Chemical and Waste Elimination

Elizabeth Jambor
Industrial and Systems Engineering
University of Minnesota Twin Cities

Organization Background

This manufacturer located in the Twin Cities Metro Area supplies components to OEMs in regulated industries across four continents. The company has about 800 employees in this location and focuses on assembly, machining, and grinding operations, as well as various design processes within their industry.

> *"The intern was very professional and productive. MnTAP's intern program is an outstanding program. I strongly recommend to tap into this resource if you have the opportunity."*
>
> *~ Fellow Scientist*

"This summer I have been able to experience the industry in a well-rounded manner that encompasses hands-on learning. I am very grateful for the opportunity to gain understanding in my career as well as industrial problem-solving skills." ~ EJ

Project Background

The purpose of this project is to facilitate the elimination of Trichlorethylene (TCE) and N-Propyl Bromide (nPB) from cleaning processes. TCE is a hazardous solvent which can cause cancer and other serious health effects. Although nPB is sometimes marketed as a safer alternative to TCE, nPB also poses worker safety concerns including nervous system damage. In 2019, 5,200 lbs of TCE and 800 lbs of nPB were used in cleaning processes. A new vacuum degreasing system is planned to replace both the TCE vapor degreaser and nPB systems and eliminate both hazardous chemicals from the facility's operations. The new machine will use a modified alcohol-based solvent. Opportunities to reduce Isopropyl Alcohol (IPA) used to clean surfaces in the manufacturing area were also investigated.

Incentives To Change

The current TCE and nPB processes work efficiently to clean parts, but also pose health and environmental risks. The company has been working proactively with MnTAP since May 2019 to eliminate these hazardous chemicals from their systems. In May 2020, the Minnesota legislature passed a ban on TCE that will become effective in June 2022. The new cleaning process will eliminate 6,000 lbs of hazardous chemicals and $13,100 in purchase and disposal cost annually. Optimizing cleaning cycles for different categories of parts will reduce waste and increase the capacity of the machine itself. There are also additional savings associated with the increased efficiency and productivity of the new machine. Reducing IPA usage represents an additional opportunity to lower air emissions, reduce waste, and save money.

Solutions

Optimize Cycle Times for the New Cleaning System

There are over 500 parts that currently go through the TCE process. These parts were categorized by their characteristics and tested in the new machine to identify optimal cycle times for different categories of parts. These cycle times vary from being the same length as the current TCE process or up to 4 minutes quicker. This designation of varying cycles for each part will increase machine capacity and efficiency. The new cleaning process will save 5,200 lbs of TCE and $10,700 per year.

Identify Single Fixture for nPB Parts in the New Cleaning System

A single fixture for the new cleaning system that can fit all parts currently cleaned in the nPB process was identified. The nPB process currently specifies various equipment based on the part. Implementation of a single fixture that will be able to fit all parts will allow different parts to be cleaned at the same time, eliminating partial cleaning batches and creating a more standardized and efficient process. Switching to the new cleaning system will save 800 lbs. of nPB and $2,400 per year.

Replace IPA Squeeze Bottles with Plunger Cans

In 2019, about 4,300 lbs of 70% IPA were purchased for surface cleaning at a cost of about $25,000. The IPA solution is currently held in squeeze bottles, where the quantity dispensed is reliant on the operator and therefore variable. Plunger cans allow dispensing of a small, consistent amount on a rag, with the excess liquid going back into the can. This will reduce variability and decrease usage across the facility.

Recommendation	Annual Reduction	Annual Savings	Status
Optimize cycle times	5,200 lbs TCE	$10,700	Implementing
Identify fixture for nPB parts	800 lbs nPB	$2,400	Implementing
Replace IPA squeeze bottles with plunger cans	TBD	TBD	Requires further study

MnTAP Advisor: Jane Paulson, Senior Engineer