CLARIFYING THE WASTEWATER TREATMENT PROCESS THROUGH WINE MAKING: AN ITALIAN'S PERSPECTIVE

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EXECUTIVE SUMMARY

My name is Anthony Domanti, and I have been involved in amateur wine making for almost 20 years. A passion which ignited when I first helped my Italian Father-in-Law. I am also a Senior Principal Water Engineer with over 25 years' experience. When the grapes arrive, my two worlds of water engineering and wine-making collide and I often reflect on the similarities of both. This paper will illustrate my wine making process, and showcase the parallels to wastewater treatment. The paper also intends to be light-hearted and entertaining, yet educational for those wanting to know the basic steps of either process.

INTRODUCTION

My exposure into the world of wine-making first began when I volunteered to assist my future Italian Father-in-Law in his yearly pursuit of crafting homemade wine. It was a good chance to bond with him, and develop my Italian cultural instincts. Now, over the last 7 years, I have travelled a similar path in creating my own wine at home. My brand is "Domanti Estate", and I have been honoured to receive medals in both National and International amateur wine competitions.

Apart from my success with wine competitions, many would consider my primary career a significant departure from this endeavour. In fact, I am better known as a Senior Principal Water Engineer with over 25 years' experience partnering with local government, private developers and construction contractors in the water industry.

When grape vintage season arrives between February and March each year, my two worlds of water engineering and wine-making collide. That is, as the wine-making process begins, I often reflect on the similarities that both activities, wine production and the process of wastewater treatment, possess.

Now, I do not claim to be a process engineer, but I have discovered that relating the wastewater treatment process to what I do with my grapes, is of immense benefit. It has helped me obtain a clearer picture of the wastewater treatment process and allowed me to leverage my engineering experience in perfecting my wine.

YEAR CASE STUDY WAS IMPLEMENTED

2015 to 2022

CASE STUDY DETAIL

Below are seven simple steps which outline an "abbreviated" journey on how to make wine. For each step, there is a description how it equates to a component of the wastewater treatment process. Enjoy !!!

Step 1 – Conveyance

Let's start simple. The conveyance component of my winemaking involves picking up my grapes from the Brisbane Market. Just like operating any wastewater network, the process of collecting my grapes needs to be carefully co-ordinated and managed efficiently. It also needs to be done in a timely manner so that the grapes are fresh and not overripe or too soft - paralleling to ensuring the sewage in the sewerage network remains fresh and does not become septic. (Refer Figures 1 and 2)

Step 2 – Primary Screening
Once the grapes have arrived, the next step is to remove the stems from the grapes, just like the primary screens of an inlet works. I have a fantastic electric crusher-destemmer that does the job very quickly. This machine operates very similar to a wastewater screw-wash press (refer Figures 3 & 4). After the stems are removed, I take chemical readings on the juice such as pH, sugar content, and acid content. These values are important to monitor as the wine making process changes these as it progresses. Figure 5 shows the "screenings" that are captured from the destemmer. Figure 6 shows the "must" (or freshly crushed grape juice that contains the skins, and seeds) in open-containers, i.e. similar to a "reactor-tank".

Step 3 – Primary Fermentation (oxygen encouraged)
After crushing the grapes, it's now time to add yeast (refer Figure 7) and get the fermentation process (converting sugars to alcohol) started. The grapes are stored in the open containers for a few days. The contact time with the grape skins provide the colour to the wine. The amount of carbon dioxide protects the wine from being oxidised. This step is similar to the aerobic process of a biological treatment plant.

Step 4 – Secondary Fermentation (limit oxygen)
As fermentation slows (reduced production of carbon dioxide as sugars are reduced), it is time to press the wine (i.e. separate the juice from the skins). Figure 8 shows the wine press in action, which is similar in function to a fine screen. After pressing, the wine is moved into large storage contains (called demijohns – refer Figure 9) and air locks are fitted to limit air-exposure. Almost like an anerobic or anoxic zone.

Note: when the wine is pressed, the skins (and stems removed earlier) are disposed of. The approximate recovery of wine is approximately 65% of the gross weight of grapes. For instance, 300 kg of grapes = 195 L of wine. Unfortunately, there is no biosolids reuse in my wine-making, however if you have plenty of garden space, you could easily use the leftover grape skins and stalks to make a great compost.

Step 5 – Racking the wine / Secondary settling
Over the next few months, it is important to remove the dead yeast and sediment that drops out/accumulated during the fermentation process (i.e. clearing the wine). In wine making, we call this "racking" and it is the equivalent to a clarifier in a wastewater treatment plant (refer Figure 10). I have a system in place where I move (or siphon) wine from the top shelf to the bottom shelf, and then pump it back-up when required. The main difference is that I dispose of the sludge at the bottom of the demijohn and don't reuse it anymore (i.e. no Return Activated Sludge).

Figure 11 shows my wine pump in action. It has a flow capacity of 0.3 L/s and a maximum pump lift of only 3.4m. Although the hydraulic performance of my wine pump is a fraction of what I normally work with (refer Figure 12), it is still essential that suitable suction conditions are provided to ensure that it operates effectively.

Step 6 – Filtration
When the wine is ready to drink (at least 6 months of age), I want to remove any haziness from the wine - so I add bentonite clay (refer Figure 13). The bentonite is negatively charged, and it binds and bonds onto any small positively charged floating particulates (which can make the wine cloudy). Bentonite acts as a coagulant to aid in the settling process. Bentonite is fast acting, and usually takes 2-3 days to fully settle out. In wastewater treatment, an equivalent process is the use of cationic-polymer dosing which is used to improve the effectiveness of the clarification or separation processes (refer Figure 14).

Step 7 – Be proud
Enjoy your work and share your accomplishments with your friends. Figure 15 shows the finished wine product. In wastewater treatment, the equivalent stage is the final treated effluent being released and reused (refer Figure 16).

OUTCOMES AND CONCLUSIONS

In my opinion, the art of wine making is a universal language, that people are genuinely keen to learn more about. When I mention that I am a wine-maker, I am often asked to explain how I do it, and what steps are involved. It is my hope that this paper helps water industry professionals to better understand the wine making process and to reflect on how similar the steps are to wastewater treatment. The aim of this paper is to also encourage and motivate more water industry personnel to consider using their skills to create the perfect wine.

Further, this paper demonstrates how a complex activity such as wastewater treatment can be better understood by others, through the use of analogies and simple story-telling.

Figures 1 & 2: No pumps or gravity sewer here. In wine making, conveyance usually starts with me picking up the grapes from the Brisbane Fruit Markets with my trailer

Figure 3 – An electric crusher-destemmer is used to remove the stems

Figure 4 – A Screw Wash Press at a treatment plant is very similar in shape and mechanism to the crusher-destermmer

Figure 5 – The removed grape stems are like "primary screenings" captured at an inlet works

Figure 6: My "reactor tanks" in action after the grapes have been crushed.

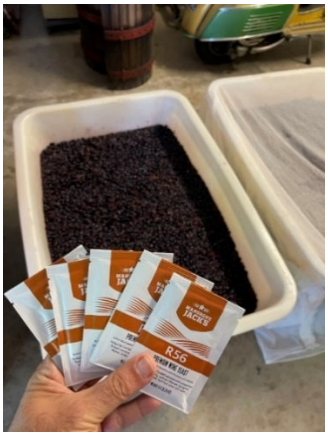

Figure 7 – Yeast being added to the grape reactor tank.

Figure 8 – A wine press is used to separate the juice from the skin. Almost like a fine-screen at a treatment plant.

Figure 9: My glass demijohns operate like a clarifier. Over time, suspended solids gently settle to the bottom.

Figure 10 – A typical clarifier arrangement

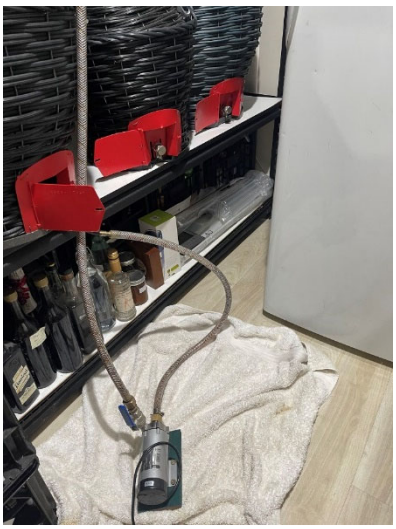

Figure 11: My trusty wine pump in action (it has a capacity of just 0.3 L/s, but it's very important in wine-making).

Figure 12: These are the type of pumps that I tend to work with (this pump has a capacity of 950 L/s)

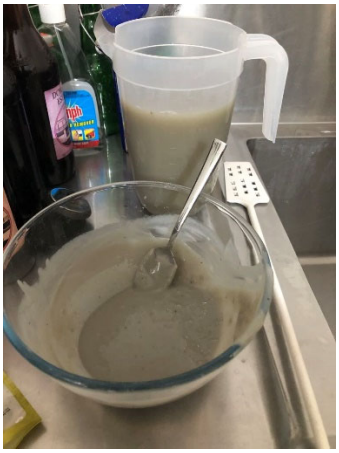

Figure 13: Bentonite clay is a fining agent that I use before bottling to remove "haziness" from the wine

Figure 14: A cationic-polymer dosing system is used as a coagulant to improve the efficiency of clarification and separation processes.

Figure 15: The finished product to enjoy with friends – Cheers!!

Figure 16: An outfall of a treatment plant showing the final treated effluent – Almost good enough to drink.