THE CENTRAL MARIN SANITATION AGENCY
TREATMENT PLANT
INITIAL ANALYSIS OF CO-THICKENING PRIMARY AND SECONDARY SOLIDS

JANUARY 2013 **PAUL PITT, PhD, PE**

1.0 Background

The Central Marin Sanitation Agency (CMSA) plant is part of a system to pump, process and dispose of wastewater from Central Marin County. As part of continuing optimization efforts at the plant, the potential for improving solids handling through the co-thickening of primary and secondary sludges was discussed. This technical memorandum presents an initial analysis of co-thickening at the CMSA plant.

Currently primary sludge (PS) is thickened in the plant's primary sedimentation tanks and waste activated sludge (WAS) is sent to dissolved air floatation (DAF) tanks for thickening. The plant has two (2) DAF tanks with one (1) typically in service. Then two waste sludge streams are then blended and sent to anaerobic digestion.

2.0 Data Analysis

Figure 1 details monthly average total flow (galls/d), total solids (TS) load (lbs/d), and total solids concentration (%) for primary sludge from July 2010 to June 2012. As indicated in **Figure 1** monthly average primary sludge flow varies between 22,246 galls/d and 35,703 galls/day with an average of 26,989 galls/day; monthly average total solid load varies between 8,134 lbs/d and 16,665 lbs/d with an average of 11,414 lbs/d; and monthly average solids concentration varies between 4.0% and 5.7% with an average of 4.8%. **Table 1** summarizes the primary sludge information.

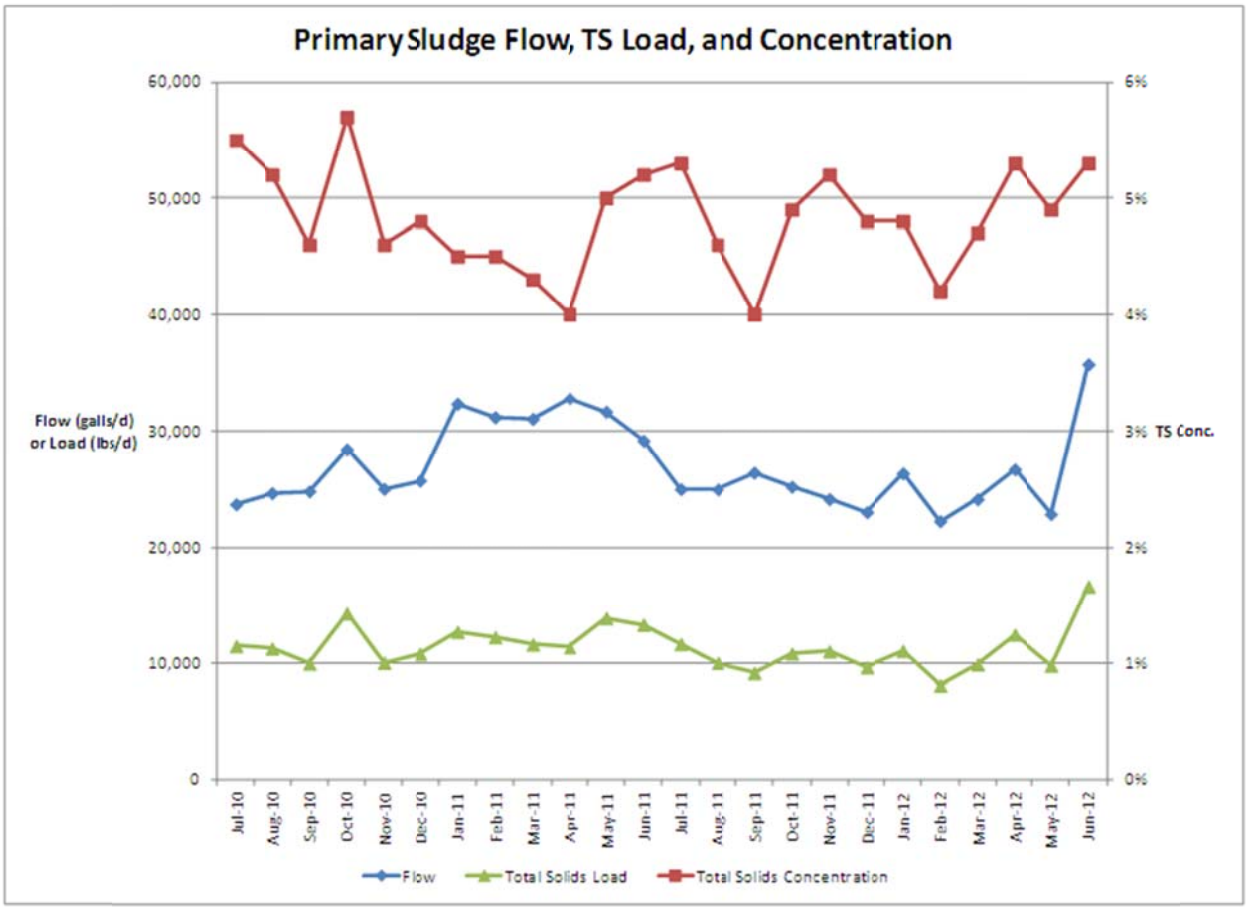

Figure 1: Primary Sludge Monthly Average Total Flow, TS Load, and TS Concentration

Primary Sludge	Minimum Monthly Average	Monthly Average	Maximum Monthly Average
Flow (galls/d)	22,246	26,989	35,703
Total Solids (lbs/d)	8,134	11,414	16,665
Concentration (%)	4.0	4.8	5.7

Table 1: Primary sludge information monthly average (July 2010 – June 2012)

Figure 2 details monthly average flow (galls/d), total solids load (lbs/d), and total solids concentration (%) for thickened waste activated sludge (TWAS) from July 2010 to June 2012. As indicated in **Figure 2** monthly average TWAS flow varies between 16,891 galls/day and 29,949 galls/day with an average of 23,397 galls/day; monthly average total solids load varies between 6,330 lbs/d and 10,327 lbs/d with an average of 8,355 lbs/d; and monthly average solids concentration varies between 3.6% and 4.4% with an average of 4.1%, **Table 2** summarizes the TWAS information.

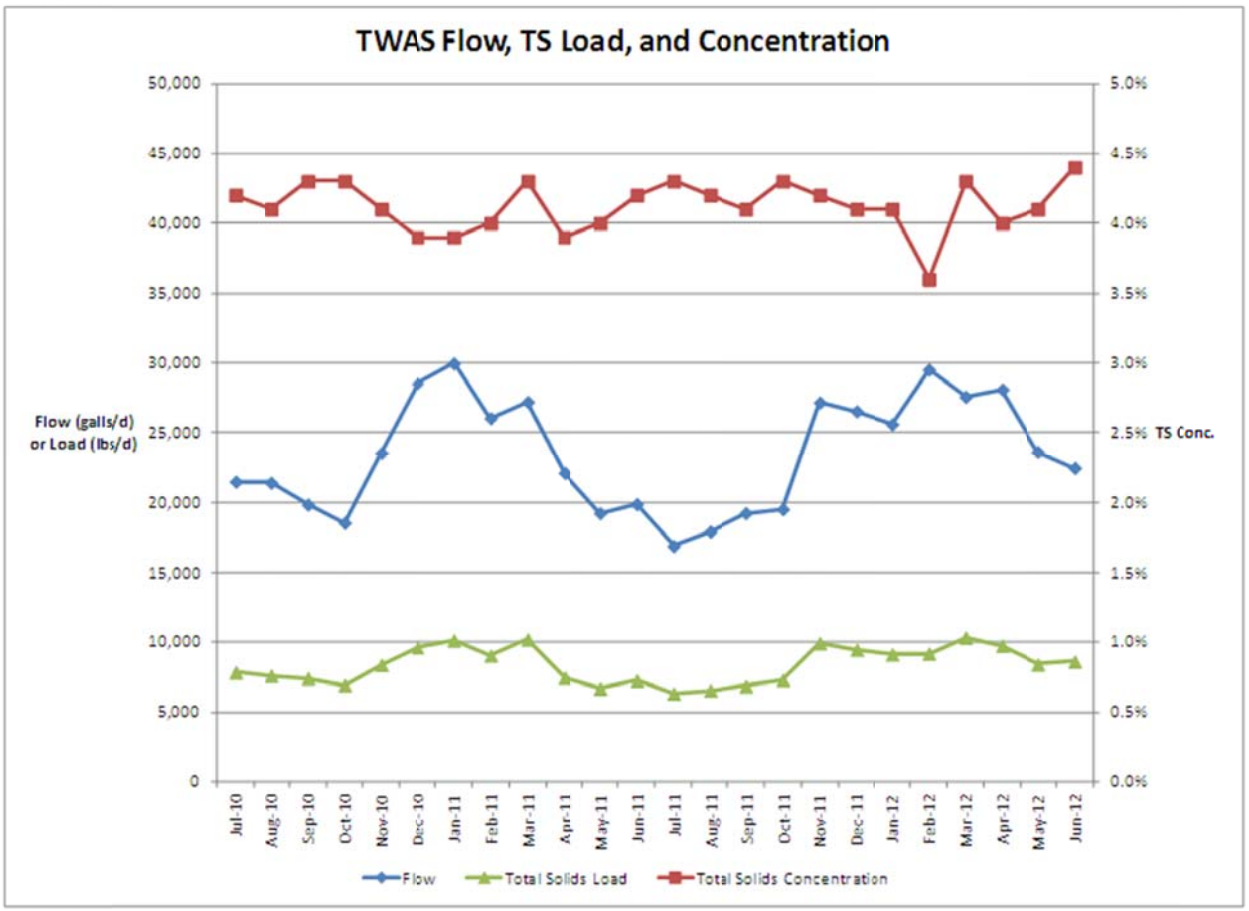

Figure 2: Thickened Waste Activated Sludge Monthly Average Total Flow, TS Load, and TS Concentration

TWAS	Minimum Monthly Average	Monthly Average	Maximum Monthly Average
Flow (galls/d)	16,891	23,397	29,949
Total Solids (lbs/d)	6,330	8,355	10,327
Concentration (%)	3.6	4.1	4.4

Table 2: TWAS information monthly average (July 2010 – June 2012)

Figure 3 details monthly average total blended (primary sludge plus TWAS), digester feed flow (galls/d), total solids load (lbs/d) and concentration (%) for July 2010 to June 2012.

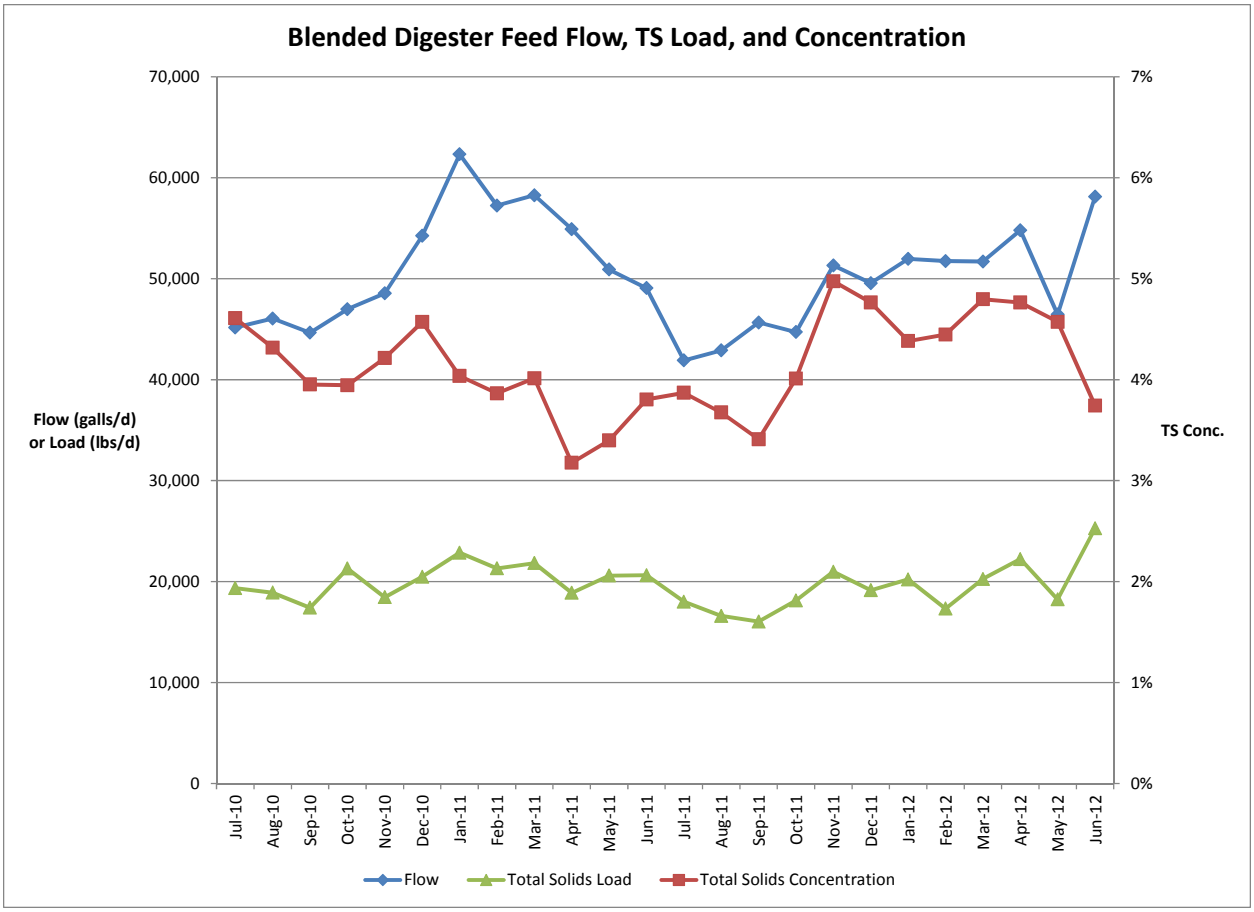

Figure 3: Blended Primary and Thickened Waste Activated Sludge Monthly Average Total Flow, TS Load, and TS Concentration

As indicated in **Figure 3** monthly average combined sludge flow varies between 41,905 galls/day and 62,328 galls/day with an average of 50,385 galls/day; monthly average total solids load varies between 16,041 lbs/d and 25,277 lbs/d with an average of 19,768 lbs/d; and monthly average solids concentration varies between 3.2% and 5.0% with an average of 4.1%. **Table 3** summarizes the digester feed information.

PS plus TWAS	Minimum Monthly Average	Monthly Average	Maximum Monthly Average
Flow (galls/d)	41,905	50,385	62,328
Total Solids (lbs/d)	16,041	19,768	25,277
Concentration (%)	3.2	4.1	5.0

Table 3: TWAS plus PS digester feed monthly average (July 2010 – June 2012)

Figure 4 presents a percentile plot of the combined TWAS and PS flowrate.

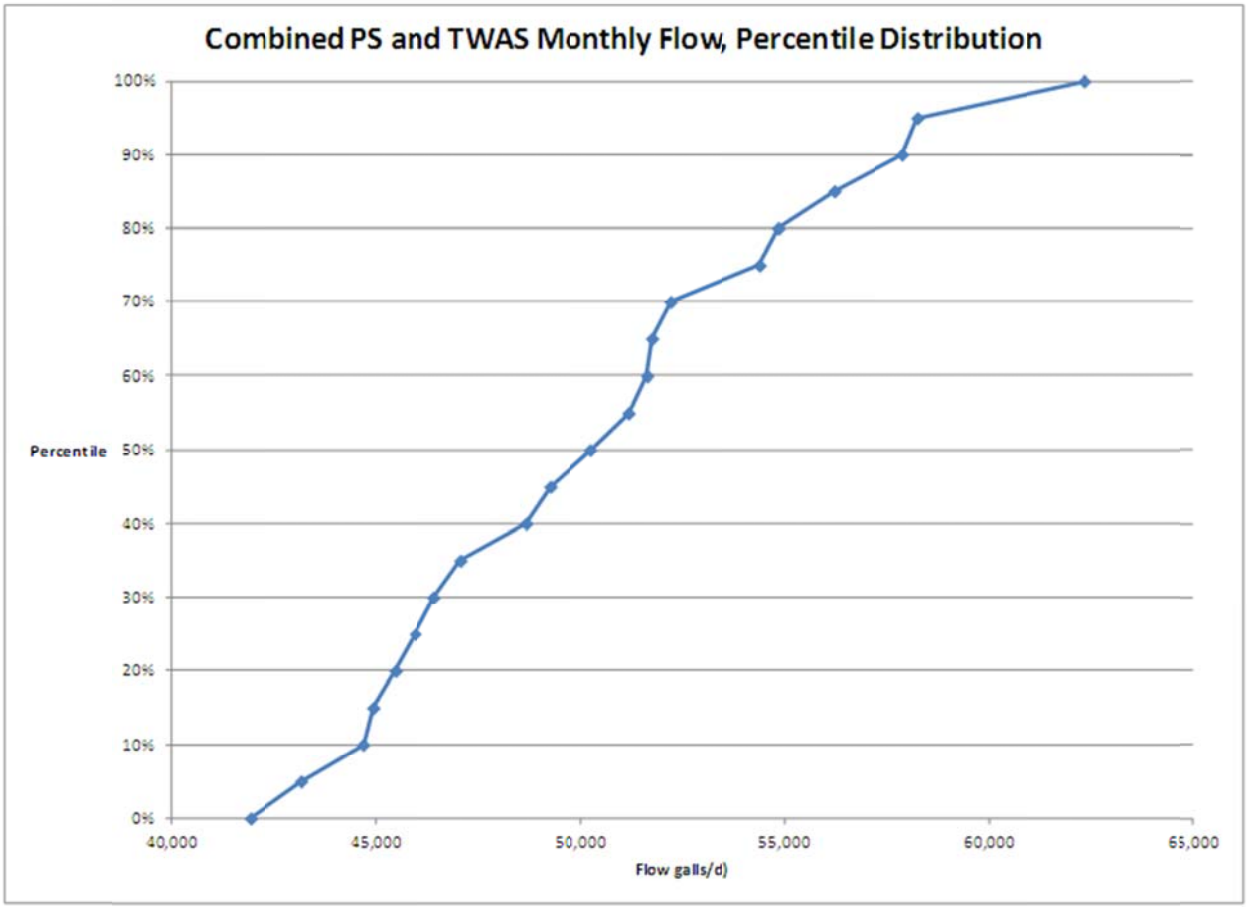

Figure 4: Percentile Distribution of Blended Primary and Thickened Waste Activated Sludge Monthly Flowrate

Table 4 details the 95, 90, 50 percentile data for combine sludge flowrate.

Percentile	Combined PS and TWAS Monthly Average Flow (gpd)
95%	58,200
90%	57,900
50%	50,200

Table 4: Percentile sludge flows

Since July 2011 the CMSA plant staff has operated one anaerobic digester (each 130,700 ft^3 volume, approx ~ 1.0 MG). Prior to this period, the plant operated two anaerobic digesters. The average and maximum month conditions for the digesters based on July 2010 to June 2012 data are detailed in **Table 5**.

	One Digester in Service (July 2011-June 2012)		Two Digesters in Service (July 2010-June 2011)	
Digester	Average Condition	Maximum Month	Average Condition	Maximum Month
HRT (days)	23	26	40	50
VS loading* lbs/1,000ft^3-d	122	159	63	72

* assume feed VS @ 82% (based on July-December 2010 average)

Table 5: Monthly average digester loading (Jul 2010 – Jun 2012)

3.0 Co-Thickening

The use of co-thickening as a separate thickening step for both primary sludge and WAS is gaining acceptance in the wastewater industry due to the following advantages:

- Consistent digester feed which allows optimization of the digester process, including operational parameters (HRT, VS loading) and gas production.
- Primary sedimentation tanks can be optimized for solids removal.
- In-tank thickening of primary sludge can lead to operational/maintenance issues such as sludge septicity and significant issues with varying sludge concentration. This can lead to maintenance issues with chains and flight performance during wet weather conditions and the potential for blanket washout.
- Increased capacity and flexibility of the digester complex.

Co-thickening of sludge is typically achieved through thickening on gravity belt thickeners (GBTs) or rotary drum thickeners (RDTs). The San Francisco Oceanside plant (OSP) switched to co-thickening of sludges in 1996 to eliminate problems with primary sedimentation operation (flight/chain maintenance, septicity) and optimize digester performance. **Figure 5** details OSP flow and feed concentration to the

GBTs. Flow varied between 258,000 and 474,000 galls/day, and feed concentration varied between 1.0 to 4.1% with an average of 1.7%.

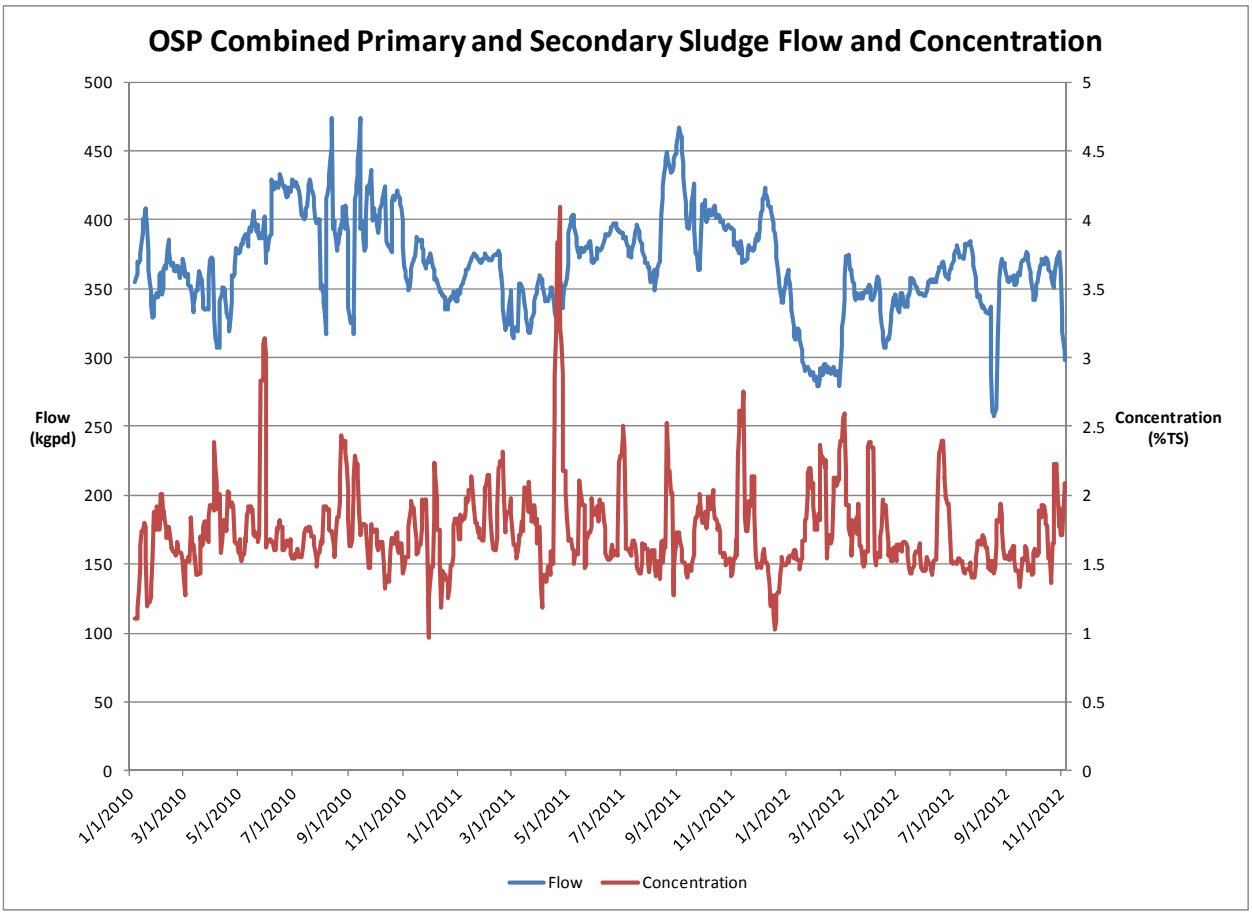

Figure 5: OSP Weekly Average Flow and GBT Feed Concentration

Figure 6 details the co-thickened (PS, TWAS) flow and concentration. As indicated in **Figure 6** flow varied between 42,000 and 153,000 galls/day and concentration between 3.8 and 12.0% with an average of 6.4%. Some of the higher recorded values (8-10%) may not be representative of actual co-thickened concentrations. Typically the plant targets a co-thickened sludge in the 5.5 – 6.0% range, although this data set indicates the sludge was often in the range of 5.0 – 7.8%.

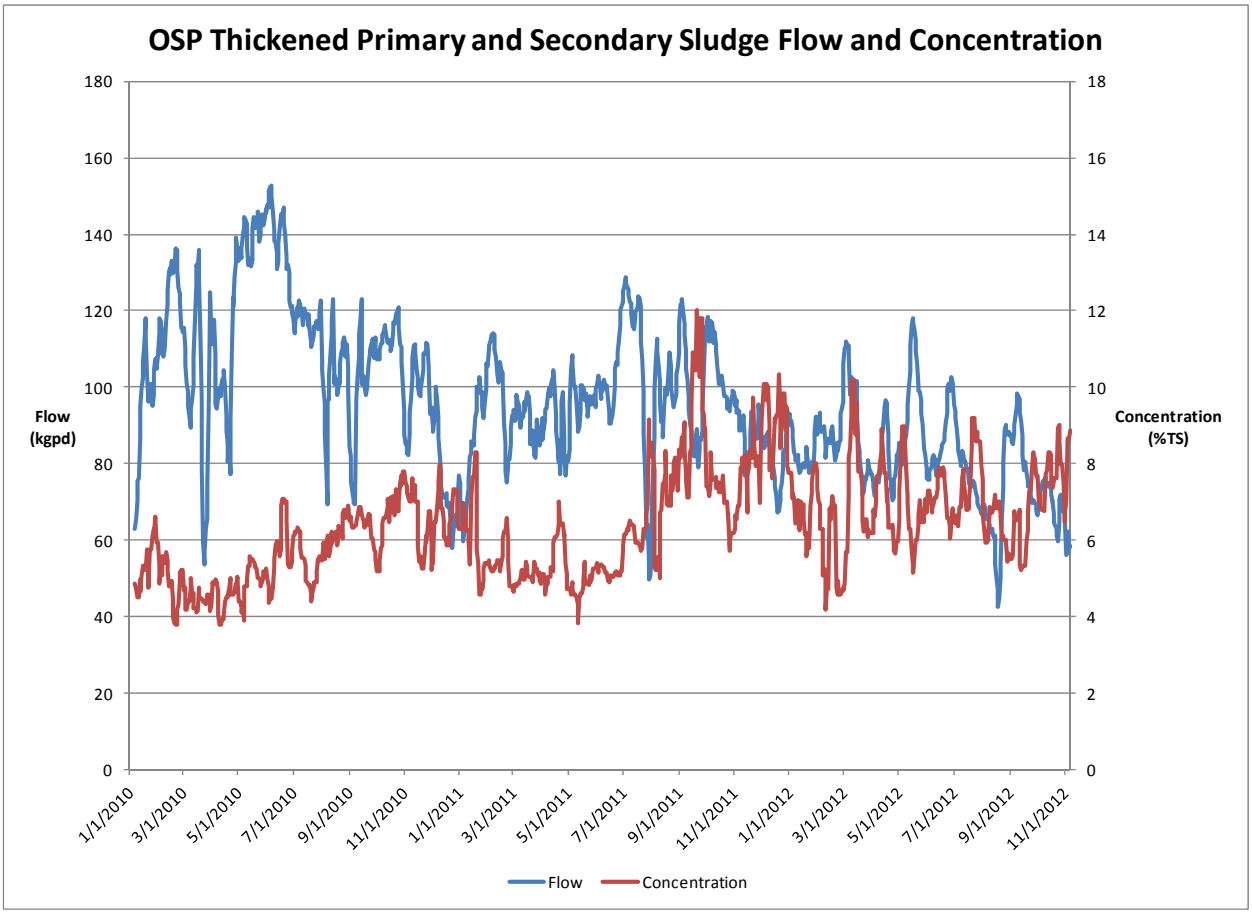

Figure 6: Co-thickened Primary and WAS Flow and Concentration

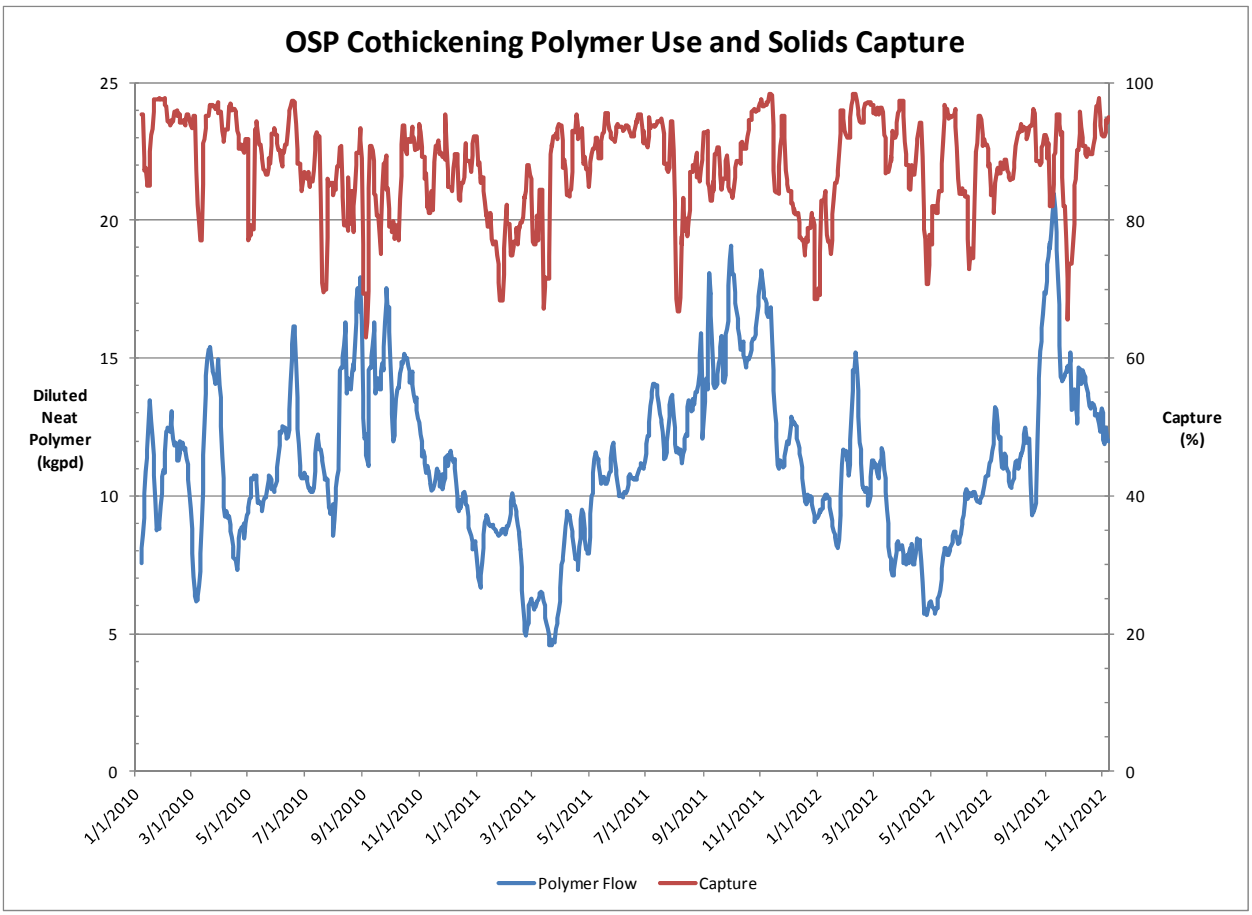

Figure 7: OSP Co-thickening Data

Figure 7 details the neat polymer use and capture for the GBTs with polymer use varying between 4,600 to 21,000 galls/day with an average of 11,000 galls/day and capture between 63% and 98% with an average of 88%.

4.0 CMSA Co-Thickening

Figure 8 details the monthly average flow (galls/day) total solids load (lbs/d) assuming a 6% co-thickened sludge for CMSA data from July 2010 to June 2012.

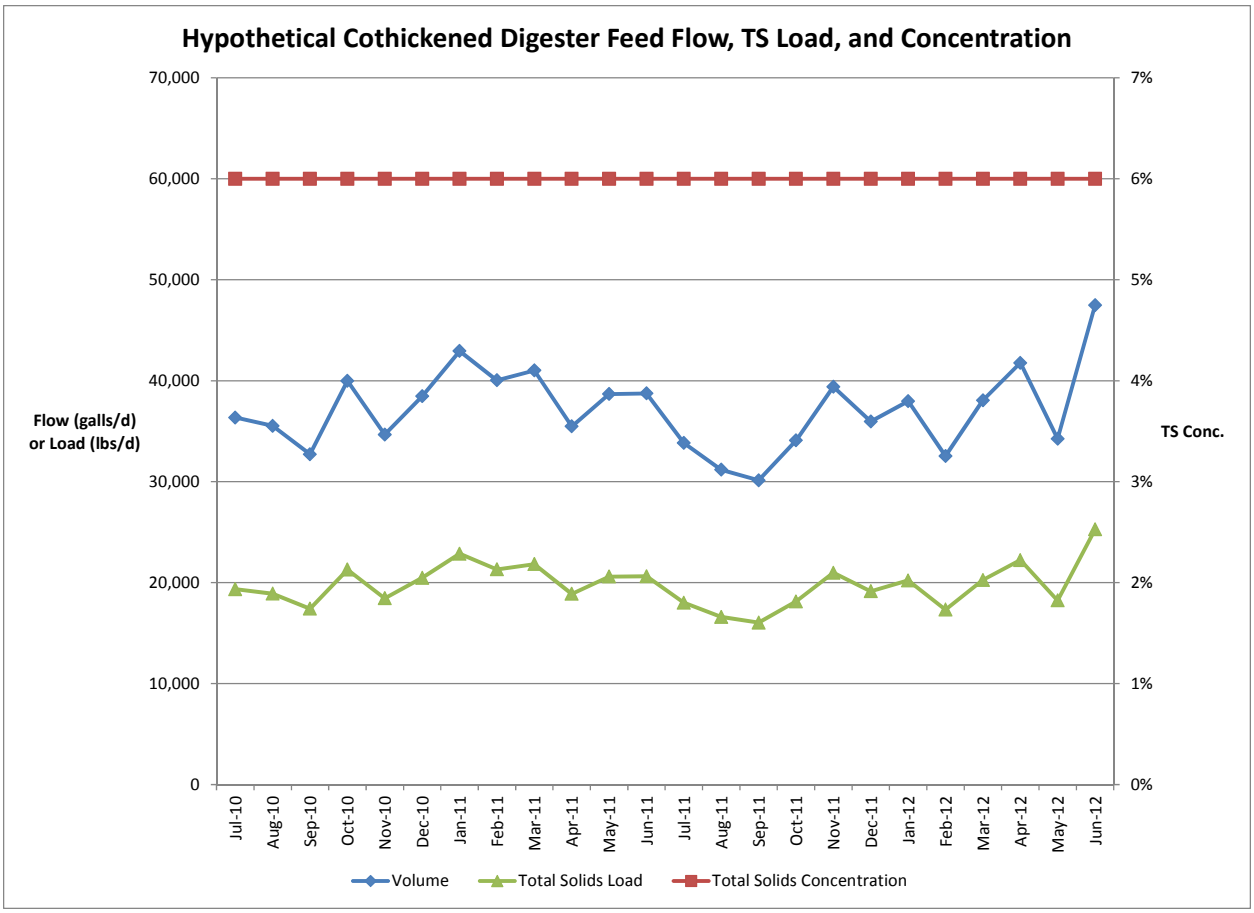

Figure 8: Hypothetical Digester Feed Conditions, Assuming Co thickening to 6% TS

As indicated in **Figure 8** the combined sludge flowrate varies between 30,133 galls/day and 47,482 galls/day with an average of 37,135 galls/day, and the total solids load varies between 16,041 lbs/d and 25,277 lbs/d with an average of 19,768 lbs/d, all for a consistent solids concentration of 6% . This assumes a solids capture rate that is a composite of 100% capture for the PS and the same capture rate for the TWAS. **Table 6** summarizes this information.

Digester Feed *	Minimum Month	Monthly Average	Maximum Month
Flow(galls/day)	30,133	37,135	47,482
Total Solids (lbs/d)	16,041	19,768	25,277
Concentration (%)	6.0	6.0	6.0

* TWAS and PS Co-thickened sludge information at 6% production

Table 6: CMSA Co-thickened data for 6% solids concentration

As indicated in **Table 7** the benefits of co-thickening would be realized in a consistent feed to the digester and a drop in digester feed flow from around 42,000-62,000 galls/day to 30,000-47,000 galls/day. **Table 7** details the improvements in digester performance from the 6% feed concentration.

	One Digester in Service (July 2011-June 2012)		Two Digesters in Service (July 2010-June 2011)	
Digester	Average Condition	Maximum Month	Average Condition	Maximum Month
HRT (days)	31	36	54	68
VS loading* lbs/1,000ft^3-d	122	159	63	72

* assume feed VS @ 82% (based on July-December 2010 average)

Table 7: Monthly average digester loading (Jul 2010 – Jun 2012) assuming a 6% co-thickened feed

As detailed in **Table 7** co-thickening increases the available digester HRT and produces a consistent feed to the anaerobic digesters.

Conclusion

An initial analysis of co-thickening at the CMSA plant indicates increased anaerobic digester HRT would be achieved. This would allow greater capacity to be available for food waste/fog digestion as well as increased process flexibility. Research has indicated that an optimum anaerobic digester volatile solids loading ratio of around 30% food waste to municipal waste is a reasonable target.

A consistent co-thickened feed to the digesters of around 6% would also allow plant staff to optimize both liquids and solids handling in the plant. Benefits would include optimization of the primary sedimentation tanks, reduced potential for septicity and primary blanket washout particularly during wet weather conditions. More consistent anaerobic digester performance and anaerobic digester gas production would also be expected from co-thickening operation, along with reduced maintenance issues.

It is recommended that the CMS plant staff consider a pilot test of the co-thickening concept using either a pilot RDT or GBT to gain detailed process information. Typically such a pilot test would last for around 3-4 weeks.