

# TCE Elimination and Improving Product Yield: A Symbiotic Relationship

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**Driven to Discover<sup>SM</sup>**

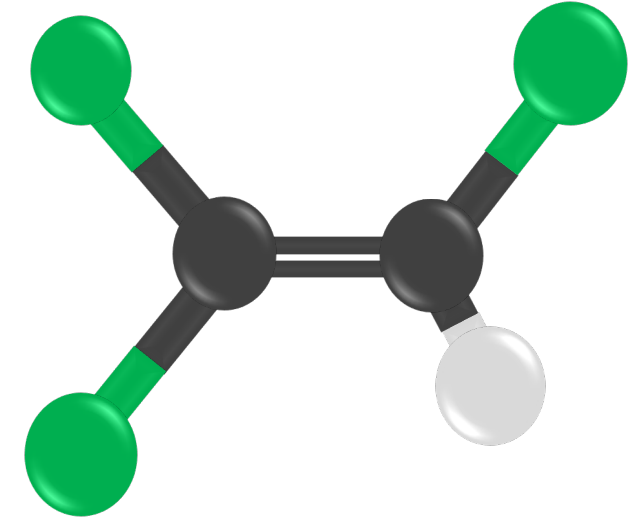
# Company Background

- **Large-scale component manufacturer.**
  - Stamping
  - Drawing
  - Trimming
- **Trichloroethylene (TCE) vapor degreaser used to remove lubricants from products.**
- **Collaboration with MnTAP over the past year to remove TCE.**



# Trichloroethylene

- Chlorinated solvent commonly used in industrial degreasing
  - Hazardous air pollutant
  - Known human carcinogen
  - Affects liver, kidneys, immune, reproductive, and central nervous systems
- Minnesota Legislature passed a TCE Ban in May 2020
  - Applies to facilities with state-issued air permits
  - Effective June 2022



# Project Overview

- TCE vapor degreaser used to remove lubricants from products.
- **New cleaning system eliminates TCE.**
  - Vacuum degreaser.
  - Modified alcohol solvent.
  - Implementation in progress.
- **Studies conducted to support the implementation and validation of new cleaning process.**

# Product Yield Improvement

- **Designed experiment to explore effects of cleaning and annealing parameters on product quality**
  - Pre-cleaning
  - Post-cleaning
  - Annealing temperature
- **Contamination on parts during annealing may result in defects.**
- **Higher level of cleaning provided by vacuum degreaser may allow for removal of:**
  - Manual pre-cleaning (mineral spirits)
  - Final automated cleaning (aqueous cleaner)
- **Parts will be assessed visually and with hardness testing.**



# Annealing

- **Currently, parts annealed off-site at high temperature.**
- **Past studies suggest improved part quality at lower annealing temperature.**
  - Uniform microstructure.
- **Lower temperature also allows in-house annealing.**
  - Lower energy (overall).
  - Reduced lead times.
  - Reduced transportation costs and emissions.



# Solutions

Recommendation	Annual Reduction	Total Cost	Annual Savings	Payback Period	Status
Reduce annealing temperature	TBD (kWh)	None	TBD	Immediate	Implementing
Elimination of Mineral Spirit (MS) Pre-Wash	2,100 lbs	None	\$2,400	Immediate	Implementing
Replacement of TCE with vacuum degreaser	15,000 lbs	\$400,000/ machine	\$9,300+	N/A	Implementing
Monitor solvent life and effectiveness through dyne testing	4,800 lbs	\$130	\$20,700	TBD	Recommended

# Personal Benefits

- Exposure to a manufacturing floor
- Understanding the intersection of process and quality engineering
- Learning how Lean and Six Sigma tools are applied
- Importance of documentation and root cause analysis

