INTERESTINGLY ATAD: OPERATIONAL DATA FROM THE NEW ATADS IN ONTARIO

Case Study including, the design conditions, construction, and operating data of four plant operations utilizing 2nd Generation ATAD technology in Ontario.

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Autothermal Thermophilic Aerobic Digestion (ATAD) was an exciting technology that drew a great deal of attention during its introduction to North America in the late 1980s and early 1990s. Approximately 10 Canadian and 20 US installations were designed and commissioned in that time frame. The promise of superior solids destruction and pathogen inactivation, especially in cold climates, combined with the ease of aerobic digestion placed this technology as a rapidly growing method of safely treating and disposing of some of the undesirables in our industry. In fact, there are always new and improved "make-it-disappear" or "for-half-the-cost" approaches that are developed and presented to us each year. Although, some of the ATAD systems installed lived up to the hype, many had fundamental problems with odours, caused by insufficient aeration; foaming, due to high temperature operations; as well as, dewatering issues, both in an understanding of the physical chemistry required and the costs associated with it.

As with all new advancements, each must be studied for any problems to be identified and dissected with new and improved versions replacing the older versions, or conversely, they may just fall off of the face of the earth, never to be heard from again. The market for these ATAD units almost completely vanished for a short time. However, during this acclimation period, continued analysis of hydraulic retention time (HRT), oxygen requirements, operating temperatures, byproduct formation, and odours were extensively studied, and the process continually refined. The second generation ATAD is just such an example of a revitalized technology. With over 50 installations now operating in North America and more going in each month, there is an indication that much of the stigma associated with the first wave of ATADs is slowly being rectified. Most of the emphasis in the redesign was on the elimination of odours by increasing the oxygen supply and transfer efficiency, thereby reducing fermentative and quasi anaerobic type of odors, i.e., hydrogen sulfide (H_2S), mercaptans, and volatile fatty acids (VFAs) from being emitted. Inherently, this also provided for increased volatile solids destruction on the order of 65% while improving the dewaterability of the thermophilically treated solids. Additionally, automation of the process control logic including the foam control system, practically eliminated the potentially for foam-overs, as well as, reduced the operating costs.

The second generation ATAD was approached with extreme caution as can be seen by the progression of volume of material treated and complexities of each system. Morrisburg, Ontario, was constructed in 2007, at a design capacity of 550 kilograms dry solids per day (kgpd), it is one of the smallest ATADs constructed in North America. As with many of its predecessors, the philosophy of constructing multiple tanks was still used, however, in lieu of being operated in series, this system was operated in parallel, providing for much higher degree-days than was accustomed to in the original designs. The treated solids are stored in an aerated post-ATAD storage tank and then hauled to the fields as a liquid for land application. Table 1. provides a summary of the wet stream operations and ATAD design parameters for all water treatment facilities presented herein.

Table 1: ATAD DESIGN PARAMETERS

Parameter	**Morrisburg**	**Amherstview**	**Mississippi Mills**	**Hawkesbury**
ADF (m^3/d)	4,610	5,200	4,700	13,800
PDF (m^3/d)	18,500	16,000	14,100	41,400
Secondary Treatment Process	SBR	Extended Aeration	Extended Aeration	CAS/IFAS
Construction Year	New 2009	New 2009	New 2012	New May 2013
Previous Solids Treatment	Aerobic	N/A	Lagoon	Aerobic
Design Solids Loading (kg/d)	550	1,500	1,286	4,700
Feed Solids	Secondary Sludge/Scum	Secondary Sludge/Scum	Secondary Sludge/Scum	Pri.Sludge WAS/Scum
Feed VS/TS (%)	65/5.3	70/5.5	65/4.9	68/5.5
VS Reduction (%)	60	70	70	65
TS Reduction (%)	39	49	45	45
Type of Final Product	Liquid	Liquid	Solid (cake)	Solid (cake)
Dewatering Method	N/A	N/A	Rotary Press	Centrifuge
Biosolid % TS	3.3	2.2	24	34
Disposal Method	Land Application	Land Application	Land Application	Land Application

Table 2: MORRISBURG OPERATING PARAMETERS

Parameter	Morrisburg
Feed Stock	TWAS
Thickener	Gravity Belt Thickener
Loading (kg/d)	371
TS in Feed (%)	5.3
No. of ATADS	2
No. of SNDR	0
ATAD Dimensions (L x W x Op. Depth, m)	4 x 3 x 5.25
Volume Each (m^3)	63
Digested Sludge TS (%)	3.3

The Morrisburg ATAD is designed to receive waste activated sludge (WAS) from the sequencing batch reactors (SBRs) following thickening through the gravity belt press. The WAS total solids concentration ranges from approximately 0.4 - 0.7% TS, which is then thickened to an average concentration of 5.2% TS. The thickened WAS (TWAS) is alternately fed to one of the two parallel flow ATAD reactors daily. As the feed stock is pumped to the reactors the process air is increased in order to provide for the increased oxygen demand. Following the design HRT (12 days) the digested sludge is transferred to the storage tank. The Morrisburg tank design and operating parameters are provided in Table 2.

Table 3: MORRISBURG DIGESTED SOLIDS CHARACTERISTICS

Parameter	Avg. Value
TS (%)	3.7
VS (%)	2
pH	8.7
NO3/NO2 (mg/L)	<3/<3
TKN/NH3 (mg/L)	3170/841
Total Coliform (cfu/100mL)	<1000
E.coli (cfu/100mL)	<1000

ATAD technology was selected for the Morrisburg facility due to its smaller footprint requirement, completely contained design, complete with odour control and the quality of the final biosolid product. This facility is directly adjacent to a residential area and golf course. The typical digested sludge parameters are shown in Table 3.

Upon successful demonstration of this innovative approach to an odour free and performance enhanced ATAD operation, Amherstview, Ont. was designed at ~1,500 kgpd nearly tripling the size of the Morrisburg plant and was commissioned in 2008. Again, this facility utilized a parallel operation for ease of operation and pathogen control as well as providing 50% of design level of redundancy. Initially, ATAD temperatures approached 75 °C, so steps were instituted to lower the temperatures to control and slow down the reaction rate kinetics. The treatment plant consistently sees the volatile solids reductions in the 70 percentiles, and utilizes a holding lagoon for long term storage of the post-ATAD treated solids.

Table 4: AMHERSTVIEW OPERATING PARAMETERS

Parameter	Amherstview
Feed Stock	TWAS
Thickener	Gravity Belt Thickener
Loading (kg/d)	600
TS in Feed (%)	5.5
No. of ATADS	2
No. of SNDR	0
ATAD Dimensions (L x W x Op. Depth, m)	10 x 6 x 5.25
Volume (m^3)	315
Digested Sludge TS (%)	2.4

The Amherstview facility is currently under capacity, and as such, one of the ATAD units is idled off line, allowing for a savings in operating costs. After a sufficient isolation period in which there is no new waste introduced into the reactor, the treated material is transferred from the operating ATAD to the long term storage lagoon where the large surface area and relatively shallow depth allow for nitrification and denitrication to occur naturally. The final stabilized biosolids material is then liquid land applied as needed. The Operating parameters for Amherstview are shown in Table 4.

In 2011, the Mississippi Mills, Almonte, Ont. was designed and constructed. And although similarly sized at about 1,300 kgpd, the additional step of adding dewatering equipment to the process train was included to facilitate solids land application as the disposal method of choice. The secondary material from the water treatment process is thickened to about 5% solids prior to introduction into one of two ATADs fed on alternate days. After the 12 day HRT is met, and the isolation period for pathogen reduction, a portion of the material is transferred to a process controlled tank called the Storage Nitrification-Denitrification Reactor (SNDR) where it is allowed to cool to mesophilic temperatures for the introduction of nitrifying and denitrifying micro-organisms. This step reduces the ammonium concentration from about 1,500

Figure 1. CAKE SOLIDS FROM THE ATAD PROCESS - MISSISSIPPI MILLS

mg/L down to about 200 mg/L. By reducing the ammonium concentration, less polymer is needed to produce a floc and dewater in the Fournier Press.™ The cake solids are light brown in color, granular and are on the order of 25% as the odourless dewatered material is conveyed to a storage building, as shown in Figure 1. where it is held prior to removal for land application. Additionally, the filtrate returning to the aeration basin is contains a significant level of nitrifying and denitrifying bacteria for continually reseeding of the activated sludge process.

The Mississippi Mills ATAD is designed to receive waste activated sludge (WAS) from the extended aeration process (ES) following thickening through a rotating disk thickener. The WAS total solids concentration ranges from approximately 0.6 - 1.0% TS, which is thickened to an average concentration of 4.8 – 6.2% TS. Here again, the TWAS is alternately fed to one of the two parallel flow ATAD reactors on a two to three times a week schedule, but designed for daily feed five days per week as loading dictates. The pump gallery and associated piping are shown in Figure 2. As the feed stock is pumped to the reactors the process air is increased in order to meet oxygen demand. Following the design HRT (12 days) the digested sludge is transferred to the SNDR. The Mississippi Mills tank design and operating parameters are provided in Table 5.

Figure 2. ATAD PUMP GALLERY MISSISSIPPI MILLS

Table 5: MISSISSIPPI MILLS OPERATING PARAMETERS

Parameter	Mississippi Mills
Feed Stock	TWAS
Thickener	RDT
Loading (kg/d)	532 - 1270
TS in Feed (%)	3.7 - 7.2
No. of ATADS	2
No. of SNDR	1
ATAD Dimensions each (LxWxOp. Depth, m)	8 x 4 x 4.6
Volume (m^3)	147.2
Digested Sludge TS (%)	3.3
Dewatering Press TS (%)	24

The Mississippi Mills ATAD was initially commissioned in February 2013, with the system temperature stabilizing at approximately 48°C after about 1 month. The facility began accepting partially aerobically digested sludge from a neighboring sewage works which has been process through their septage facility and further to the headworks of the plant. This additional solids loading (as indicated in the range in Table 5) has increased from a start-up value of about half of the design value (532 kg/d DS) to near the design value (1,270 kg/d DS).

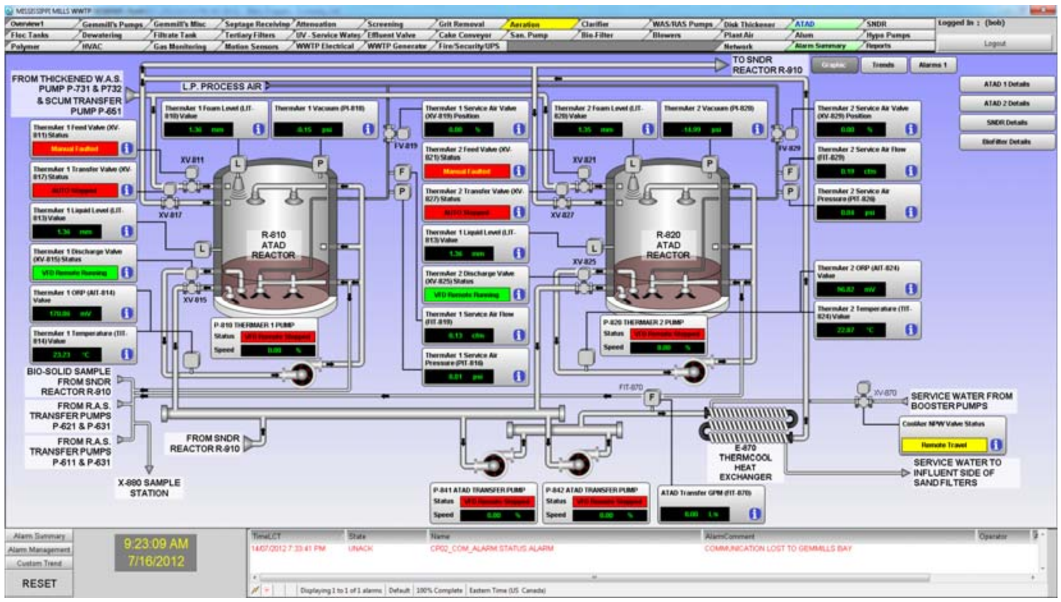

Figure 3. MISSISSIPPI MILLS SCADA DEPICTION OF THE ATAD SYSTEM

The facility ATAD can be monitored or controlled by the Human Machine Interface (HMI) touch screen in the pump gallery, or at the integrated SCADA screen (shown in Figure 3.) along with the other components at the water pollution control facility.

To date, the Mississippi Mills facility has only removed and land applied biosolids in the Fall 2013; the biosolids quality data has not yet been made available for review at this time.

Hawkesbury, Ont. by far the largest Canadian ATAD installation of any generation, coming in at 4,700 kgpd, also utilizes the parallel design in the treatment of both primary solids and TWAS. Primary material is fed on a timer operation directly from the primary clarifier. This feed system is completely automated and is determined based on the solids flux in the clarifier as controlled by setpoints from the operator. Additionally, WAS is feed to one of two rotary drum thickeners, also completely automated, into the same ATAD tank unit. Then once per day, the feed valves are actuated and the material is automatically fed into the second ATAD, as the first ATAD is isolated for the prescribed time under temperature as the pathogen concentrations are reduced. The post-ATAD material is then transferred to the SNDR where nitrification and denitrification are optimized prior to dewatering on an Andritz Centrifuge. The facility typically sees ~65% VSR and ~34% TS in the cake solids. Furthermore, the offgas odours are collected and routed through the SNDR tank where the gas is cooled and the ammonia in the air is removed and reintroduced into the liquid stream utilizing the biosolids solution spray prior to being treated in the biofilter (shown in Figure 4.) The Hawkesbury tank design and operating parameters are provided in Table 6.

Figure 4. HAWKESBURY BIOFILTER ODOUR CONTROL UNIT.

Table 6: HAWKESBURY DESIGN AND OPERATING PARAMETERS

Parameter	**Hawkesbury**
Feed Stock	PS/TWAS
Thickener	RDT
Loading (kg/d)	1650
TS in Feed (%)	5.6
No. of ATADS	2
No. of SNDR	1
ATAD Dimensions each (LxWxOp. Depth, m)	16 x 8 x 5.5
Volume (m^3)	704
Digested Sludge TS (%)	3.1
Dewatering Press TS (%)	34

The Hawkesbury facility has been in operation for approximately six months, with the final completion date for the overall plant upgrades scheduled in February 2014. Although the ATAD system has been in operation the actual operating data may be subject to change based on the stabilization of the entire water treatment plant operation.

Two additional ATAD facilities are also under construction at this time in Ontario. The Iroquois facility is scheduled to begin operations in the spring of 2014 and Penetangishene near the end of 2014.

CONCLUSIONS

The second generation ATAD system is well suited for small to medium sized water pollution control facilities providing an exceptional process for producing safe biosolids for land application programs at a competitive price. Although, the initial offering of this technology had some problems, they were not insurmountable, and have been generally rectified in the new designs, taking into account the variable nature of both the volume and volatility of the feed material, and the need for an enhanced oxygen delivery system. Solids reduction, that can be easily measured by trucks-out-the-gate have been demonstrated in the studied facilities without many of the actual and perceived problems that were associated with the original offerings of ATAD units in North America.