ENVIROMIX

BioMix™-AD Project
Anaerobic Digester Mixing System
Fourche Creek WWTP, Little Rock, Arkansas

May 2014

Introduction:

Assessment of the BioMix™-AD compressed gas mixing system at the Fourche Creek Wastewater Treatment Plant (WWTP) in Little Rock, Arkansas began in the spring of 2013. The objectives of the BioMix-AD project for anaerobic digester rehabilitation were to; (1) effectively mix the contents of the digester (2) significantly reduce the energy required to mix the digester, and (3) increase the gas production from the digester.

The Fourche Creek plant is a 16 million gallon per day (MGD) facility which provides primary and secondary treatment. After screening, the sludge from this facility, as well as the nearby Adams Field WWTP, is thickened and digested at the Fourche Creek WWTP. This digested sludge produces methane gas that is utilized in the engine generator building to produce electricity used for the operation of the plant. The excess is sold back to the generating utility.

The facility has eight 100-ft diameter digesters with an approximate volume of 1,230,000 gallons in each. Current operation of the facility utilizes between four and six digesters. All digesters were originally equipped with a lance style gas mixing systems that are supplied gas from 40-hp positive displacement blowers. Due to the expected performance benefits, the BioMix-AD compressed gas mixing system was selected by Hawkins Weir Engineers & Little Rock Wastewater as the basis of design for the rehabilitation project for Digester No. 3.

Technology Overview:

BioMix-AD provides effective and efficient mixing in anaerobic digester applications by collecting the biogas, comprised principally of saturated Carbon Dioxide and Methane, compressing the biogas and injecting the biogas intermittently and sequentially through a system of uniformly distributed nozzles fixed to the basin floor. Breaking the mixing energy into smaller increments spread across the basin floor provides better mixing to overcome the non-Newtonian sludge characteristics typically found in thick, anaerobic sludge. Compared to conventional mixing technologies, which utilize more localized mixing energy in the form of an impeller, draft tube or lance, the distributed energy model provided by BioMix-AD leads to a more energy efficient system as well as provides better mixing and process performance as demonstrated by analysis of biogas flow data, volatile solids reduction and suspended solids distribution shown in figures 1.1, 1.2 and 1.3.

The core components of the system include a customized sliding vane compressor, capable of handling the corrosive biogas, valve panels, to control the pressure, sequence, duration and interval of firing biogas back into the bottom of the digester and a series of nozzles and headers which distribute the gas uniformly across the basin floor.

The BioMix-AD system began operation on April 16, 2013 in Primary Digester No. 3, a 100' diameter primary anaerobic digester containing 2% sludge, at the Fourche Creek Wastewater Treatment Plant. The system has been operating continuously since then. Biogas flow meters were installed on Primary Digester No. 3 as well as control Digester No. 4.

As stated previously, the BioMix-AD technology is far different from other mixing technologies in that the mixing energy is being distributed across many nozzles (176 nozzles in this application), versus a point source lance, impeller or draft tube type mixing system in which the mixing energy is isolated. It is this uniform distribution that creates better mixing, provides for a greater destruction of volatile solids, and in turn creates more biogas. The biogas flow meters indicate that Digester No. 3 in which BioMix-AD is installed has been producing an average of 23% more biogas than the control Digester No. 4 corresponding to a 12% greater reduction in volatile solids as shown in the figures below. This excess biogas can be used to augment electricity generation and be sold as renewable green energy to the utility.

Figure 1.1 Gas Flow vs. Volatile Solids Digested

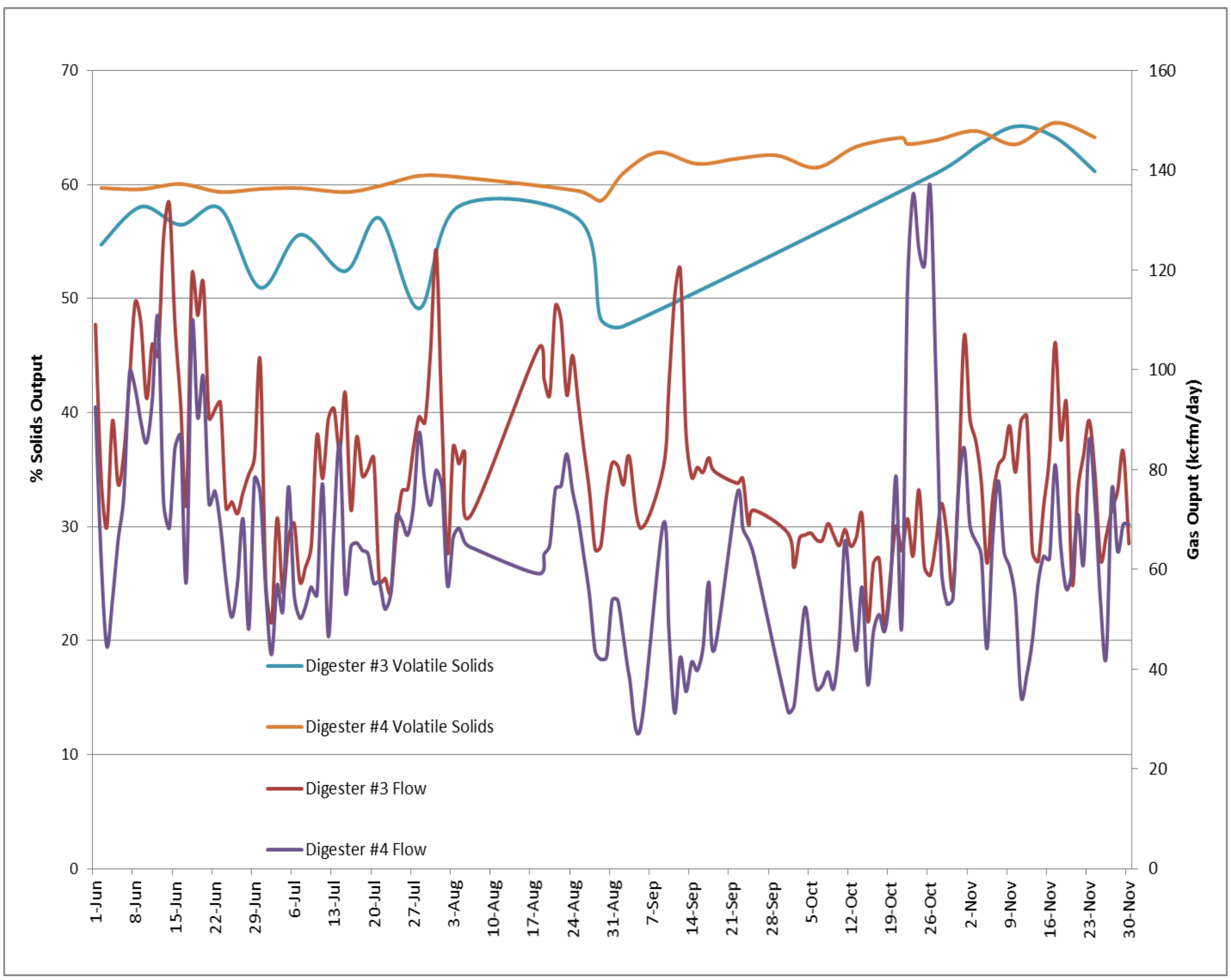
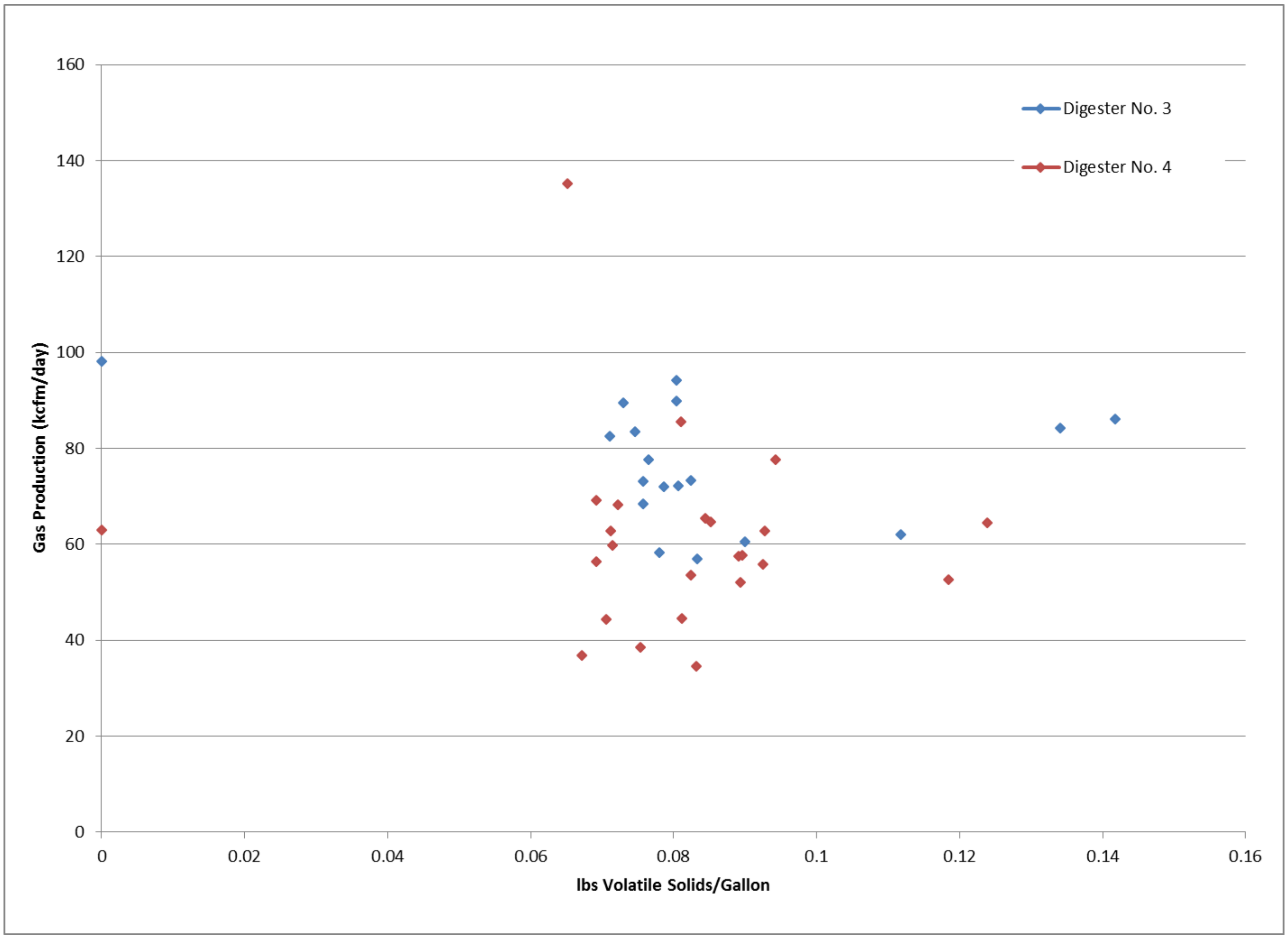


Figure 1.2 Biogas Flow vs. Volatile Solids Concentration



The effectiveness of mixing was verified by collecting sludge samples from multiple points and depths within the digester, analyzing the concentrations and calculating the Coefficient of Variation amongst the samples. The Coefficient of Variation is equal to the standard deviation of these samples divided by the mean. Effective mixing by industry accepted metrics are CV < 10%. The initial set of results for the BioMix-AD system indicate a CV of 8.6%.

Primary Digester No. 3 Sampling Summary Table				
Sample ID	**Lab ID**	**Description**	**Sample Time, Date**	**TSS Concentration (mg/L)**
SW 260.5	1304010661	Southwest Hatch, Elevation 260.5	4/22/2013 12:15	19200
SW 253.0	1304010662	Southwest Hatch, Elevation 253.0	4/22/2013 12:17	17600
SW 244.0	1304010663	Southwest Hatch, Elevation 244.0	4/22/2013 12:18	21000
SE 260.5	1304010664	Southeast Hatch, Elevation 260.5	4/22/2013 12:25	18800
SE 253.0	1304010665	Southeast Hatch, Elevation 253.0	4/22/2013 12:26	19800
SE 244.0	1304010666	Southeast Hatch, Elevation 244.0	4/22/2013 12:27	19800
NE 260.5	1304010667	Northeast Hatch, Elevation 260.5	4/22/2013 12:28	15600
NE 253.0	1304010668	Northeast Hatch, Elevation 253.0	4/22/2013 12:31	18800
NE 244.0	1304010669	Northeast Hatch, Elevation 244.0	4/22/2013 12:33	18000
NW 260.5	1304010670	Northwest Hatch, Elevation 260.5	4/22/2013 12:34	16400
NW 253.0	1304010671	Northwest Hatch, Elevation 253.0	4/22/2013 12:36	17200
NW 244.0	1304010672	Northwest Hatch, Elevation 244.0	4/22/2013 12:38	20000
			STD DEV	**1599**
			MEAN	**18517**
			CV	**8.6%**

Not only does BioMix-AD offer superior performance in the form of better volatile destruction and higher gas production rates, it does so while consuming significantly less energy. Compared to other, point-source gas mixing technologies, which generally require a power input of about 0.3 BHP/1,000 ft^3, the BioMix-AD operating in Digester No. 3 at the Fourche Creek WWTP requires only 0.127 BHP/1,000 ft^3. This represents decreased power and energy consumption in the range of 50 – 60%.

Conclusion:

As shown in this summary, the BioMix-AD system has achieved the targeted results of; effectively mixing the contents of the digester, significantly reducing the energy required to mix the digester, and increasing the biogas production from the digester.

There are many options available for mixing in Anaerobic Digester applications. While some may appear to offer very low power/energy consumption, the level of actual mixing and digester performance measured through volatile solids destruction and gas production may be questionable. BioMix-AD has demonstrated the ability to achieve both enhanced mixing and digester performance concurrently with a significant reduction in connected power and energy consumption.

Engineers and end-users should consider the BioMix-AD compressed gas mixing solution for anaerobic digester mixing applications as it offers:

- Reduced energy consumption – 60% savings versus traditional mixing devices
- Enhanced mixing and associated boost in gas production
- Reduced maintenance – no moving or wearing parts in the basin
- Adaptable to any basin geometry
- Variable mixing intensity to optimize operation and energy efficiency

To assist in evaluation of your application, please contact your local EnviroMix advisor or EnviroMix at:

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