https://doi.org/10.48047/AFJBS.6.14.2024.3919-3932

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Advance Wastewater Treatment System Implementation in Pesticide Industry

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Volume 6, Issue 14, Aug 2024

Received: 09 June 2024

Accepted: 19 July 2024

Published: 08 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.3919-3932

Abstract. In India industrialization expansion at full tilt. Worldwide India has known as biggest exporter of agricultural products such as Fruits, Vegetables and other food staples. For this well and good agricultural products many people's are using pesticides such as Metribuzin technical (Herbicide), Bispyribac, Tricylozole (Fungicide), Thiamethoxam, Tebuconazole, etc. sort under Pesticides. Process of manufacturing of these Pesticides numerous chemical reactions like Hydrolysis, Chloro-Bromination, Distillation, Chlorination etc. is done. During process many hazardous chemicals are used such as Bromine, 2-4-D Acid, CSCl4, EDC, 2-Chloro-4(4-Chlorophenoxy) Benzyl chloride as an input at different stages of reaction. Manufacturing of this products have major ramification in Environment as well as on human beings. Pollutants extracted during the process in the form of air, water, noise, soil having a toxic effect on living system and ecosystem. Reaction of chemicals releases toxic vapors and mist during process can be passed through Scrubber system before releasing into open atmosphere. Effluent generated which cannot be directly discharged into river or ponds as per CPCB Norms. So for this all possible treatment are done to achieve the Zero Liquid Discharge (ZLD). All the possible measures will be taken to for the proper and effective Environmental management plan(EMP) can over the risk and pollution on environment. In the Pesticide industry, utilization of fresh water in process, washing, other utilities because of this the consumption of fresh water increases, it directly or indirectly effect on the environment system. In the process generally in many reactions water is added with many hazardous chemicals. After the process completed finished good collected and waste liquid is separated out. This waste liquid contains water and other hazardous chemicals in dissolved form or in suspended form. Now waste water is collected into Effluent collection tank for treatment purpose to reduce the environmental impacts on marine life. Treatment of effluent with different stages according to parameters and ready to reuse/ recycle the treated water to reduce the consumption of fresh water into the process or other utilities. Multiple products effluent generation and collection in common tank which contributes the higher range of Chemical Oxygen Demand (COD) mg/L, Biochemical Oxygen Demand (BOD) mg/L etc. Range of COD: 30000 mg/L to 80000 mg/L. Range of BOD: 10000 mg/L to 15000 mg/L. which damages the aquatic life by reducing the Oxygen level present in the water in dissolved form.

KEYWORDS: Industrial wastewater, ZLD, Environmental management plan, Activated sludge, Pesticides.

INTRODUCTION

Advance wastewater treatment system is a process in which the present impurities are removed. In this, now a day's Reverse Osmosis (RO) application is being followed for completely removal of impurity level. After the treatment the treated water is discharged into river or ocean. As per our system we will not discharge the treated water outside the industry. We will reuse/recycle the treated water for utility purpose and in process for reduce the freshwater consumption in industry.

Waste Water Generation And Impact On Environment And Mitigation Plan.

Total fresh water requirement in pesticide industry are (Process + Domestic + Greenbelt). During the process or manufacturing generally, fresh water is used which is supply from Industrial Development Corporation area. Because of Hazardous process the water consumed is released in the form of Effluent which contains traces of toxic chemicals that cannot be directly discharged into open environment. Water contaminated by runoff or leaching may find its way in. The earth's hydrologic cycle is connected to these two essential activities. Generally, industries which are located near to the Ocean or River are discharging their effluent into it. Because of this it has a negatives impact on water bodies such as on marine animals and plants. So to mitigate the negative impact on environment the Effluent will directly send to Treatment unit consist of these three stages Primary + Secondary + Tertiary to utilize the treated water for process and other areas. Main target is to achieve ZLD process which also reduces the consumption of fresh water or groundwater.

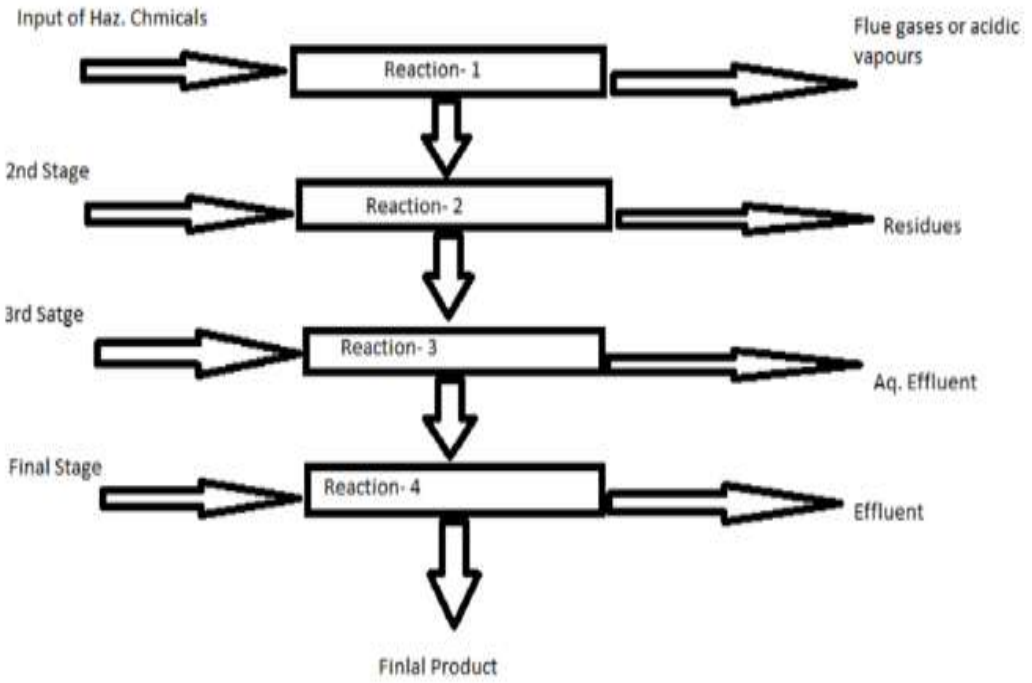

FIGURE-1: *Effluent generation during process reaction manufacturing of Pesticides*

ZLD (Zero Liquid Discharge) Concept

Zero liquid discharge (ZLD) describes a treatment method where the facility doesn't release any liquid effluent into the surface water or rivers etc., effectively eradicating all associated environmental pollutants. The advantage of the ZLD process is to use in an effectively wastewater treatment, recycling, and reuse, which helps with water conservation by reducing the need for fresh water. Concentrating the effluent by a range of techniques, including water recovery and recycling and membrane- and Multiple Effect Evaporation-based systems, can result in zero discharge solutions.

Advance Waste Water Treatment System

The misuse of pesticides around the world has resulted in significant environmental issues and considerable concern. Because of their extensive killing range, large impact, and high pest lethality, toxicity-containing pesticides serve as the primary agricultural agent in both domestic and international agricultural output. Dimethyl phosphite and phosphorothioate are the main intermediates used in the synthesis of pesticides, which are typically made from raw materials such Bromine, 2-4-D Acid, CSCl4, EDC, 2-Chloro-4(4-Chlorophenoxy) Benzyl chloride methanol, and toluene. The characteristics of production effluent include high toxicity, high salt concentration, offensive odor, and poor biodegradability. Large amounts of toxicity-containing wastewater produced during the production of pesticides. The rapid development of agriculture has released dangerous compounds into water bodies that can be absorbed by passive plants, such as in Rivers, Lakes, and Oceans. Because of their enrichment in the food chain, these toxins pose a major threat to human life and health. The release of wastewater that contains toxicity increases the amount of nutrients in the water body, makes water bodies more likely to eutrophicate, and endangers the ecological environment. Therefore, efficient degradation processes or methods are required to reduce the environmental pollution caused by effluent containing toxic substances in it. Because of this, the effluent treatment system design is regarded as an Advance wastewater treatment system. Two streams of the generated wastewater will be separated for treatment. High concentrations of dissolved substances and salty materials can be found in stream one. Effluent from stream one will be sent to MEE (Multiple Effect Evaporator) and condensate of MEE will be reused in the activated sludge process. Wastewater from stream two, which has a lower concentration, will be treated at ASP's secondary stage (Activated Sludge Process). Both streams will be sent through the RO (Reverse Osmosis) process, and the RO permeate will be used for additional processes, such as in production plants, cleaning, greenbelt areas, etc. As a result, the unit will discharge no liquid.

METHODOLOGY

Advance Waste Water Treatment System Methods

An advanced wastewater treatment system removes current contaminants through a procedure. In this, now a day's Reverse Osmosis (RO) application is being followed for completely removal of impurity level. After the treatment the treated water is discharged into river or ocean. As per our system we will not discharge the treated water outside the industry. We will reuse/recycle the treated water for utility purpose and in process for reduce the freshwater consumption in industry.

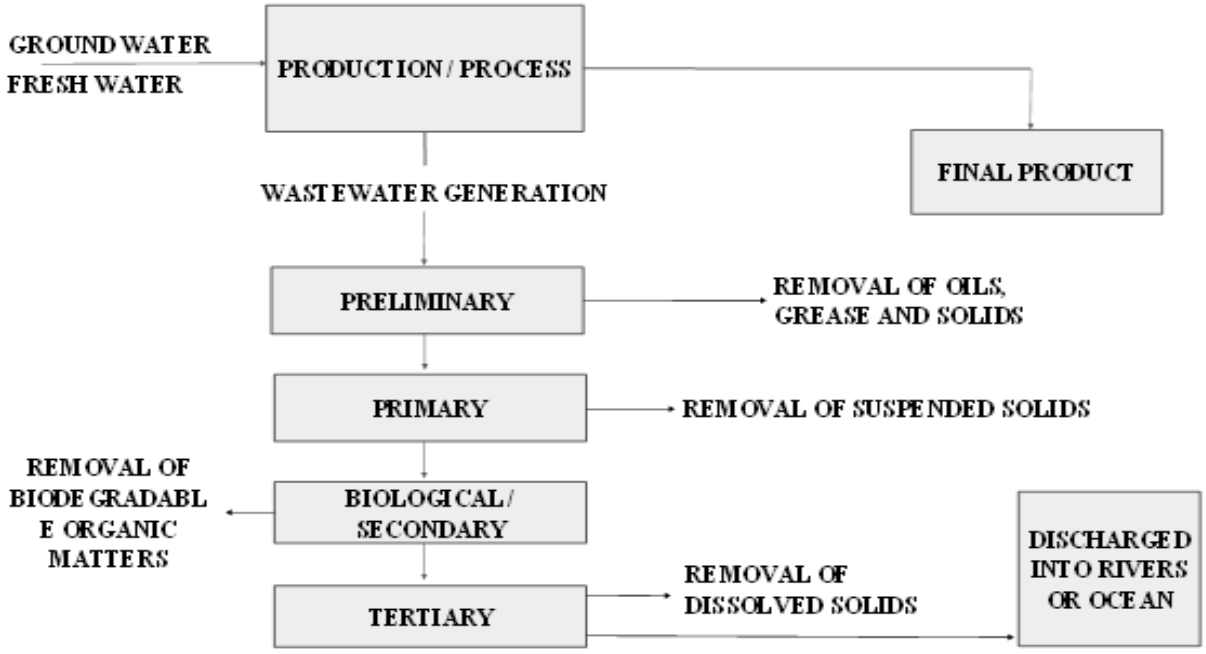

Figure-2: *Old method for waste water treatment.*

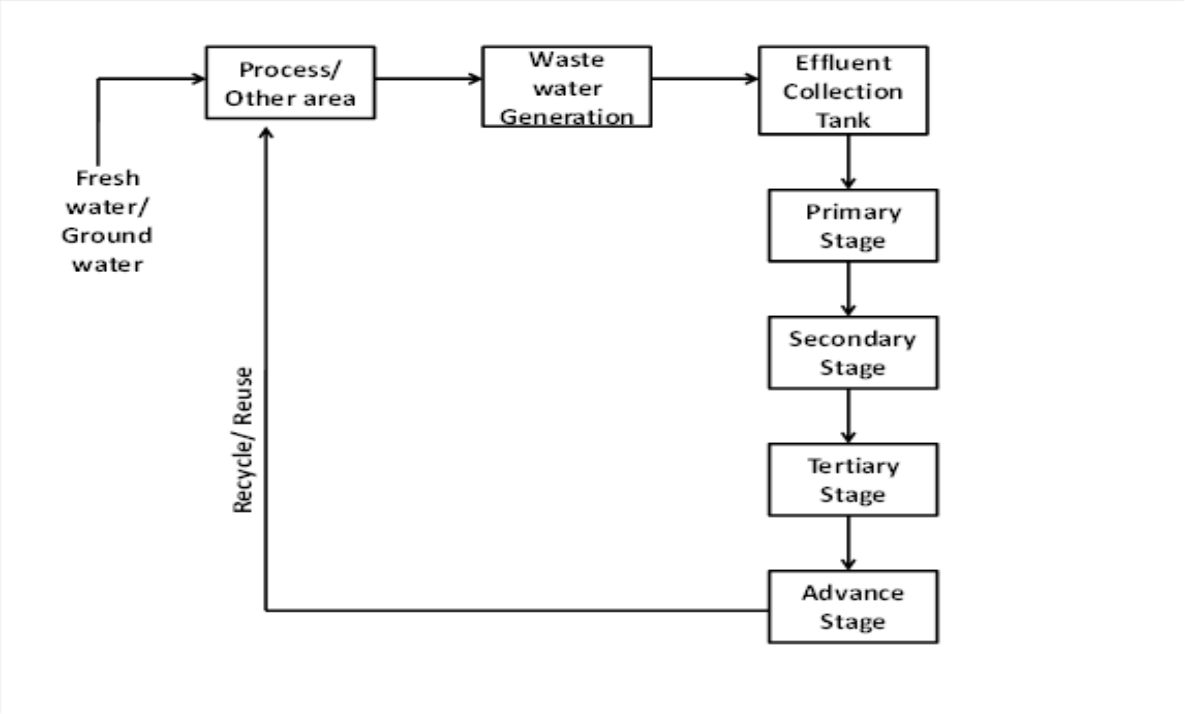

Figure-3: *Advance method of wastewater treatment*

Collection of Effluent

From the Production Process effluent will be collected into Collection tank.

Primary Stage Treatment

In this effluent transferred from collection tank to Treatment unit for Primary tank. Effluent will pass through Grit chamber first for removals of unwanted scrap/floating material. After this Oil and grease are skimmed-off by passing the effluent through skimming tank connected with the Belt skimmer to extract the floating layer of Oil & Grease extracted oil & grease collected in tank and send for the Recovery or incineration process. Now the Neutralization process if effluent is acidic or alkali, by addition of acid or alkali chemical to maintain the pH range 7.0 – 8.0. After this process transferring of effluent into Settler tank where the suspended or heavier matters are settled in the bottom of the tank by gravity only and clear supernant overflow and transferred for Evaporation process. Settled matter will be removed from the bottom of the tank and collected or dried on filter bed. After drying the sludge is collected in the bag for disposal or landfill at TSDF (Treatment storage disposal facilities) site.

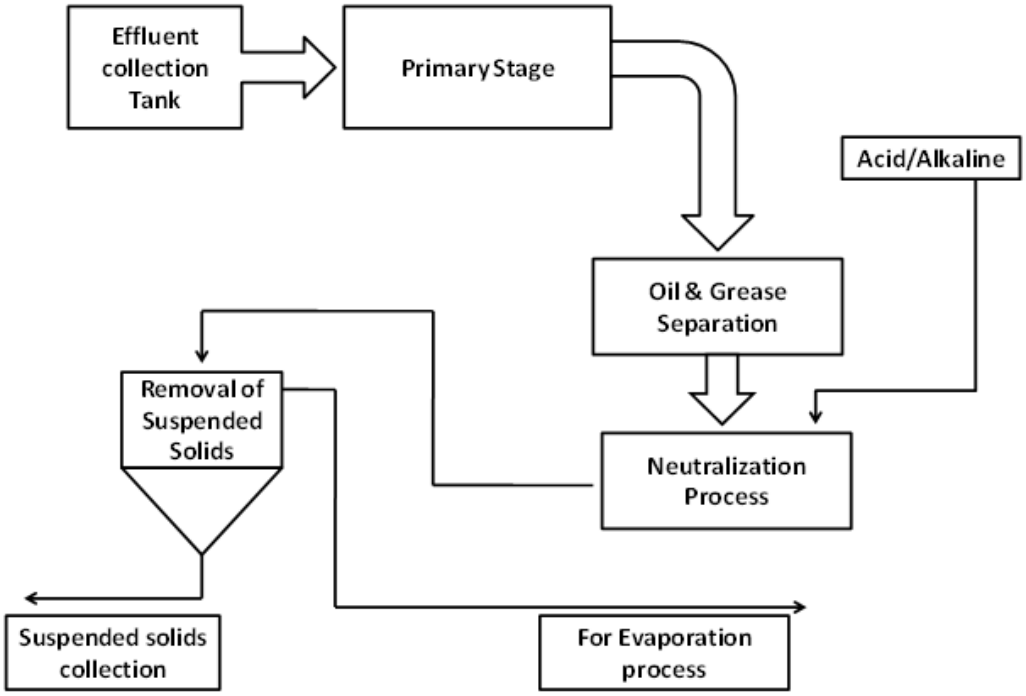

Figure-4: *Primary treatment methods.*

Evaporation Method

After the Primary stage, Effluent is treated into the evaporation system which is consisting of three sections (Stripper column + Evaporators + Dryer).

Stripper Section

In this effluent is feed into the stripper column and external heat is supplied for increasing the temperature up to 90˚C. Heated effluent high volatile compounds present in the effluent in dissolved form will be stripped out in the stripper column, these solvent vapors will condense in stripper column condenser & solvent collected into the solvent holding vessel, the vapors and effluent get separated and solvent sent out for recovery. After this stage effluent is free from dissolved solvent. After this effluent is transferred to evaporation stage.

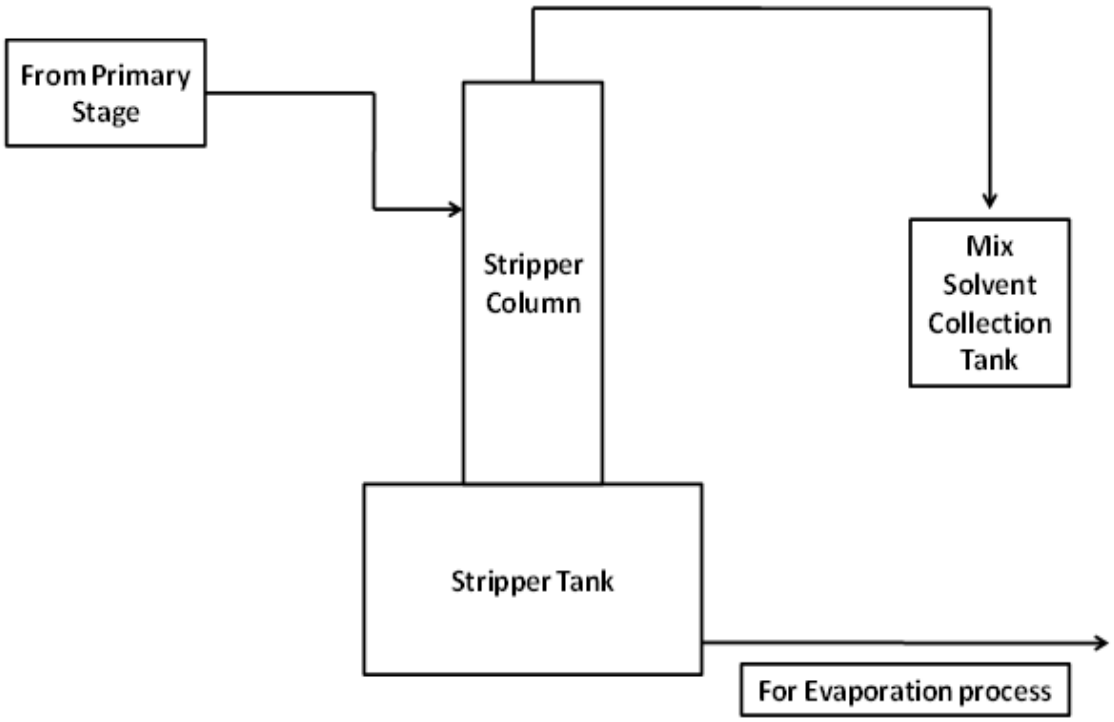

Figure-5: *Stripper section for solvent extraction*

Evaporation Section

This section is designed for the removal of dissolved solids present in the effluent. After the stripper section highly TDS (Total dissolved solids) effluent is circulated into the evaporation section. By applying the external heat to the system and maintaining the temperature by 100˚C to 110˚C. At this temperature water is started to evaporate in vapour form. The vapour is passed through the condenser and condensed water is collected into tank. Continuous feeding and circulation into evaporation section the vapour is separated from liquid, concentration of liquid will increased. After high concentration of liquid this will be collected into tank for drying purpose. In this condense water is send for the Secondary treatment and concentrate material will send for drying section

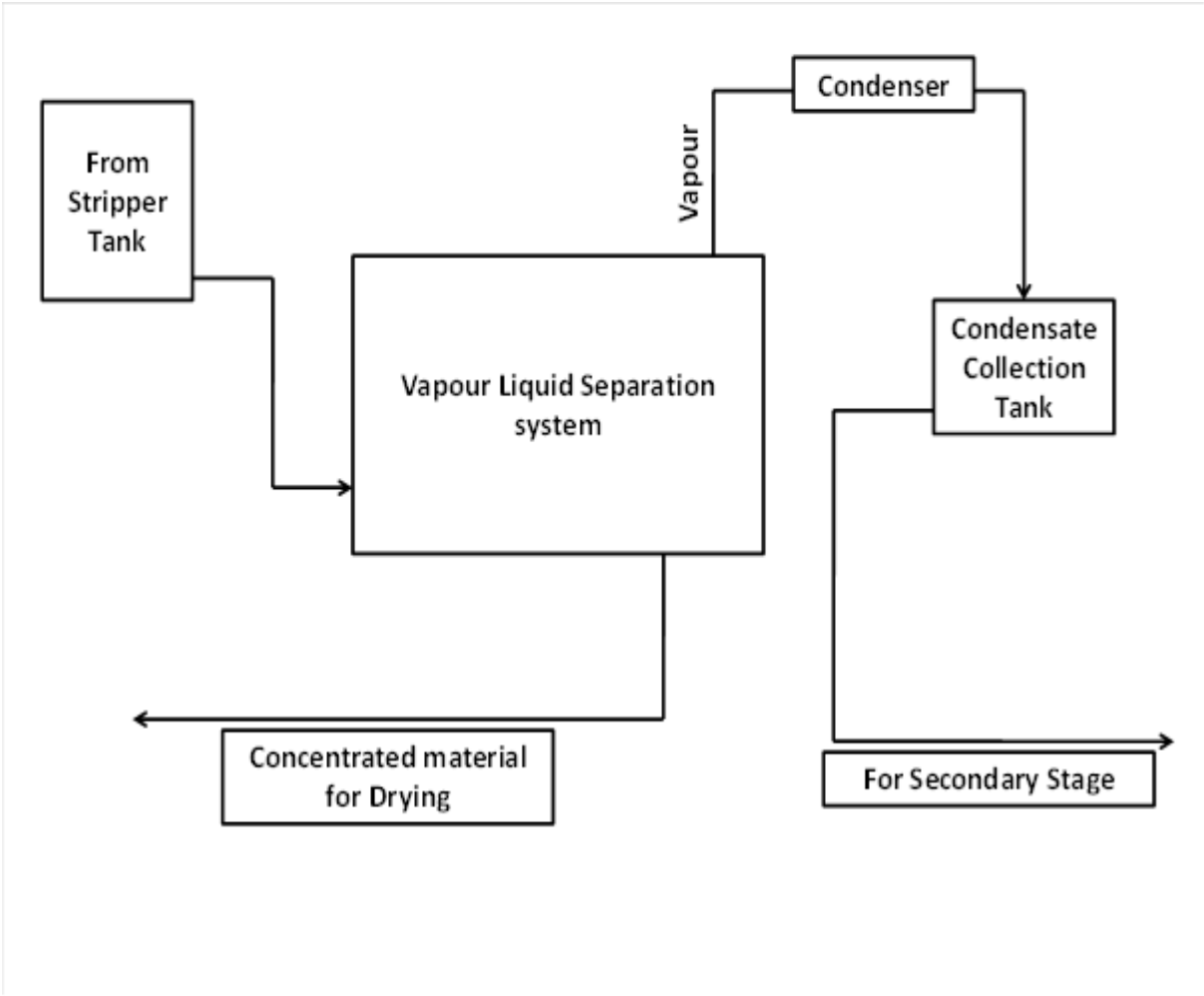

Figure-6: *Evaporation section for dissolved solid removal*

Dryer Section

This section is designed for the separation of solid and liquid. The concentrated material is feed to dryer. By applying the external heat to the dryer concentrated material feeding into dryer, solid is separated out at bottom and liquid is separated in the form of vapour which is passed through the condenser and condensed water is collected into tank. Solids which is collected at bottom known is chemical salt, and send for the disposal at TSDF site. And condensed water is send for the Secondary treatment.

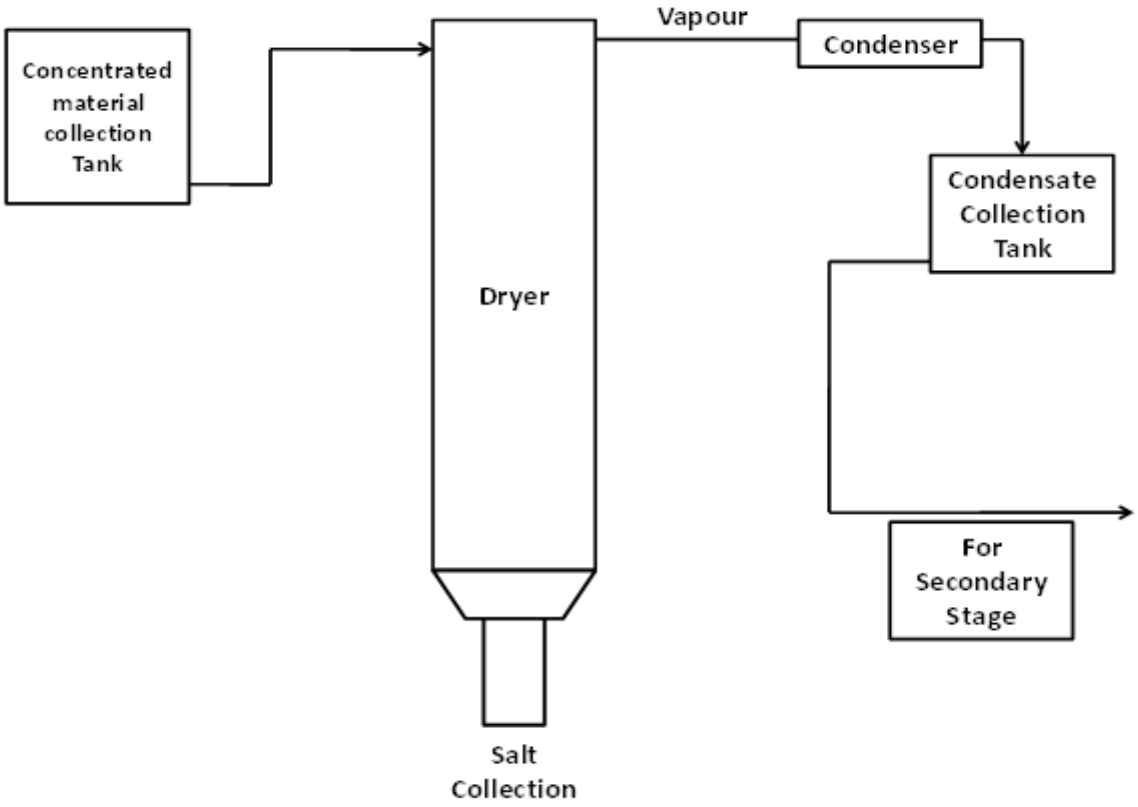

Figure-7: *Dryer section for solid removal.*

Secondary Stage Treatment

This stage is consisting of biological stage treatment. In this after the evaporation stage the effluent is treated under the biological process called as ASP (Activated sludge process). This process takes place under the presence of oxygen which is supplied by the blowers in the bottom of the tank. Degradation of organic compound in the presence of micro-organism, it breakdown the organic waste into the simpler cellular process which easily degradable. This process is easier and cheap no chemicals are used for the process. Present organic waste helps the micro-organism for the growth increases the strength in the tank easily. For the better efficiency we will maintain the SV (Sludge volume) 30 % of the aeration tank, MLSS (Mixed liquor suspended solid) and MLVSS (Mixed liquor volatile suspended solid) are 1600 mg/L and 3500 mg/L approx. DO (Dissolved oxygen) approx. 2.0 mg/L. After the evaporation the condensate passes through the 1st stage Bioreactor then 2nd stage Bioreactor for biological treatment.

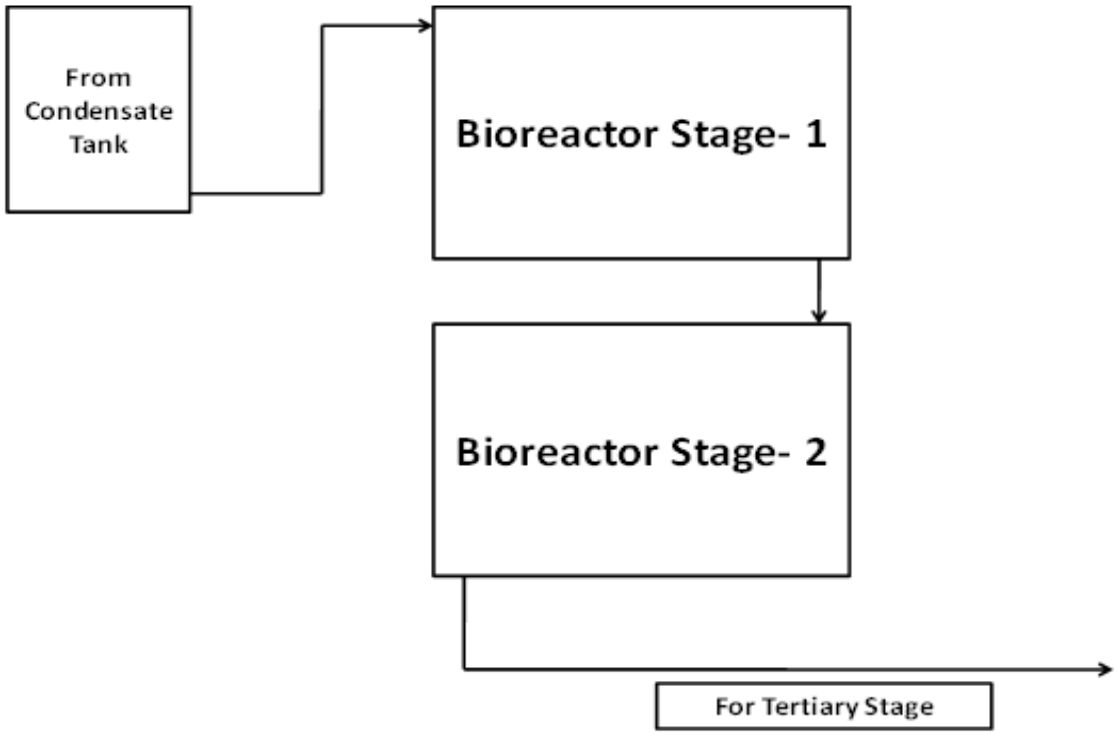

Figure-8: *Secondary treatment method.*

Tertiary Stage Treatment

This stage is same as Biological stage. Working principle is same as effluent is treated under the biological process called as ASP (Activated sludge process). In this MBR (Membrane Bioreactor) module is installed under the aeration tank. The module is fixed with the membrane sheet. Effluent is passed/ filtered through the semi-permeable membrane and the clear treated water from this stage is collected in the tank. This process eliminates the Clarifier and filtration section, no chemical used. Activated sludge is continuous circulated to secondary stage.

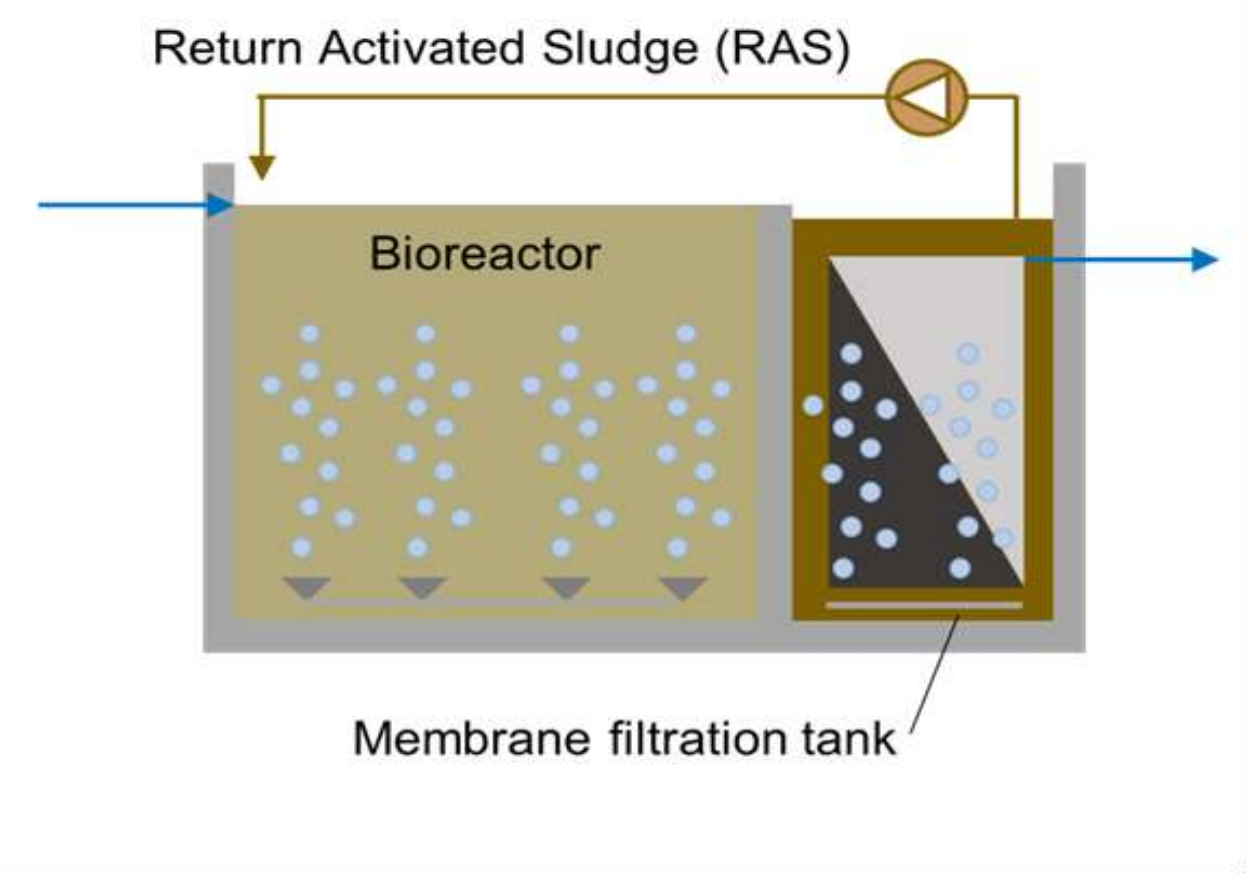

Figure-9: *Tertiary treatment method.*

Advance Stage Treatment

After filtration from MBR (Tertiary stage) the effluent feed to Advance treatment for removal of present impurities such as TDS (Total dissolved solids), COD (Chemical oxygen demand). For this we are using RO (Reverse Osmosis) process. A semi-permeable membrane separates two solutions with varying concentrations; the less concentrated solution flows towards the side of the membrane with higher concentrations; this process is known as osmosis. In Reverse Osmosis, Effluent is forced through a Sand filter and then cartridge filter for the removal of present suspended particles in the feed effluent then it will pass to semi-permeable membrane to Permeate water recovery. Pure water may flow through the thin membrane material, but the salt ions found in the effluent water are rejected by the membrane. In actuality, only around 80% of the effluent water permeates the membrane. The contaminants, including salt ions, are removed from the membrane surface by the residual concentrated effluent water. In order to push the clean water molecules through the semi-permeable membrane, pressure is applied to the effluent water. Reject is the term used to describe the bulk of the dissolved salts as well as all organic compounds, microorganisms, and suspended particles that are retained by the membrane and released from the system. The last treated collection tank receives the clean water from the RO Modules.

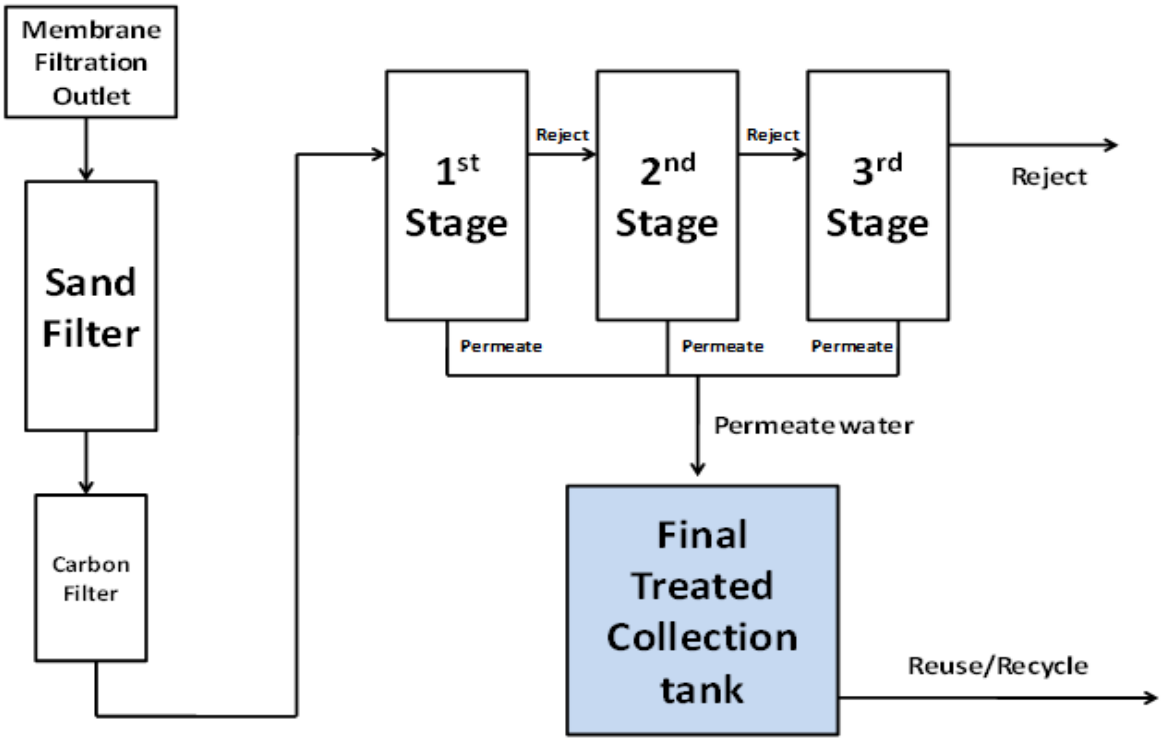

Figure-10: *Advance treatment method.*

CONCLUSION

The consumption of freshwater is increases because of rapid growth in the pesticides industries. For the better and growth of crops and also for kill the unwanted bacterial growth on plantation public are using pesticides. Manufacturing of pesticides hazardous chemicals are used for process which are very dangerous for ecosystem. Some of the solvent such as Hexane, EDC, Xylene, Toluene, Methanol, Butanol etc. are in dissolved form which are dangerous for the Biological process. In the pesticide industry the finished good product is used for the killing of bacteria, micro-organism etc. so their waste water (Effluent) contains the same chemical in the dissolved from. Solids are in dissolved form. Which is toxic to biological stage, it is very difficult to maintain the biological growth in the Secondary stage. For each stages elimination of critical compounds accordingly. In the industrial area after the basic treatment the effluent is transferred to the CETP (Common effluent treatment plant) or discharge into rivers or oceans results in negative impacts on marine life, soil fertility decreases, underground water contamination etc. Many industries are trying to adopting the cleaner technology to reduce the impact load in environment.

ACKNOWLEDGMENTS

It brings me great pleasure to express my gratitude to Prof. Priyanka Mehta for his direction and frequent counseling and for providing essential guidance regarding this project. Prof. Priyanka Mehta and gave me the right direction whenever I ran into trouble or had questions about my project. I am thankful to him for learning many things which helps enhance my knowledge and gave me valuable time to guide me through this completion of the project.
I am also thankful to Prof., H.O.D., Civil Engineering Department, PIT, Vadodara and our Principal Dr. Swapnil Parikh, PIT Parul University, Vadodara for your positive encouragement.

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