

Dear Water Warriors,

Biological Process in Waste Water Management employ thousands of micro-organisms that are responsible of degradation of pollutant and control C,N & P to make sewage or effluent fit for disposal to aquatic bodies or for recycle and reuse.

Bugs are living entity and their Role unparallel.



In this edition of ‘Waughter’, we understand their role, importance and needs to be happy and performing a role. Certain indicators can point to their health and that’s what we need “Health Microbiology”

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Civil Engineer

Microbiology & Waste Water Treatment

COD, NH₃-N & P Reduction are primary goals of a ETP/STP. Here Reduction is *English*, chemistry wise all are oxidized.

Bacteria, the unicellular plants, the smallest creatures in our ETP Tanks do this wonderful job. Simply putting, the pollution must go somewhere so:

- C : Goes in atmosphere as CO₂ and C₅H₇NO₂ in Sludge
- N : Goes in atmosphere as N₂ and C₅H₇NO₂ in Sludge
- P : Goes in Sludge as higher Cell Structure (synthesis) or Precipitate of P in PO₄ form.

As we say pollution changes form, now the sludge produced need attention and microbiology again helps us in conversion of Organic Sludge (Bio-mass) into CH₄ and CO₂, CH₄ on combustion converts to CO₂ so ultimately if we talk circular economy in waste, planting tree shall be the end goal of any WWTP.

Glance of this Edition...

This Edition of magazine we focus on the “Role of Microbiology in Waste Water Management” and try to make it useful to Waughter Warrior for the day-to-day work with further.

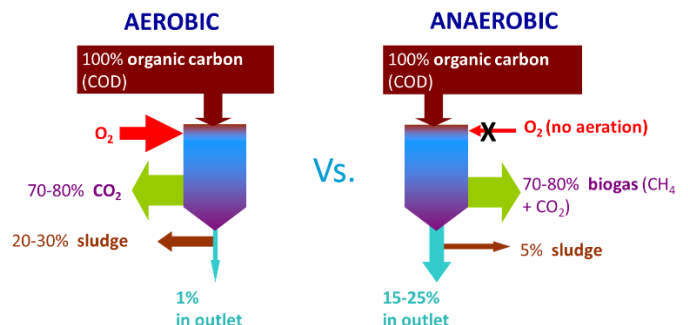
- ❖ Difference between Aerobic & Anaerobic
- ❖ How bacteria help in Bio-degradation & Micro Organism growth requirements ?
- ❖ Oxidation – The most important Energy Requirement Reaction for Bugs
- ❖ Role of Dissolved Oxygen & Microorganisms in Biological Treatment

Before going to deep dive into this Edition, request you to go through our previous edition of [Waughter magazine – Volume 1 Edition 3 : The Water Microbiology](#).

Aerobic Vs Anaerobic

Aerobic & Anaerobic bio degradation of Pollutant is usually viewed from the process point of view:

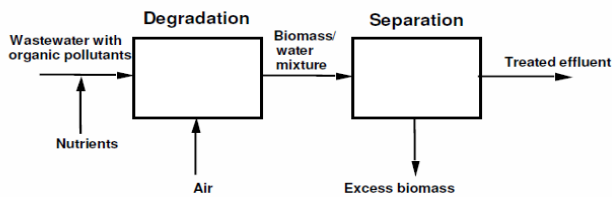
1. With or Without Air
2. Higher Efficiency of COD Removal
3. NH₃ Oxidation



Engineers of today must look from Environment View Point and focus on end products – CH₄ (The Energy Possibility) and Less Sludge (The Landfill Advantage)

How Bacteria help in Bio-degradation ?

Simply putting they eat Pollution (COHNS) and create a new suspended biomass named $C_5H_7NO_2$ (A new Cell). Therefore, we can draw a two-step process as below:



- A. Degradation : Where pollution (Soluble) goes in the body of bug (Suspended) and CO_2 (gas)
- B. Separation : Where Purifying bacteria (Suspended biomass) is separated by any physio-chemical process such as Clarification, DAF or Membrane

Thus, producing effluent that is treated and pollutant is taken care off.

Micro-organisms growth Requirements?

If we ask a question to readers; “What gives us the Energy?”, the majority answer is “Food”. Unfortunately, that is a wrong answer as the Energy to humans is given by process of Respiration (Breathing).

The O_2 of Air goes in our body and returns as CO_2 . So, in our body we have this reaction:

$C + O_2 = CO_2 + \Delta H$, (The Heat), this is the source of energy that is channelized in our body to give us strength and ability to work.

In a similar way to reproduce (Multiplication) and function properly (degradation) microorganism need:

- A. Energy
- B. Food
- C. Nutrients

All as per their needs in a particular Environment.

Oxidation – The most important Energy Requirement Reaction for Bugs

Bacteria need to produce their own energy. They do not have lungs like human but they produce energy by oxidation of Pollutant:

Heterotrophic Bacteria:

$COHNS + O_2 = CO_2 + \text{Other Products} + \Delta H$, simply putting COD Oxidation.

Autotrophic Bacteria:

$NH_3-N + O_2 \rightarrow NO_2 + O_2 \rightarrow NO_3$, 2 step NH_3-N Oxidation

As we can see the above reactions need O_2 and thus these are the basics of Aerobic Biological Systems.

$C_5H_7NO_2$ Development : The Cell Carbon

The C is available in two substances:

1. COD – Organic Pollutant
2. CO_2

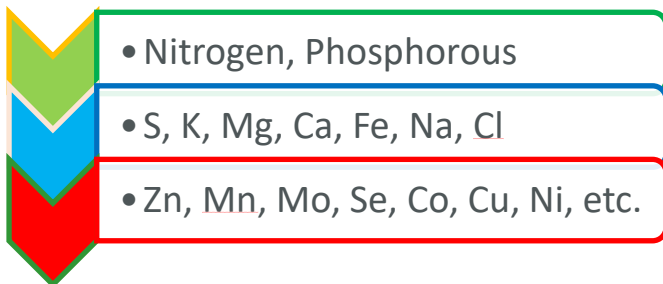
Some Bacteria take “COD” as food and keep the C in their cell carbon, they are known as **Heterotrophic Bacteria**, more like humans.

On the other hand, some bacteria are like tree, they take CO_2 as Food and meet their Cell carbon requirement of producing $C_5H_7NO_2$ using CO_2 . **Autotrophic Bacteria**.

The biological waste water treatment system use this ability of bacteria to consume Pollutant or it's By-products (e.g. CO_2) as Food.

Nutrients

Nutrients are important for cell synthesis & growth. The bacteria and higher forms of life are made of complex organic material starting from simple cell $C_5H_7NO_2$. Here below is the nutrition need:



N & P are Primary Nutrients. They are usually available in Sewage and may not be required. C:N:P fractions of 100:5:1 if available in feed waste, their addition is not required. Chemicals such as Urea, Diammonium Phosphate or phosphoric acid are common editions.

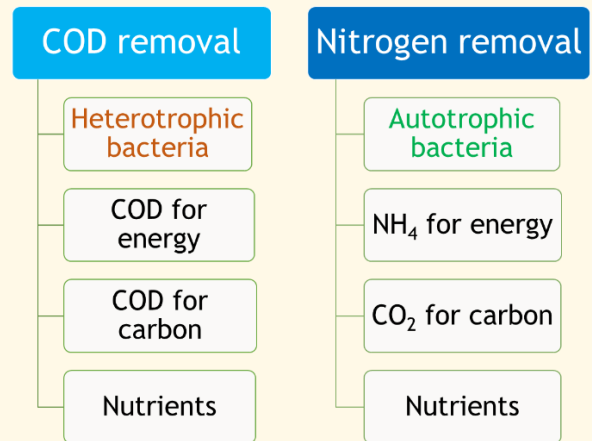
Micro Nutrients like S, K, Mg, Ca, Fe, Na, Cl can be added only by expert microbiologist, who monitors the growth of bugs in aeration tank through specific tests.

Zn, Mn, Mo, Se, Co, Cu, Ni can be used only when treating complex waste water that exhibit some toxicity. These trace elements shield bugs from effect of toxicity. Usually their addition is first monitored in Pilot before implementing in main stream process.



Bugs (Microbiology) Development – Summary Needs

To summarize heterotrophs and autotrophs are responsible for COD & N Removal based on different Energy generation mechanism as well as Food requirements.



Both have different “Strengths” and requirements and a good waste water engineers checks if above reequipments are met in his specific process.

Role of DO – Dissolved Oxygen

In aerobic biology the waste water must have sufficient DO to ensure bugs are comfortable and able to perform the oxidative reactions.

Autotrophs are more sensitive to DO and thus $DO > 2 \text{ mg/l}$ is always required for them to function effectively. Such high level of DI is more than sufficient for Heterotrophs.

Heterotrophs grow well and can function as good as they should up-to $\sim 1.00 \text{ mg/l}$ DO. Once the DO level drops further, they can still survive in Anoxic conditions subject to availability of NO_3 ,

But $DO < 1.8 \text{ mg/l}$, Autotrophs death rate increases and disturb the entire process.

Veolia's High Pressure RO Membranes (HPRO)



IDEAL FOR **CONCENTRATION OF EFFLUENT & REDUCING LOAD ON EVAPORATOR (MEE)**



EFFLUENT CONCENTRATION -
Helps in concentrating to a high TDS



LOW OPERATIONAL COSTS -
Lesser load on evaporators (MEEs)



ENVIRONMENTAL SUSTAINABILITY -
Lower energy consumption



ENHANCED TREATMENT EFFICIENCY -
Higher flux, efficient removal of TDS

Our always-ready **technical support and service team in Maharashtra** go the extra step to be your most trusted resource. We're here for you.



Metabolism

Metabolism is the term used for all the chemical reactions that go on inside an organism's body. These reactions build up molecules, and break them down. They are controlled by enzymes. All organisms respire in order to release energy to fuel their living processes. The respiration can be aerobic, which uses glucose and oxygen, or anaerobic which uses only glucose.

The three main functions of metabolism are:

1. the conversion of the energy in food to energy available to run cellular processes
2. the conversion of food to building blocks for proteins, lipids, nucleic acids, and some carbohydrates
3. the elimination of metabolic wastes.

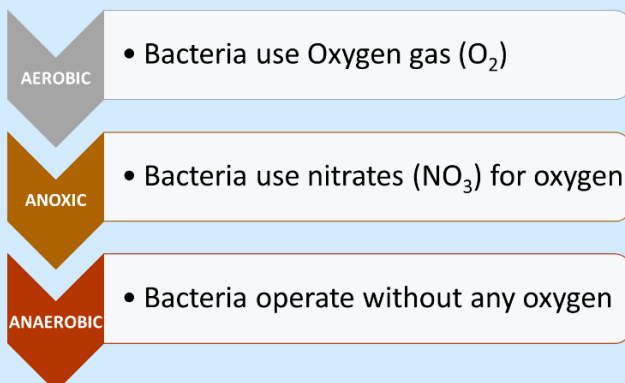
Enzymes are crucial to metabolism because they allow organisms to drive desirable reactions that require energy and will not occur by themselves, by coupling them to spontaneous reactions that release energy.

Metabolic reactions may be categorized as

Catabolic – the breaking down of compounds (e.g. of glucose to pyruvate by cellular respiration)

Anabolic – the building up (synthesis) of compounds

Usually, catabolism releases energy, and anabolism consumes energy. We have 3 main metabolisms:



Microorganisms in Biological Treatment

Biological waste water treatments have thousands of microorganisms that are responsible for various actions that result in degradation of pollutant. At the front “Workforce” level we have: bacteria.



Bacteria are Uni-Cellular Plants. Once they grow, we have presence of first Uni-Cellular Animal named Protozoa that feed on Bacteria. As the system grows, we have Rotifers, the multicellular animal that hunt “protozoa”. Since survival is the order of the nature, we have formation of Fungai, Algae the multicellular plants to stop onslaught of Protozoa.

As the system matures further, we have presence of higher form of life in our biological systems such as Nematode, snails etc.

Microorganisms grow and die. For them to remain in the system, balance needs to be found between:

- Residence time
- Biological growth & Decay

The dead biomass ($C_5H_7NO_2$) is a pCOD and needs to be managed either in-house (Endogenous Respiration) or in Sludge management.

जल जीवन जननी !!

On Dec 22, 23 Aktion Waughter is organizing a training program at Vadodara, Gujarat. This shall focus on Design, O&M and Trouble shoot for Waste Water Treatment Plants.



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🔗 Thrilled to announce the commencement of our comprehensive training program on Water and Wastewater Management by [Sanjeev Srivastava](#) who has 33 years immense experience! 🌱

📅 Save the Date: Dec 22 - 23
📍 Venue: Vadodara

👉 Join us in fostering sustainable water practices and building a cleaner, greener future for the world! 🌱

📞 Register Now: Ms. [Vrushika Parmar](#) (+91 9099155227)
- info@aktionconsultancy.com

🗣️ Let's make a difference together! Share and spread the word. 🌍 Looking forward to seeing you there! 💖💙

#WaterManagement #WastewaterTraining #Vadodara #SustainableFuture #wastewatertreatment #watertreatment #waterandwastewater #innovation #greenerworld #zld #operationandmaintenance #dontmissit #registernow #traininganddevelopment



The objective of the Master Class is to focus on Theory, Design & Operation, Trouble Shoot of ETP. We equip the participants with the knowledge & skills that will help them to refine their existing practices and apply newly learned skills in day-to-day design & operations.

Dear Waughter Warrior,

Aktion Waughter to its credit has shared knowledge with over 110+ organizations and have benefited 5000+ professionals engaged in Water Treatment Plant & Wastewater Treatment Plant.

Covid could not deter us and when CONTACT was not possible, we took E route to create our monthly knowledge magazine Waughter, that has seen a circulation to over 6000 water warriors.

Back 2 Back, We believe our Master Class gives quick :

- Knowledge to Save energy,
- Reduction in Chemicals.

Master Class

Advance Level Training on Water & Wastewater Management including ZLD, O&M and Innovation

Date & Venue?

Dec 22 - 23, 2023
Vadodara

Who can Participate?

- EHS Professionals
- O&M Teams

Highlight of the Month

In this section, we shall highlight the new achievements of our team. In case you wish to have more details on the same, please let us know:

- Received an Order for Supply of Tube Settler, PSF & ACF from an Industry engaged in production of Pesticide. This is part of ETP Modification.
- Received an order for Pilot study for treatment of Condensate (Waste) from H2 Plant.
- Appointment of 2 new team members for a project at Nalbai, Assam.
- Supply of MBR Plant for 10 KLD STP at MP through our partner Technorbital & Inhibeo.

Our World is Waughter

The technical knowledge share attempt of Aktion Consultancy and the contents in the magazine shall be qualified by Sanjeev Srivastava our Technology Lead. The purpose is purely education and empowerment of engineers.

Our next edition focuses on: “Future MBR Considerations and development of small STPs”

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Alka Srivastava – Founder

