McKenzie, TN Wastewater Digester Restoration Aug. 12

OCTOBER 25

G3 Wastewater Tech
Authored by: Erin Widner

Background Aerobic Digester

The aerobic digester (Figure 1) at the wastewater plant in McKenzie has a maximum volume capacity of nearly 240,000 U.S. Gallons. When the digester G3 Wastewater Tech cleanout started the volume was 150,000 U.S. Gallons of septic sludge. The reason for the septic sludge:

- Rotating blowers on the digester are not functioning properly
- Grit screen at the head of the plant is also incapacitated
- McKenzie's dewatering belt filter press is not functioning

These factors lead to the buildup of sludge in the digester over the course of time. The digester itself has not been completely emptied in over 25 years.

Figure 1 Picture taken during the premixing stage in the startup of G3 Wastewater Tech Process

On a routine visit, B.A.M.2, Inc. in neighboring Gleason, TN checked into the McKenzie plant in June. It was then they introduced technology they have been working on for years-G3 Wastewater Tech. B.A.M.2 had no idea the extent of the condition in the digester but presumably did know it needed attention through public record. One-week later B.AM. 2, Inc., recognized an opportunity to provide the City of McKenzie with their services and gather data for G3 Wastewater Tech services in the future. These patented services were provided *pro bono publico.* Estimated price for such services with lab work, research, equipment rental, chemical and labor were at $60,000.00 U.S. Dollars.

Background Aerobic Digester-Bio-Solids Make Up

Samples were taken with the operator's permission in June and were extensively tested to see the reactivity with G3 Wastewater's chemical utilized in their patent. *EPA Method 160.2* was utilized determining the biosolids make up with TS, TSS, TDS, TVS and TFS.
Total Solids amount for the digester before G3's process was 56, 295 lbs. or 28.15 tons or 4.5%.
The pH and dissolved oxygen were extremely low. The pH of the digester was very acidic at 3.6 pH. The dissolved oxygen contributed to septic conditions 0.6 mg/L (when digester blower turns off).
TNT phosphorus and ammonia test were performed with a Hach 890 were out of range and an accuracy in both cased couldn't be determined.
Samples were taken using a column tester and then homogenized for solids testing. Three GoPro Silver7's was utilized for time lapse, and a drone was utilized for video documentation.
In the makeup of 4.51% solids-

- 3.045% were Total Suspended Solids
- 1.46% were Total Dissolved Solids. See Figure 2. Below.
- 3.0% Volatile Solids
- 1.51% Fixed Solids. See Figure 3. Below.

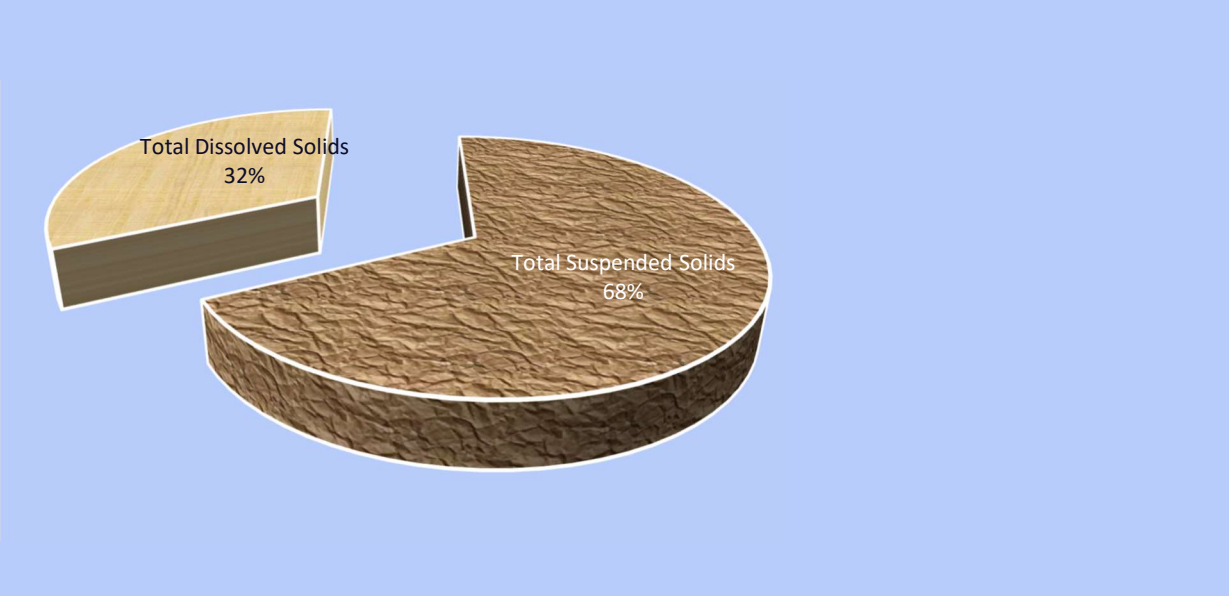


Figure 2 Distribution of Total Solids

150,000 gallons at 4.51% solids=56,420.10 lbs. of Total Solids
37,530.00 lbs. of Suspended Solids
18,891.10 lbs. of Dissolved Solids

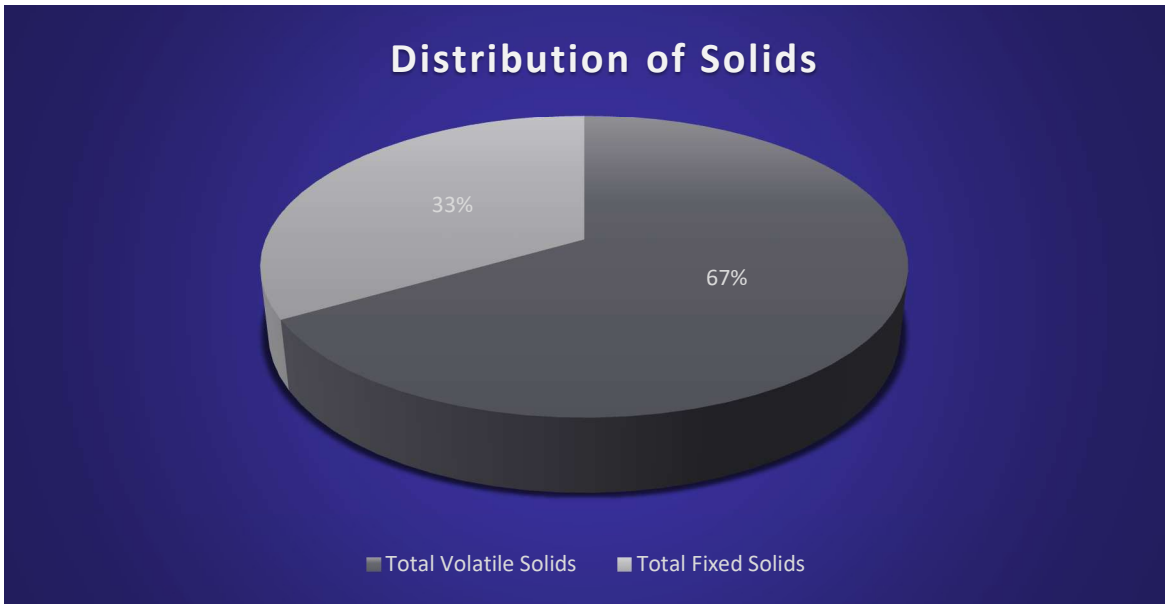


Figure 3 Distribution of Total Solids

150,000 gallons at 4.51% solids=56,420.10 lbs. of Total Solids
38,092.95 lbs. of Total Volatile Solids
18,260.60 lbs. of Total Fixed Solids
***In some spots in the digester there is up to 2 feet of hardened sludge.**

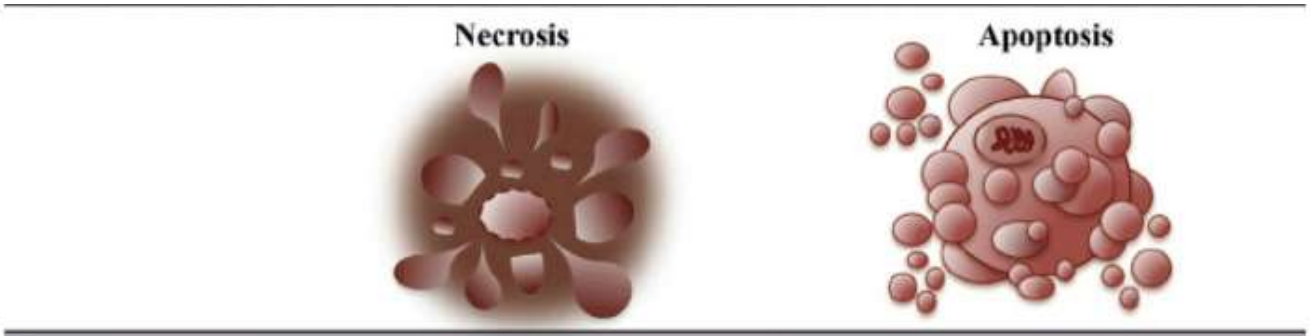
DAY 1 -August 12, 2022

G3 Wastewater Tech started setup for our patented process at 04:30. The degrade we used was chemically altered because it had been left out in damp conditions earlier in the year and had lost some of its efficacy at another job. Under normal conditions we would have used a fresher batch. Our delivery system was also altered due to time constraints and lack of staff. In our normal mixing process, we obtain 10 times higher velocity to receive the same results as far as Reynolds Numbers and more structured water in that process. The G3 process is 70% Mechanical and 30% Chemical and most of the equipment we normally utilize was not on site. We applied roughly 1/8 the dosage of degrade we used in the lab to degrade sludge.

Day 4 -August 16, 2022

After 5 days of mixing without our patented and engineered G3 pump. We collected a sample lab testing for solids. There wasn't any smell of H2S. The digester had a strong earthy smell. The solids went up significantly. See Figure. 4.1. Only when you understand the necrotic nature of the cell's interaction with the G3 Wastewater Process does the puzzle fit together perfectly. G3 Wastewater Tech is a forced and accelerated oxidation process on a cellular level that destroys the cellular membrane and causes a release of water and intracellular material. The dying of organic material is necrotic vs. apoptotic. The middle jar was taken in the middle of cell necrosis on August 16. This is indicated Figure 4.3. The middle jar is in the middle of necrosis. If the cells were apoptotic, the solids would have decrease right away and in an orderly fashion and the cellular membrane would remain intact. There would be no secondary tissue damage. The cells were in a state of dying but not dead and were in a state of expansion but not yet bursting. The necrotic nature of the cell fosters inflammation and eventually bursting of the cellular membrane. After bursting, intracellular material becomes food or energy source for some of the good bacteria Figure 4.2. Under the

normal G3 Wastewater conditions, necrosis of the cells would have taken place in a much more rapid fashion.



Stimuli	Cell homocide	Cell suicide
Cause	Infection, toxins, trauma	Natural cell death program
Effects	Large cells, swelling, hypoxia, acidosis, liquefaction, random, metabolic collapse, diffuse fragmentation, membrane integrity loss, nuclear dissolution	Cell shrinkage, membrane blebbing, apoptotic bodies, chromatin condensation, and DNA fragmentation
Tissue reactions	Inflammation, surrounding normal tissue damage	No inflammation, no secondary tissue damage

Figure 4.2

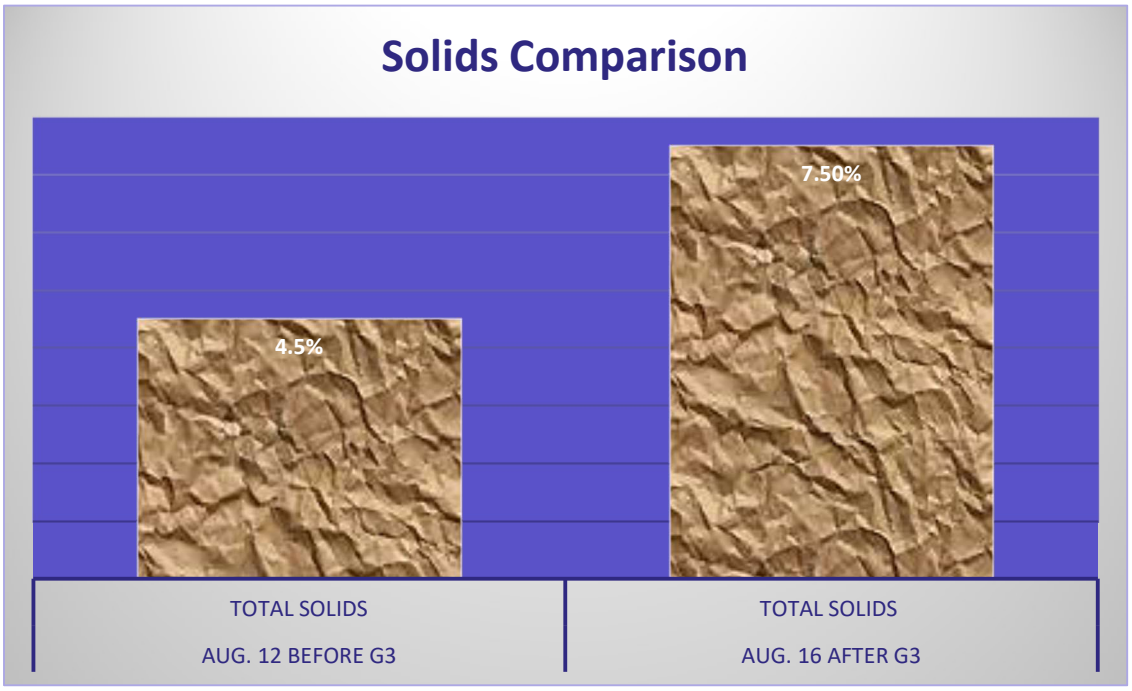


Figure 4.1 Necrotic Cells

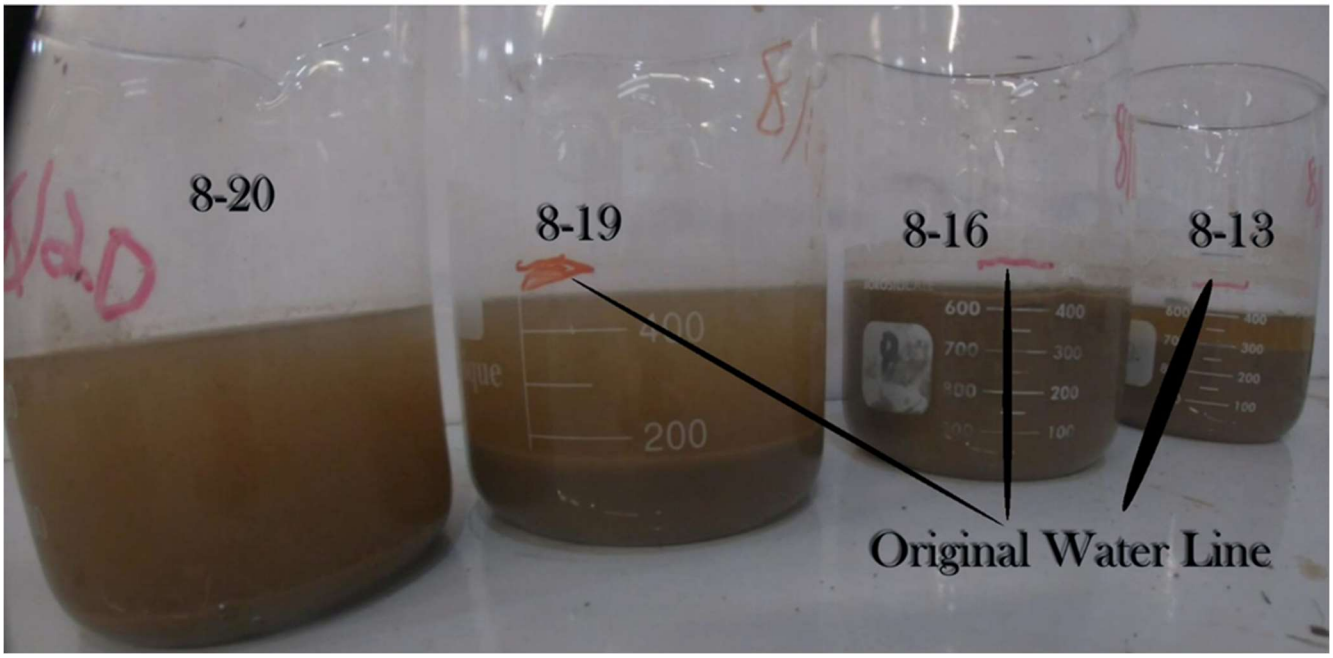


Figure 4.3. Necrotic cells on 8/16 in suspended animation before mixing.

Day 7 -August 19, 2022

Endogenous respiration is taking place in the dying cells and the dying cells are becoming food for other bacteria. The solids are beginning to decrease significantly. See figure 5. Strong earthy smell permeates the area.

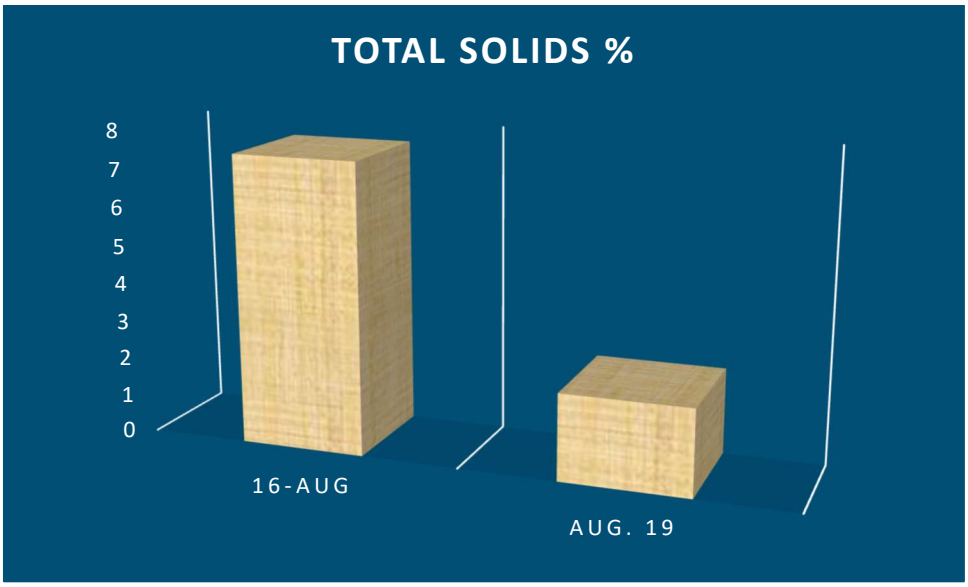


Figure 5 Total Solids Decrease Aug. 16 to Aug. 19

Day 19 -August 31, 2022

G3 Wastewater Tech process is completed. Some solids that were petrified at the bottom of the digester are now dislodged and floating. More efficient mixing and better degrading material would have dislodged solids faster in the process. There was a slight decrease in volatile solids from Aug. 19.

Total Volatile Solids

Total Volatile Solids *decreased* in the digester from 37, 530 lbs. to 13,010.40 lbs. or 3.0% to 1.04%. This would be a decrease of 65%. See figure 6.

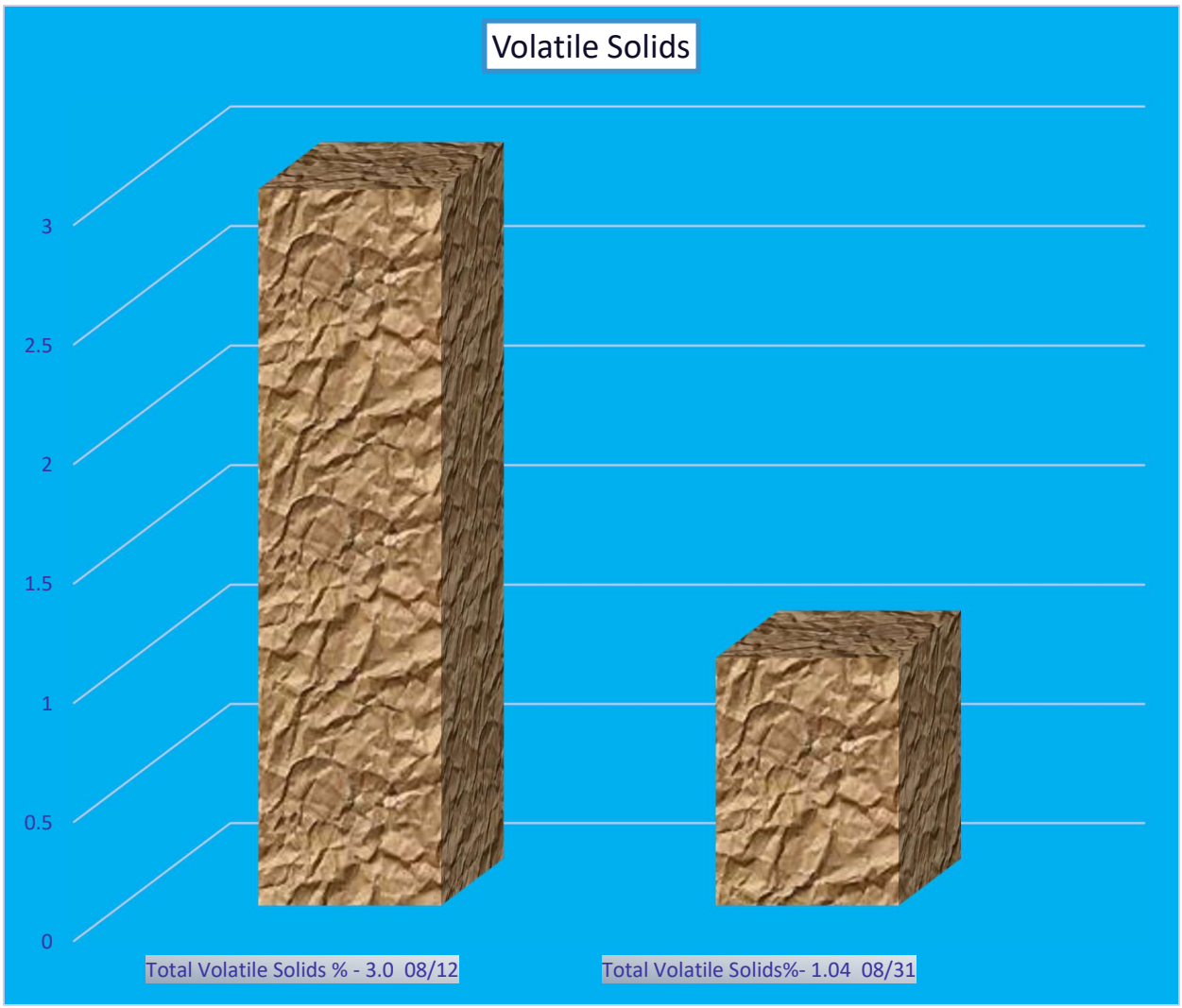


Figure 6 Volatile Solids at Start of project and End of project

Total Solids

Total Solids *decreased in the digester from 56,295 lbs. to 31,762.89 lbs. or 4.5 to 2.539%. This would be a 44% decrease.*

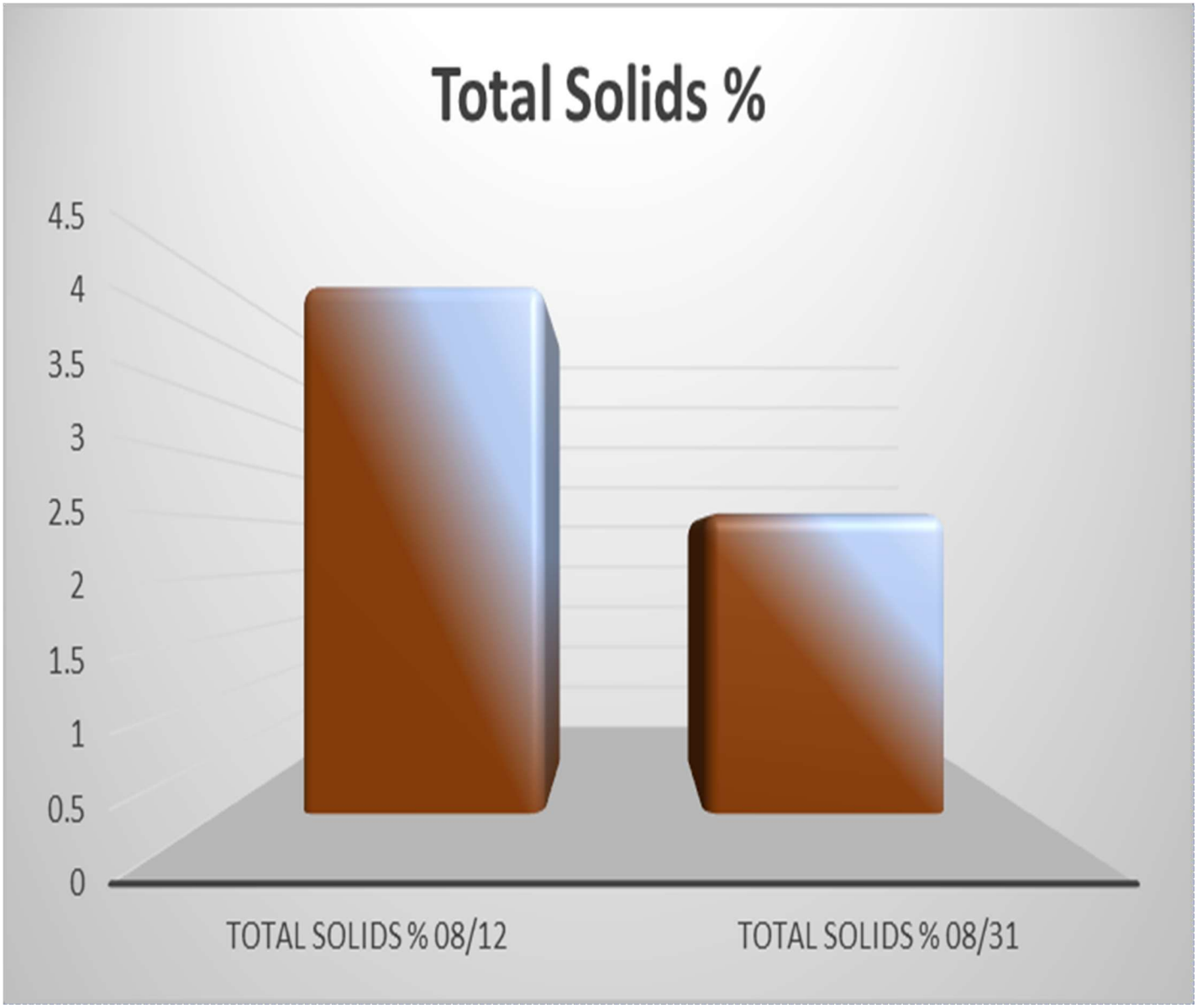


Figure 7 Total Solids 44% decrease.

Total Fixed Solids

There was only a .01% decrease change in fixed solids or a weight of a weight of 125 lbs. total.

Total Suspended Solids

The Total Suspended Solids *decreased 38,092.95 lbs. to 21,517.20 for 44% decrease or 3.045% to 1.72%. See Figure 8 below.*

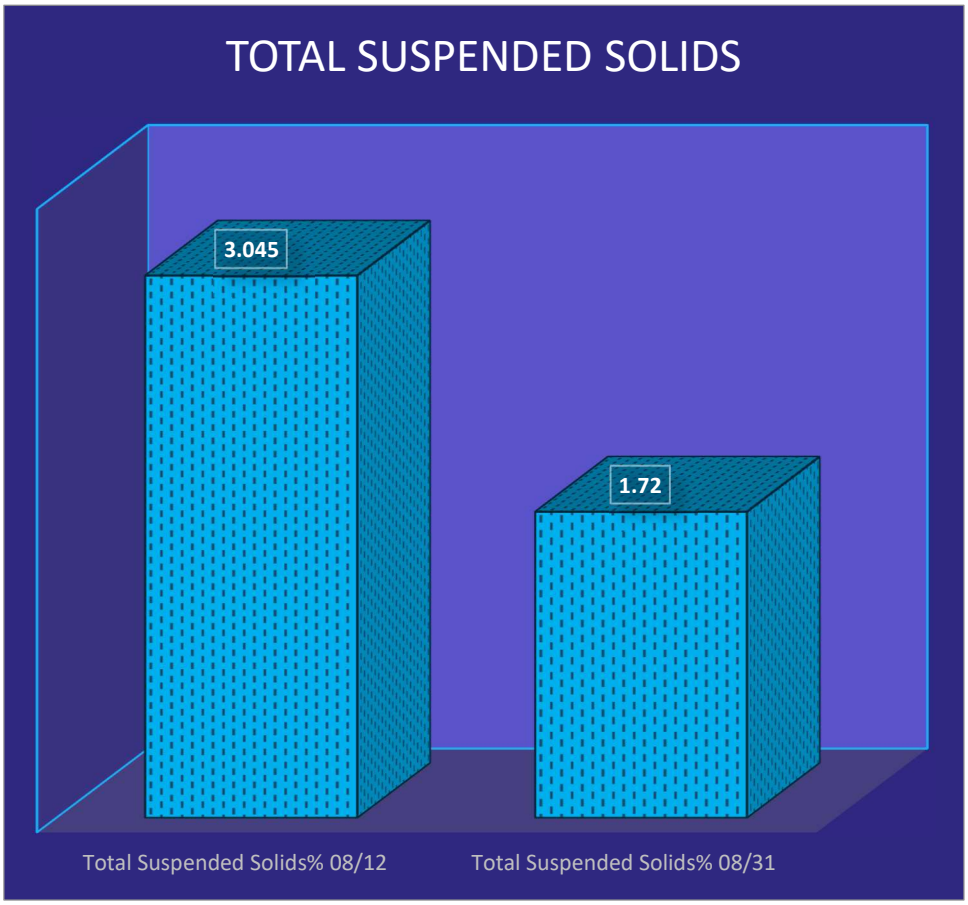


Figure 8 Suspended Solids

Total Dissolved Solids

The Total Dissolved Solids *decreased* from 1.46% to 0.819% or 18,264.60 to 10,245.69 lbs. This is a decrease of 44%. See Figure 9.

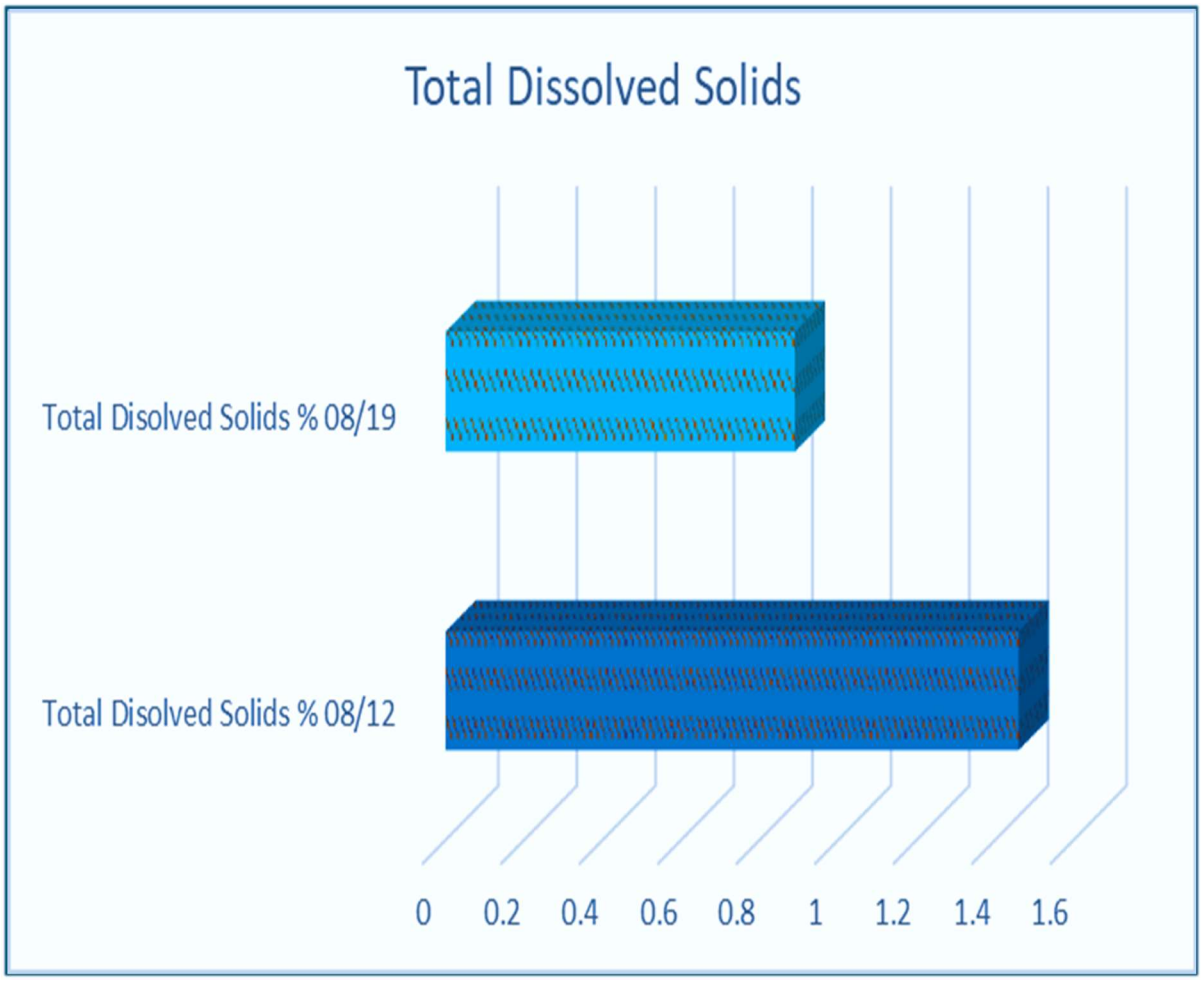
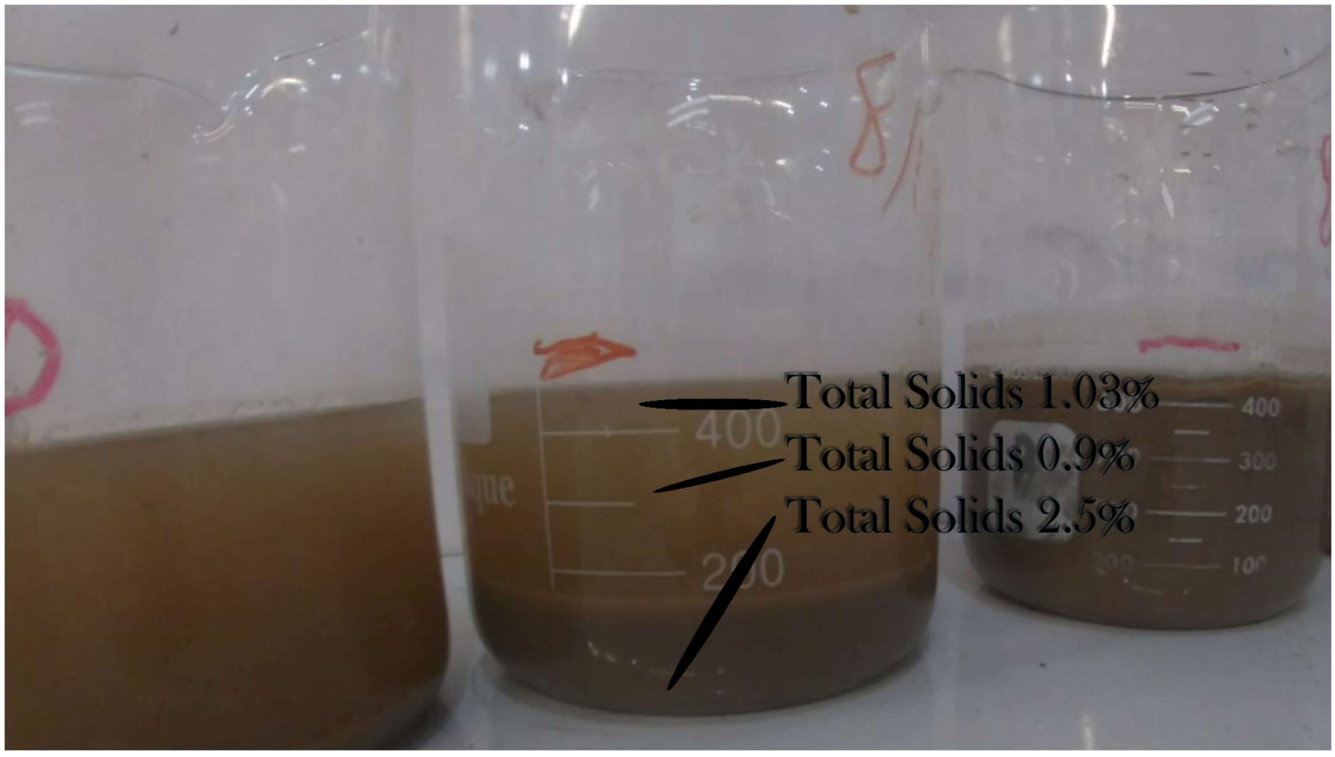


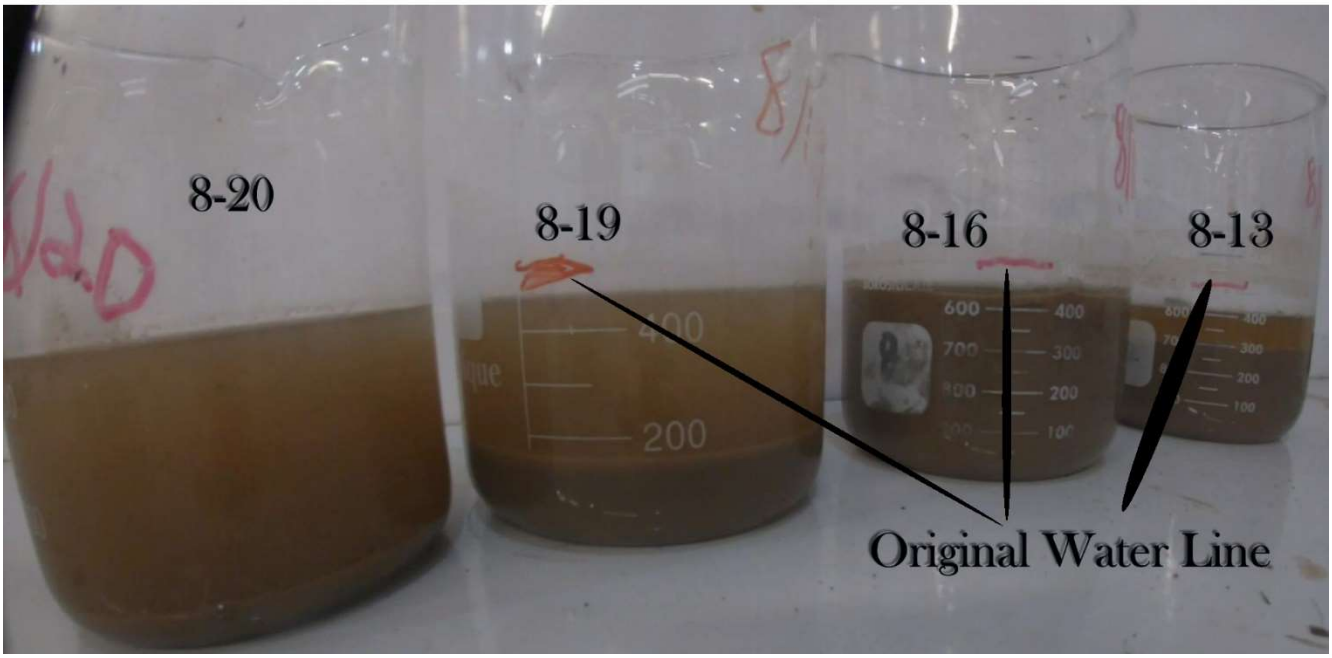
Figure 9 Dissolved Solids

Aug. 12 start of process above Aug. 19 below.

Solids Distribution In A Jar



Jars Taken After Specific Mixing Dates



Dewaterability

With the proper mixing and degrade amounts dewatering may not be needed. This of course depends on the number of organics and inorganics in the sludge. When this is not the case, the G3 Wastewater Tech Process could be a nice amplifier to a plant's dewatering modality. The amount polymer or coagulant could be reduced significantly. Here are the reasons why:

- The energy and chemical in G3 Wastewater Tech are a nice catalyst in raising pH. When pH is raised, the amount hydrogen is decreased. Hydrogen is of course the building block of all matter/solids.
- When the organic matter is going through necrosis and not programmed cellular death (apoptosis) it expands making it easier for polymer to grab. After organic matter expands it burst through necrosis its contents spread again making it again easier for the polymer to grab.
- When the organic matter dies the volatile solids are depleted lowering total solids count. Less solids less dewatering.

Preliminary results with a crosslink cationic polymer were promising. We were showing a 90% capture rate with a belt press sample fabric. See Figure 10 and 11.

Figure 10 polymerized sludge

Figure 11 Filtrate Off Sludge

Conclusion

The G3 Wastewater Process is incommensurate to all traditional wastewater dewatering processes. Although necrosis carries a negative denotation and connotation regarding the human body, G3 uses necrosis in a good way for wastewater in destroying cells detrimental to a wastewater plant's process. 65% of all volatile solids are killed in the case mentioned above. The expansion of the cells and eventually bursting of the cells allow bacteria that are beneficial to carry out their objective. This is a forced and accelerated oxidation process on a cellular level that destroys the cellular membrane and causes a release of water and intracellular material. The digester mentioned above has not been cleaned thoroughly in 25 years. Although G3 and operators are happy with the results, a much larger success rate would have been achieved catching the problem sooner, with fresher chemical and better strategic mixing.

Benefits of G3

1. **Could be used in emergency situations -flooding of industrial and municipal wastewater.**
2. **Prevents eutrophication of phosphorus into surface water.**
3. **Eliminates e coli.**
4. **Eliminates vectors.**
5. **Does not kill good biology.**
6. **Increases dissolved oxygen.**
7. **Reduces amounts of coagulant or flocculant used for further process.**
8. **Provides wastewater with more workability.**
9. **Reduces hauling cost.**
10. **Eliminates the need for dredging.**
11. **Eliminates the need for dewatering (although you still could)**
12. **Precipitates phosphate.**
13. **Could precipitate calcium.**
14. **Could be used Korean in farming technique.**
15. **Precipitate could be used in biomedical.**
16. **Precipitate could be used as fire retardant.**
17. **Could replace the need for PFAS/plastics.**
18. **Precipitate could be used in wallpaper as fire retardant.**
19. **Precipitate could be used in concrete.**
20. **Precipitate could be used in insulation.**
21. **Precipitate could be used as a cardboard replacement.**
22. **Precipitate could be used as a slow-release fertilizer.**
23. **Precipitate could be used as animal bedding.**
24. **Precipitate could be used in cosmetics.**
25. **Precipitate could be used in cosmetic surgery.**
26. **Frees up trapped water being held hostage by sludge to evaporate.**
27. **Increases capacity and freeboard of the lagoon or digester.**
28. **Enhances nitrification.**
29. **Enhances denitrification.**