

PROCESS ISSUES ENCOUNTERED WHEN USING SUGAR SYRUP AT BUCASIA WWTP



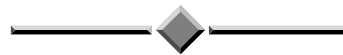
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ABSTRACT

Sugar syrup is used at Bucasia Wastewater Treatment Plant (WWTP) in Mackay Qld to assist in the removal of nitrogen from the wastewater. A number of issues have been encountered in its use including the type used, the temperature it is delivered at and process problems and solutions. This will be useful for other operators where sugar syrup is proposed or being used.

1.0 INTRODUCTION

The Mackay North WWTP is a two basin Sequencing Batch Reactor process constructed in 2008 with a designed ADWF of 5 ML/day.

Sugar syrup is used to assist in achieving a Total Nitrogen (TN) limit of 5mg/L.

2.0 DISCUSSION

2.1 Nitrification and Denitrification

The largest part of the nitrogen in wastewater is ammonia. During aeration, ammonia is nitrified and converted to nitrite and then nitrate, provided oxygen is limited, and sufficient organic carbon is available. Nitrate and nitrite are converted to nitrogen gas via the denitrification process.

What is Sugar Syrup Used for?

All living organisms need oxygen to consume food (carbon). When no oxygen is available, the microorganisms obtain their oxygen from nitrate and nitrate and nitrogen gas is released. Therefore, for denitrification food is required. When the food is gone, denitrification stops so by adding sugar, denitrification can continue.

When is sugar syrup added?

During the morning and evening peak flow periods there is usually enough food (organic carbon) to complete denitrification. During the mid afternoon and early morning low flow periods, sugar syrup is added to boost denitrification and lower total nitrogen.

2.2 Characteristics

Sugar syrup available in two types - 5BO and D-Nitro. Both are liquid, both have a similar COD value, both are manufactured at approximately 100°C and must be allowed to cool before being put into a poly tank or PVC pipework.

D-Nitro, or liquid sugar, is used in the food industry mostly in soft drink manufacture. It is a clearer product.

5BO is a by-product. 5BO means it has been through the process and boiled out 5 times. It is a darker colour and contains contaminants, including lime.

2.3 Two Types Available

At commissioning only 5BO was available from the sugar refinery, however the refinery later began the production of D-Nitro.

Both have a similar COD value however, 5BO is a by-product and contains impurities including lime, which forms a sludge in the bottom of the holding tank.

5BO is darker in colour and will affect the colour of the final effluent.

Sludge causes dosing issues with blocked pumps and pipework. The sludge has to be cleaned out every few deliveries. If too much sludge is put into the process in one hit, it causes major process upsets including secondary phosphorous release. Therefore it must be dosed in small amounts.

In the beginning, D-Nitro was offered at a discounted price however, this changed to spot pricing which means now D-Nitro is more than twice as expensive as 5BO.

2.4 Issues Encountered

Both D-Nitro and 5BO are produced at very high temperatures and must be stored in a tanker overnight to cool before delivery into the poly storage tanks which adds extra cost to the delivery. However, even after cooling the temperature is between 40 and 50°C when delivered.

The poly tanks change shape when hot, and the radar level sensors installed in the lid of the tank go out of calibration until the product cools.

Sugar is abrasive and wears the pump mechanical seals more frequently.

5BO contains lime and over time, this settles into a lime sludge that blocks pipework, valves etc. The lime sludge needs to be cleaned out after a few deliveries. Mechanical mixing has been included in the design of all future installations.

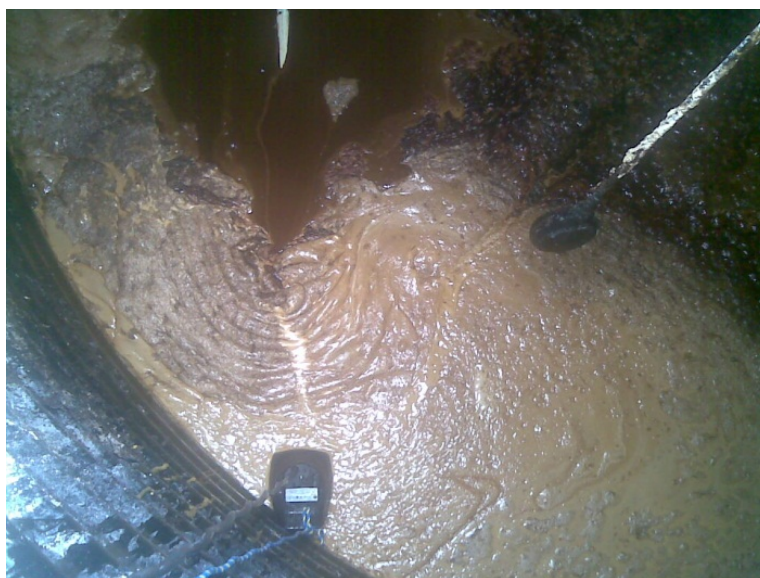


Figure 1: *Lime sludge in sugar syrup*



Figure 2: *Improved tank design*

2.5 Operator Beware the Sugar Syrup Cycle

Sugar syrup isn't a magic bullet to remove nitrate. The aeration cycles need to be optimised for the best NH_4 to NO_3 balance before adding sugar syrup.

If too much sugar syrup is used, a biomass growth imbalance can occur limiting ammonia oxidising bacteria growth and hence nitrification can be limited. This means the effluent ammonia level increases. The reaction from the operator may intuitively be to increase aeration... but this will then result in an increase in NO_3 . The usual response to this is to then increase the sugar dose and off we go increasing aeration, increasing sugar again etc etc.

Sugar syrup is an extra load on the process and too much will increase the biomass and therefore more sludge cake will be produced.

3.0 CONCLUSION

Sugar syrup:

- is effective in reducing nitrogen in the effluent
- only needs to be dosed during periods of low organic load and ideally when aeration is minimal (off-peak).
- causes process problems if over dosed
- is abrasive and causes wear on pump seals
- may contain impurities that form sludge
- needs to be kept mixed
- is hot when delivered and must be allowed to cool or the storage equipment needs to be made of heat resistant materials.

4.0 ACKNOWLEDGEMENTS

Brenton Gibbs (pers. comm.) PhD industrial microbiology
<http://www.haifa-wwtp.co.il/.upload/nitrification.jpg>