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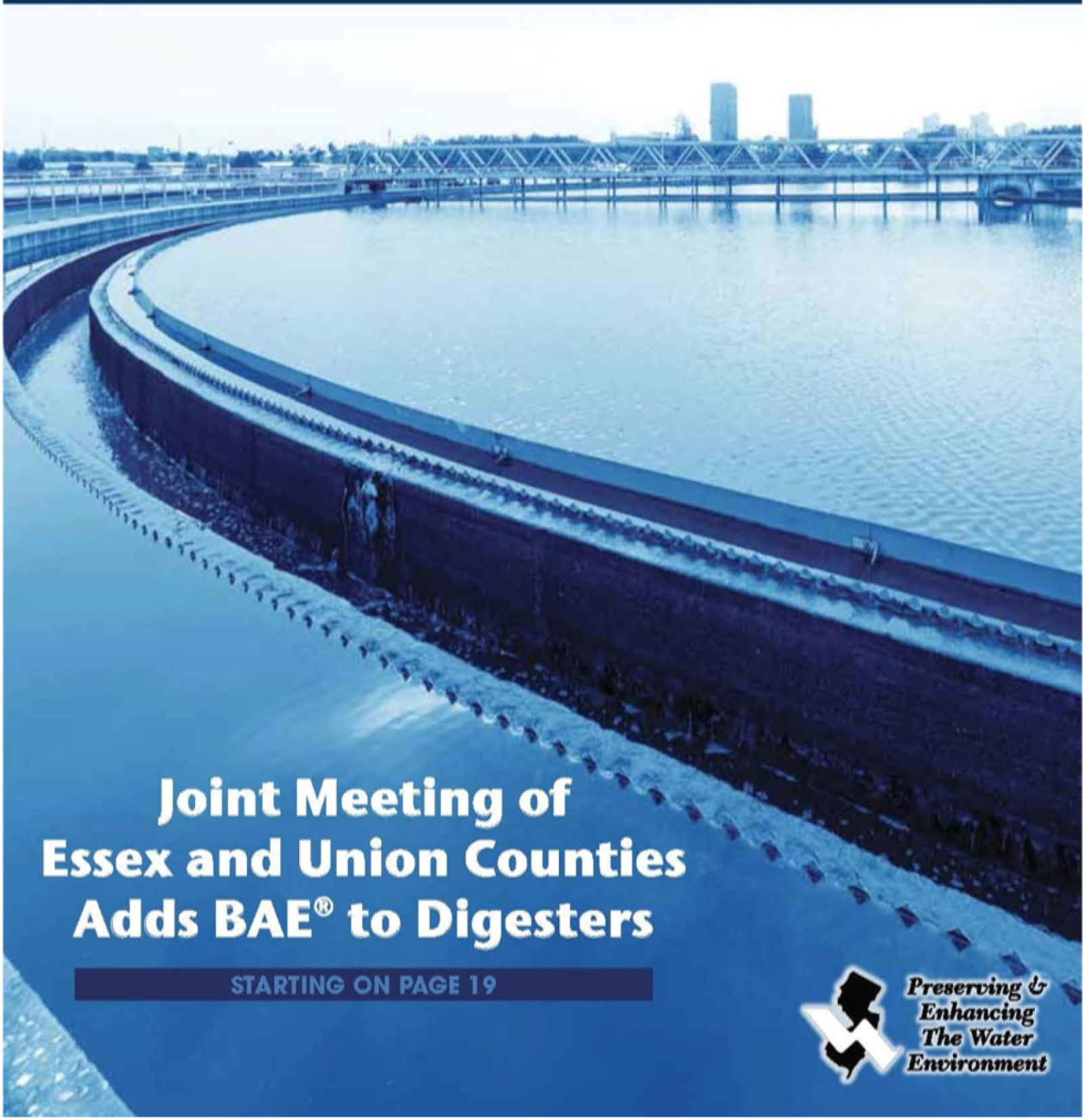

Joint Meeting of Essex and Union Counties Adds BAE® to Digesters

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Preserving & Enhancing The Water Environment

ADDITION OF BAE® TO THE DIGESTERS AT THE WASTEWATER TREATMENT FACILITY OF JOINT MEETING OF ESSEX AND UNION COUNTIES, ELIZABETH, NJ

by
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PLANT OVERVIEW

The Joint Meeting is charged with the responsibility of operating and maintaining a sewage collection and treatment system serving residents of portions of Essex and Union Counties connected to local sewer collection systems. The Joint Meeting is comprised of regional segments within the Counties to which local sewage collection systems connect.

The system has been designed to provide secondary levels of wastewater treatment and sludge dewatering and drying facilities.

The Joint Meeting is comprised of eleven municipalities in Essex and Union Counties who originally contracted for the purpose of constructing and maintaining an outlet sewer. The eleven member municipalities include all or portions of: City of East Orange, Township of Hillside, Town of Irvington, Township of Maplewood, Township of Millburn, City of Newark, Borough of Roselle Park, Township of South Orange Village, City of Summit, Township of Union and the Township of West Orange. Customer municipalities include all or portions of the City of Elizabeth, Township of Livingston, City of Orange, Township of Berkeley Heights, City of Linden and Borough of New Providence. Collectively, the member municipalities and the customer municipalities constitute the Participating Municipalities.

In the 1970's, the primary treatment plant was expanded to provide secondary wastewater and residuals treatment. Originally designed and constructed as a 75 million gallon per day secondary treatment facility, the treatment facility was subsequently re-rated to a hydraulic limit of 85 million gallons per day.

Secondary treatment is a wastewater process used to convert dissolved or suspended materials into a form more readily separated from the water being treated. The secondary treatment process at the Joint Meeting was designed to be able to be operated either as a conventional or step aeration process utilizing mechanical aerators. The plant is and has been operated as a conventional aeration process with a single feed point.

Sludge handling deals with the solids that are removed by various plant units, such as raw sludge from the primary settling tanks and waste activated sludge and scum from the secondary biological process.

Removal of the suspended solids that are above the amount required for the proper operating levels in the aeration tank is controlled by withdrawal of mixed liquor from the aeration process.

The flow of removed solids is directed to the sludge thickeners. At this point, the thickened sludge flows to the thickened sludge pumps which pump the sludge to the digesters. A portion of this thickened sludge flow to the digesters is processed in gravity belt thickeners to achieve higher solids content.

Each of the four digesters (1.77 million gallons each) employs floating covers to collect and store the gas which is generated in the digestion process. This gas may be consumed in three ways. First, the gas is returned to the digester in order to aid in the digestion process by mixing the tank contents. The digester mixing system consists of ten thirty-inch cannon style bubble mixers. Secondly, the gas is consumed as fuel for boilers heating the sludge and various buildings or in the co-generation system for the production of electricity. Finally, excess gas could be consumed by the waste gas burner.

The digested sludge is pumped to the sludge dewatering facility where it is dewatered in centrifuges. The dewatered sludge can be stabilized by mixing in lime or remain as cake. The material is stored in bins and then pumped to the truck loading facility. The trucks remove the material (dewatered cake or lime stabilized cake) from the site for disposal.

Joint Meeting installed four co-generation units with a capacity of 800 kW each. The co-generation system came on line in late 2009. The engines are capable of using either methane gas from the digesters or natural gas supplied by public utilities. Power produced by the co-generation system accounts for over 70% (average 1,455,000 kWh/month) of the total power required to operate the entire facility (average 2,066,000 kWh/month).

The addition of the co-generation system became a strong incentive to produce more digester gas. Following pilot testing on one digester (number 4) with Biological Activity Enhancer (BAE), manufactured by Prodex, from January 18 through March 18, 2011 it became obvious that the additive significantly improved digester gas production as well as volatile solids reduction.

The representation of the impacts of BAE into one digester did not allow for the overall evaluation of the system since the streams are joined and directed to the dewatering process but did strongly suggest significant gas production improvement. It was noted prior to removing the number 2 digester from service for rehabilitation that gas production had fallen. Following internal inspection the reduction was found to be related to clogging of several cannon mixer bubbler generators.

BASELINE PRE-PILOT DATA

Data is from the number 3 digester from August 2010 to December 2010.

Percent Volatile Solids Reduction	Average Daily Digester Gas	Cubic Feet of Digester Gas Produced per Pound of VSD
48.8%	200,863 ft^3	14.9 ft^3 / #VSD

PILOT DATA

The following data is from the number 3 digester after 1 detention time (approximately 32 days) from January 18, 2011 to March 18, 2011. 5.5 gallons of BAE were added per day.

Percent Volatile Solids Reduction	Average Daily Digester Gas	Cubic Feet of Digester Gas Produced per Pound of VSD
54.4% (+13.4%)	216,474 ft^3 (+7.8%)	24.3 (+66.2%)

FULL SCALE OPERATIONAL DOSAGE

The below data is from all four digesters receiving BAE at a rate of 6.7 gallons per day (gpd) each, or a total of 26.8 gpd.

The following Pre-Dosage Data is the average of two detention times prior to BAE use from January to February 2012:

Percent Volatile Solids Reduction	Average Daily Digester Gas (each)	Cubic Feet of Digester Gas Produced per Pound of VSD
45.31%	195,234 ft^3	16.78

Full Scale Results show the effects of BAE on all four digesters after one detention time, from April 2012 to August 2012:

Percent Volatile Solids Reduction	Average Daily Digester Gas (each)	Cubic Feet of Digester Gas Produced per Pound of VSD
49.75% (+11.7%)	216,638 ft^3 (+9.2%)	18.36 (+28.0%)

FULL SCALE RESULTS

The below data is from three digesters with solids and BAE redistributed proportionately. Each digester used 12.5 gallons of BAE per day for a total of 37.5 gpd. Data is taken from October 2012 to April 2013. Dosage was increased from 30 gpd to 37.5 gpd to accommodate the increased solids loading and reduced detention time for the system, coincident with the removal of the number 2 digester from service.

Percent Volatile Solids Reduction	Average Daily Digester Gas (each)	Cubic Feet of Digester Gas Produced per Pound of VSD
51.94%	279,480 ft^3	26.9

Respective increase over Pre-Dosage results:

Increase in Percent Volatile Solids Reduction	Increase in Average Daily Digester Gas	Increase in Cubic Feet of Digester Gas Produced per Pound of VSD
+16.6%	+40.9%	+87.6%

It is apparent from the data that the increased volatile solids reduction, gas production and volatile solids destroyed resulting from the redistribution to three digesters during the rehabilitation of one digester and the concurrent proportional increase of BAE represented the greatest impact of BAE on the digester process.

The process will be evaluated again upon the restoration of the rehabilitated digester to service.

The second aspect of the evaluation of BAE was the impact on the Joint Meeting Dewatering Facility and solids disposal processes.

The data indicates that fewer solids were returned through the treatment plant during BAE dosing, and ultimately less polymer was used to accomplish acceptable dewatering results. With the capture of more solids in the second dosing period, the tons of solids produced for land application increased versus the first dosing period.

RESULTS AND FINANCIAL BENEFITS

Average Dewatering Facility solids recovery experienced went from 82.2% prior to using BAE to 83.0% when using BAE in all 4 digesters to 86.0% after the number 2 digester was taken out of service for repair. Cake solids increased from 23.1% to 23.5% to 23.8% respectively.

Prior to the addition of BAE, the following characteristics of the processes were noted:

Centrate Solids Returned to Treatment (% TS Average)	Polymer Used (average gpd)	Centrate TSS mg/L	Wet Tons per Day Land-Applied (Average, excluding lime)
0.51%	8,189	3,557	86.86

During the addition of BAE to four digesters (April 2012 to September 2012):

Centrate Solids Returned to Treatment (% TS Average)	Polymer Used (average gpd)	Centrate TSS mg/L	Wet Tons per Day Land-Applied (Average, excluding lime)
0.43%	10,893	3,040	84.44

During the addition of BAE to three digesters (October 2012 to April 2013):

Centrate Solids Returned to Treatment (% TS Average)	Polymer Used (average gpd)	Centrate TSS mg/L	Wet Tons per Day Land-Applied (Average, excluding lime)
0.31%	9,639	1,708	84.83

Sludge Cake removed for disposal decreased from 85.07 tons per day to 82.79 tons per day, or a 2.7% reduction. Expected annual savings for sludge removal is approximately $68,000 annually.

RESULTS SUMMARY

Sludge Removal
- Sludge cake reduced by 2.7%
- Provides an annual cost savings of $68,000

Digester Gas Production
- Increased by 40.9%
- Provides an annual savings of more than $68,000

TSS Returned to Treatment
- Reduction of over 50%
- Provides an annual cost savings of over $350,000

Electrical Energy
- Provides a cost avoidance of over $390,000

Total Operational Savings
- Over $881,968

Net Savings
- Approximately $401,968 after product and operational expenses

Digester gas production increased by 40.9%. This equates to 48.7 additional therms per day per digester, valued at approximately 6,372 therms per month. Financially, the plant can save an additional $68,800 annually due to increased gas production ($0.9 per therm x 6,372 therms/month = $5,735 per month. Over the course of one year, this is over $68,800).

Reduction of TSS returned to Treatment Plant (3,557-1,708=1,849 mg/L) 9.3 million gallons per month at $410 per ton (cost allocated to TSS Treatment only) value: $352,793.

There was also a significant electrical energy cost avoidance experienced with the use of BAE. Each co-generation unit utilizes 250 cubic feet per minute (cfm) of digester gas to produce 800 kW or 19,200 kWh per day. Each co-generation unit consumes 223,200,000 BTU/day. Additional gas produced (30,194,000 BTU per digester) is approximately 14% of the fuel required per day, or 56% when all four digesters are considered. The cost savings resulting from the additional gas produced equates to $1,075 per day or $392,375 annually (19,200 kWh produced daily or 10,752 x $0.10/kWh = $1,075/day or $392,375 annually).

Total operational savings: $881,968. Net savings approximately $401,968 after product and operational expenses.

The system will be analyzed further with respect to impact on the quantity of polymer required to achieve appropriate capture and cake concentration upon the restoration of the rehabilitated digester to service.

It is expected that with the fourth digester restored to service, gas production would increase beyond what was experienced previously as would the destruction of volatile solids, resulting in greater savings in power production and impacts to solids handling processes and disposal.