

CASE STUDY: Ft. Pierce WWTF

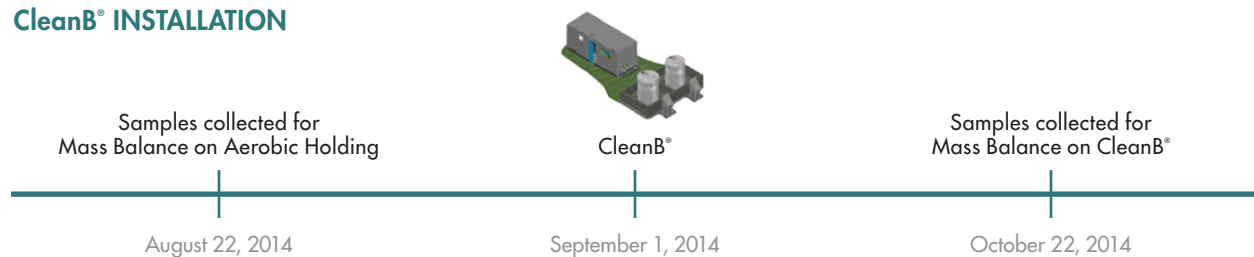


EXECUTIVE SUMMARY

In September of 2014, a CleanB® system was installed at the Ft. Pierce WWTF. Before the CleanB® installation, the plant wasted to a DAF unit for thickening and held sludge in an aerobic holding tank prior to contract dewatering and landfill disposition. After installation of the CleanB® system, the plant started wasting directly from the clarifier to the CleanB® unit and centrifuge dewatering.

The following chart illustrates the timing of sample collections and CleanB® installation. Differences in nutrients leaving the clarifier were noted and were attributed to the timing of the samples. The capture rates of solids and nutrients after installation of the CleanB® show a substantial improvement when compared to the previous practice. Percent capture of Nitrogen went from 25.9% with DAF thickening and aerobic holding to 92.9% with CleanB® treatment. Percent capture of Phosphorous went from 21.1% to 83.1% with CleanB® treatment.

CleanB® INSTALLATION



The key conclusions from this work effort are:

1. Solids return via filtrate was reduced by 70% (76 tons/year)
2. Total Nitrogen return via filtrate was reduced by 92% (45 tons/year)
3. Total Phosphorous return via filtrate was reduced by 66% (9 tons/year)
4. %TS on dewatered biosolids improved by 21% (52 less Truckloads/year)
5. Total polymer consumption was reduced by 34% (reduction of 26.8 lbs/DT)
6. Total Nitrogen leaving with the biosolids was increased by 182% (35 tons/year)
7. Total Phosphorous leaving with the biosolids was increased by 476% (20 tons/year)
8. A \$57k per annum expense from the aerobic holding tank blowers were taken off-line
9. Energy/GHG emission savings equates to 50.8 cars per year or 86.4 tons of waste sent to the landfill

In addition to the advantages of higher capture rates and reductions in greenhouse gas (GHG) emissions, it is estimated that Ft. Pierce WWTF will now realize a \$242,000 savings per year in operating cost using the CleanB® vs. their original aerobic holding processing. Below is a summary of the net impact to operations utilizing the CleanB® as compared to aerobic holding at Ft. Pierce:

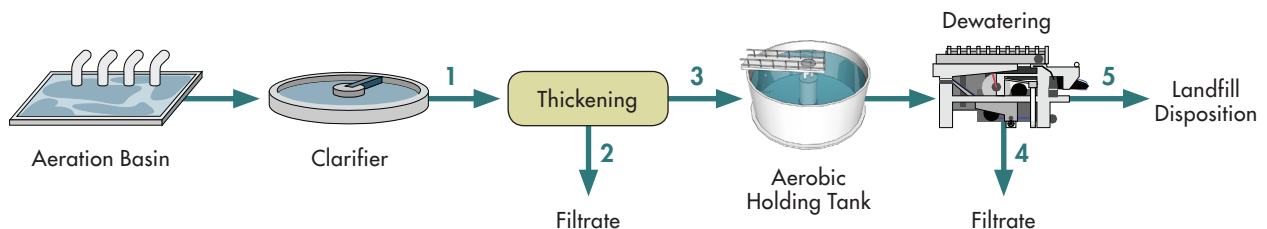
NET IMPACT TO OPERATIONS		
Total per DT	[\$/DT]	\$ (254.38)
Total per Year @ 952 DT	[\$/yr]	\$ (242,166.87)

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AEROBIC HOLDING MASS BALANCE

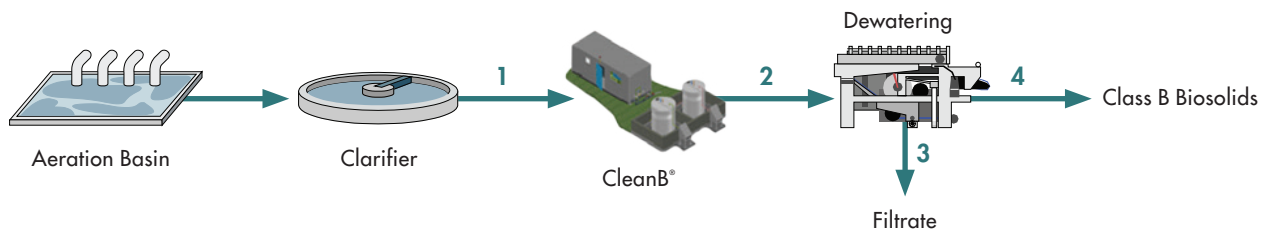
The following is a mass balance for the aerobic holding process while treating 2.6 DT/day. Using the results provided by the lab analyses, a complete mass complete balance was calculated around the Aerobic holding process at Ft. Pierce WWTF. The balance was done by simultaneously solving equations to calculate the filtrate and dewatered biosolids flow by using the *Thickener Inflow %TS*, *Thickener Outflow %TS*, *Thickener Filtrate %TS*, *Dewatered Filtrate %TS*, and *Dewatered Biosolids %TS*. The mass balance represents a 952 DT/yr facility operating 7 days a week. Since surface aerators were used at Ft. Pierce with a short SRT, their aerobic holding process did not achieve a volatile solids reduction.



Process Stream	Stream #	Total Solids [%]	Flow [gpd]	Wet Solids [lbs/day]	Dry Solids [lbs/day]	Total Nitrogen [lbs/day]	Total Phosphorous [lbs/day]
Thickener In	1	0.80	88,091	734,678	5,892	410	109
Thickener Filtrate	2	0.06	75,588	630,404	366	182	47
Thickener Out	3	5.30	12,503	104,273	5,526	228	62
Dewatered Filtrate	4	0.41	8,927	74,450	307	122	39
Dewatered Biosolids	5	17.50	3,576	29,823	5,219	106	23

CleanB® MASS BALANCE

The following is a mass balance for the CleanB® process while treating 2.6 DT/day. Using the results provided by the lab analyses, a complete mass complete balance was calculated around the whole CleanB® unit. The mass balance represents the CleanB® installed directly after the clarifier and treating 952 DT/yr operating 7 days a week.



Process Stream	Stream #	Total Solids [%]	Flow [gpd]	Wet Solids [lbs/day]	Dry Solids [lbs/day]	Total Nitrogen [lbs/day]	Total Phosphorous [lbs/day]
WAS in	1	0.62	104,706	873,244	5,405	322	160
CleanB® Treated	2	0.62	104,706	873,244	5,405	322	160
Dewatered Filtrate	3	0.02	101,886	849,733	186	23	27
Dewatered Biosolids	4	22.20	2,819	23,511	5,219	299	133

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MASS BALANCE COMPARATIVE

The table below summarizes the results of lbs of nutrients returned to the plant via centrate and the solids concentration of dewatered biosolids requiring disposal:

	Units	Aerobic Holding	CleanB®	Tons of filtrate removed/yr	Percent Improvement
Dry Solids (filtrate return)	[lbs/DT]	228.5	68.8	76	70%
TN (filtrate return)	[lbs/DT]	103.1	8.5	45	92%
TP (filtrate return)	[lbs/DT]	29.1	10.0	9	66%
%TS Biosolids	[%]	17.5%	22.2%	N/A	27%
Lbs Wet/DT	[lbs/DT]	11,429	9,009	N/A	21%
Truckloads Hauled*	[TL/yr]	247	195	N/A	21%

*Truckload = 44,000 wet lbs

It should be noted that the filtrate returns were summed for aerobic holding (thickening and dewatering) and then compared to the filtrate return for the CleanB® process (dewatering). The total nitrogen return on a dry ton basis with their aerobic holding was 103.1 lbs, whereas the CleanB® showed 8.5 lbs return per dry ton, or a 92% reduction. The high capture rate of nitrogen in the biosolids reduces 45 tons of nitrogen being returned to the head works per year for this size facility (952 DT/yr). Total phosphorous returned via the centrate is smaller, 66%, reduction or 9 tons per year, but still is significant. The benefits of reducing the amount of nutrients returning to the plant are two fold, less returned nutrients means less reprocessing within the liquid treatment train, and secondly more captured nutrients in the biosolids means a more valuable soil amendment.

The CleanB® produced a much drier cake; there was an observed 27% increase in cake solids (17.5% to 22.2% cake solids) for the dewatered biosolids. The change in cake solids equates to a 21% reduction in wet weight. When considering this facility produces 952 DT/year, the facility can now expect to decrease the number of truckloads hauled per year by 52 (assuming 44,000 lbs per truckload), or a 21% decrease in hauling. In addition to a producing a drier cake, there was an observed 40% reduction in polymer consumption (see below).

POLYMER COMPARISON

In addition to an increase of nutrient capture and greater dewatered solids concentrations, the CleanB® has significantly reduced polymer consumption of the plant. Below are the consumption rates of each process.

Aerobic Holding:

Thickening polymer Consumption: 19.3 lbs/DT
Dewatering Polymer Consumption: 59.5 lbs/DT
Total Polymer Consumption: 78.8 lbs/DT

CleanB®:

Total Polymer Consumption: 52.0 lbs/DT

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DEWATERING & HAULING COSTS

In normal operation FPUA WWTF dilutes its stream from the digester from 5.3% TS to 2.5%TS in order to dewater. They were paying 5.39 cents per gallon dewatered. This cost included dewatering, hauling and disposition. Assuming an annual output of 952 dry tons per year, their dewatering, hauling, and disposition costs amounted to \$492,209 per year.

PROJECT ECONOMICS

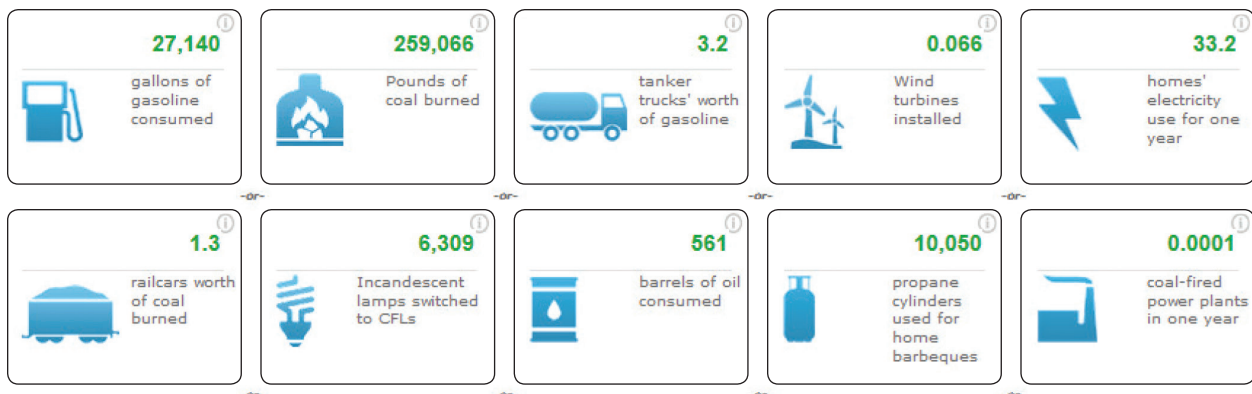
+ CleanB® Chemical Cost
- CleanB® Impact on Polymer
- CleanB® Impact on Cake Solids
- Aerobic Digestion Blower
= CleanB® Net Impact to Operations of – \$254.38/DT
= \$242,166.87 Annual Savings @ 952 DT/year

ANNUAL GHG EMISSION SAVINGS & EPA EQUIVALENCIES

Annual Greenhouse Gas Emissions from:



CO₂ Emissions from:



Carbon sequestered by:

