

REDUCTION OF SEA WATER TDS BY OXIDATION,CAVITATION AND AERATION THROUGH MICRO NANO BUBBLE TECHNOLOGY

Submitted in partial fulfillment of the requirements of the award of Bachelor
of Engineering degree in Mechanical Engineering

By

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DEPARTMENT OF MECHANICAL ENGINEERING

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INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **D. MADAR BASHA** (Reg No.**38150026**) and **D. PAVAN KUMAR REDDY** (Reg.No.**38150707**) who carried out the project entitled “**REDUCTION OF SEA WATER TDS BY OXIDATION, CAVITATION AND AERATION THROUGH MICRO NANO BUBBLE TECHNOLOGY**” under my supervision from November 2021 to May 2022.

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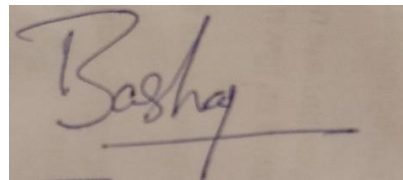
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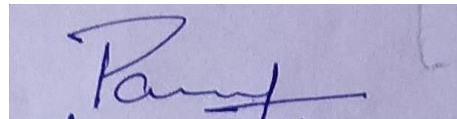
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DECLARATION

We, **D. Madar Basha (38150026)** and **D. Pavan Kumar Reddy (38150707)** hereby declare that the Project Report entitled “**Reduction of sea water TDS By Oxidation, Cavitation and Aeration through Micro Nano Bubble Technology**” done by us under the guidance of **Dr. M. PURUSOTHAMAN, M.E, Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.



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ABSTRACT

This research focuses on using Micro Nano Bubble Technology to reduce TDS in sea water through oxidation, cavitation, and aeration. Micro nano bubble technology (MNBT) has steadily gained attention and has been implemented successfully due to its benefits of high oxidation capacity, high mass-transfer efficiency, high reagent utilization rate, and simple system for treating impurities. Its current applications in this sector are mostly in the areas of surface water purification, seawater treatment, soil and groundwater rehabilitation, and sludge treatment, all of which are examined. These researches are largely concerned with MNB generating (MNBG) methods, pollution management parameters and impact improvement, and technology connection approaches. However, in order to successfully promote its applications, the following efforts are required: oxidized, cavitation, and aeration, which will result in lower electricity consumption and more efficient MNBG devices. Because of the greater biocompatibility of MNBs, such approaches have been widely used for purification of domestic and industrial water treatment in recent years. MNB-based water treatments are also being used for other industries, including industry and agriculture, due to its huge flexibility. the current state of MNB research, as well as development of multi in MNB use. MNBs for water-related applications have received a lot of attention in recent years, with research exploring their viability as a long-term water treatment solution. Despite a plethora of studies and experimental evidence, the use and application of MNBs for rain and we got TDS value of 41920mg/l for groundwater sample, TDS value of 36440mg/l for oxidation process, TDS value of 38390 mg/l for 1 hour cavitation process, TDS value of 33275 mg/l for cavitation 2hours of time, TDS value of 17260mg/l for cavitation 5 hours of time TDS value of cavitation gets reduced more when all processes are compared.

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LIST OF SYMBOLS AND ABBREVIATIONS

O₂	-	Oxygen
TDS	-	Total Dissolved Solids
MNGB	-	Micro Nano Bubble Generator
μm	-	Micrometer
Nm	-	Nanometer
DO	-	Dissolved Oxygen

CHAPTER-1

INTRODUCTION

1.1 BACKGROUND

Currently, in many developing countries, water resources are facing extreme challenges such as water scarcity, for instance, China is a vanguard involving rises in different fields going from ecological sciences. China was perhaps the earliest country to have utilized miniature nanobubble air circulation with respect to eutrophication of metropolitan scene water. China is the principal country with Japan, but as it may, has been supplanted by the USA. The third country with the most commitment is Japan, nations that have been dynamic in utilizing microbubbles and distributing about them are similar trailblazers in the nanobubble field. Air miniature nano bubbles have different novel properties that recognize them from common air bubbles, like high unambiguous region, adversely charged surface, longer life time because of the development of gas hydrates and free extreme when microbubbles breakdown, and better adsorption limit.

MNBs are rises with measurements inside the nano to miniature meter scale, which offer higher explicit surface region than traditional milli bubbles. The created ultrafine MNBs can shrivel lastly vanish submerged because of the long stagnation driven by sluggish rising speed and great gas disintegration capacity driven by high interior tension. The breakdown of these air pockets can create enacted oxidizers like hydroxyl revolutionaries. The immediate evacuation of the organics content from SE, the organization variety of the organics, and conceivable synergistic system were researched inside and out. The discoveries of this work would be useful for the further turn of events of comparative green science techniques for cutting edge oxidation processes. The utilization of anti scalants in the SWRO tasks can be financial furthermore, natural weights in the waste administration or saline solution removal.

Much exertion has been made on gathering and summing up MNBs' age strategies, properties, or applications in water and wastewater treatment. There is restricted substance on the upscaling of MNB applications to the modern level, numerical demonstrating of foreign substance expulsion, and modern investigations of the ongoing difficulties and future points of view. In this paper, we give an exhaustive audit of essential subjects including updates of the

latest research results and rules for MNB portrayal that are supposed to especially be. miniature air pockets or potentially nano-bubbles are utilized in different modern applications, including water treatment and rural and substance designing cycles. Contrasted with synthetic substances like sanitizers and oxidants, water bubbles have lower cost and are all the more environment friendly.

In this review, we report the utilization of feed water containing air MNBs in the SWRO film cycle to really control the calcium scale arrangement as a substance free scaling alleviation strategy. Contrasted with regular substance strategies, the MNBs approach towards scale controlling enjoys a benefit, for example, reliable penetrate transition. This approach would likewise help with diminishing the functional expense of the SWRO layer process by wiping out the utilization of synthetic compounds. A few strategies are utilized to defeat this issue. Zero fluid release technique is utilized to take out the brackish water removal totally; be that as it may, this is the most costly strategy. . Contrasted with synthetic compounds like sanitizers and oxidants, water bubbles have lower cost and are all the more environment friendly. Further, a combination of air pockets and cleaning synthetic compounds can be utilized to clean the RO films by unsettling the fouling layer.

A high-energy response field emerges from the connection point breakdown, which is accepted to set off hydroxyl revolutionary age by scattering of the flooding synthetic potential at the connection point. At last, the creation of oxygen extremists' decay and the following response with protons and electrons is supposed to produce supply as per the response system. Some anticalins can modify the physiochemical properties of the layer, like hydrophobicity, which expands the connection of the microscopic organisms to the film. Hence, miniature air pockets and additionally nano-bubbles are utilized in different modern applications, including water treatment and horticultural and substance designing cycles. Additionally, it has been accounted for that film biofouling by the expansion of antiscalants into the feed water arrangement on the grounds can be a nourishment to the microorganisms.

In particular, DO joins with photoelectrons and protons. The component of extremist creation by MNB has been bantered during last ten years as displayed in During the MNB breakdown process, the expanded air pocket shrinkage prompts amassing of particles close to the gas-

fluid interface, which then prompts sharp expansion in the zeta potential. a mix of MNB innovation and photocatalysis was analyzed for SE treatment in light of a progression of examination tests. The most famous use of MNB is enhancing water with oxygen and eliminating foreign substances by revolutionary oxidation. In the method broke down oxygen capacities as a photo-electron catch specialist.

Air micro nano bubbles have different remarkable properties that recognize them from common air bubbles, like high unambiguous region, adversely charged surface, longer lifetimebecause of the development of gas hydrates and free extreme when microbubbles breakdown, and better adsorption. Along these lines, Profound well infusion and saline solution removal into surface water bodies, like stream, lakes, and seas, are a portion of the business techniquesutilized in the current RO treatment plants. As shown in fig 1.1

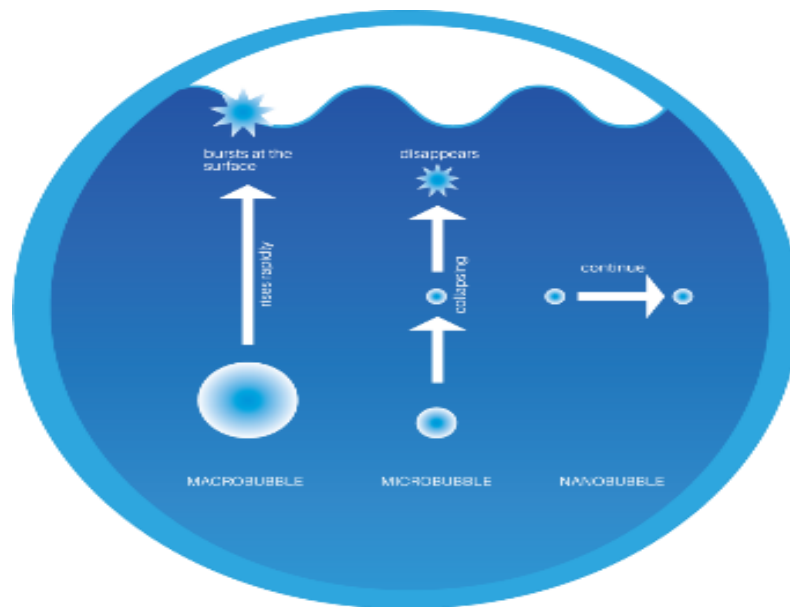


Fig 1.1 Motion of Macro bubble Micro bubble and Nano bubble

1.2 CHARACTERISTICS OF MICROBUBBLES

1.2.1 *Negatively charged surface of MB*

When bubbles dissipate into water without cavitation, it's irrelevant. In MNBT applications that infer extremist age, the gas disintegration property is crucial. From miniature to nanoscale, there are distinctions. For methane, the apparent expansion in real gas disintegration at the nanoscale is ranging ds. Concentrate on what various gas NBs did to hydroxyl revolutionaries in the water.

1.2.2 *Slow rising velocity*

It reduces the oxidation potential of water, producing it less oxidant and resulting in shorter bubble durations. The expanding salt substance slows the air pocket combination and reduces the air pocket size until the progress point emerges at focus, at which time it resumes everyday functioning with further salt options. Different variables, such as zeta potential, ionic strength of arrangement, bubble size, and so on, are also used to characterize the strength of a gas bubble. Going to follow that, these boundaries should be controlled unequivocally in order to provide additional stability.

1.2.3 *Decreasing friction drag*

The impact of temperature on the size of oxygen NBs is not set in stone, where ONBs size was diminished as temperature increased. The reduction in size can be related to the reduction in water surface strain as temperatures rise. Other actual features of NBs in testing conditions, such as surface pressure and surface charge, were found to have an impact on the solidity, reactivity, and outward impression of the NBs. A new nanobubbles age approach in watery arrangement has been effectively encouraged by one evaluation. An outward multiphase cavitation (CMP) with a needle valve was used to infer cavitation. CMP was used to create NBs varying in size from 150 to 200 nm at various tensions and gas-fluid surface pressures.

1.3 WITH LIQUID FLOW

1.3.1 Rotational liquid flow method

Ohnari concentrates on, it was clear that NBT offers enormous potential in custom-made NBs applications where a precise combination of gas types and dose quantities is required. NBs, for example, track applications for microbiological development advancement as well as their eradication. In this way, the important difference arises from their inherent characteristics,

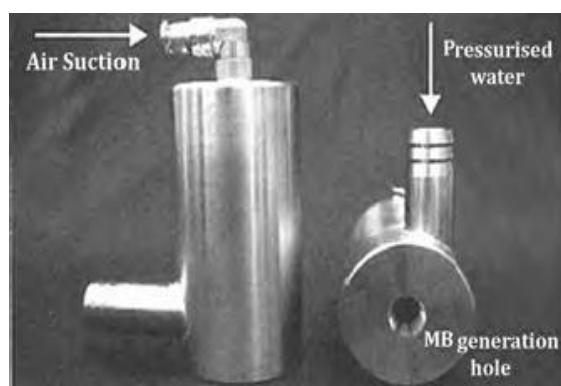


Fig 1.2 Direction of air suction and Pressurized water

which relate to the adjustment of explicit gas determination and their expected objectives to successfully carry out a specific biochemical response. Extremely responsive extremist age capability of certain gases may be appealing for microbe evacuation, but restricted extremist creation with optimum gas-fluid mass exchange potential would be appealing for microbiological development as shown in the Fig 1.2 .

1.3.2 Ejector type

Ejector-type nozzle ejects liquid in high speed as aspirator, and gas is absorbed by the back pressure at the outlet, finally produces MBs by turbulent mixing and shearing mechanism. Nanobubbles have a wide range of use in different fields of knowledge and endeavors. Natural, clinical, agribusiness, marine and territory creature generation and support, and sanitation are all covered. Its most recent substantial application has been in natural cycles, primarily groundwater and wastewater cleanup

1.4.1 Method of Bubble Generation

Our microbubble generator is classified to the two-phase turbulent type, and the generator uses ultra-high-speed turning flow method by multiple cylinder structure. In existing modern processes, the impact of tiny and nanobubbles is promising in order to reduce energy and yield improvement. Compositions and biofuels manufacturing processes, as well as groundwater and wastewater medicine, are examples of these. However, breakthroughs in the nanobubble era are costly. As a result, research should move in the direction of becoming more energy efficient. The possibility of manufacturing resource NBs using a fluidic oscillator was examined for microbubble age, but the equivalent was used for Nano bubble age, with the main benefit being the fluidic oscillator's wide range of penetration. As shown in the fig 1.4 .

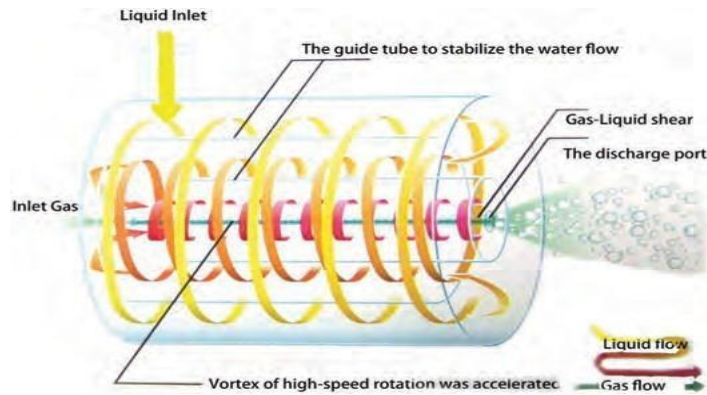


Fig 1.3 Schematic diagram of Generator

1.4.2 Characteristics of the Microbubble Generator

The typical multiple cylinder structure of the generator. These MNBs were constant in size as their fixation expanded, and they were immune to shearing power and high pressures during surface strain during a few age cycles. A common approach for bubble development was to use a gas, such as air, and a fluid, such as water, regardless of the surfactant, which also had an exact impact. For the tiny and nanobubble age, numerous hydrodynamic strategies have been proposed, including winding fluid stream generators, ejector type generators, decompressing generators, venturi tube or spout based power stations, and permeable film type generators. Sonication, actuated blend, wavering recurrence, and light dissipation have been used to achieve different methods for micro and nanobubble ageing.

The smallest air pockets were framed with ejector, intermittent tension change, and ultrasonication, per the relative record of these methods. Cavitation chambers, compressed disintegration, ultrafine pores, shear planes, electrolysis, and whirling liquids have all been claimed as special accomplishments by the US, Canada, Japan, and South Korea. More headways are essential for resolving the unaffordable MNBs generation challenges. Additional chances for developing financially sound solutions must be sought by design.

1.5 CHARACTERISTICS THAT MAKE NANOBUBBLE AN AERATION METHOD.

Nanobubbles are exceedingly small gas bubbles having various physical characteristics that set them apart from normal bubbles. Because of these features, nanobubbles are an effective ventilation solution for a number of applications all over the world. According to the results of extensive testing. Because bubbles this tiny lack the stability to reach the surface, they travel in Brownian motion instead. The nanobubbles float in the water for several months before decomposing, travelling across randomly over the body of water and effectively aerating the entire column of water. As a result, dissolved oxygen levels measured deep within the tank or pond will match those recorded above.

1.5.1 *Surface charge*

A surface charge is present in all bubbles by nature. The stronger the surface charge, the smaller the bubble. The electro kinetic potential in colloidal dispersions is called zeta potential, and nanobubbles have a high zeta potential. The significant negative charge of nanobubbles has been found to prevent their coalescence in zeta-sizer tests, implying that the bubble's integrity is sustained at any depth for extended periods of time. Additionally, the particles' negative charge, together with their high concentration, improves flotation separation efficiency by increasing the frequency of collisions.

1.5.2 *Gas Reserve*

Nanobubbles can stay in suspension for months due to their neutral buoyancy and negative surface charge. This happens even after the solution has reached oxygen saturation. In this way, the nanobubbles act as a gas reserve in the solution.

1.5.3 Surface Area

The surface area of a nanobubble is 400 times that of a microbubble, which has a diameter of 40 micrometers. Because of the higher surface area, mass transfer is increased, guaranteeing that almost any gas is effectively delivered to water.

1.5.4 Oxygen Transfer Efficiency

A crucial need of any aeration application is the efficient transport of oxygen into the water body. Traditional aeration systems barely transfer 1% to 3% of oxygen per inches of water based on size and accompanying rapid increase speed. Traditional aeration is inefficient as a result. As a corollary, it is estimated that aeration absorbs 20% of the world's energy, without nearly all of it going toward wastewater treatment. The Nanobubble System uses nanobubbles' special properties to achieve an industry-leading oxygen mass transfer of over 85% per foot of water. Nanobubbles' prolonged lifespan in water, along with their huge surface area per volume, make them the most economic aeration technique presently available, allowing operators to greatly minimize running costs.

1.5.5 Oxidation

The zeta potential is a fundamental indication of colloidal dispersion stability. The stronger the zeta potential, the more stable the colloidal particle's behavior which means that their interactions with colloidal particles are more stable than bigger bubbles. Excess ions are produced as a result of the greater zeta potential, as are free radicals. When oxygen reacts with specific molecules, it can produce free radicals. Atoms possessing an odd number of electrons are termed simply odd-number atoms. Reactive oxygen species are being used in combustion, atmospheric chemistry, polymerization, plasma chemistry, biochemistry, and other chemical reactions.

1.5.6 Size of the bubbles

Nanobubbles approximately 500 orders of magnitude lower than microbubbles, than about the size of a microbe, and are the smallest bubbles ever discovered. At this scale, far more nanobubbles might fit in about the same volume of water as other bubbles. Because of their small size, they also have a variety of unique features, such as flowing water, an intense electric charge, and a high transfer rate.

1.6 APPLICATION OF MNB TECHNOLOGY IN WATER TREATMENT

1.6.1 *Aeration in water*

Aeration is required for oxygen transport in water treatment for oxygen is not only an important factor for aquatic creatures' survival, but it is also a biochemical reaction substrate for the degradation of oxidative pollutants. Traditional ventilators, on the other hand, use a lot of electricity, and their oxygen transfer efficiency is only 610 percent. Using MNB instead of typical aeration bubbles can enhance dissolved oxygen concentration, promote oxidation, and promote mass transfer of oxygen. The oxygen usage and mass transfer coefficient of synthetic wastewater treatment systems using MNB aeration are nearly double that of conventional bubble aeration systems. Hong The effects of MB aeration and conventional aeration on the Black Doll River's water treatment studied researched. MB can provide more dissolved oxygen at the same bubbling intensity (DO). The DO concentrations of MB and ordinary aeration after

60 minutes of aeration averaged 9.87 mg/L and 6.54 mg/L, respectively. MNB not only increases chemical utilization due to its high mass transfer efficiency, but it can also generate hydroxyl radicals when it decomposes and reacts non-selectively with organic contaminants, generating hydroxyl radicals. Hydraulic cavitation-produced MNBs have been shown to effectively accelerate the oxidative degradation of refractory organic contaminants. The improved performance of MNB in ozone oxidation with wastewater simulated with azo dyes was investigated, and it was discovered that the total mass transfer coefficient of ozone and the removal rate of TOC rose by 80% and 30%, respectively. The breakdown pathway of nitrobenzene was studied utilizing MB produced by cavitation.

The stratosphere mass connection speed of MB is 1.31.5 times but this of normal axial dispersion, and approximately 70 MB of air circulation uses just 50 percent of overall ozone. Traditional bubbling necessitates this. Although the decomposition of formaldehyde follows the fundamental reaction rate, overall visual reaction rate consistent of MB is 1.8-4.3 times higher than traditional bubbles.

1.6.2 *Flotation with MNBs*

Air levitation as an efficient solid-liquid separation technology Their size fluctuated somewhat in deionized water over the course of six days, but was massive in saline water. The same one that stood out the most was the one that showed the fewest number of solidities. The reliability

of in deionized water was weak, and it dissolved after 5 days, while it was more reliable in 1 mM saline settings for a long period. By counting the link between both the terminal drifting NB speed and NB size, their drifting and blasting are still up in the air. With the impact of oxidation decrease potential, saltiness seems to have an impact on water science.

1.6.3 Membrane cleaning

In addition, the recovery of membrane permeation flux can reach 100% with simple physical purification. The adsorption rate of bovine serum albumin on the MNB-modified HOPG surface produced by Hu Jun et al. 20 seconds of electrochemical treatment is 66% 74%, which is 26% higher than that of the unmodified HOPG surface MNB. % 34% lower was observed by Amateur 50 seconds of chemical treatment, when BSA was thoroughly bound to the surface of HOPG, effective coverage of BSA was reduced to 82. For OH revolutionary age synthetic responses between species formed during the furious cavitation bubbles when throb was on, during its water disintegration without a powerful upgrade, multiple alternative consequences have been hypothesized. The compound response with cavitation or without cavitation was used in the study to recreate the age response of OH extremists numerically. Despite this, the prior response is really rather sluggish in acidic settings, despite the fact that it is enormous, and OH extremists were active in basic conditions. It was tracked down that NB buoyancy is a practical interaction for the mechanical and substance treatment of wastewater tests kept a 40% expansion in the productivity with around 95% expulsion of strong waste and silica. Other than this, the expense and execution of buoyancy innovation utilizing NBs are essentially lower than in typical processes

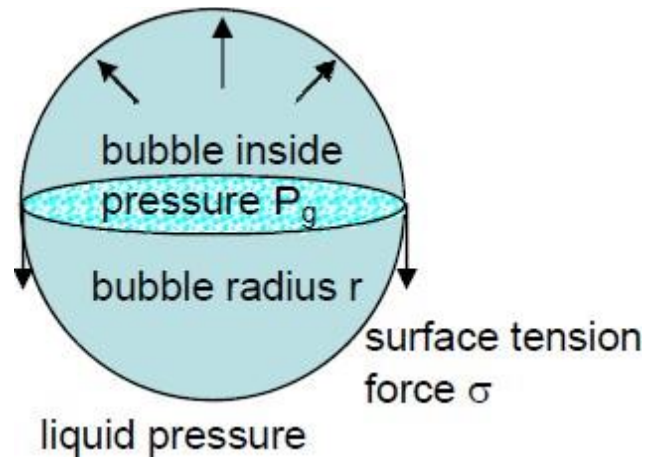


Fig 1.4 Surface tension, Liquid pressure

Low gadget costs. Simple redesign for extra oxygen necessities Speedy and simple establishment even in working plants Versatile to any state of tanks Elevated degree of oxygenation at any profundity. Bright decreased upkeep as shown in the Fig 1.7. Quiet and harmless to the ecosystem activity Plausibility to ventilate destinations that are hard to reach Air circulation with various gases: Air, Oxygen, Ozone What's more, Yoon showed that the decrease in the size of the air pocket in buoyancy is firmly associated with an expanded chance of the minuscule particles slamming into the little air pockets, which thusly lead to an expansion in division effectiveness. Notwithstanding molecule sizes and little air pockets, surface charges likewise play a critical part in buoyancy. Emphatically charged MBs are supposed to actually confine green growth from the water, with a pace of 90% disposal of cells and 92% decrease in chlorophyll. Concerning natural substances, i.e., broke up and natural carbon and aliphatic or sweet-smelling combinations, the MBs could accomplish an end pace of over 30%. Yukimura additionally explored that the NBs extended the area of buoyancy particles and expanded prompting improved effectiveness of buoyancy

CHAPTER – 2

LITERATURE REVIEW

Nanobubbles Technology for Propylene Glycol Coolant Oil Heat Transfer Enhancement Case Study Due to strong anti-freezing properties, the heat transfer potential of Ethylene Glycol as an antifreeze for vehicle radiator nanofluids is explored experimentally in this study. The fluid being examined is a 50:50 mixture of water and ethyl alcohol by volume. Individually, pico and nanobubbles are air rises with dimensions of 10-15 μm and less than 200 nm. These air pockets have unique properties that make them ideal for water treatment. Microbubbles ascend at a considerably slower rate unlike full-scale bubbles, usually arrive at the surface at a considerable speed and then burst, and they burst halfway. Soon after the release of microbubbles, impurities are reacted to and dissolved.

Despite the fact that perhaps the thermally activated hotness of appreciably cools the air pocket, the air pocket temperature increases fundamentally in the last snapshot of the severe air pocket dissolution. The substance's reactivity to water fume soon consumes most oxygen molecules inside an air pocket. Extremists are formed inside the air pocket during expansion, as mentioned in the synthetic response above, making them excellent for sanitation and ruination of foreign substances. tells how the air pocket exploded and the revolutionary era came to be. When formed adequately, nanobubbles can stay above water in the water's body for a long time, up to a few days [2].

Aside beyond their exceptional robustness, discrete have three unique characteristics. For instance, they exhibit Brownian mobility, which means they can cover a bigger surface area while ascending to the surface or staying in the water, making them ideal for bringing fine material or oil drops back to the surface. Second, on the off chance that a typical bubble has a surface region proportion similar with nanobubbles, which is roughly 1.3 times more surface per millimeter, they have an unusually big surface region. Third, nanobubbles can develop electrostatic charge in the presence of surface-dynamic specialists, due to increased mass exchange. As a result, nanobubbles can include contaminants of Science [3].

As a result, we anticipate that the ongoing study will be useful for a quick, to-the-point audit of current nano and microbubble applications. Despite the fact that microbubbles are a slightly more established issue than nanobubbles, the search duration was chosen in both cases. A

total of 1038 distributions were found with either nanobubble and water or microbubble and water in their titles, catchphrases, or digests. To respond to the question about the difference between incorporating and rejecting the keyword water Miniature and nanobubbles are extremely effective and beneficial ways for various aspects of the environment, and they are unavoidably being used in this way [4].

Air sparging is a groundwater treatment process that requires syphoning a gas, usually air, into a location underneath the table via a network of infusion wells. The injected aviation- based armed forces penetrate groundwater and circulate air across it to remove volatiles. Furthermore, the air sparging technique increases groundwater cleanup by increasing the levels available for biodegradation. This is determined by the rate of mass transport between the gas and fluid stages, as well as the peculiarities of water diffusion and blending. Air sparging is frequently used in areas where groundwater and wet soils have now become contaminated with unstable, semi-unpredictable, and non-predictable violently biodegradable natural pollutants [5].

MNBs are micro- to nanometer-sized gas bubbles. Microbubbles and nanobubbles are extremely small bubbles with lengths less than a millimeter. The existence of NBs was not increasingly known due to the difficulty of thermodynamic stability, which generated a lengthy debate. New technologies such as dynamic light scattering, acoustic spectroscopy, and electron microscopy have all been merged in past years. Microscopy is amassing yet more evidence that NBs exist and have the potential to be stable. On the surface, there are two different kinds of NBs. NBs in bulk and at the aqueous surface in aqueous solution [6].

At the same moment, two distinct endeavors were led to survey two different themes. The first nanobubble was selected for use in titles, watchwords, and digests. Then, with the ability, "water" was added, which would then be coupled with nanobubbles. The reason for this decision stems from the fact that nanobubble designs, properties, and development are the focus of a significant portion of nanobubble-related investigation, primarily more seasoned studies. It's important to remember that nano and microbubbles are very new topics. Throughout this way, the use of nanobubbles in water, as well as wastewater treatment, buoyancy, cleaning, agriculture, and other environmental improvements, all appeared toward being closely related to the watchword water. As a result, the designers concluded that combining these two catch-all was the most reasonable solution, even if it meant lowering the

number of distributions. Given the large number of irrelevant distributions, referring to such distributions would have confounded the readers who would most likely use this article as a standard for their research. [7].

Nanobubbles: principles and applicability In the central air flotation method, little air pockets are important for removing low-thickness particles and oxidizing the natural chemicals contained in wastewaters. Layer cleaning with air bubbles has also been a rapidly evolving innovation in recent years, as the expansion of air into the treated wastewater increases the channel choppiness on the layer, lowering the focal polarization. [8] .

The realization concerns zeta potential measurement and methodologies. MNBs have recently gained a lot of press regarding their usage in environmental remediation and bioremediation. Their distinguishing features have garnered attention, such as a specific surface area, a negatively charged surface, a longer retention duration in water, a high mass transfer efficiency, and the synthesis of highly oxygen radicals. Another methodology for treating civil optional gushing is proposed in this review, which incorporates coupling MNB and ways for therapy [9].

In the broken-up air floating procedure, little air pockets are important for removing low-thickness particles and oxidizing the endogenous cannabinoids contained in wastewaters. Layer cleaning with air bubbles has also been a rapidly expanding innovation in current history, as the expansion of air into the feed water increases the stream choppiness on the layer, lowering focus polarized. Secondly, by disturbing the fouling layer with only a variety of air pockets plus cleaning chemical concoctions, the RO films can be cleaned [10].

Historically, heated air at 2-5 is some. Despite this, recent laboratory studies of MNBs in water treatment have revealed that MNBs can improve mass exchange effectiveness and yield higher broken up oxygen fixations. In contamination control, advanced oxidative and ozonation technology, particularly MNBs technology, is gaining traction. And for its properties, the majority of the available audit studies focus on a single different types of air pocket and very specific views, such as masses vehicle, solidity assumptions, and ozonation, among others [11].

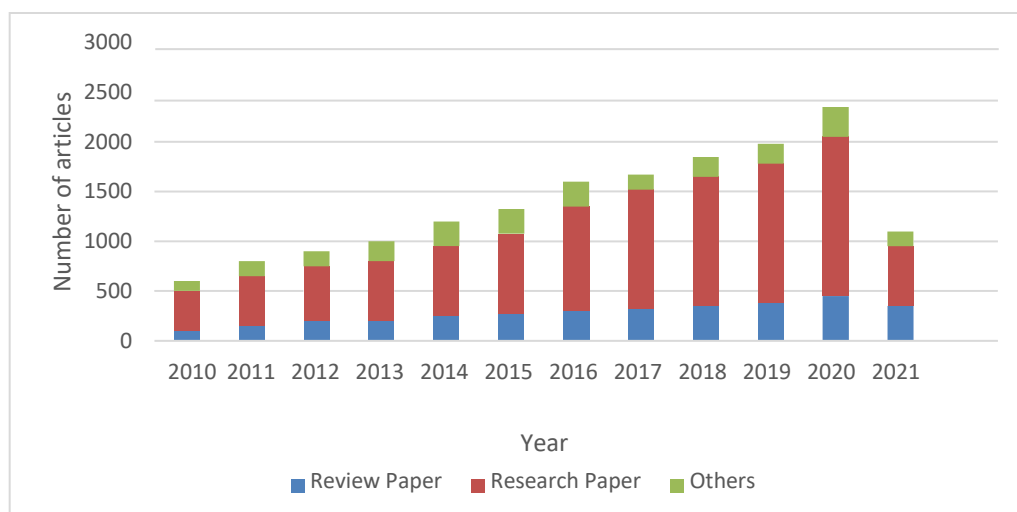


Fig 2.1 Number articles published from 2010 to 2021

Nanobubbles' durability is likely the most significant characteristic before their sensitive applications. Depending on the gas parameters, the safety of various gas methodology is commonly varies. In order to employ them efficiently in a variety of applications, a thorough examination is required. These NBs were created using hydrodynamic cavitation. Bubble meansize, zeta potential, and pH of the NB suspensions were studied. The Straightforward Beak Theory was found to be effective in assessing and explaining NB integrity while accounting forthe entire anticipated energy between two air pockets. The large majority of NBs in demineralized water had a long period of soundness, approximately two months, but not in a low focused saline setup. Because of the variances in their surface pressure or surface charges, these MNBs generated from various gases in water displayed variability in the pace of air pocket size as well as zeta possibilities. The effect of NBs was also tested for a relative increase in broken up oxygen levels.

CHAPTER – 3

AIM AND SCOPE OF PRESENT INVESTIGATION

3.1 AIM

The main aim of this project is to use micro nanobubble technology to reduce Total Dissolved Solids (TDS) of sea water using Oxidation, Cavitation and Aeration. And Compare which method will reduce more TDS Value. In addition to the various technologies that exist in the world today, such as reverse osmosis and distillation, for purification of wastewater the nanobubble technology is the modern strategy for the refinement of wastewater and most cost efficient method compare to other methods. Micro Nanobubble technology is an up-and-coming technology with a wide range of applications.

3.2 SCOPE

Due to unique characteristics, miniature nanobubbles stand out enough to be noticed as of late. Up to this point, the systems of MNB age, i.e., the age of air pockets that dislodge air, making bubbles that structure the air, and creating bubbles utilizing electrolysis, have been contemplated. The utilization of MNB generators in mineral lightness, water treatment, lessening the opposition of boats, drug organization, and warm fly printing are broadly noticed. In any case, there are sure regions where the patterns of MNB application appear to be seriously encouraging.

For example, because of the improved time-cost proficiency and lower compound utilization, the use of MNB has incredible potential in natural maintainability notwithstanding water treatment. The particular properties, for example, higher mass exchange rate, crash productivity, lower rising speed, tweaked surface charge, and extremist age give MNBs a really encouraging job in ongoing procedures of water treatment like sanitization and buoyancy.

In such treatment, high time-cost effectiveness is anticipated regarding higher natural toxin partition, buoyancy, air circulation productivity for organic medicines, and progressed oxidation utilizing OH revolutionaries. The compound free extreme age property has tremendous potential in ozone-based MNB utilizes for the oxidation cycle. Further, the higher blasting energy of MNBs and higher air circulation effectiveness likewise have resulting potential as far as diminishing layer fouling and ooze development in film bio-reactors.

What's more, future exploration on MNB innovation may likewise zero in on the streamlining

and mechanization of MNB generators to redo the MNB age system in different areas, including industry and agribusiness. For example, further developed savvy advancements based robotization and control might work with the exact use of MNB-based water treatment in horticulture and satisfy the developing interest for water treatment at different scales.

Finally, in spite of the tremendous capability of MNBs as a brilliant, proficient, and savvy treatment innovation, its application is as yet restricted to the research facility. Henceforth future examination and tasks need more spotlight on its turn of events and application at the agrarian and modern scales. Ever since beginning of the century, precision microcapsules have been employed in clinical imaging. In any event, it has evolved dramatically in recent years in a small number of bioprocesses, such as treatment of wastewater, where it is now being deployed on a wide scale. However, it is still being studied at the pilot size in some areas, such as oxygenation consumption maturation and anaerobic absorption, that have been well established as a portion or entire invention in a few biomanufacturing and therapeutic processes.

KEY BENEFITS FOR MICRO NANO BUBBLE TECHNOLOGY IN WATER

- Reduced chemical usage
- Low Energy usage
- Reduce COD and BOD
- Can use Ozone or any gas
- Low cost of ownership
- High return on investment
- Low maintenance
- Easily serviced

CHAPTER - 4

MATERIALS AND METHODS

4.1 MATERIALS AND METHOD

Micro Nanobubble generator, seawater, 10 Liters of Oxygen cylinder, Hose pipe, Regulator, Clamps, Spanner, Key, are the components used in this method. To begin, we gathered seawater from ECR BEACH(Chennai),.



Fig 4.1 Hose Pipe



Fig 4.2 Sample water



Fig 4.3 Oxygen Cylinder

4.2 Seawater sample Collection

The seawater sample above was taken from seawater collected from ECR beach . The water is now being tested for TDS. And I collected several tests from the Chennai Mettix lab private limited, which is located near Guindy in Chennai. pH reading at 25 degrees, dissolved oxygen content (DO), total amount of dissolved solids (TDS), present in the sample, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), salinity.

Table 4.1 seawater sample (Before purification).

Sl. No	Test parameters	Results
1.	pH at 25°C	8.06
2.	Dissolved Oxygen(DO)	5.76 mg/l
3.	Total Dissolved Oxygen (TDS)	41920 mg/l
4.	BOD at 27°C for three days COD	4 mg/l
5.	SALINITY	17 mg/l
6.		33.84%

We can confirm that the seawater from sea is contaminated based on the preceding test results. The key goal now is to use Micro nano bubble technology to purify this seawater and reduce TDS AND SALINITY. As a result, the first and most important step is to create micro nanobubbles. The technique of hydrodynamic oxidation is used to create micro nano bubbles. The figure 4.2 is the equipment for nanobubble generation. A motor, inlet valves, outlet valves, a nozzle, and a pressure regulator these are the equipment's used for MNB generation.

To provide a controlled flow of air, the amount of air to be drawn from the oxygen cylinder is adjusted using an inlet valve. So that nanobubbles can be generated in a controlled manner in the water. Bulk nanobubbles, micro-nanobubbles, and macro-nanobubbles are among the nanobubbles produced. It shows the inlet valves in which the pressure is regulated and the figure 4.6 shows the motor.



Fig 4.4 MNBG device

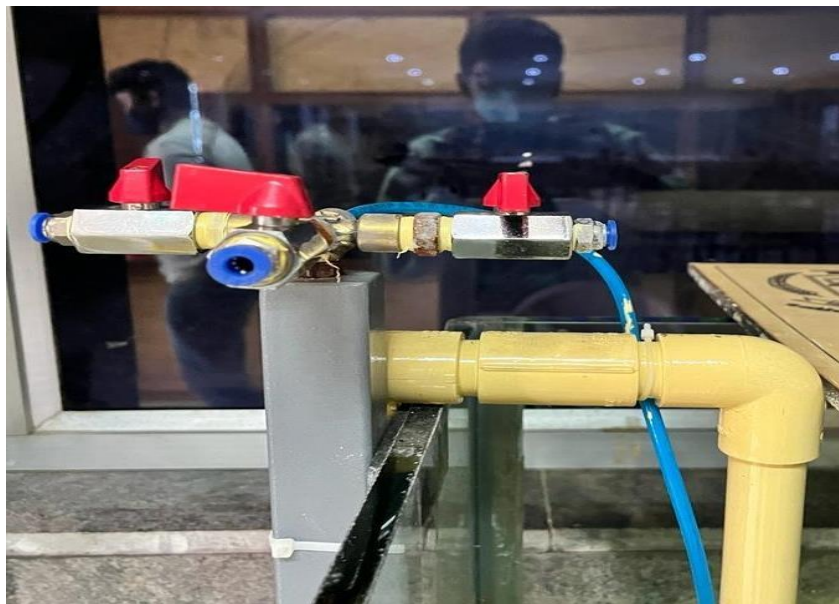


Fig 4.5 valves



Fig 4.6 Motor

Table 4.2 Oxygen cylinder specifications

Oxygen cylinder 10.2 liter (b type cylinder /Bed side cylinder)	
Height of cylinder (without valve)	865mm
Height of cylinder (with valve)	940mm – 950mm
Water capasity of cylinder	10.2 Ltr of Water
Cylinder working pressure	150 kgf/cm at 150c

Collected sea water in cans is filled in micro nano bubble machine process has been done inthe micro nano bubble generator device.



Fig 4.7 Collecting Sea water

For Oxidation, Cavitation and Aeration 1hour, samples collected in one litre bottles, and we have given samples for testing.

Later samples collected in one litre bottles, sample are collected at 1 hour, 2 hours and 5 hours samples during process of Cavitation



Fig 4.8 Collecting Sample

CHAPTER - 5

RESULTS AND DISCUSSION

5.1 Cavitation process

Execution Typical cavitation tests were completed at various working circumstances. the variety of siphon head with the NPSH at stream rate proportions of 25%, 33% and half and water with salt grouping of 6% and 10% extra to the unadulterated water and Seawater. These figures demonstrate, for all working circumstances tried, that the head ascend across the siphon is kept up with almost at steady worth from the most extreme accessible net positive attractions head down to the initiation condition. Additionally there is an inclination for the head ascend across the siphon to diminish as the NPSH diminishes for created cavitation condition. This peculiarity might be credited to the presence of circulatory stream. The outcomes show that the breakdown point happened before in the Seawater condition then in the 10% and 6% of salt focus and finally unadulterated water separately. The fundamental justification for this pattern is the high arrangement of air pockets, which increments with the increment of salt focus.

Table 5.1 Cavitation 1 hour result sample

Sl. No	Text parameters	Protocol	RESULTS
1	pH at 25°C	IS 3025 Part 11:1983 (Reaff: 2017)	7.99
2	Dissolved Oxygen(DO)	IS: 3025 Part 38-1989 (Reaff.2014)	6.66 mg/l
3	Total Dissolved	IS 3025 Part 16:1984 (Reaff: 2017)	38390 mg/l
4	Oxygen (TDS) BOD at 27°C for three days	IS 3025 Part 44:1993 (Reaff: 2014)	4 mg/l
5	COD	IS: 3025 Part 58:2006 (Reaff: 2017)	16 mg/l
6	SALINITY	By Argentometric Titration	36.24 %

The seawater from sea is contaminated based on the preceding test results. The key goal now is to use Micro nano bubble technology to purify this seawater and reduce TDS .As aresult, the first and most important step is to create micro nanobubbles. The process of Cavitation process is used to create micro nano bubbles. is the equipment for nanobubble generation. A motor, inlet valves, outlet valves, a nozzle, and a pressure regulator these are the equipment's used for MNB generation. By without air, by closing valves of micro nano bubble generator device So that nanobubbles can be generated in a controlled manner in the water. Bulk micro-nanobubbles are generated in Cavitation process. By comparing with Oxidation and Aeration process the value of TDS is more reduced in Cavitation process. For example of TDS value of Aeration for 1 hour is 40195 mg/l ,TDS value Oxidation for 1hour is 38390 mg/l TDS value of Cavitation for 1 hour is 36440mg/l from table 5.1

Table 5.2 Cavitation 2 hours sample result

SI. NO	TEST PARAMETERS	UNIT	TEST METHOD	RESULTS
1	TOTAL DISSOLVED	Mg/l	IS:3025 (part - 16): (Reaffirmed 2017)	33275

After doing Oxidation, Cavitation and Aeration for 1 hour we got TDS value of Aeration for 1 hour is 40195 mg/l ,TDS value Oxidation for 1hour is 38390 mg/l and TDS value of Cavitation for 1 hour is 36440mg/l . by comparing the above processes Cavitation TDS reducedmore by remaining all of them so we decided to reduce more TDS Value for Cavitation process.we did Cavitation for 2 hours of time by By without air by closing valves of micro nano bubble generator device So that nanobubbles can be generated in a controlled manner in the water. Bulk micro-nanobubbles are generated in Cavitation process. and TDS value of 2 hours Cavitation process is 33275mg/l from table 5.2

Table 5.3 Cavitation 5 hours sample result

SI. NO	TEST PARAMETERS	UNIT	TEST METHOD	RESULTS
1	TOTAL DISSOLVED	Mg/l	IS:3025 (part -16): 1984 (Reaffirmed 2017)	17260

After doing Oxidation, Cavitation and Aeration for 1 hour we got TDS value of Aeration for 1 hour is 40195 mg/l, TDS value Oxidation for 1 hour is 38390 mg/l TDS value of Cavitation for 1 hour is 36440 mg/l and TDS value for Cavitation 2 hours is 33275 mg/l by comparing the above processes Cavitation TDS reduced more by remaining all of them so we decided to reduce more TDS Value for Cavitation process. we did Cavitation for 5 hours of time by By without air by closing valves of micro nano bubble generator device So that nanobubbles can be generated in a controlled manner in the water. Bulk micro-nanobubbles are generated in Cavitation process. and TDS value of 5 hours Cavitation process is 17260 mg/l from table 5.3

5.2 AERATION PROCESS

The practice of injecting oxygenation into a water solution is known as aeration. Air circulation is important in the inventory of oxygen in water treatment because oxygen is an important factor for physiological substrate responses and oceanic life.

The impact of air circulation techniques on wastewater and organic water treatment, as well as subterranean recovery, has been the subject of several studies. Increasing the productivity of the elements that impact the speed of mass exchange was one of the main objectives of countless studies. In most healthy frames, As the majority of the contact gear employs or mechanical aerators that require enormous upkeep costs and electromagnetic information, the mass transfer measure of oxygen is critical in these frameworks. The degradation season of natural waste creation in NB-circulated air through units was not exactly half contrasted and the regular frameworks. In conclusion, the rot and development rate in the NB circulated air through unit was likewise a lot quicker than the regular framework. Because of such properties, there is further need for exploratory examinations around here

SALINITY

saltiness or the pungency of the oceans, goes from 32 to 37 sections for each thousand of disintegrated salts, averaging around 35 sections for every thousand. The majority of the pungency of the oceans is as broken up sodium chloride, which is equivalent to table salt. There

are, be that as it may, numerous other broke down salts in the oceans also. Broken down materials in ocean water are gotten from enduring of minerals and rocks ashore. The broke up components are moved to the ocean by waterways. A few salts are additionally brought into ocean water by submerged emissions of ocean bottom volcanoes and volcanic vents. Dissipation gathers salts in ocean water, up to the place where the water becomes immersed with those salts. At the place of immersion, salt precious stones accelerate from ocean water and are in this manner eliminated from ocean water. Thusly, the pungency of the ocean is keptup with throughout lengthy time spans.

Table 5.4 Aeration 1 hor sample result

SI. NO	Text parameters	Protocol	RESULTS
1	pH at 25°C	IS 3025 Part 11:1983 (Reaff: 2017)	7.88
2	Dissolved Oxygen	IS: 3025 Part 38-1989 (Reaff.2014)	5.76 mg/l
3	Total Dissolved	IS 3025 Part 16:1984 (Reaff: 2017)	40915 mg/l
4	Oxygen (TDS) BOD at 27°C for three days	IS 3025 Part 44:1993 (Reaff: 2014)	4 mg/l
5	COD	IS: 3025 Part 58:2006 (Reaff: 2017)	16 mg/l
6	SALINITY	By Argentometric Titration	39.18 %

The seawater from sea is contaminated based on the preceding test results. The keygoal now is to use Micro nano bubble technology to purify this seawater and reduce TDS. As aresult, the first and most important step is to create micro nanobubbles. The process of Aerationis used to create micro nano bubbles. The equipment for micro nanobubble generation. A motor, inlet valves, outlet valves, a nozzle, and a pressure regulator these are the equipment's used for MNB generation. To provide a controlled flow of air, the amount of air to be drawn fromatmospheric air is adjusted using an inlet valve. So that micro nanobubbles can be generated

in a controlled manner in the water. And micro-nanobubbles are produced. finally after 1 hour of time the TDS value for Aeration is reduced from 41920mg/l to 40915 mg/l from table 5.4

5.3 OXIDATION

During a transaction, a molecule, atom, or ion releases electron, which is known as oxidation. When a molecule's, atom's, or ion's electron configuration is increased, it is called oxidation. When an atom, enzyme, or ion's oxidation state lowers, the process is called reductions.

OXIDATION 1 HOUR

Sl. No	Text parameters	Protocol	RESULTS
1	pH at 25°C	IS 3025 Part 11:1983 (Reaff: 2017)	7.62
2	Dissolved Oxygen(DO)	IS: 3025 Part 38-1989 (Reaff.2014)	5.9mg/l
3	Total Dissolved	IS 3025 Part 16:1984 (Reaff: 2017)	36440mg/l
4	Oxygen (TDS) BOD at 27°C for three days	IS 3025 Part 44:1993 (Reaff: 2014)	BDL (DL2.0 mg/l)
5	COD	IS: 3025 Part 58:2006 (Reaff: 2017)	16 mg/l
6	SALINITY	By Argentometric Titration	33.84%

The seawater from sea is contaminated based on the preceding test results. The key goal now is to use Micro nano bubble technology to purify this seawater and reduce TDS. As a result, the first and most important step is to create micro nanobubbles. The process of Oxidation is used to create micro nano bubbles. The equipment for micro nanobubble generation. A motor, inlet valves, outlet valves, a nozzle, and a pressure regulator these are the equipment's used for MNB generation. To provide a controlled flow of Oxygen, the amount of oxygen to be drawn from oxygen cylinder is adjusted using an inlet valve. So that micro nanobubbles can be generated in a controlled manner in the water. And micro-nanobubbles

are produced. finally after 1 hour of time the TDS value for Oxidation process is TDS reduced from 41920mg/l to 38390 mg/l ,from table5.5. By comparing Oxidation and Aeration the TDS value more reduced in Oxidation process

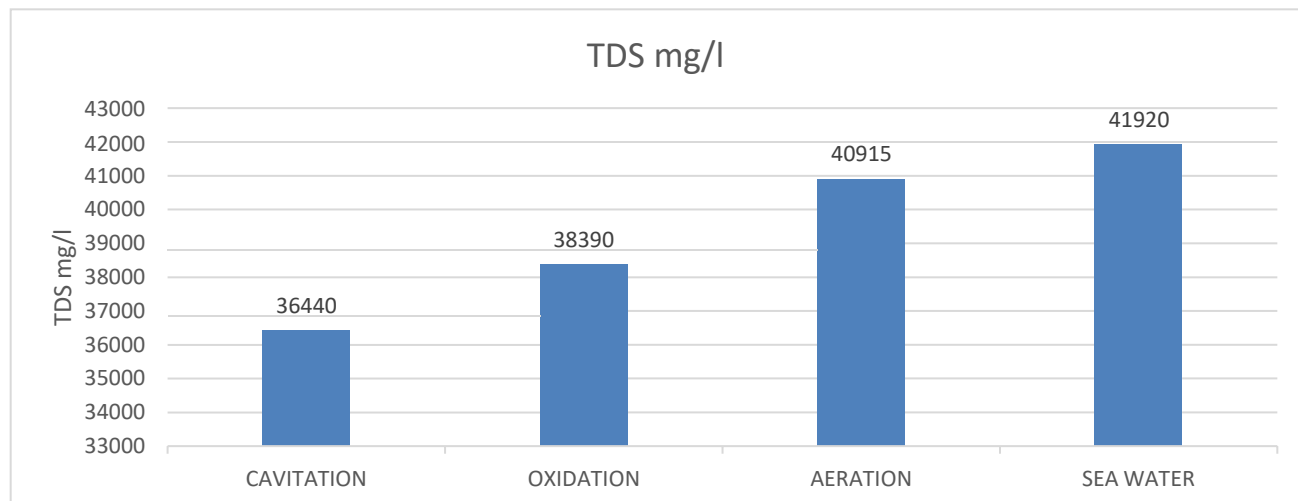


Fig 5.1 Comparison sea water and other three processes TDS

The above graph illustrate the reduction of TDS values in four different processes through micro nano bubble technology .AS we seen that in cavitation process we have got the TDS value of 36440mg/l in process of doing for one hour . When compared to the aeration Process. The oxidation was slightly decreased with respective values of 40915 mg/l, 38390 mg/l. At finally the comparison with the original sea water value of 41920 mg/l with the other three process through micro nano bubble technology for doing the process of continuously for one hour has slightly decreased and if we go through the process continuously for hours the TDS values will get reduced and converted into a fresh water . After doing the process of cavitation for continuously of 5 hours the TDS value have got reduced as shown in the figure 5.2

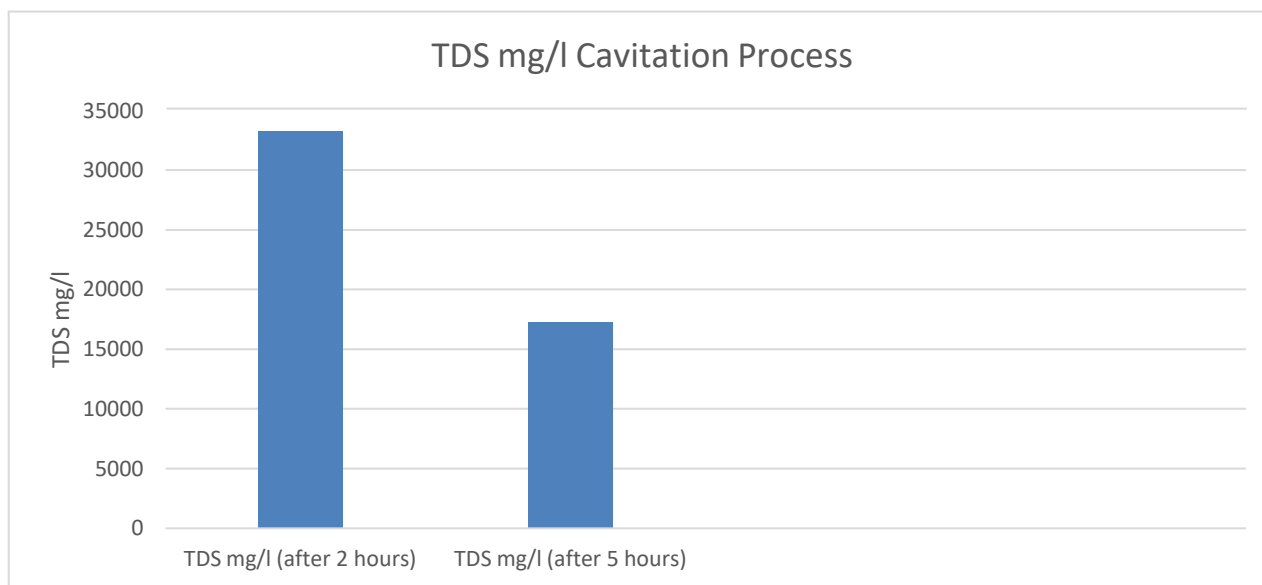


Fig 5.2 Comparison of 2 hours and 5 hours of TDS Cavitation process

5.4 EXPLANATION

In the above three cases the sea water is first treated through Micro Nano bubble Generator device and added the Oxidation, With Air, and Without Air after these samples are taken for 1 hour respectively. Each sample is tested in Chennai Mettlex Lab and there is decreases in the total dissolved solids of each sample so, due to decreases in TDS we can saythere is decreases in salinity of sample .so here the TDS is decreased trough Micro nano bubbletechnology. In this Cavitation Process gives better result by comparing with Oxidation and Aeration. So next we decided to decrease TDS value for Cavitation so we run the device 2 hours and 5 hours.

5.5 DISCUSSION.

After analyzing the characteristics of Micro Nanobubbles and determining the bubble number density, bubble diameter, and dissolved oxygen content, we are now moving on to thenext phase, which is determining the extent to which water may be purified utilizing nanobubble technology. The water collected after the nanobubbles are created is delivered to a laboratory. pH reading at 25 degrees, immersed oxygen content total amount of dissolved solids total Carbonate content, dissolved solids, and chromium content.

Based on the and flow results, the MNBT can clearly be described as an innovation withless element use, smaller gear size, less land area, faster use of oxidants such as ozone,

less/no formation of optional contaminants, and excellent contamination treatment impacts. As a result, it is plausible to think that it is a low-cost, productive, and environmentally friendly innovation that demonstrates its exceptional benefits in natural pollution management applications. Its uses in the realm of natural pollution control will likely be considered as well. It could be a good idea to expand its pollution abatement field to include the decontamination of smoke gases. Consider the treatment of VOCs and vent gases, for example. One viable strategy for treating VOCs is the retention approach. The assumption is that if VOCs are pumped into the membrane as MNBs, high retention rates can be achieved successfully. The investigation into the removal of vent gas pollutants using the MNBT in conjunction with the oxidation-retention technology should be interesting and worth looking into. The most important criterion for oxidation-assimilation innovation is that the dangerous parts in pipe gas are oxidized by oxidants and devoured by the retaining vehicle for contaminations. It's one of the most exciting innovations in the treatment of pipe gas. The MNBs' six common elements increase the likelihood of NO and SO₂ in vent gas being oxidized and swallowed, allowing the evacuation capability to be improved further. It may even be considered leading research into the non-separated and non-specific integrated ejection of multi-toxins in pipe gas using the MNBT. In water treatment. The hydroxyl revolutionaries are the dominant species in O₃-based AOP reactions (percent OH). In such frameworks, any chemical can be oxidised either directly through O₃ atom oxidation (direct reaction) or indirectly through hydroxyl revolutionaries shaped from O₃ atom oxidation (indirect response) (circuitous response). Because the usual oxidation is lower than the hydroxyl extremist (2.80 V), the abnormal oxidation of water contaminations via -OH age is extremely responsive and non-specific to a wide variety of natural poisons. As a result, the aberrant responses help to accelerate the oxidation response with contaminations. Whatever the case may be, it is vital to continue to enhance both response tools in order to improve overall sanitization productivity. The ozonation and ozone were investigated in various ways.

CHAPTER 6

SUMMARY AND CONCLUSION

6.1. SUMMARY

Nanotechnology is a term used to represent branches of science and engineering that exploit nanoscale phenomena in the design, characterization, fabrication, and application of materials, structures, devices, and systems. Water treatment techniques are increasingly incorporating nanotechnology. Nanotechnology is the process of manipulating atoms on a nanoscale. In nanotechnology, nano membranes are used to soften water while also eliminating pollutants like physical, biological, and chemical contaminants. It is possible to make nanobubbles utilizing hydrodynamic oxidation. After that, the nanobubbles will be used to remediate ground water. After that, the water is transported for testing to determine its quality. The results are then used to conduct some analysis.

6.2. CONCLUSION.

To reduce Sea water TDS by the process of Oxidation, Cavitation and Aeration through Micro nanobubble technology with 120 liters of water with different interval of time, like running machine for 1 hour firstly for oxidation, cavitation and aeration, samples are given for testing. And Later the results of the samples are given by the lab there we observe that by comparing all TDS value of all the processes the Value of TDS is reduced more in Cavitation process. Same as Salinity is also most reduced in Cavitation Process by comparing process of Aeration and Oxidation. After that we have run the machine for 2 hours and 5 hours for Cavitation process to reduce more TDS value and for reference, we attached the results in the above pages. This study looks for additional examination in regards to upgrades in execution procedures, TDS reduction, and size under different physical and substance conditions, bubbleage strategies, and computerized improvement. Finally, we Conclude that by Comparing Oxidation, Cavitation and Aeration processes the TDS value of Sea Water is most reduced in Cavitation Process

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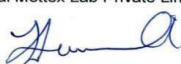
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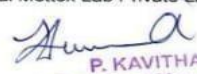
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APPENDIX

ORIGINAL SEA WATER SAMPLE RESULT

CML • CML • CML • CML • CML • CML • CML • CML • CML • CML • CML • CML • CML • CML • CML • CML E-mail: test@mettexlab.com Phone : 044-22323163, 22311034 Web : www.mettexlab.com 42179490, 42179491																													
 CHENNAI METTEX LAB PRIVATE LIMITED Jothi Complex, 83, M.K.N. Road, Guindy, Chennai - 600 032. (Approved/Recognized by APEDA, AGMARK, GAFTA, EIC, FSSAI, BIS & MoEF)																													
TEST REPORT																													
Page No. 1 of 1																													
ISSUED TO : Mr. Dr.Purusothaman.M, Dr.Senthil Kumar.G, Sathyabama Institute of Science and Technology, Chennai - 600 119.	T.C Date : 17.02.2022 T.C No : CML/21-22/67359 Date Of Receipt : 12.02.2022 Analysis Commenced On : 12.02.2022 Analysis Completed On : 17.02.2022																												
Cust. Ref : SRF Dated : 12.02.2022 Lab No : 2274273																													
Sample Description : Sea Water Original Sample. (as stated by customer)																													
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End of Report																													
For Chennai Mettex Lab Private Limited  P. KAVITHA Technical Manager																													
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OXIDATION 1 HOUR SAMPLE

 CHENNAI METTEX LAB PRIVATE LIMITED Jothi Complex, 83, M.K.N. Road, Guindy, Chennai - 600 032. (Approved/Recognized by APEDA, AGMARK, GAFTA, EIC, FSSAI, BIS & MoEF)		E-mail: test@mettexlab.com Web : www.mettexlab.com Phone : 044-22323163, 22311034 42179490, 42179491	
TEST REPORT			
ISSUED TO : Mr. Purusothaman.M, Senthil Kumar.G, Madar Basha.D, Pavan Kumar Reddy.D, Sathyabama Institute Of Science And Technology, Chennai - 600 119.		T.C Date : 16.02.2022 T.C No : CML/21-22/67133 Date Of Receipt : 11.02.2022 Analysis Commenced On : 11.02.2022 Analysis Completed On : 16.02.2022	
Cust. Ref : SRF Dated : 11.02.2022 Lab No : 2274066			
Sample Description : Sea Water - Sample - 7 (60 min). (as stated by customer)			
S.No	Test Parameters	Protocol	Results
01	pH at 25°C	IS 3025 Part 11:1983 (Reaff. 2017)	7.62
02	Dissolved Oxygen	IS: 3025 Part 38-1989 (Reaff.2014)	5.9 mg/l
03	Total Dissolved Solids	IS 3025 Part 16:1984 (Reaff. 2017)	36440 mg/l
04	BOD @ 27°C for 3 days	IS 3025 Part 44:1993 (Reaff. 2014)	BDL(DL:2.0 mg/l)
05	COD	IS: 3025 Part 58:2006 (Reaff. 2017)	16 mg/l
06	Salinity	By Argentometric Titration	33.84 ‰
End of Report 		For Chennai Mettex Lab Private Limited  P. KAVITHA Technical Manager	
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CAVITATION 2 HOURS TDS RESULT

**ISO / IEC 17025
NABL ACCREDITED LABORATORY**



TEST REPORT

Test Report No: TR2202150-01	Date: 24.02.2022	Page 1 of 1
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CUSTOMER DETAILS				
Customer Name & Address		Dr. Purusothaman, Dr. Senthil Kumar, Madar Basha.D, Pavan Kumar Reddy.D. Sathyabama College Student, Andhra Pradesh		
Customer Reference		: Test Request Form dated on 22.02.2022		
SAMPLE DETAILS				
Sample Code		: 2202128-01	Sampled on	: 22.02.2022
Sample Name		: WATER	Sampled by	: Customer
Sample Description		: SEA WATER	Sample Received Qty	: 2 Lit
Sampling Location		: ---	Sampling Procedure	: ---
Identification by Client		: 4 Hours	End Use	: ---
Test Started on		: 23.02.2022	Sample Received on	: 22.02.2022
Test Completed on		: 24.02.2022	Sample Condition	: Fit for analysis

Sl. No.	Test Parameter	Unit	Test Method	Results
1	Total Dissolved Solids	mg/L	IS:3025 (Part-16):1984 (Reaffirmed 2017)	33275

Verified by
J. Dharmarajan
Lab Incharge



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 ① The test results relate to the items tested
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 ③ The report shall not be considered to be the representative of similar or equivalent items.
 ④ Any correction makes the report invalid.

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CAVITATION 5 HOURS TDS RESULT

**ISO / IEC 17025
NABL ACCREDITED LABORATORY**



TEST REPORT

Test Report No: TR2202139-01	Date: 22.02.2022	Page 1 of 1
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CUSTOMER DETAILS

<i>Dr. Purusothaman, Dr. Senthil Kumar,</i>	
Customer Name & Address :	<i>Madar Basha.D, Pavan Kumar Reddy.D Sathyabama College Student, Andhra Pradesh</i>
Customer Reference :	Test Request Form dated on
Identification by Customer :	Sea water Sample Without air 5 hours

SAMPLE DETAILS

Sample Code :	2203103-02	Sampled on :	02.03.2022
Sample Name :	WATER	Sampled by :	Customer
Sample Description :	Sea Water	Sample Received Qty :	2 Lit
Marked in Sample :	---	Sampling Procedure :	---
Test Started on :	03.03.2022	Sample Received on :	02.03.2022
Test Completed on :	05.03.2022	Sample Condition :	Fit for analysis

Sl. No.	Test Parameter	Unit	Test Method	Results
I	Total Dissolved Solids	mg/L	IS:3025 (Part-16):1984 (Reaffirmed 2017)	17260

Verified by

J. Dharmacharan
Lab Incharge

*** End of Test Report ***



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