Aveda Energy Solutions

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UNIVERSITY OF MINNESOTA

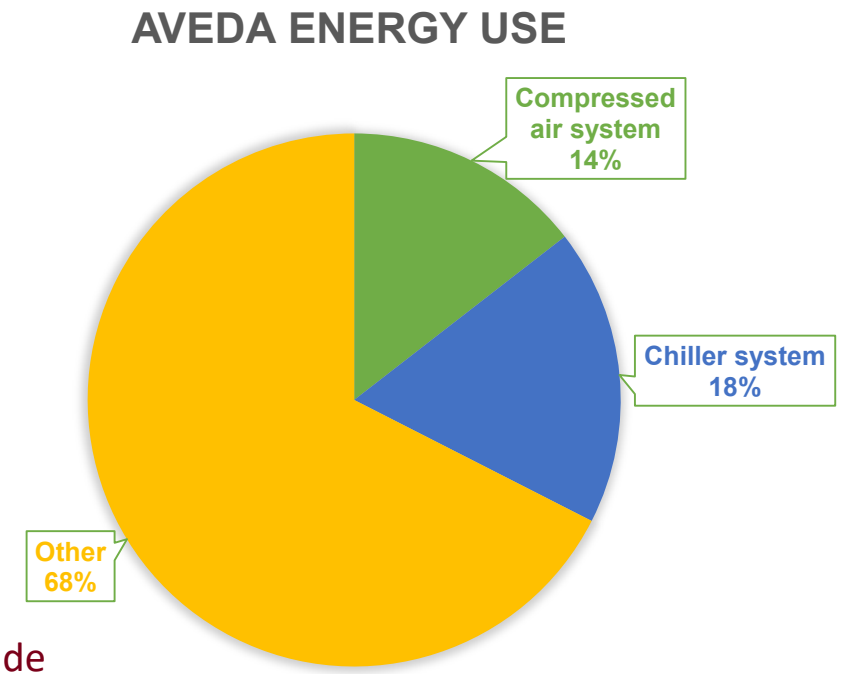
Driven to Discover℠

Aveda Company Background

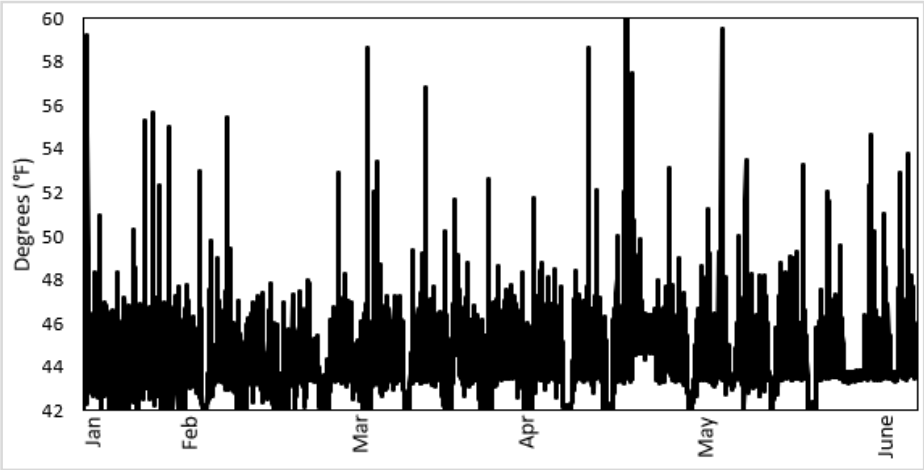
- Part of Estée Lauder
- Blaine, MN
- 750 employees
- Organic, cruelty free hair and personal care products
- Environmentally sustainable business model

Project Motivations

- **Aveda's mission, environmental sustainability**
- **Compressed air:**
  - Estimated 15-20% leaks
- **Chiller system:**
  - Current system over 20 years old
  - Production requires more capacity
- **Waste:**
  - Strength and sewer accessibility charges from off-grade product waste



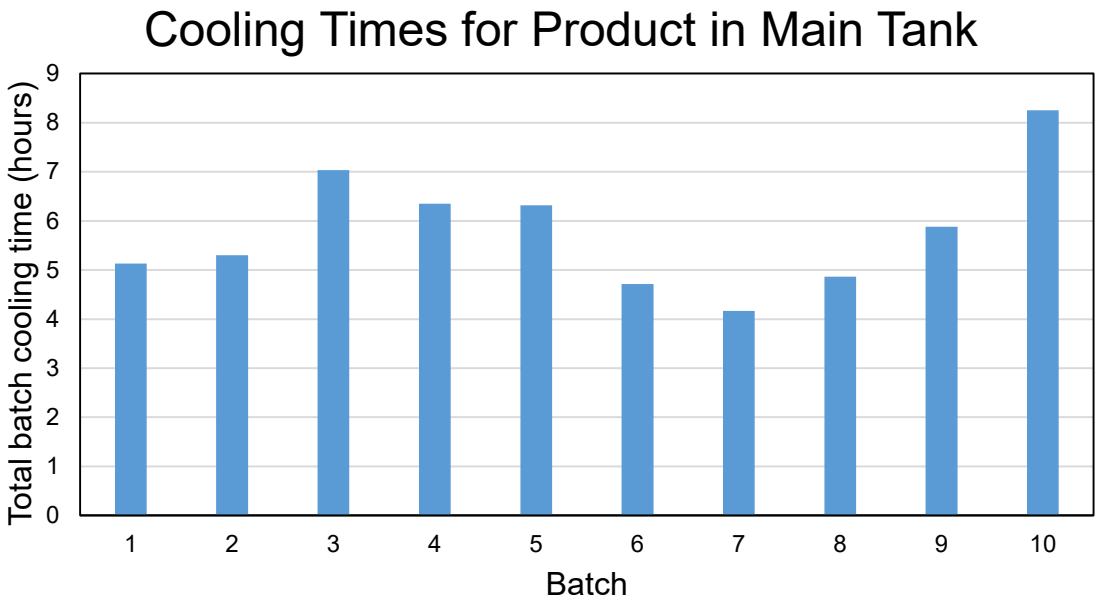
Project Motivations - Chiller



Chiller Supply Temperatures

- Chilled water temperature is highly variable
- Peaks correlate to increased production demand
- New chiller system: larger capacity, will keep the chilled water supply temperature stable

Project Motivations - Chiller



- Varied chilled water temperature causes variation in batch cooling times
- Range: 4.2 hours to 8.3 hours
- Larger capacity chiller with stable water supply temperatures will minimize batch cooling times

Project Goals

- Reduce energy use in compressed air system
- Recommend more efficient chiller with higher capacity to meet increased production demands
- Reduce off-grade waste generation, improve waste management procedure

Approach

- Gathered and analyzed energy use data for plant
- Compressed air end uses
- Current chiller system performance
- Process map of waste management system

Chiller Energy Reduction Options

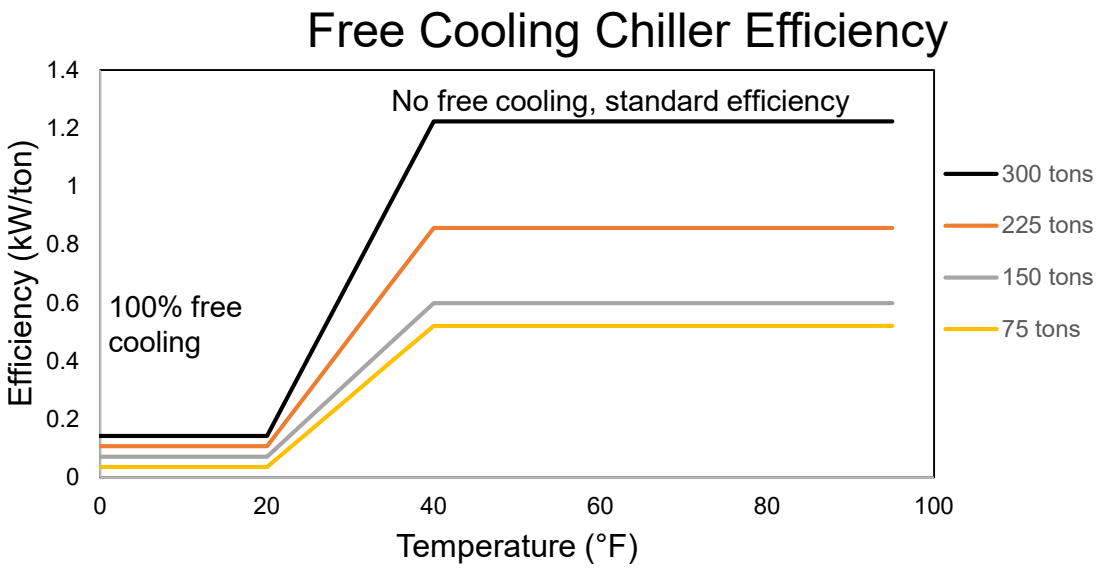
Heat recovery chiller

- Efficiency varies with percent load
- Higher average system efficiency
- Lower initial cost
- Smaller plant footprint

Free cooling chiller

- Efficiency varies with temperature and percent load
- Larger plant footprint, would be installed on rooftop
- Minnesota temperatures: free cooling mode 41% of time

Free Cooling Chiller Efficiencies



- Efficiency varies with load and temperature
- Below 100% free cooling temperature (23°F), chiller power consumption is condenser fans
- Above chilled water temperature (40°F), standard efficiency
- Linear relationship between efficiency and temperature in free cooling mode

Primary Recommendation:

Heat recovery screw chiller system

	Current chiller system	Heat recovery chiller system	Free cooling chiller system
Total capacity	360 tons	600 tons	600 tons
Efficiency	1.77 kW/ton	0.93 kW/ton	1.02 kW/ton
Savings (per year)	-	128,100 kWh	115,110 kWh

Benefits of heat recovery chiller system:

- Two equal sized chillers, full redundancy
- 53% energy reduction, saves 128,000 kWh/year
- $13,500 savings in energy costs annually
- Decreased cooling times, extra production time

Recommendation	Annual reduction	Initial cost	Annual savings	Payback period	Status
Heat recovery chiller	128,000 kWh	$500,000*	$ 13,500 + increased production capacity	< 1 year**	Planned
Compressed air leak maintenance	42,000,000 ft^3 air 58,500 kWh	None	$10,000	Immediate	Implementing
Turn off air to production lines that are not in use	8,000,000 ft^3 air 22,500 kWh	None	$2,000	Immediate	Implementing
Replace current air compressor system with one, larger variable speed compressor	55,000 kWh	$40,000*	$5,500	7.3 years	Planned
Replace 5 portable compressed air motors with electric motors	3,000,000 ft^3 air 8,500 kWh	$7,500*	$750	10 years*	Recommended
Filter drum for wastewater	18,000 gal water 180 kWh	$190,000	≤ $30,600	6.2 years	Recommended

*rebates available, **including decreased cooling times and increased production savings (some reduction options not shown)

Total Potential Waste Reductions (per year)

- 640,000 kWh
- 50,700,000 ft^3 of compressed air
- 18,000 gallons of water
- 18,000 gallons of off-grade waste
- 175,000 kg CO_2
- Additional 245 + hours of production time
- $240,000

Personal experience

- Great learning opportunities, engineering work experience
- Nice working environment, chance to work with several different teams
- Wonderful products, appreciated chance to try all different kinds of Aveda products