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Autothermal Aerobic Digestion Using Turborator Aerators

8 Years of Experience at Salmon Arm

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Background:

The District of Salmon Arm is situated midway between Calgary, Alberta and Vancouver, British Columbia, on the Trans-Canada highway. The Pollution Control Center services approximately 8,500 people with flows of 600,00 imperial gallons per day. Extreme temperatures (Celsius) vary from 40.0deg. C in July to -36.7deg. C in January. Daily mean temperatures (Celsius) vary from 19.4deg. C in July to -4.6deg. C in January.

The District of Salmon chose an Autothermal Aerobic Digester (ATAD) for the upgrade of the Pollution Control Center in 1986. The original concept was to use surplus air from a 75 hp blower to mix and aerate the insulated digester tanks through coarse air diffusers. The inability to generate high temperatures resulted in a retrofit of the digester in 1988. The retrofit included the installation of two Turborator aerators in each of two newly constructed cells. The cells were constructed in one third of the original digester reducing the theoretical retention time from 30 to 10 days. However, since the Salmon Arm plant does not have grit removal, grit accumulated in the digester reducing the retention time to approximately 5 days. A further upgrade of the digester to provide grater flexibility in operations resulted in the addition of two more Turborator aerators in an additional tank (1992). This doubled the actual retention time to 8 to 12 days.

Installation:

Installation and assembly of the Turborators was found to be a relatively easy task providing a proper lifting davit is on site. The Turborator assembly is straight forward with only the bearing/adapter sleeve tightening being a slightly subjective task. Failure to tighten sufficiently will result in the shaft sliding down in the bearing housing, while excessive tightening will result in bearing failure and possible shaft fracture. The locking nut for the adapter sleeve should be tightened with a solid metal standard slotted screwdriver and a hammer. This will allow the installer the "proper feel" for the correct tension. When tightening the locking nut, it will turn on easily by hand until it is snug. Then using the screwdriver and hammer gently tighten the locking nut until a distinctive "solid metal ting" sound accompanied by a greater reluctance of the locking nut to tighten is achieved. At this point gently tap the top of the locking nut with a hammer. This will free the sleeve allowing the locking nut to be tightened further. The proper tightness is achieved when the tapping on the top of the locking nut results in no appreciable loosening of the sleeve and nut. At this point it is very important to remember to lock the nut in place by bending one of the lock washer tabs into one of the four slots on the locking nut. When the rest of the Turborator is assembled, start the equipment and watch for any shaft slippage (insufficient locking nut tightening should cause this to occur almost immediately). Retighten if necessary. Check also for bearing excessive heat (locking nut too tight). On initial start up, bearings will heat up but the temperature should drop overnight. If the bearings will not cool, shut the Turborator off and turn the shaft by hand. If there is a resistance and a grinding feeling and sound then the locking nut must be loosened. In order to do this, the tapered sleeve must be unlocked from the shaft until it is free and the entire tightening process restarted (see note). Belt tightening should be such that no slippage occurs while not being to tight as to cause excessive friction on the top bearing. Generally 1/2 inch play in the belt (s) at the midway point between the sheaves has been found to be optimal.

Operations:

The digester is fed on a semi-continuous basis with both air and mixing supplied solely by the Turborator aerators. The feed consists of prethickened waste activated and crude primary sludges. Total solids should be between 3 and 7 percent solids with an average of 5 percent for optimal performance. Too high a solids will result in insufficient mixing while too low a solids will washout the digester and result in excess foam production. The effects of ambient temperature appears to be minimal (see Table 1). Although average ambient temperature variations were in the 30 - 40 deg. C range, variations in the cell temperatures were only in the -0.4 - 1.6 deg. C range.

Table 1

Effects of ambient Temperature Variations on Digester Temperature

	Date	Ambient Temp (deg. C)		Digester Temperatures (deg. C)		
		Low	High	Cell 1	Cell 2	Cell 3
	25-Jan-96	-10	-1	62	60	61
	26-Jan-96	-13	-3	59	60	61
	27-Jan-96	-12	-4	58	59	62
	28-Jan-96	-15	-4	59	59	62
	29-Jan-96	-25	-10	59	59	62
	30-Jan-96	-25	-8	58	58	62
	31-Jan-96	-25	-9	56	57	61
Avg.		-17.9	-5.6	58.7	58.9	61.6
	25-Jul-96	14	33	59	60	64
	26-Jul-96	12	33	55	60	62
	27-Jul-96	12	33	57	60	64
	28-Jul-96	13	34	59	60	62
	29-Jul-96	20	34	58	60	61
	30-Jul-96	16	33	61	62	64
	31-Jul-96	15	34	59	61	64
Avg.		14.6	33.4	58.3	60.4	63
Difference		32.4	39	-0.4	1.6	1.4

Note: It is easier to increase the tension on the locking nut rather than to back off a locking nut that has been tightened to excess.

Maintenance:

The Turborator aerators have been found to require a minimal amount of maintenance. This can largely be attributed to the simplicity in design and the new patented non-plugging impeller (1990). Upon installation bearings should be greased quarterly with approved grease. Approximately 3 - 5 pumps from a standard grease gun will do. The Turborator impellers should be cleaned at regular intervals using one of two methods. If water is available in sufficient pressure (approximately 100psi) a static adapter can be made (telescope water connector) to flush the Turborator while the aerator is stationary. Alternatively, a second method is to direct water directly into the rotating air inlet while the unit is operational. Great care must be taken in this procedure because (1) without the aspiration of the air the impeller draws a greater amount of power which may possibly result in an overload and consequently shut down of the motor and (2) as the unit is operational, the belt cover should be left on. Cleaning of the impeller should be done on a weekly or bi-monthly basis. It is also recommended that Turborators be pulled out and the impellers inspected for wear and material build up in the shaft. In order to check the build up of material in the shaft, the impeller must be removed and the shaft cleaned if necessary. This is only required on a semi-annual basis.

Operational Costs:

Operational costs upon proper installation are quite low. This is directly related to the simple nature of the equipment. At the District of Salmon Arm Pollution Control Center flushing of the four Turborator aerators takes one operator 15 minutes. Shaft cleaning and inspection takes two hours. An annual average of two impellers and four belts are required to service the four Turborator aerators installed at the plant, although it should be noted that impeller wear is quite high since this Center does not currently have grit removal and significant amounts of grit accumulate in the digester. Plants with adequate grit removal can expect reduced impeller wear. Since 1992 only one bearing has failed in all four units which run continuously.

Conclusions:

From the operators point of view, over our eight years of experience with the Turborators, they have proven to be a simple, solid and reliable piece of equipment, easy to install and low in maintenance costs and operational hassles.