered instead of centralized one with good reason [1].

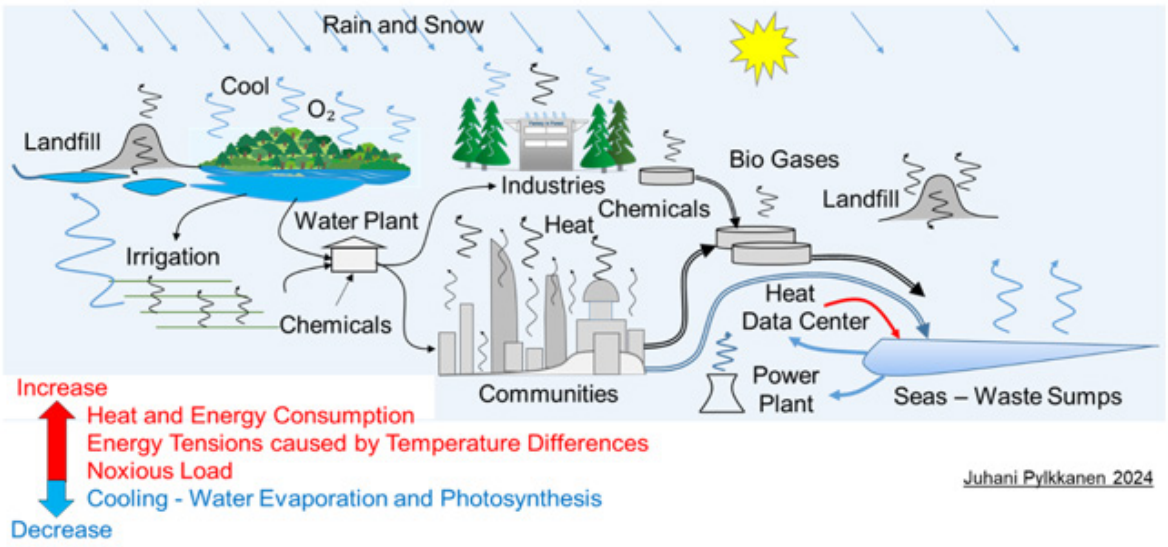

Figure 1: Growing Civilization and Unnatural Water Cycle. Heat sources can be switched to climate coolers by proper wastewater treatment and water buffering with wide area evaporation and photosynthesis [5,2,3].

First of all, the key issue is to reduce waste and wastage as well as related transportation to minimum. There are many good and best practices that could be applied right away. Zero Waste Shopping and related Shops particularly in The UK as well as Loop Bag in Japan can eliminate disposable packaging and huge amount of plastic waste. Composting Bags are applied in Japan for treatment of bio waste in city households. Industries have applied zero waste concepts in supplies for decades already that could be easily applied in households, public sector, markets, hospitals and restaurants. Fanuc's Zero Waste (Wasteless) Factory in Forest might be the most famous concept implemented already in the early 80s. The manufacturing site of some ten factories is promoted as a nature reserve nova day [2,3]. There are many good practices in the landfill waste management. Fukuoka Method has been applied successfully in Japan and elsewhere decades already [4]. However, it's complex and expensive, and it doesn't combine with wastewater. Recycling materials is applied steadily in the product and services development, and in execution in practice. However, the recycling needs quite a lot of resources and energy. Combining zero waste and recycling could be considered with good reasons.

Today wastewater with their loads pumped thousands of kilometers to the centralized treatment plants and further, poorly processed in the waters through the huge underground sewer network as illustrated in (Figure 1) [5,2,3]. Rainwater is led through various ways, mostly underground in the waters, too. Climate cooling by water evaporation is reduced significantly by extension of civilization, and the sewer network causes serious floods [3]. Water and ingredients recycling is little. Many serious problems, disasters, awful smell and serious unbalanced and resistive microbe growth can be avoided by the water clarification and wide area water buffers with solar evaporation. The combined water clarification integrated into the natural water cycle is necessary for the bio systems and food chains as well as for the climate balance [6,7,5]. The combined water clarification and fountain is an efficient natural water refreshing as well as a combined wastewater discharge and biogas collection practice at landfills. 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, in medical care as well as in agricultural and industrial processes. Water gets rid of the load by evaporation caused by solar heat, and leaves it in the ponds, lakes and seas. The waters and eco systems suffer increasing amounts of toxins, drug and pharmaceutical residues, nutrients, various poisons, many other chemicals, micro plastics, and unbalanced microbe growth, algae and large area zero oxygen. The natural water cycle functions as a major climate cooling element together with the photosynthesis powered by the sun. A lot of evaporation cool has been lost by extension of civilization, open area building and construction, and underground sewerage systems. The civilization heat sources can be turned to climate coolers by the proper wastewater treatment and buffering, large area water evaporation and photosynthesis [7,5]. Just giving an example, low efficient photo voltaic panels could be cooled and their efficiency enhanced by evaporation of clarified wastewater on panel surfaces, so electricity can be generated and the climate cooled at the same [3]. It's urgent to refresh water and food chains as well as to improve wastewater treatment so that it can be sprayed on ground, plants as well as on all kinds of heat sources like photo voltaic panels, data centers, factories, parks, streets and city roofs [2].

Conversion of OxTube Water Clarification in Brief

The OxTube water clarification in tube condition is illustrated in (Figure 2) [5]. It consists of four seamless treatment phases and as the fifth step a firm gas bubble generation in the flow as follows [8]:

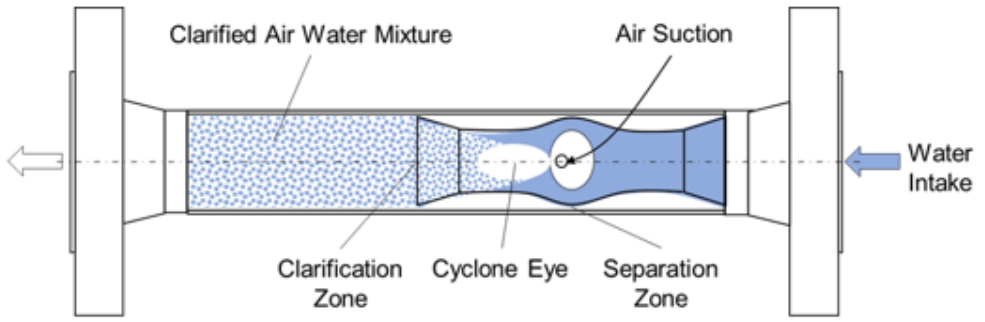

Figure 2: Conversion Process of Ox Tube Water Clarification in Tube Condition [5].

Separation of dissolved substances

Activation of molecules

Immediate clarification reactions

Replacement dissolving

Bubble generation in water flow for combined flotation and clarification

Separation of dissolved substances, molecular activation and firm air suction are performed in the DuOx Nozzle of OxTube Machine. Desirable clarification reactions are initiated immediately after the cyclone eye caused by the split water flow. (Figure 3) presents OxTube Machine and its functions briefly [5]. (Figure 4) shows visibly the clarification efficiency of OxTube Machine by a practical case study [9]. The air flow into the water by the free suction could be over ten times of water in volume. So, density of the air-water mixture reduces in relation to the air volume by the suction, and the mass flow volume and flow speed increase respectively. Particles start to attach on bubbles already in OxTube by flotation [11]. Further, viscosity of the air water mixture is much lower than water has, and dynamic pressure increases by the factor of flow speed to the power of two. This results in high conversion efficiency and low losses by means of mass flow. (Figure 5) illustrates the conversion by a practical test. The air-water mixture is coherent, and the spray head could increase up to hundred times from plain water spray. Bubbles mixed in water can be used for reduction of water resistance, e.g. in ship cruising [10] and water transfer in a piping. A lot of energy is saved.

Figure 3: Ox Tube Machine and its functions in one [5].

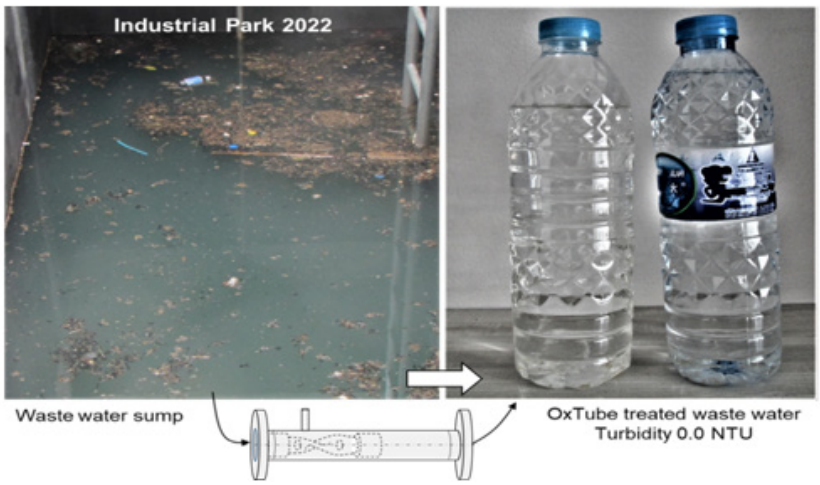

Figure 4: Ox Tube test runs of an industrial wastewater resulted turbidity of 0.0 NTU and zero smell. The clarified water is recyclable in industrial process use [9]. The wastewater is clarified and aerated, and with ozone feed the water is disinfected, too.

Figure 5: Height of the air-water mixture could be nearly 100 m, i.e. over hundred times higher than the just water has in the exact same condition of water intake. Just water spray left and air-water mixture spray right with the same pumping energy.

Dynamic Pressure is described by the formula

$q = ½ * \varrho * v^2$

where ϱ is the fluid density and v the 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.

Potential Energy is described by the formula

$Ep = \varrho * V * g * H$

where ϱ is the fluid density, V fluid volume, g acceleration of gravity (nominal average 9.81 m/s2) and H spray head.

Spray head is described by the formula

$H = v^2/2g$

Where v is flow velocity of the fluid and g acceleration of gravity.

Density drop is significant in the conversion from plain water to mixture of air and water in the tube. When ratio of water and air is 1/10 in volume in the nominal pressure condition results density of the air-water mixture as about 0.1 of water density. The flow velocity increases respectively in the conversion from water to air-water mixture.

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

- Viscosity of air $\eta = 17.4*10^{-6}$ Pa*s
- Viscosity of water $\eta = 1.002*10^{-3}$ Pa*s

Based on the formulas above the dynamic condition of the tube OxFountain400 in various water intake and air suction is presented in (Table 1). If the water flow in intake is doubled from 10.12 to 20.24 m^3/h and air suction is ten times of the water intake, the spray head increases from 24.6 to 98.6 m.

Table 1: Dynamic condition of OxFountain400 in various water intake mass flow with air suction. Air suction can be adjusted by a valve.

Viscosity Pa*s		**Density kg/m³**		**Kinetic Energy Ek = 1/2 *ϱV*v²**		**Potential Energy Ep = ϱVgH Spray Head H = v²/2g**		**Dynamic Pressure q = 1/2*ϱ*v²**	
Water	**Air**	**Water**	**Air**						
0.001002	**1.74E-05**	**1000**	**1.293**						
Water Intake Q m^3/h	Water Flow Velosity m/s	Air Suction of Water in Volume	Density of Mixture kg/m^3	Viscosity of Mixture Pa*s	Velosity of Mixture m/s	Spray Head H m		Dynamic Pressure N/m^2	
						Air-Water Mixtuter	Water	Water	Mixture
10.12	2.0	5/1	201.0344	0.000182	12.0	7.339	0.204	2,000.00	14,474.48
10.12	2.0	10/1	101.1637	0.000107	22.0	24.669	0.204	2,000.00	24,481.62
12.65	2.5	10/1	101.1637	0.000107	27.5	38.545	0.319	3,125.00	38,252.52
15.18	3.0	10/1	101.1637	0.000107	33.0	55.505	0.459	4,500.00	55,083.63
20.24	4.0	10/1	101.1637	0.000107	44.0	98.675	0.815	8,000.00	97,926.46

Combined Water Clarification and Fountain

OxTube conversion process is suitable for combined water clarification and fountain. It provides a high spray of the coherent air-water mixture as described in Section 2. The fountains are common in the waters of urban areas where the natural water clarification is the most needed. The power consumption is reduced significantly by OxTube Conversion together with the integrated clarification compared to the present fountains without clarification function at all. Condition of water and food chains is identified to improve by the combined water clarification and fountain as shown in (Figure 6). Fish, crayfish and mussels are found to grow bigger and become clearer colorful than before.

The combined wastewater clarification and fountain spray can be utilized in landfills as well as many similar sites. Today the city waste is carried onto landfills on countryside nature. The landfills generate a lot of biogases and awful smell far away from our sights. Only a little of the biogases is collected and utilized worldwide. OxTube conversation can be used for improvement of biogas collection and discharge of clarified wastewater. The OxTube Fountain Spray can form a biogas and smell trap as illustrated in (Figure 7). Birds can be kept out of the landfills, and many epidemics are eliminated.

Figure 6: Small Scale Combined Water Clarification and Fountain of 18 W. Impact on balancing of food chains is identified to be significant. Fish, crayfish and mussels have grown noticeably and became cleaner colorful and lively.

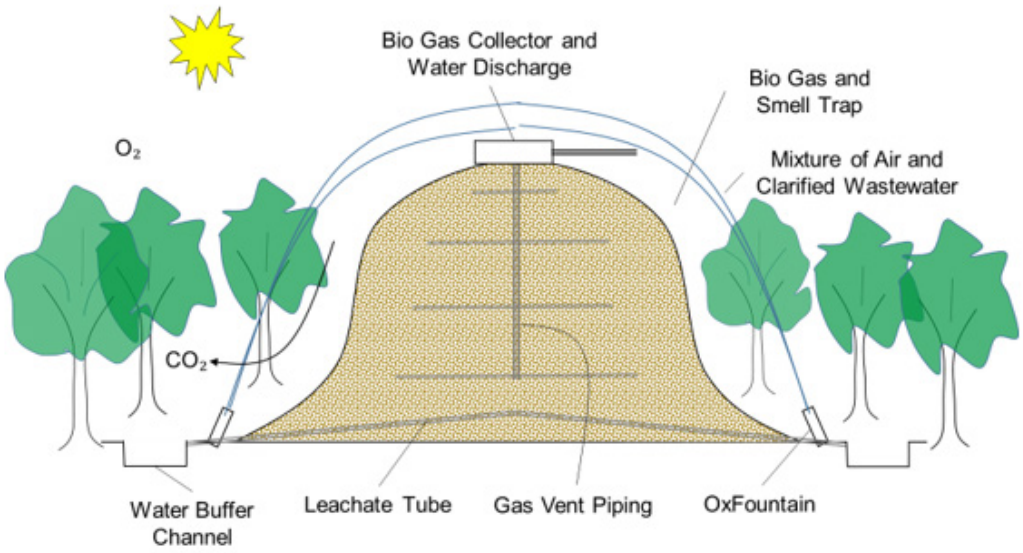

Figure 7: Combined Water Clarification, Landfill and Biogas Collection. The water spray eliminates bio gas leak to air and repels birds, bats and rodents. Proper way clarified and aerated wastewater is used. Power consumption is low, and the combined waste and wastewater treatment saves nature and money [5].

Combined Waste and Wastewater Management

Satisfactorily clarified wastewater can be pumped to the nearest landfill instead of into seas. Clarification of the wastewater can be executed and finished on the way by OxTube Machine in tube condition. Particles and agglomerates can be removed by flotation and possibly recycled [11,8]. Air bubbles in the water flow generated by OxTube Machine reduce the fluid viscosity and tube resistance. Energy consumption could be reduced significantly by proper engineering of the piping. Flowing resistance drop by air bubbles in ship cruising is presented in the reference [10]. Tube resistance in a piping can be reduced respectively by mixing bubbles into the flowing water. The bubble water is compressible which is to be considered in the related engineering.

Ox Fountain set creates a high air-water spray around the landfill as illustrated in (Figure 7). The water spray forms a trap for biogas and smells over the landfill, and cools air. The wastewater spray cover improves biogas collection and fermentation. Leachate is led via drain tubes into water buffers, clarified by OxTube Machine and distributed on ground and plants. Birds and animals are expelled away and spread of hazardous diseases can be eliminated. Carbon dioxide under the spray trap is led to the trees around. Further, the wastewater spays cools climate effectively by evaporation powered by the sun.

Summary

Waste and wastewater management can be integrated at landfills. Well clarified wastewater can be sprayed over a landfill in order to improve fermentation, biogas collection and elimination of biogas and smell leak into air. Birds and animals are expelled away from these virus and microbe breeding grounds. Many serious epidemics can be avoided. OxTube Water Clarification in tube condition has been applied successfully in removal of pharmaceutical residues, radon gas, calcium, manganese and iron from various water matrices, and in disinfection of wastewaters with ozone. Oxygenation of the wastewater is executed at the same time. Microbe and variant growth is reduced with just clean air suction and eliminated with ozone feed. The OxTube clarified water can be discharged on ground and plants for evaporation cool with nature respect. Hybrid and decentralized wastewater treatment should be carefully considered instead of centralized one with good reason [1]. In principle, the wastewater can be clarified by OxTube Machine in sewage drain on the way back to the nature. However, it's definitely a better way to clarify wastewater combined with other water systems promoting recycling and evaporation cooling [12]. OxTube Machine is easy to be integrated in and combined with present water systems. The DuOx nozzle can be integrated into hydro turbines combined with power generation and water clarification [13]. Combined fountain and water clarification by integration of OxTube reduces energy consumption into one fifth or even more.

Acknowledgments

None.

Conflict of Interest

None.

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