WASTEWATER TREATMENT BY OZONE AND MICRO NANO BUBBLE TECHONOLGY- A REVIEW

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Abstract : Reuse of wastewater is regarded as one important way to deal with the world's shortage of potable water. The main focus is on a disinfection system using micro nano bubbles and capability for wastewater reuse. In this we further study about the characteristic of ozone Micro Nano Bubbles(MNBs) including their size distribution, potential and bubbles quantity and surface. The MNBs can greatly improve remediation efficiency and represent an innovative technology. In recent years, microbubble and nanobubble technologies have drawn great attention due to their wide applications in many fields of science and technology, such as water treatment, biomedical engineering, and nanomaterials. In this paper, we discuss the physics, methods of generation of microbubbles (MBs) and nanobubbles (NBs), while production of free radicals from MBs and NBs are reviewed with the focuses on degradation of toxic compounds, water disinfection, and cleaning/defouling of solid surfaces including membrane.

I.INTRODUCTION

Wastewater can be a valuable resource in cities or towns wherever population is growing and water provides are limited. In addition to easing the strain on limited water supplies from source, the reprocess and reuse of wastewater can improve the quality of streams and lakes by reducing the effluent discharges that they receive. Wastewater may be rescued and reused for crop and landscape irrigation, groundwater recharge, or recreational purposes. Reclamation for drinking is technically attainable, however this reuse and reprocess faces significant public resistance.

The basic purpose of Water Treatment Plant area unit as follows to produce water that is save for human consumption, to produce water that is appealing to the consumer, to produce water – by make use of facilities which may be set-up and operated at an affordable price.

The sequence of water treatment units in a very water treatment plant is principally remains same, because the principle objectives to get rid of murkiness and 24 decontaminate to kill pathogens.

Disinfection

Disinfection is considered to be the first mechanism for the inactivation of pathogenic organisms to prevent the spread of waterborne diseases to downstream users and the environment. It is necessary that untreated wastewater should be sufficiently treated prior to disinfection in order for any disinfectant to be effective. Ozone is produced and it is unstable gas, it is used to disinfect wastewater. Ozone are decomposes to elemental o2 with short time interval. It is very strong oxidant and virucide. Disinfection kills or inactivates disease-causing organisms presented in a wastewater and should offers the 99.9 % inactivation of Giardia lamblia cysts and enteric viruses to protect health and to comply with the U.S. Environmental Protection Agency (EPA) regulations

II.OZONE

Ozone (O3) or trioxygen is a molecule composed of three oxygen atoms, temporarily existing in a very unstable and reactive state. Ozone is reactive in nature so that a suitable container for storage probably does not exist. Compared to O2, O3 is an very reactive molecule, probably by a factor of 1,000 times and is sometimes referred to as activated oxygen. If we consider monoatomic atom O1 from the O3 atom, this O1 atom does not like to be alone, and it refuses to remain with the fairly stable O2 covalent bond. This active oxygen molecule won't stabilize until it can break away from the O2 and form a stable molecule with something else, virtually any other molecule that is available. If no other or alternative molecule is obtainable, it will eventually unite with another O1 atom in the same situation, and restabilize as O2. Ozone is used as a disinfectant, decolorizer, deodorizer, detoxifier, precipitant, coagulant and for removing tastes. Ozone is of important value in water treatment systems because of it's ability to disinfect without adding other chemicals which may later need to be removed.

The OZONE can be created naturally when the free oxygen atoms can recombine to form oxygen molecules but if a free oxygen atom collides with an oxygen molecule, it joins up, forming ozone. Ozone molecules can also be decomposed by ultraviolet radioactivity into a free atom and an oxygen molecule. Ozone can formed unnaturally by some methods as like Electric Discharge Method, Radiochemically, Electrolytically etc. Ozone can initiate a series of reactions in water that are so much complicated and quite specific to the water being treated. O3 is a lopsided dogleg shape. Being of dipolar structure with extreme forms of resonance, it is very versatile while still being quite selective in its direct reactions. O3 can attack as a dipole, molecule, electrophilic or as a nucleophilic agent.

III.MICRO NANO BUBBLE

Micro-bubbles (micron scaled bubbles) and Nano-bubbles (nano scaled bubbles) are getting increasing interest in industrial fields because their properties are so different from those of mill-scaled bubbles. Figure below shows the differences in behaviors between mill scaled bubbles and Micro-bubbles. The form rise rapidly and burst on the liquid surface but the latter stay stable for longer time and gradually decreases in size because of dissolution of interior gases by surrounding and disappear, releasing sound and light energy. Hence, leaving Nono bubbles whose stability is influenced by ionic moieties in liquid.The interior gas pressure and the bubble diameter relationship is expressed by the Young-Laplace equation:-

$$P = Pl + 2\sigma/r$$

where:-P = gas pressure, Pl = liquid pressure, σ = surface tension,r=radius of the bubble. The Young-Laplace equation explains the collapsing behaviour. [6-a]free radicals are generated through collapsing process of Micro-bubbles.

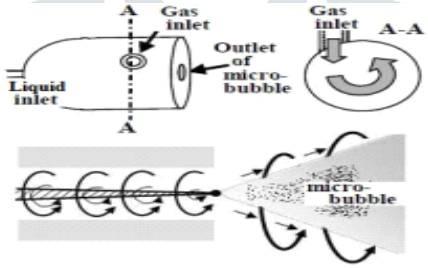

Fig 1 :-Micro-bubble generator

How Micro-Nano Bubbles Work

In Micro-Nano bubbles, bubbles do not rise to water surface due to lower buoyancy, that makes the bubbles float at various level and then eventually sink to the bottom level which result in making a oxygen deficient lower layer into an oxygen rich environment. All this makes bacteria grow and accelerate break down of organic compounds.

Table 1: Different types of MNB generator

Swirl Type Liquid Flow Method	Ejector Method	HoneyComb Method	Ultrafine Pore Method
Gas transfer efficiency is 65%	Gas transfer efficiency is 35%	Gas transfer efficiency is 35%	Gas transfer efficiency: 90%
Size limitation is upto 3 inches	Size limitation is upto 2 inches	Size limitation is upto 2 inches	No size limitation
Running cost is 11KW/10L/min	Running cost is 15KW/10L/min	Running cost is 18KW/10L/min	Low operating cost is 0.75 KW/10L/min
Fairly low bubble number density	High Pressure Pump required	High Pressure Pump required,Complex Structure	Simple construction and working

How to create Micro-Nano bubbles

In creating Micro-Nano bubbles a compressor is used to compress gas by which gas is pumped into the bubble generating medium being used in creating Micro-Nano bubbles and a liquid jetting device is also used. Both of them get to in creating bubble generating medium to produce super microbubbles. The bubble generating medium is a rigid carbon ceramic compound with high density. It is electrically conductive and hence negatively charged ions tends to range on the surface. The bubble generating medium is inorganic i.e. no-damage or no-degradation.

Size Distribution Analyzer

The size distribution of the generated ozone MNBs were measured by a nanoparticle tracking analyzer (NanoSight LM-10, Malvern Instruments, Malvern, Worcestershire, UK). The water containing the MNBs was analyse by an ultra-microscope fitted with a camera was used to track the movement of the bubbles. The range varies from 10 nm to 1000 nm and the size distribution of the bubbles was calculated based on the Stokes-Einstein equation.The quantity and size of the MNBs affect their mass transfer efficiency. Larger amounts of the MNBs result in larger total surface area and increases the mass transfer flux from bubbles to solution,and smaller bubble size results in higher internal pressure and larger specific area.

IV.CONCLUSION

In the past few year ozonation and oxidation associated process has widely used in wastewater treatment due to numerous advantage. The most application have been developed for drinking treatment and replenish aquatic life, as concern about potential reuse of wastewater is quite recent. This process(MNBs) offers opportunity further treatments as like in hospital wastewater, industrial wastewater, etc.

Degradation of toxic pollutant is initially present in water with subsequent minimization of byproducts formed during this process. Disinfection process is used after ozone wastewater treatment due to several problems such as bacterial growth in distribution network. Chemical oxidation should be followed by biological step(either sand or GAC filteration) before the final disinfection and distribution. Before the ozonation process we should check for the bromide concentration in waste water. The bromide concentration cause more harmful effect in ongoing treatment of water. Ozone micro-nano bubbles have a lot of promising applications. By many contributors research and the practical applications have got a good progess gradually but steadily. Ozone micro-nano bubble stay low into water due to which it increases the degradation of organic compounds. The ultra fine bubbles has the higgest efficiency and low operation cost.

REFERENCES

[1] TOMOHIRO MARUI " An introduction to Micro/Nano Bubbles and their Application " .Nano bubble technologies LLC General Manager , Technical Department (Futya Laboratory).

[2] ZHIRON XIA AND LIMING HU "Treatment of organics contaminated wastewater by Ozone micro nano bubbles "Tsinghua University , Beijing, China.

[3] ANZAIKANETSU CO LTD ,PACIFIC DRIVELINE LTD " MicronanoBubble for water treatment".

[4] LIMING HU "Application of ozone micro nano bubbles to groundwater remedition.

[5] ASHUTOSH AGARWAL ,WUN JERN YU LIU " Principle and applications nanobubble technology for water treatment of microbubble " Nanyang technological university, Singapore.

[6] TORTAJADA , C. 2006. Water management in Singapore.

[7] APHA, AWWA and WEF. 2005. Standard Methods for the Examination of Water and Wastewater , 21st ed., Alexandria, VA, USA: Water Environment Federation.

[8] Burns, S., Yiacoumi, S. and Tsouris, C. 1997. Microbubble generation for environmental and industrial separations.