Digester Mixing Test at DeKalb Illinois Sanitary District WWTP

Preliminary Test Report October 2013

Background:

The District operates 2 separate anaerobic digester trains; each with a nominal 60,000 $ft^3$ 55ft diameter primary digester with floating covers and dedicated heating and mixing systems. Each primary digester feeds its own 65,000 $ft^3$ gas-holder covered secondary digester.

Raw sludge is fed semi-continuously to both trains. Biogas and spent sludge streams are combined; biogas is used for gas fired boilers and spent sludge is processed further.

One primary digester is mixed with a 2 year old Jet Mix mixing system. The 2nd primary is now fitted with a top mounted Stamo/WPE mechanical mixer. This dual train process allows side-by-side comparison of the mixing efficiency of both mixing systems.

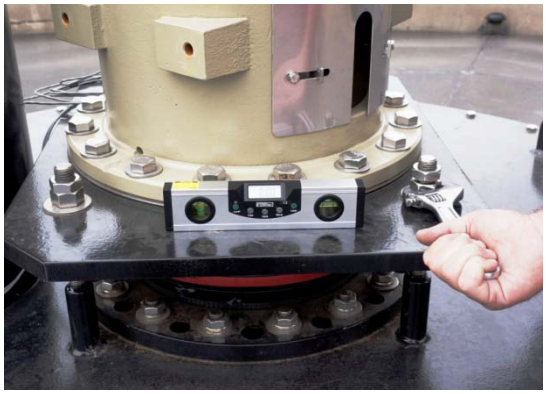
Walker Process is sampling both primary digesters to document comparative digester mixing uniformity by analyzing for TSS and VSS, in multiple locations. We are further collecting data to document material balances around each primary digester to compare digester efficiency by calculating VS Reduction.

Mixing System Description:

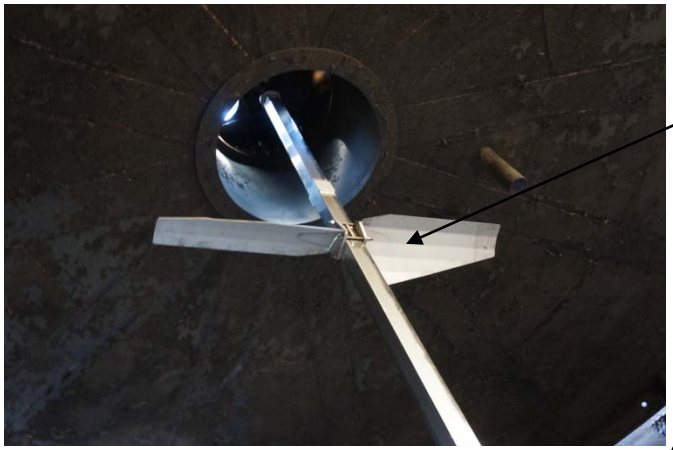
Here is a description of the two mixing systems being tested.

**Stamo/WPE Mixer:** The top-end of the mixer installed on the floating digester cover:

- Ensuring plumbness of the mixer shaft is accomplished by final leveling of the Adjustable Leveling Plate, after a digester is in operation with the cover floating on Biogas.




- The mixing impellers inside the digester:



One set of 2 impellers, mounted near the top of the digester

A second set of impellers mounted near the digester bottom

The existing Jet Mix piping; disabled for the test.

**Jet Mix System:**

Internal Piping, pictured during initial installation

Internal piping for Jet Mix suction

Jet Mix chopper pump discharge mixing manifold

2 - 50 hp circulation chopper pumps, valves, piping etc. located in adjacent building

Summary of Mixing Test Data Collected to Date:

Digester Sampling: Once per week, both digesters are sampled using a sample bomb similar to the one pictured here and used as follows:

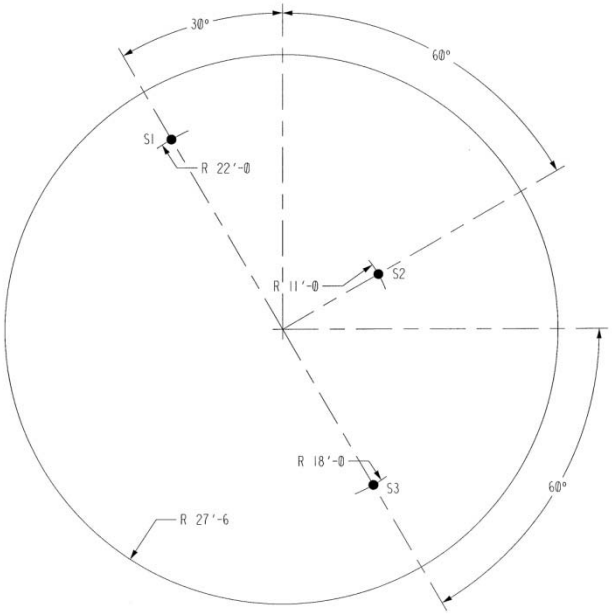
The sampler is lowered to a given depth in the digester, the sampler cap is opened and allowed to fill and the sampler then pulled back to the surface to transfer the sample to a sample jar, labeled and sent to a USEPA certified lab for analysis.

Each digester is sampled in 3 different cover sampling ports.

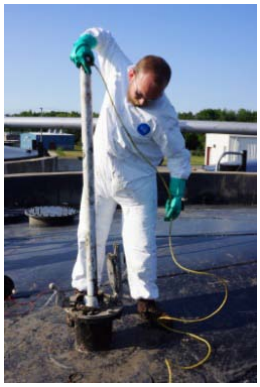
Samples are taken from the top liquid surface to the bottom of the digester, in 5 foot increments.

Lowering and retrieving the sampler

Sampling Points; S1, S2 and S3



Early in the testing program there was found to be a thick crust at the top of the Jet Mix digester, and this crust was not penetrable by the weight of the sampler. Thus a procedure was developed to puncture this crust layer with a PVC pipe section and then lowering the sampler through the temporary 'hole' in the crust; as pictured here.



Preliminary Mixing Test Conclusions:

**1. A difference in the electrical energy required to mix a typical WWTP Anaerobic Digester exists between the two mixing systems. Preliminary calculations follow:**

Digester 1A Jet Mix Mixing

-installed mixing pump motor: 50 Hp -Mixing Cycle: 2 hour mix, 4 hour off, cycled 24/7

- Normal Motor Draw: 40 amps

Power and Energy Cost Calculation:

Current, amps x Voltage, volts x 1.73 x Power Factor/1000 = W Assume Power Factor = 0.75
kW = 23.87

Assume energy cost is ~ $0.10/ kWh. The annual cost to operate the motor for a year at the given mixing cycle is: $0.10 x 23.87 kW x 8 hr x 365 days = **$6,970 per year.**

Digester 2A Stamo/WPE Mixer

-installed mixing motor: 3 Hp -Mixing Cycle: mixed 24/7 - Normal Motor Draw: 2.56 amps

Power and Energy Cost Calculation:

Current, amps x Voltage, volts x 1.73 x Power Factor/1000 = W Assume Power Factor = 0.75
kW = 1.53

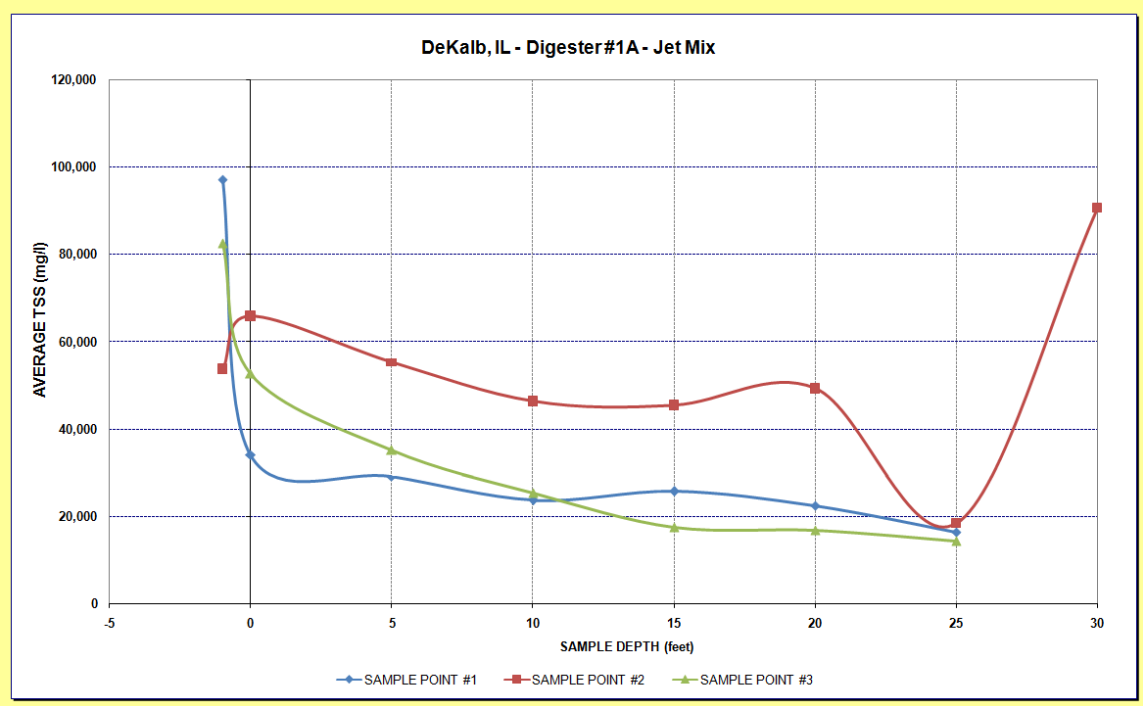
Assume energy cost is ~ $0.10/ kWh. The annual cost to operate the motor for a year at the given mixing cycle is: $0.10 x 1.53KW x 24 hr x 365 days = **$1,338 per year.**

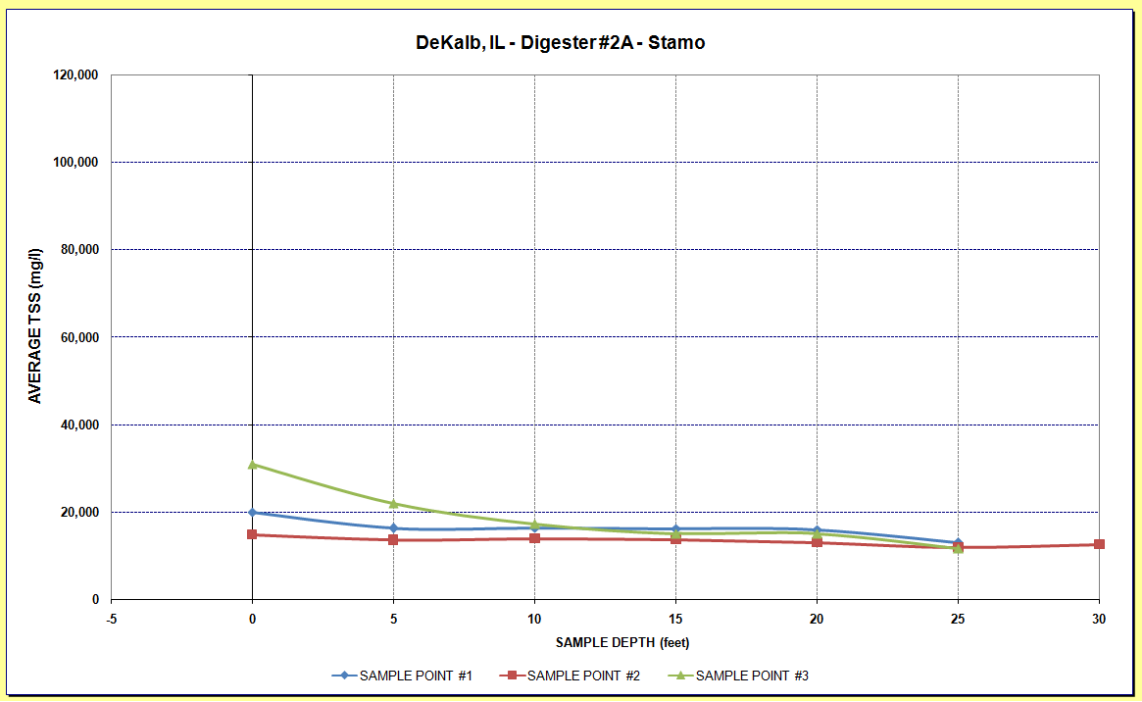
**2. The vertical sampling and analysis of the samples indicates differences between the mixing provided by the different mixing systems.**

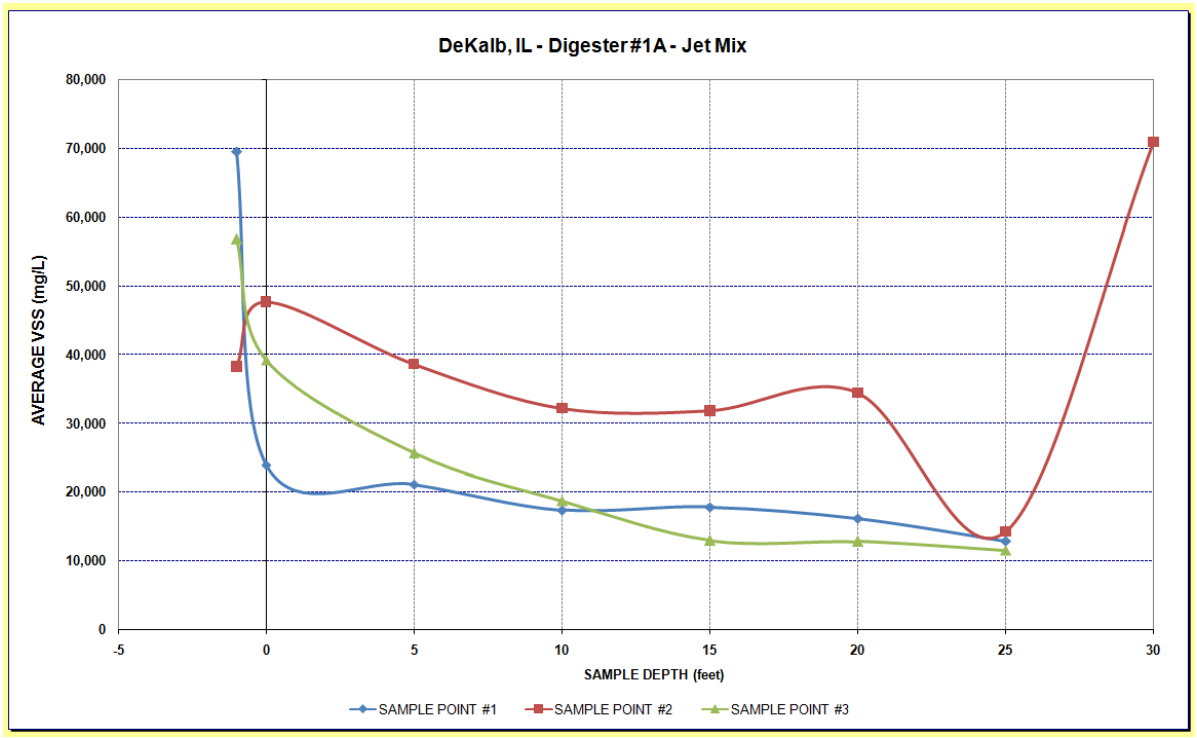
- Greater variability in TSS, VSS and density distribution from the top to the bottom of the Jet Mix digester.

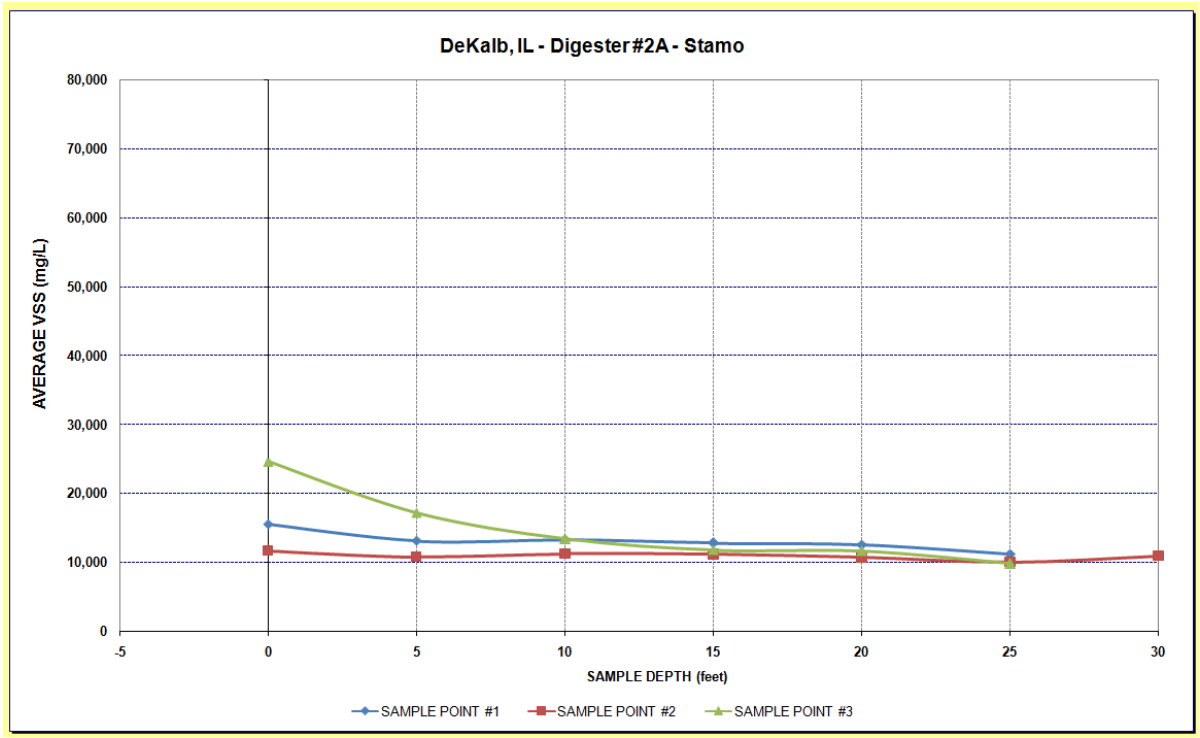
- Generally lower % solids in the Stamo digester.

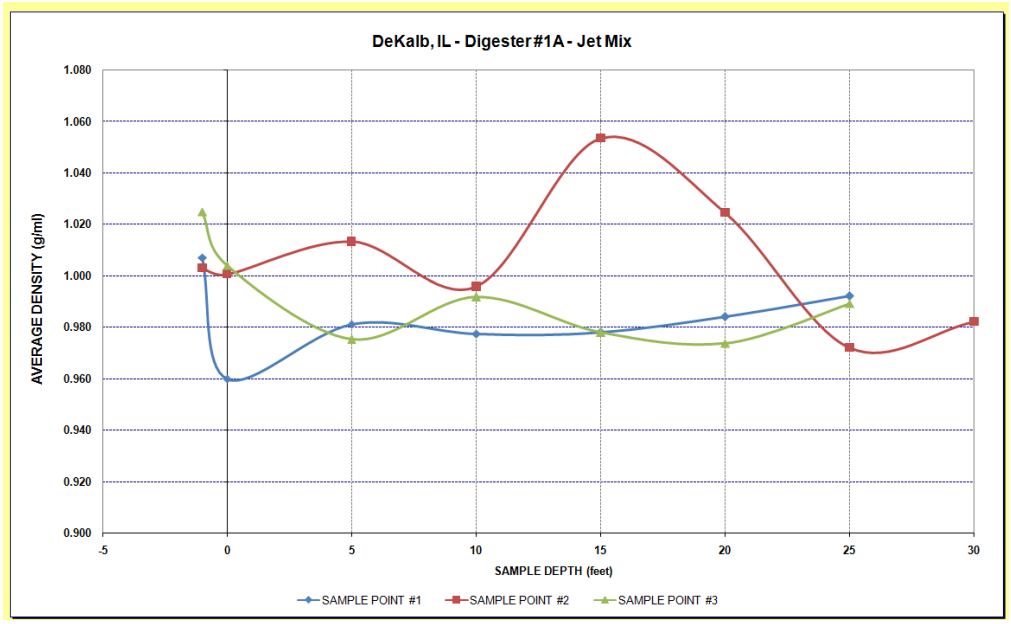
- Some graphical results are shown below.

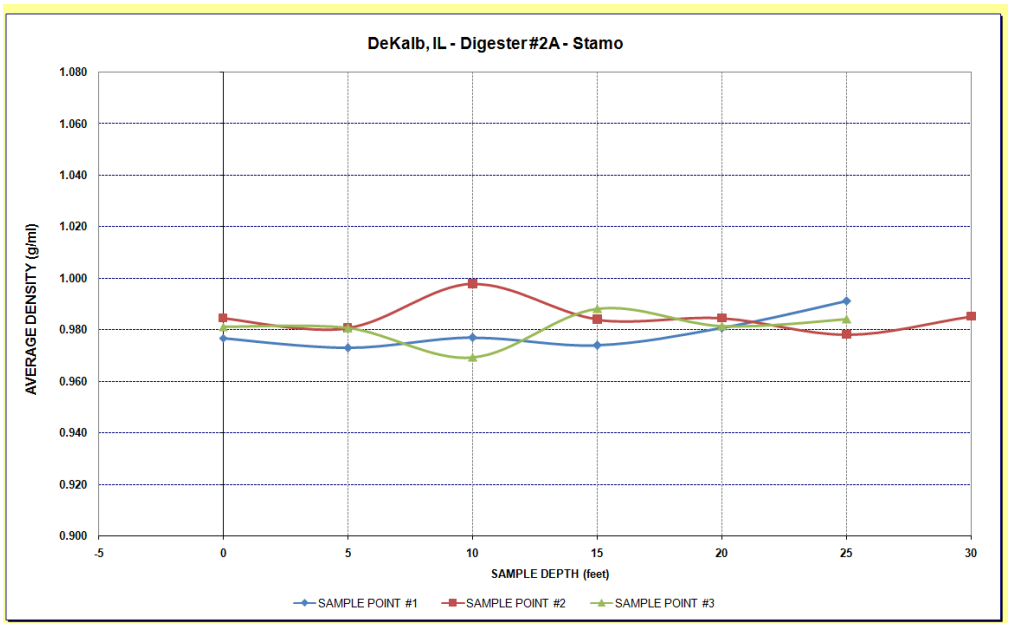



DeKalb, IL - Digester#1A - Jet Mix
AVERAGE VSS (mg/L)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
-5
0
5
10
15
20
25
30
SAMPLE DEPTH (feet)
SAMPLE POINT #1
SAMPLE POINT #2
SAMPLE POINT #3


DeKalb, IL - Digester#2A - Stamo
AVERAGE VSS (mg/L)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
-5
0
5
10
15
20
25
30
SAMPLE DEPTH (feet)
SAMPLE POINT #1
SAMPLE POINT #2
SAMPLE POINT #3




**3. The digester mixed with the Jet mix system exhibits a significant upper crust above the liquid level. This crust is not found in the digester mixed with the Stamo/WPE Mixer. The thickness of this un-mixed crust varies, up to nearly 10 feet. Its composition and origin are being investigated.**

This mixing test program will be continued for several more months. Comments from the reader are welcomed and can be forwarded to:

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