



# Understanding It Better Helps You Do It Better

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# Acknowledgments



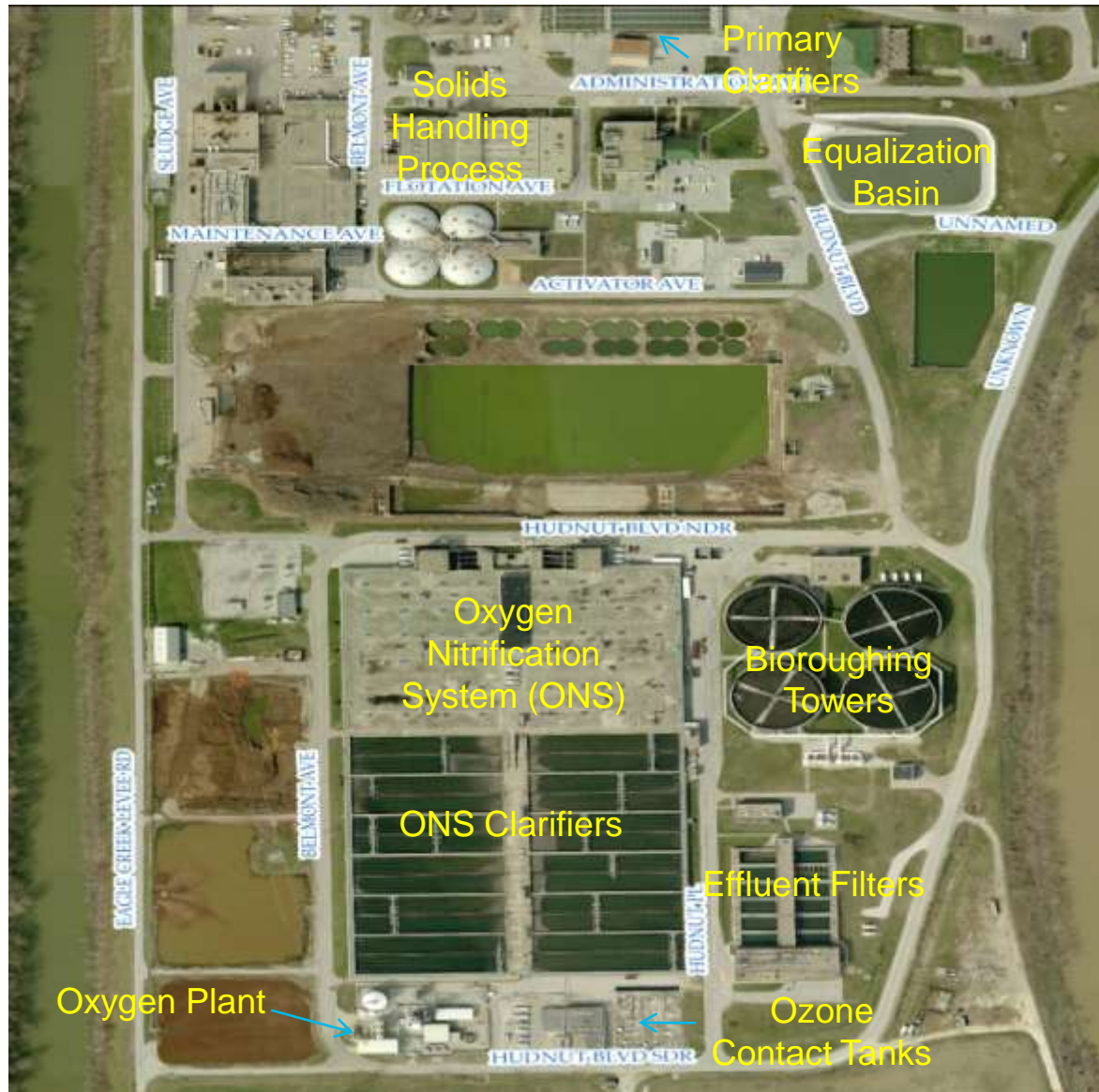
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- **Department of Public Works – the City of Indianapolis**
- **Lab, operation and maintenance staff of United Water in Indianapolis, IN**

# Outline

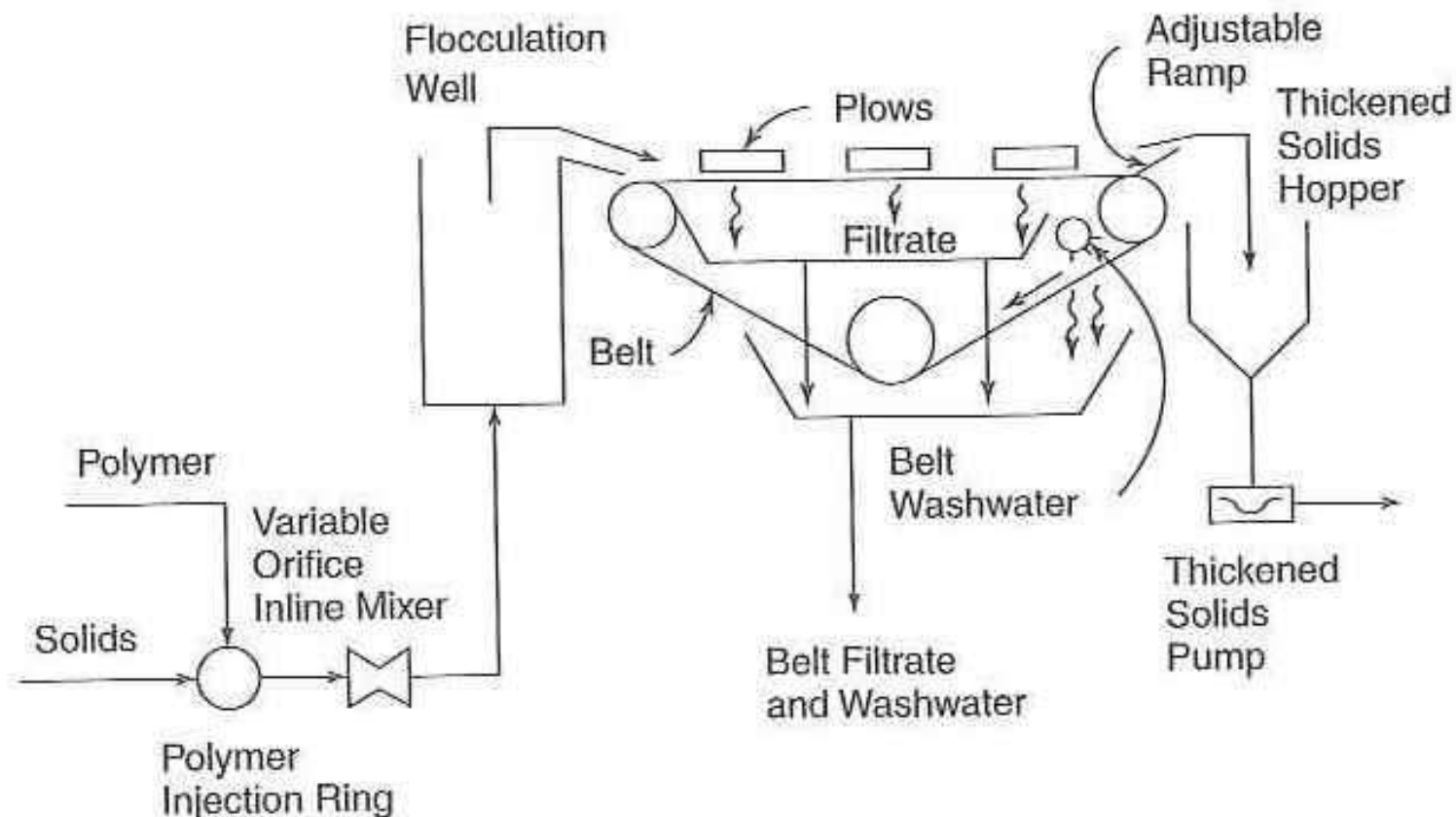


- **Introduction of Testing Facilities and Gravity Belt Thickeners (GBT)**
- **Experimental Design**
- **Results and Application**
- **Conclusions**

# Belmont Wastewater Treatment Facility Process Schematic



# Introduction – How does a GBT work?



**GBT schematic diagram (WEF MOP 8)**

# Introduction – Impacting factors



## ○ Important operating factors:

- **Sludge Feed – flow (varying)**
- **solids type and concentration (varying).**
- **Polymer – type, concentration and dosage (varying).**
- **Mixing energy – polymer injection and initial mixing set up.**
- **Belt Speed – varying.**
- **Belt Tension – set up at the beginning.**
- **Adjustable Ramp – varying.**

# Introduction – Solids handling process



## Gravity Thickeners

Primary  
Sludge



## Gravity Belt Thickeners

Waste  
Sludge



## Belt Filter Presses



## Incinerators



# Introduction- Installed GBTs

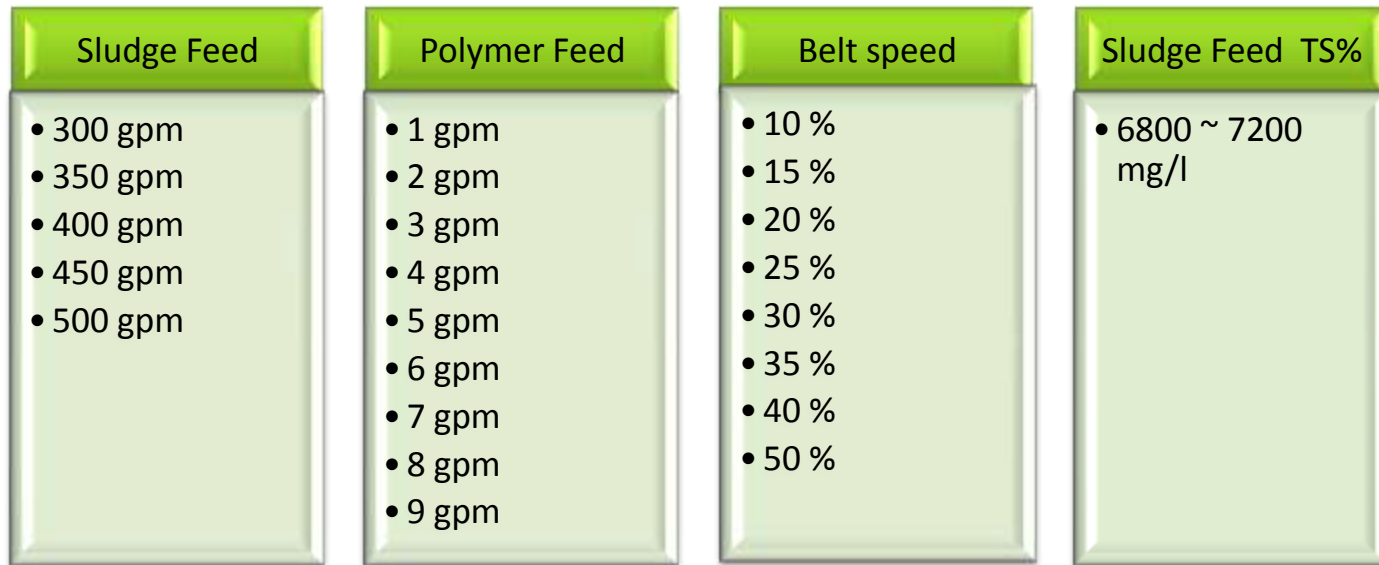


- **Six 2-meter GBTs**
  - **Sludge feed rang: 0- 600 gpm**
  - **Belt speed rang: 0-100% or 0-130 fpm**



- **GBT polymer feed system**
  - **Seven polymer feed pumps**
  - **Polymer feed rang: 0~10 gpm**
  - **Mannich polymer**

# Experimental Design

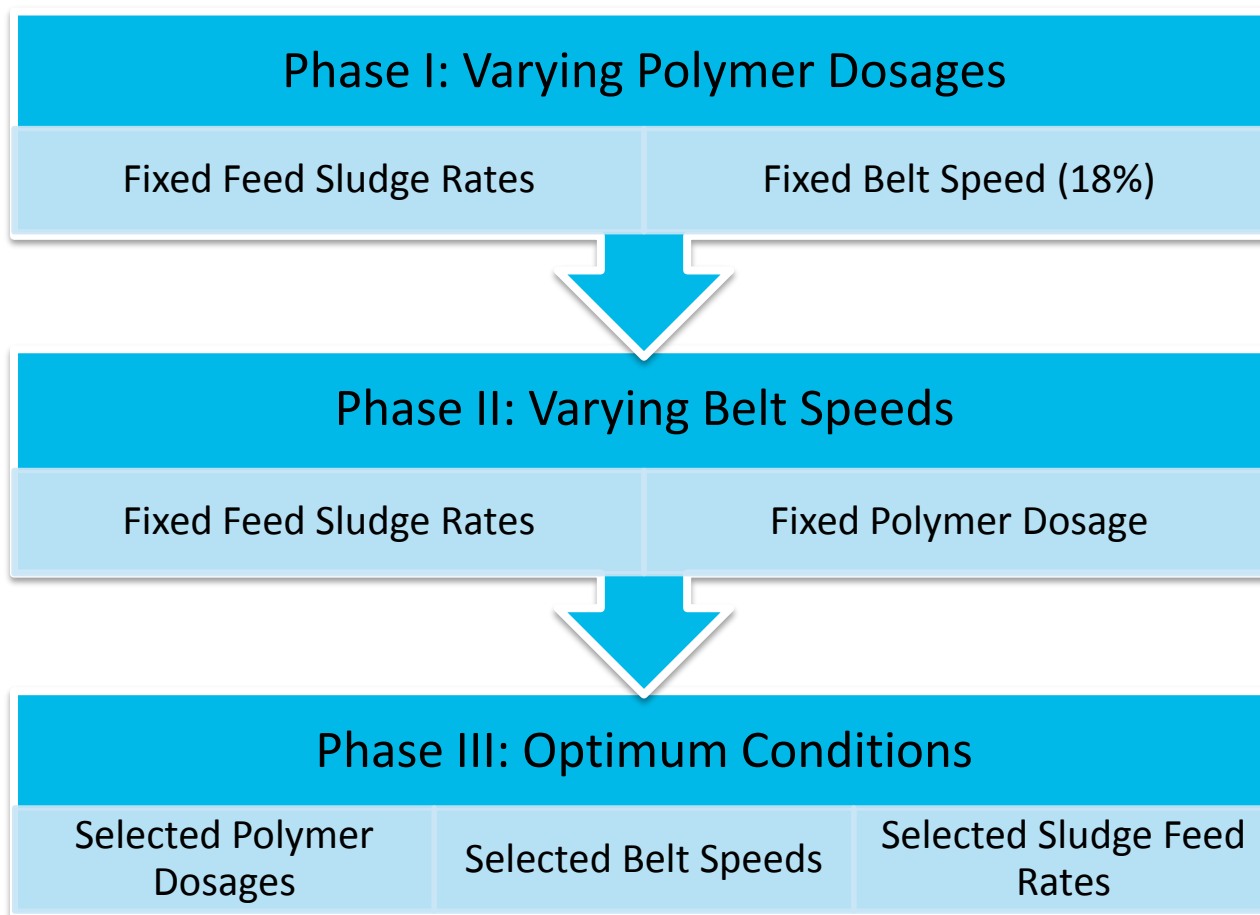


122 tests



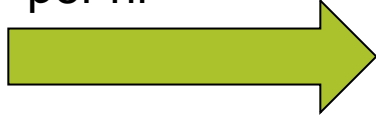
**CAKE Total Solids (TS)**

# Experimental Design – con'd





# Experimental Design – sampling plan

Feed TS Samples  
per hr



Cake TS  
Samples per test

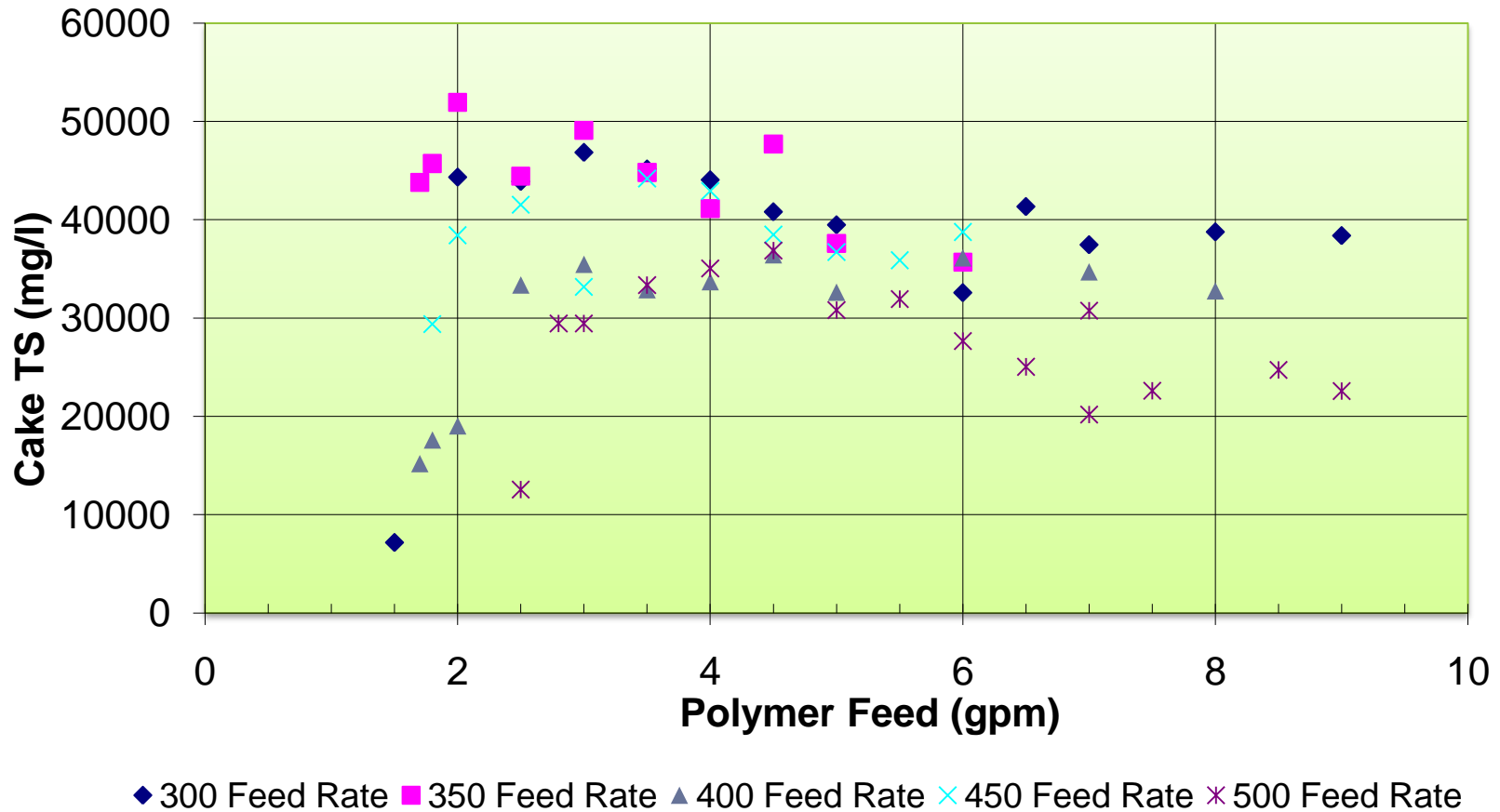


Filtrate TSS  
Samples Randomly

Recorded test data: sludge feed rate, polymer feed rate, and GBT belt speed.

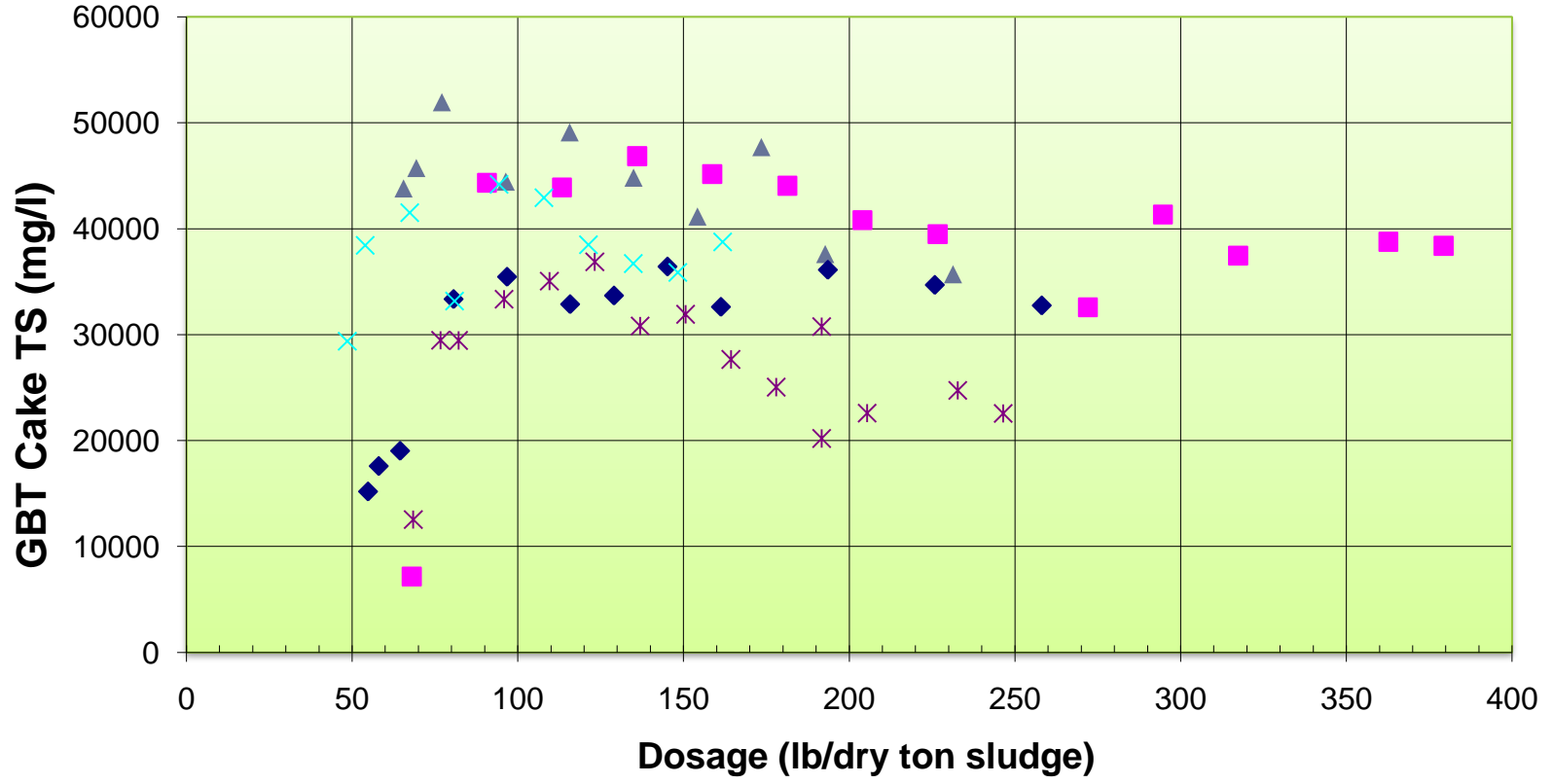
# Results – Phase I

## GBT Cake TS vs. Polymer Feed Rate



# Results – Phase I

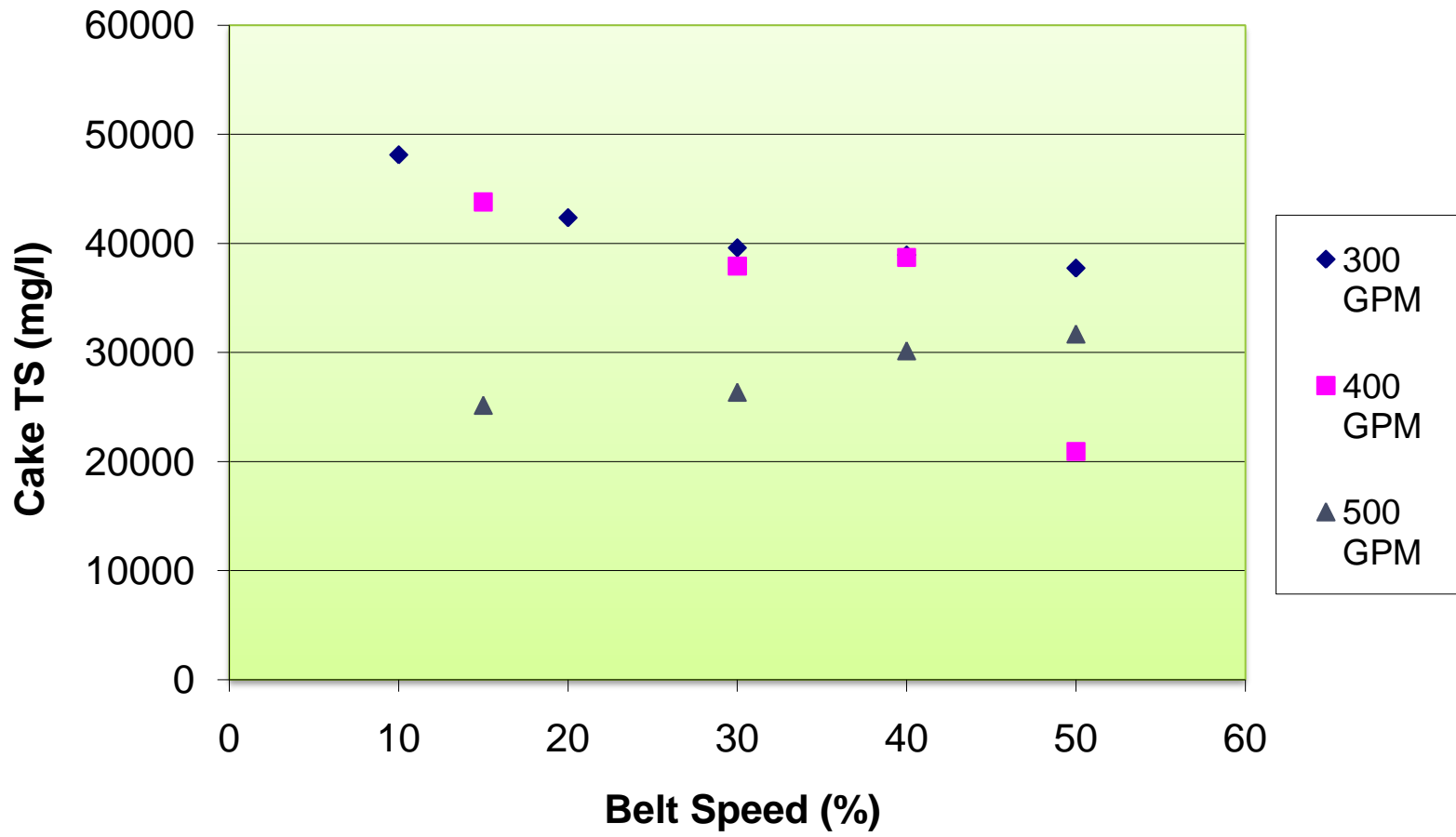
## Cake TS vs. Polymer Dosage



■ 300 gpm Feed   
 ▲ 350 gpm Feed   
 ◆ 400 gpm Feed   
 × 450 gpm Feed   
 ✖ 500 gpm Feed

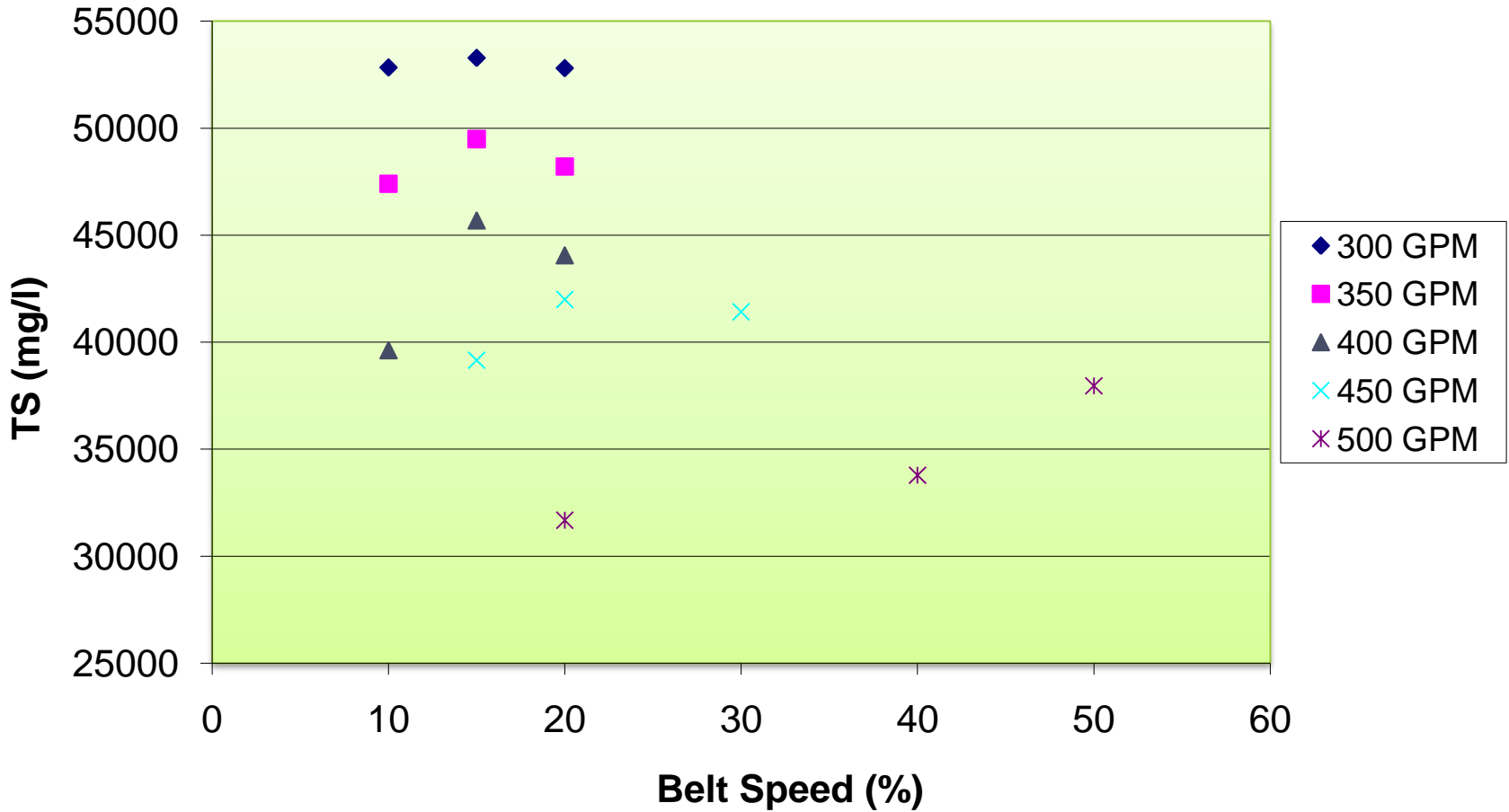
# Results – Phase II

## Cake TS vs. belt speed at the polymer dosage of 100 lb/dton



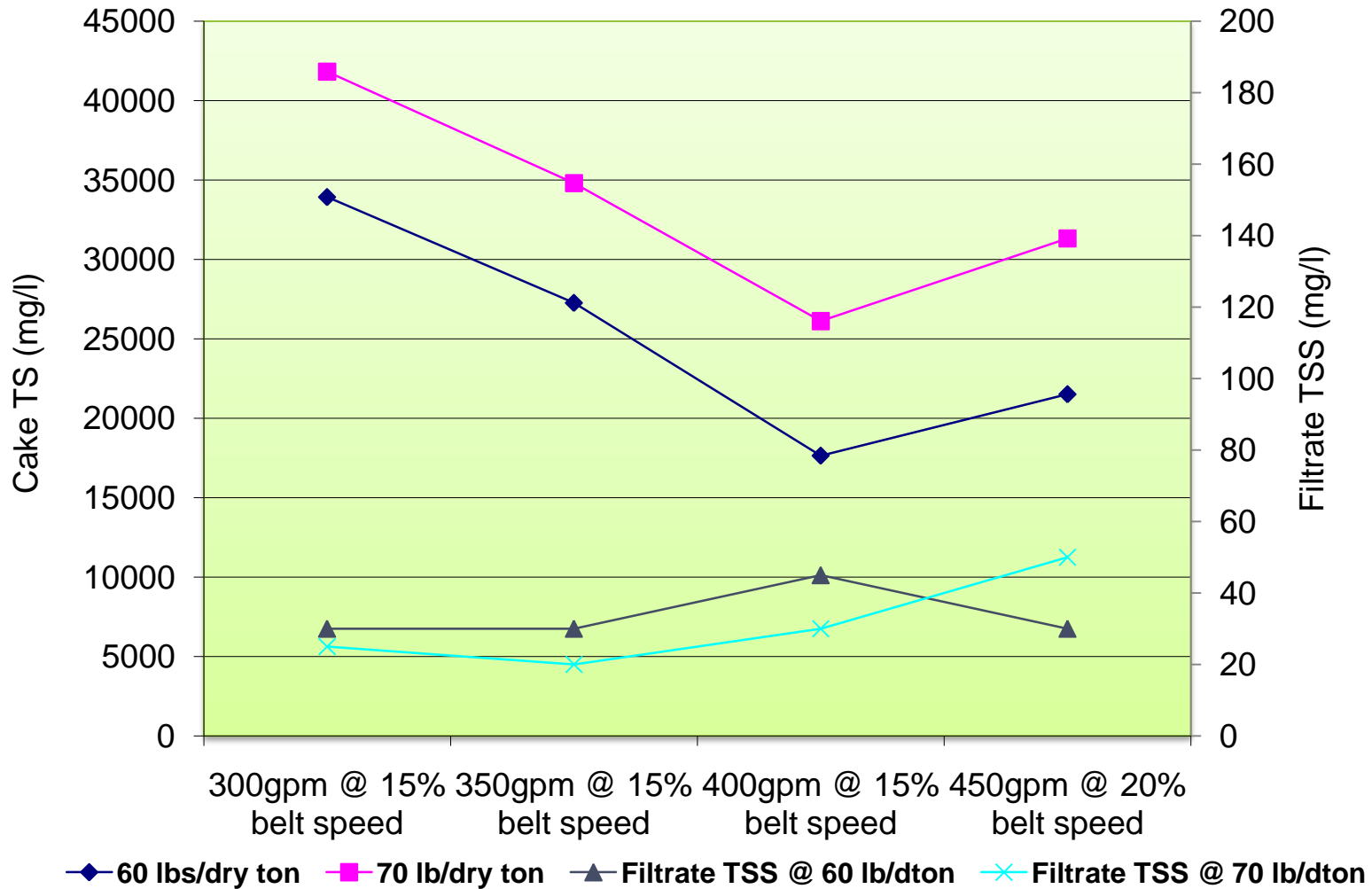
# Results – Phase II

**Cake TS vs. belt speed at the polymer dosage of 65 lb/dton**





# Results – Phase III





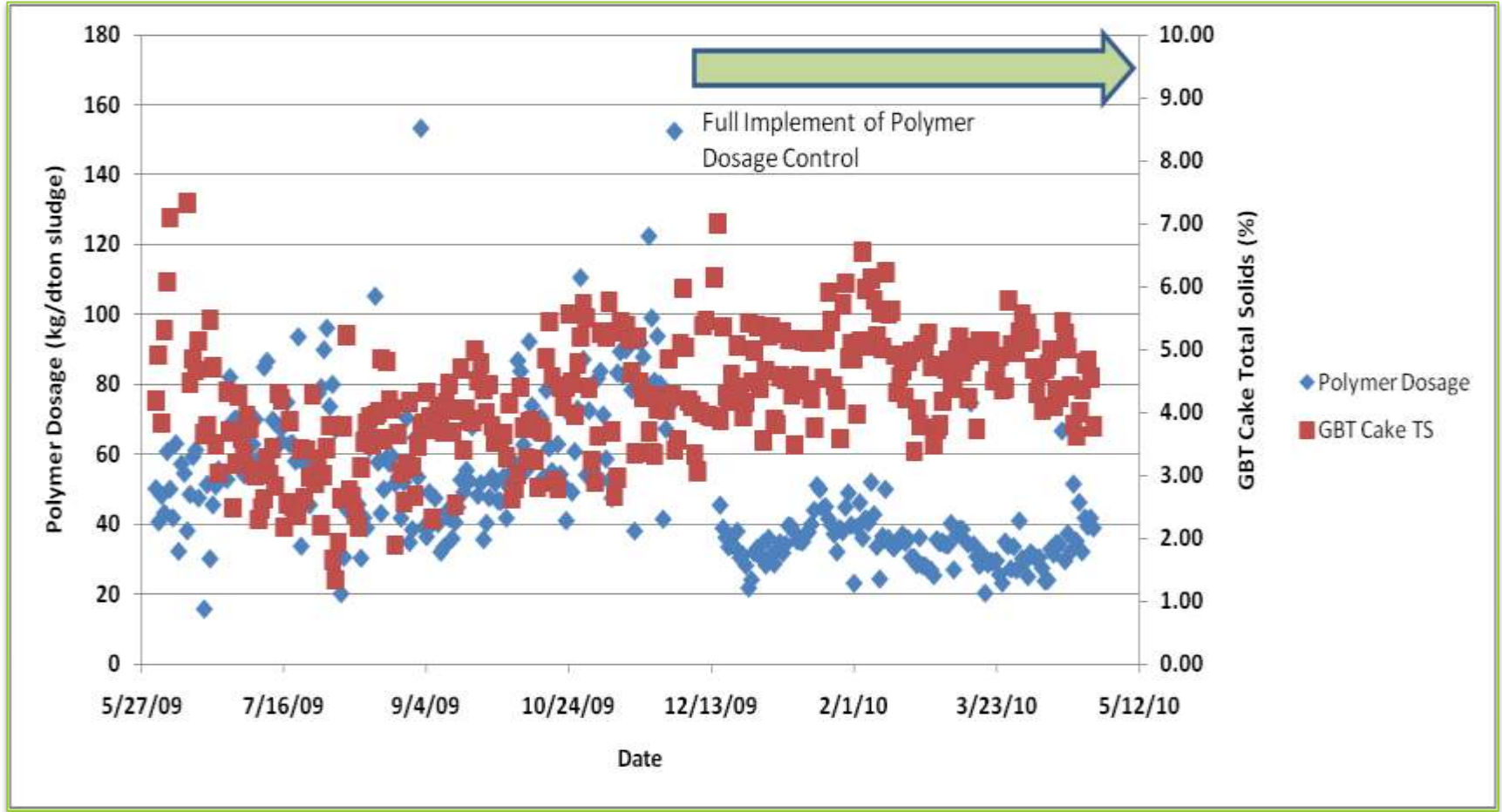
# Application – GBT operating table

<b>GBT OPERATING ORDER FORM</b>	
Date	_____
Time	_____
Operator Name	_____
WAS FLOW	1200 gpm
GBT Feed TSS	0.5 %
<b>Operating Order</b>	
GBT online	4Number
Sludge Feed per GBT	300gpm
Belt Speed Range	10-15%
Polymer Feed per GBT	19.3%
Every 10gpm	
Sludge Feed* =	0.64% Polymer Feed
*If field sludge feed varies from the suggested rate, the corresponding polymer feed should be calculated based on this ratio.	
Process Sludge	36.0tons/day
Polymer Usage	300Gal/d
<b>Target Polymer Dosage</b>	<b>70lb/dryton</b>

## Operations Guidance

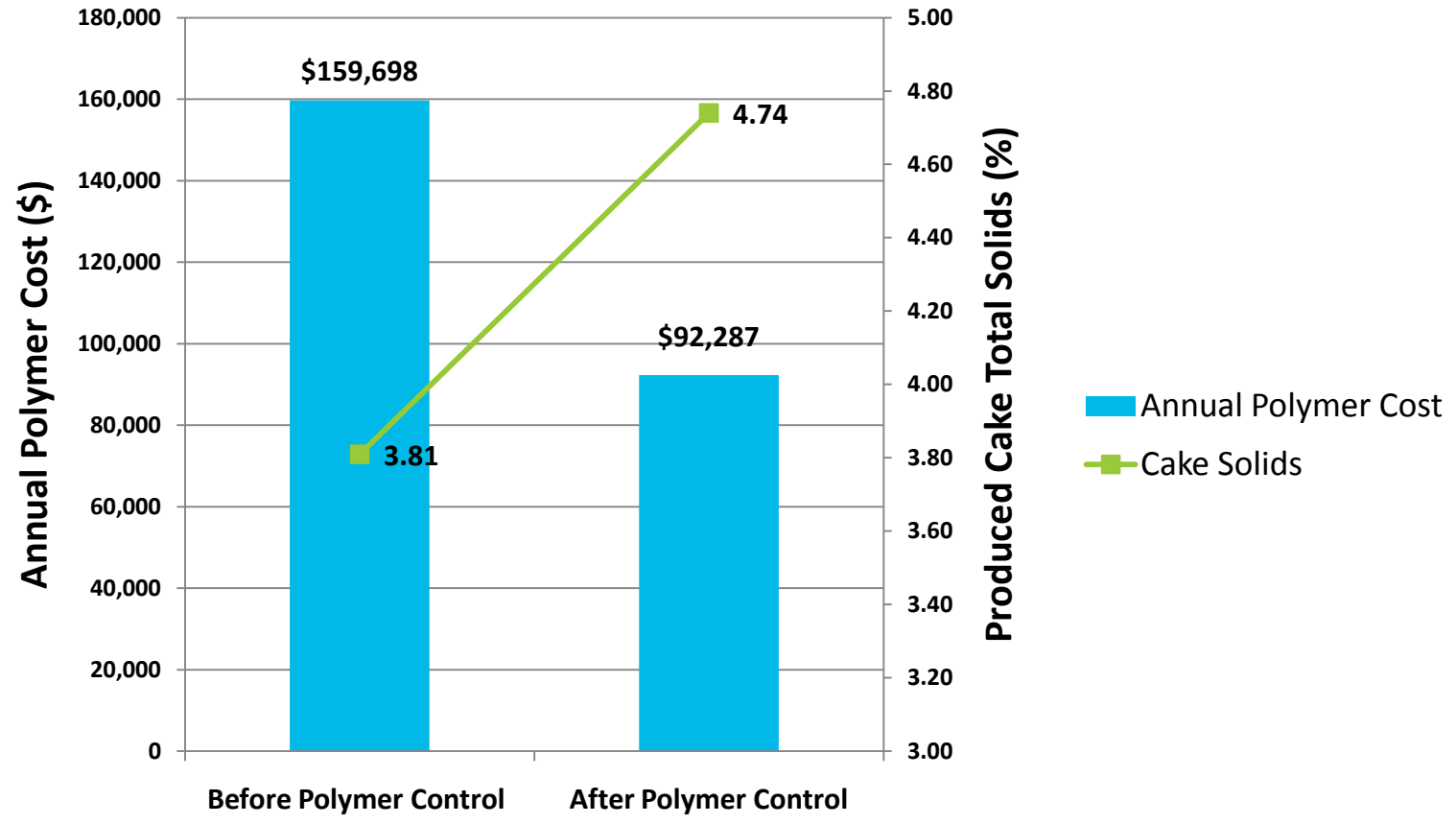
GBT FEED SLUDGE	GBT SPEED	POLYMER DOSAGE lb/dton			
		60	70	80	90
gpm	%	Polymer Dose (%)	Polymer Dose (%)	Polymer Dose (%)	Polymer Dose (%)
220	10-15	12.1	14.1	16.2	18.2
230	10-15	12.7	14.8	16.9	19.0
240	10-15	13.2	15.4	17.6	19.8
250	10-15	13.8	16.1	18.4	20.7
260	10-15	14.3	16.7	19.1	21.5
270	10-15	14.9	17.4	19.8	22.3
280	10-15	15.4	18.0	20.6	23.1
290	10-15	16.0	18.6	21.3	24.0
300	10-15	16.5	19.3	22.0	24.8
310	15-20	17.1	19.9	22.8	25.6
320	15-20	17.6	20.6	23.5	26.4
330	15-20	18.2	21.2	24.2	27.3
340	15-20	18.7	21.9	25.0	28.1
350	15-20	19.3	22.5	25.7	28.9
360	15-20	19.8	23.1	26.4	29.8
370	15-20	20.4	23.8	27.2	30.6
380	15-20	20.9	24.4	27.9	31.4
390	15-20	21.5	25.1	28.6	32.2
400	15-20	22.0	25.7	29.4	33.1

# Application – Performance improvement





# Application – Projected Cost Savings



# Conclusions



- **The sludge feed rate to GBTs has a big impact on the GBT performance. Lower feed rates certainly help produce a thicker cake.**
- **Polymer dose rates show a significant influence on the GBT performance too. An optimum dosage rate can be obtained through a series of performance tests. This study reveals that the optimum polymer dosage is at 100 lb/Dton Mannich polymer or 4.5 lb/Dton active polymer which can produce the highest cake solids. A dosage higher this rate will probably result in polymer waste.**

# Conclusions – con'd



- **GBT belt speed is another important factor affecting the GBT performance.**
  - **Low belt speeds favor low sludge feed rates, but high sludge feed rates need higher belt speeds.**
  - **The belt speed of 15% - 25% or 20 fpm - 33 fpm is the optimum operating range for the sludge feed lower than 450 gpm. A high speed of 50 % (70 fpm) or higher is more appropriate for the feed rate of 500 gpm and above.**
  - **The belt speed is a useful tool for plant operators to fine-tune the GBT system in order to obtain desired cake solids after the optimum polymer dosage has been set up.**

# Thank You !

