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NITROGEN REMOVAL

WHALE TOOTH TECHNOLOGY

BACTERIA FOUND IN THE BIOLOGICAL TREATMENT OF SEWAGE USING A SUBMERGED FIXED-FILM AERATED TREATMENT PROCESS

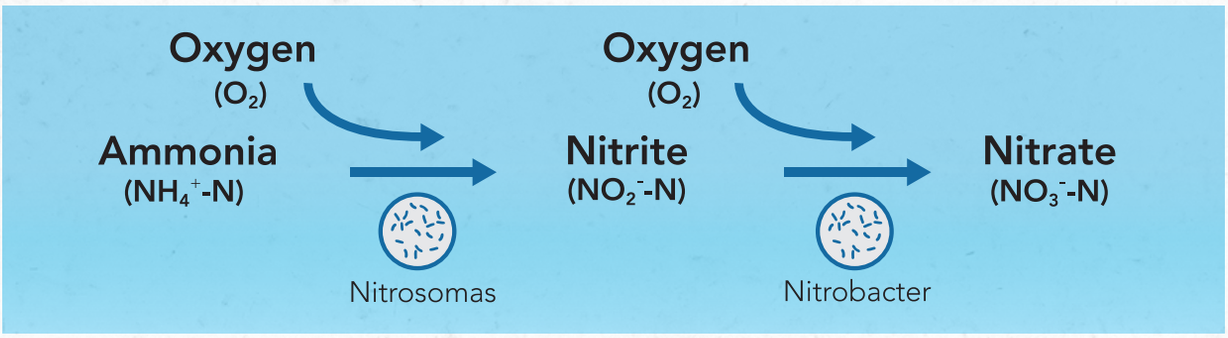
AMMONIA TOXICITY

The principle forms of Nitrogen are Ammonia (NH_4/NH_3), Nitrite (NO_2) and Nitrate (NO_3). In aquatic systems the presence of Ammonia, especially in its un-ionised form NH_3, can be highly toxic to stream life.

Furthermore Ammonia complexes with other heavy metals such as Nickel can Cadmium, further increasing toxicity levels. It is for this reason that a major function of effluent treatment plants is dedicated to the removal of Ammonia through Nitrification and Denitrification.

NITRIFICATION (Biological Oxidation)

An understanding of the Nitrogen Cycle sheds light on how Ammonia removal in sewage plants work. Faecal matter and Urea entering the sewage works will contain Ammonium. Further Ammonia is produced by the decomposition of proteins, and this is removed as follows:



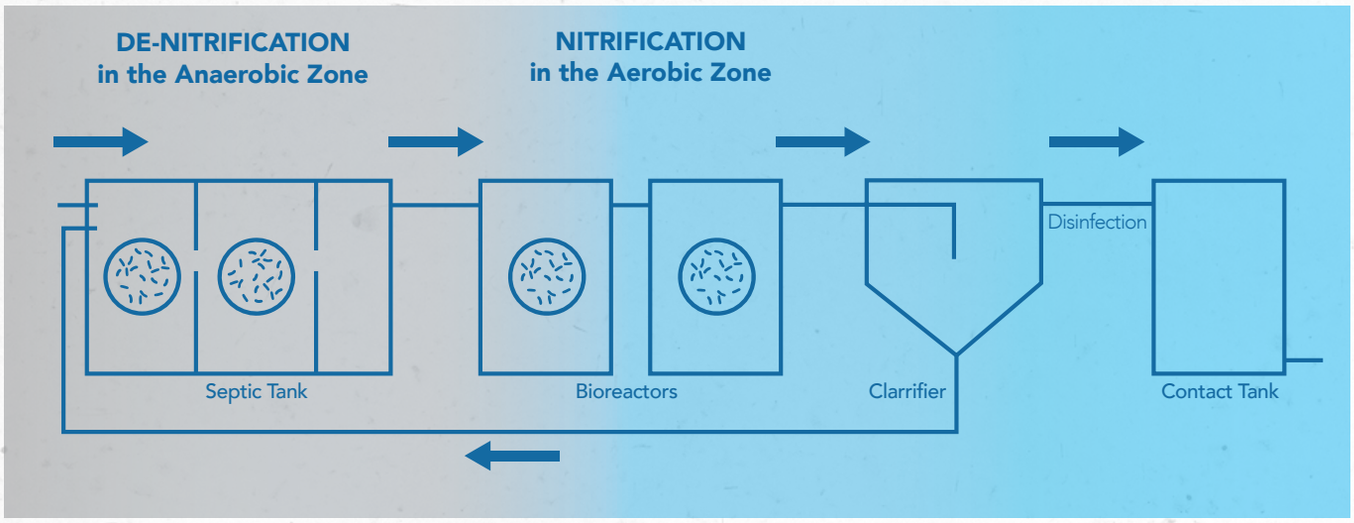
Through biological oxidation, (Nitrification) in the bioreactors, by pumping in high levels of Oxygen, Nitrosomonas bacteria convert Ammonium to Nitrite. These Nitrifiers are found in our bioreactors.

The second reaction relies on the Nitrobacter converting the Nitrites to Nitrates also relying on Oxygen input. The reaction rate of the Nitrobacter is about three times the reaction rate of the Nitrosomonas and Nitrite does not accumulate. It takes approximately 4.6mg/L of Oxygen to oxidize 1 mg/lLof Ammonia completely.

DE-NITRIFICATION (Biological Reduction in an Anaerobic zone)

Nitrates are still toxic to aquatic systems and need to be removed from the final effluent. High levels of Nitrates can lead to uncontrolled growth of fauna such as the water hyacinth. These plants grow covering the surface of entire water bodies and starve the water of Oxygen resulting in adverse and knock-on affects for other organisms. This is known as eutrophication.

Denitrification occurs in the anaerobic tanks of our treatment system. In an environment where there is no oxygen, the bacteria will look for an alternative oxygen source to grow and respire. NO_3 provides this oxygen source andonce this is depleted nitrogen gas (N_2) is released into the atmosphere.

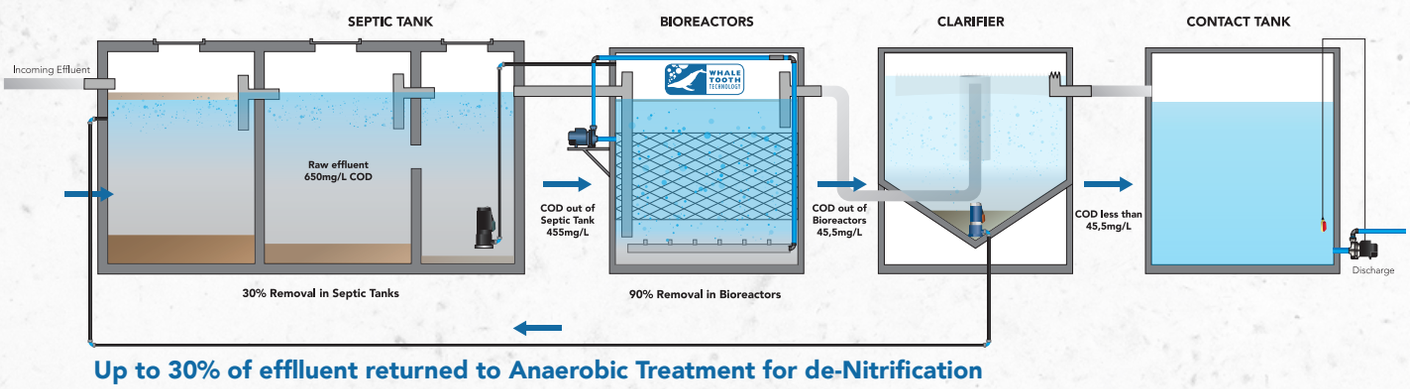


The process of De-Nitification (Nitrate to Nitrogen) is accomplished by a number of bacteria such as Psuedomonas, Micrococcus, Achromobacter, Bacillus, Proteus, Flavobacteria, Alcaligenes and Aerobacter.

They are all facultative (i.e. can switch between Respitation if Oxygen is present and Fermentation if Oxygen is absent) and fit into the general category of chemoorganotrophs.

The bacteria also require a carbon food source for energy and conversion of nitrogen. The bacteria metabolize the carbonaceous material or BOD in the wastewater as this food source, metabolising it to Carbon Dioxide (CO2).

SYSTEM FLOW



Up to 30% of effluent returned to Anaerobic Treatment for de-Nitrification

References

Russell, D. (2006) Practical Wastewater Treatment. John Wiley & Sons, Inc. Canada.

GET IN TOUCH

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