Optimizing Energy Efficiency at City of Saint Cloud Wastewater Treatment Plant

Emily Campion

Advisor: AJ Van den Berghe

Minnesota Technical Assistance Program

UNIVERSITY OF MINNESOTA

Driven to Discover℠

Company Overview

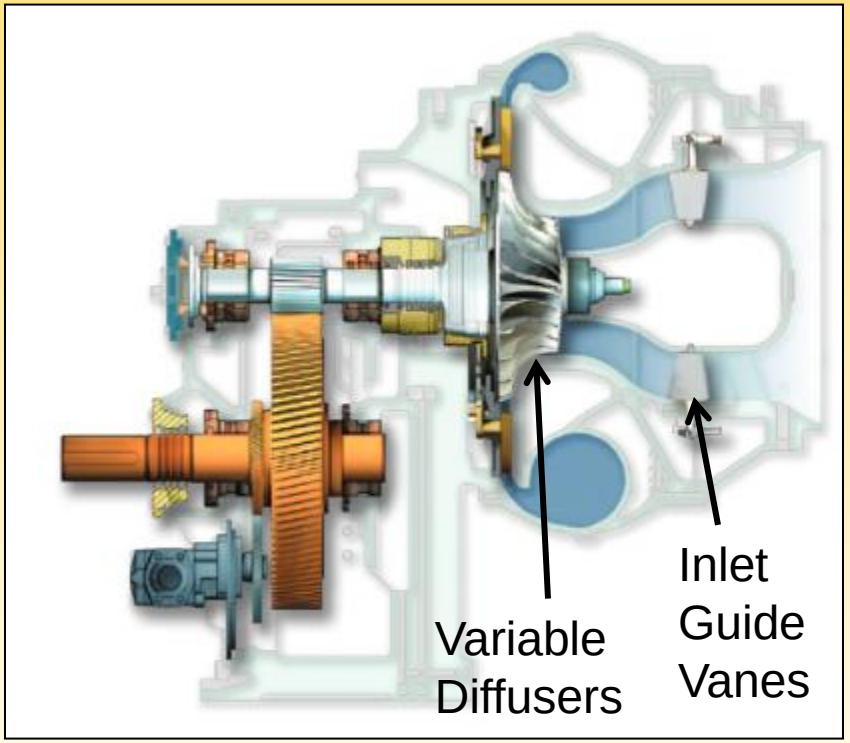
- Treats industrial, commercial, and residential wastewater prior to discharge into the Mississippi River
- Cities Served:
  - St. Cloud
  - St. Joseph
  - Sartell
  - Sauk Rapids
  - St. Augusta
  - Waite Park

Wastewater Treatment Process

- Biological Nutrient Removal (BNR)
  - Removes nitrogen and phosphorous from wastewater using bacteria
  - Bacteria require a dissolved oxygen concentration of 2 mg/L

600 HP Turblex Blowers

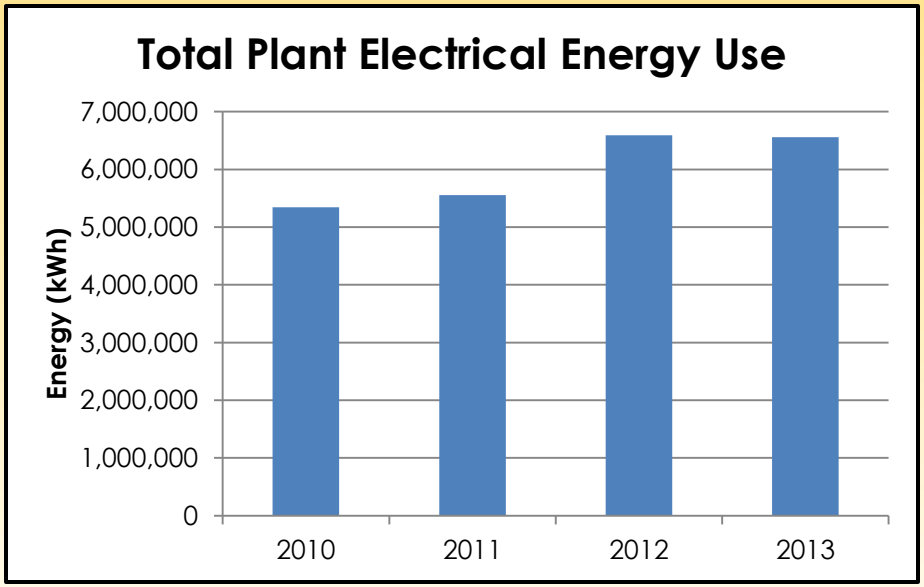
- Proprietary Dual-Point Control™



http://www.energy.siemens.com/us/pool/hq/compression/special-applications/aeration/STC-GO%20Brochure_EN_lay_120312.pdf

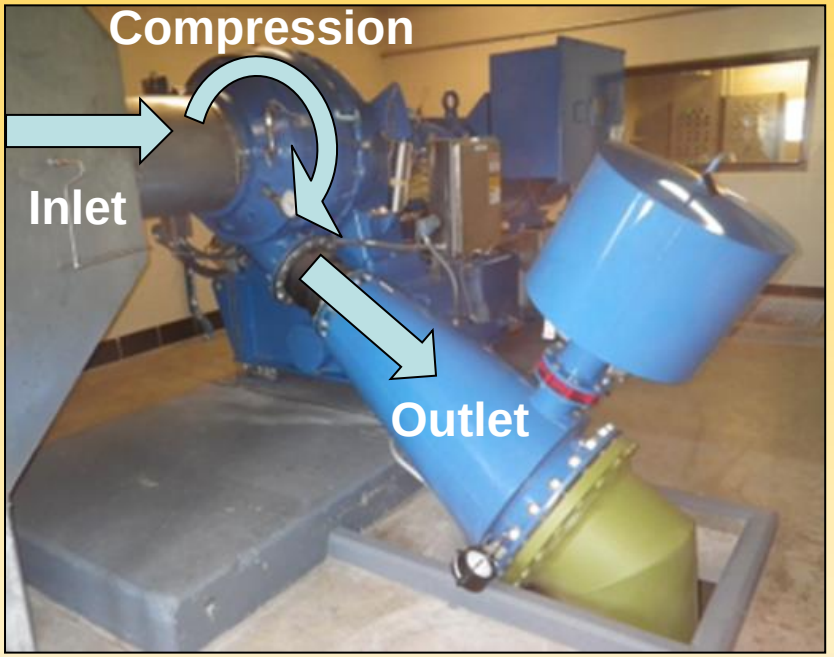
Motivations for Change

- Commitment to Energy Efficiency and Resource Recovery
- Decrease blower energy use



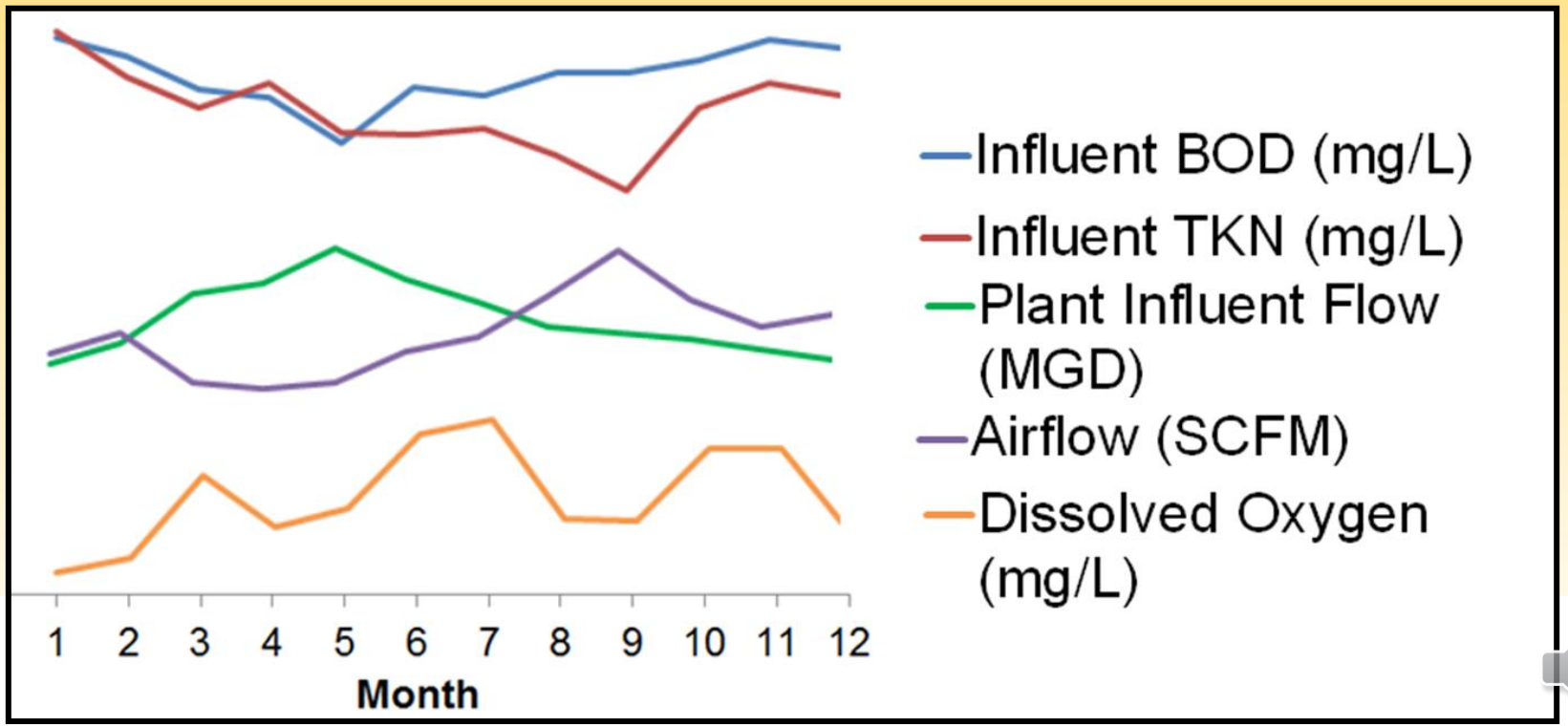
Reasons for MnTAP Assistance

- Prevent blower surging
- Optimize aeration process to maintain the dissolved oxygen setpoint of 2 mg/L



Approach

- Calculate blower energy use with the Aeration Model
  - Trend data using SCADA software



Process Investigation

- Decreasing blower differential pressure decreases the power consumption

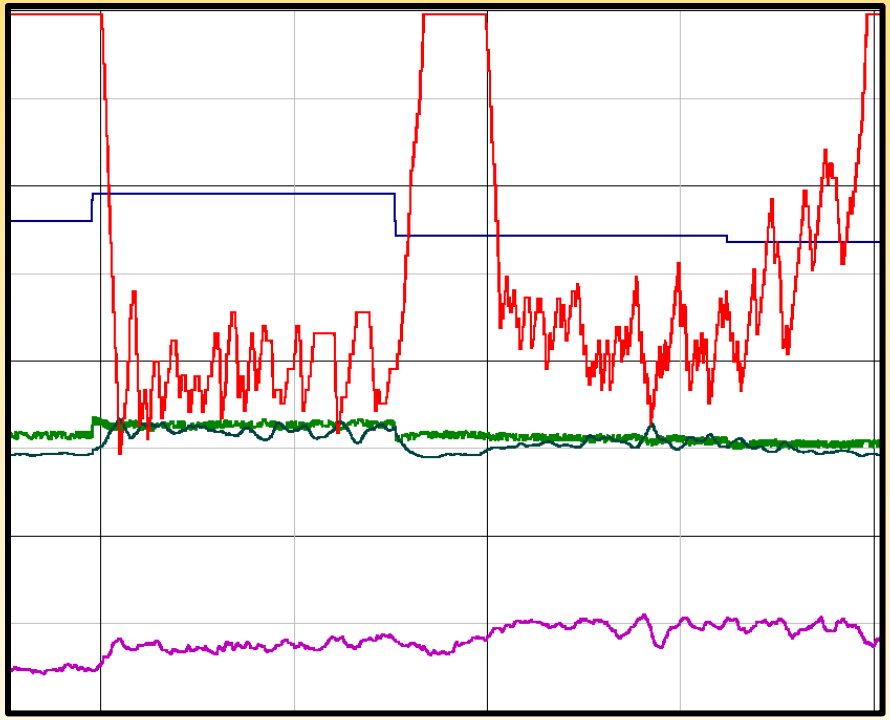
Fan Affinity Law	
$\frac{P_1}{P_2} = \left(\sqrt{\frac{h_1}{h_2}}\right)^3$	P=Power (kW) h=differential pressure (psia)

- The pressure is decreased by opening downstream valves (Most-Open Valve Control)

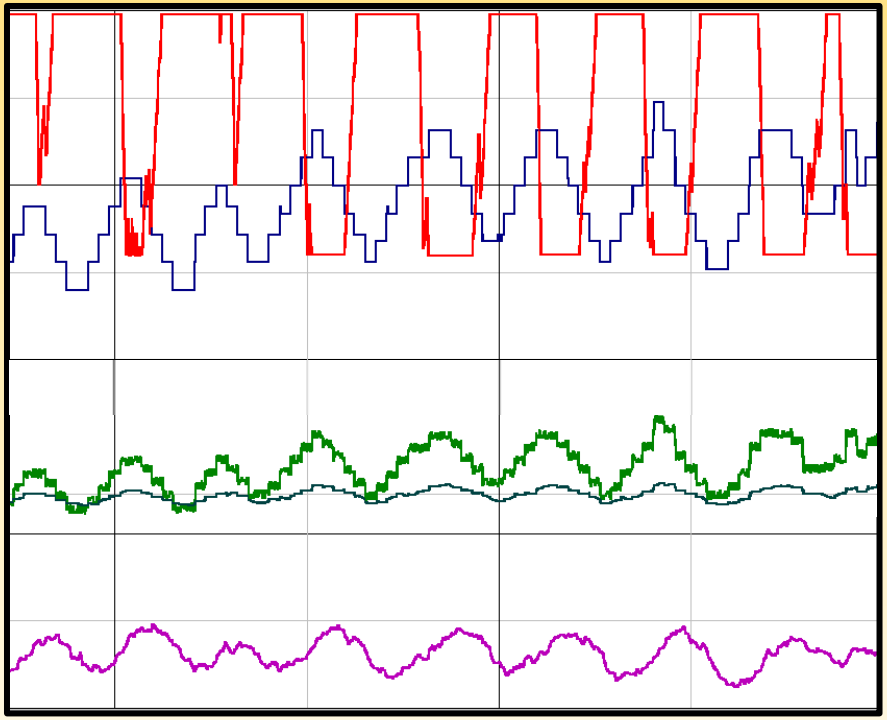
Most-Open Valve Control Strategy

Most-Open Valve Comparison

- Before MOV



- After MOV



Most-Open Valve Results

- Decreased blower discharge pressure from 22.3 psia to 21.5 psia
- Eliminated blower surging
- Allowed blower to decrease capacity

Turblex Master Control Panel

- Automate Most-Open Valve Control Strategy
  - Saves labor associated with optimization and programming
- Improve Dissolved Oxygen Control
  - Maintains setpoint of 2 mg/L
- Master Control Panel was quoted for $88,500

Modeled Savings

	Energy Reduced (per year)	Net Savings (per year)	Simple Payback Period (yr)	Status
Most-Open Valve Control Strategy	392,000 kWh	$27,000	Immediate	Implemented
Master Control Panel	766,000 kWh	$54,000	1.6	Under Review

- Turblex Master Control has larger savings because of better dissolved oxygen control

Successful Process Changes

- Improve existing Most-Open Valve program to mimic Turblex Master Control
  - Less variance in dissolved oxygen concentration
- Saved energy by enabling the blower to operate at lower capacity
- Eliminated blower surging

Personal Benefits

- Collaborative teamwork
- Continuous processes, chemical engineering equipment
- Equipment efficiency
- Process Control
- Contractors, Vendors, and Utilities
- Meetings and presentations

Questions?