Ultrasonic Aqueous Parts Cleaning in Auto Repair

Introduction

In October 2020, PPRC conducted an EcoBiz certification visit with Autobahn Motorwerks (Autobahn). Among several best practices in place, EcoBiz learned of their replacement of a solvent parts washer with an ultrasonic system, utilizing an EPA Safer Choice all-purpose cleaner.

Ultrasonic parts cleaner and Safer Choice Simple Green All-Purpose Cleaner

PPRC discovered that these ultrasonic cleaners are commonly used by jewelry makers and laboratories, but are becoming popular for auto repair shops, due to excellent cleaning performance and avoidance of solvents. A 30 liter (30L) unit seems suitable for throughput typical of smaller shops (under 10 employees), and 100L may be a better size for larger auto shops.

During an EcoBiz certification at another auto shop in Oregon, PPRC found they were interested in ultrasonic cleaning as well, especially because of staff sensitivity to some solvents. They periodically used non-chlorinated aerosol cleaners for parts cleaning, and for larger-part cleaning jobs, would send out an entire part for cleaning. They purchased a 30L ultrasonic unit and are trialing two non-hazardous aqueous cleaners. Both shops are pleased with ultrasonic cleaning and eliminating solvents for parts washing.

Tips, best practices for use, and brief success stories and cost benefit analyses are presented below.

Tips & Best Practices

A few tips and best practices from these shops, manufacturers, and regulatory agencies, for using ultrasonic cleaners, include:

- ❒ Around 125°F is an effective operating temperature for most auto part cleaning.
- ❒ Units need ~15 minutes to come to operating temperature.
- ❒ Non-hazardous aqueous degreasers or "general purpose" type cleaners seem to be highly effective at a ratio of around 10:1 to 12:1 water to cleaner concentrate. Other users report higher concentrations of a cleaner, however, the best practice is to optimize at the lowest effective concentration.
- ❒ A quick pre-clean of especially grimy parts beforehand conserves bath life.
- ❒ Ultrasonic cleaning cycle is effective at around 15-20 minutes.
- ❒ If part is too big to submerge the entire part, it can be partially submerged, cleaned, then flipped and cleaned. In this case, it is not critical that the lid be fully closed.
- ❒ Allow parts to hang over the tank for a minute or so to avoid wasting bath solution. This may help reduce rag use for drying.
- ❒ When changing the bath and cleaning the unit:
    - ✓ If oil is present on the liquid surface, skim, and manage with used oil waste.
    - ✓ Use a spill absorption mat over the sink drain to capture debris and some dissolved oils.
    - ✓ Dispose of sludge and spill pads as hazardous waste.
    - ✓ When emptied, wipe clean with a rag.
    - ✓ Refill the tank with warm tap water (as recommended by manufacturers).
- ❒ If the unit is not needed frequently, and/or not used during a night shift, the solution does not need to remain warm. Conserve energy by turning the unit off when not needed for longer periods.

Autobahn Motorwerks • Success Story

Autobahn purchased a 30L ultrasonic aqueous cleaner which has reduced time, money, solvent use, solvent and sludge waste, along with employee exposure to harsh solvents. Customers are impressed with the shiny "new" look of the ultrasonically cleaned parts, and often ask if the shop purchased a brand new part.

Autobahn's former cleaning method was a solvent-based parts washer using a non-chlorinated solvent. Due to the strong smelling fumes of the solvent, and hazard ratings on the Safety Data Sheet (SDS), including flammability, respiratory hazards, and high volatile content, they were concerned about exposure. Their main goal was to prevent exposure and handling of around 180 gallons of solvent and resulting waste annually.

Left: Before; Right: After
Source: TimNummy from Youtube

After researching options, Autobahn trialed a smaller ultrasonic unit with an aqueous all-purpose cleaner, before purchasing the 30L unit. They optimized performance with temperature and concentration of the bath. They are happy with the performance of EPA Safer Choice certified, Simple Green All-Purpose Concentrate, because it is affordable and non-hazardous, so touching it with hands is not a problem and it easily washes off.

Before, the time-intensive cleaning process involved donning filtered masks, heavy gloves, safety goggles, then manually removing debris and oil, running the parts washer, and removing the solvent from the cleaned parts. Periodic replacement of the dirty solvent also caused exposure and took time to properly contain and manage the spent solvent for hazardous waste disposal.

Now they simply place a part inside the pre-heated ultrasonic cleaner, set the timer and go back to work. When parts are too large to fully fit in the unit, they are flipped and run for another cycle. Autobahn says this has allowed their shop to be more efficient and focus on more important tasks. Disposal of the spent solution is much easier. The unit needs cleaning once or twice a month depending on usage or if a greasy part creates too much sludge.

Comparison of Solvent Parts Cleaning to Ultrasonic

Note: Some values in the cost-benefit analysis are estimates.

Metric (Annual Basis)	Solvent Cleaning (Before)	Ultrasonic Cleaning (After)
Investment in New Ultrasonic Unit	$600	
Annual Operating / Maintenance Costs		
Amount of bulk solvent used	~180 gal	N/A
Cost to purchase bulk solvent	$1,400	N/A
PPE and cleaning-related supplies	Filtered masks, gloves, safety goggles, rags	Paper towels, safety glasses.
Cost of PPE and rags	$200	$100
Cost of solvent and sludge disposal*	$360	$100 (Sludge only))
Staff hours in parts cleaning and spent bath / solvent management	8 hrs/week x 50 weeks = 400 hours/year	4 hr/week x 50 weeks = 200 hours/year
Labor cost	$16,000	$8,000
Energy to heat	N/A	$50
Cleaning solution purchase		$300
Drainage mats		$100
Annual Costs	$17,960	$8,650
Simple Payback Period	About one month!	

**Assumes $2/gallon typical hazardous waste management and disposal cost. Exact cost unknown.*

Oregon Auto Shop #2 • Success Story

PPRC conducted an EcoBiz certification walk-through at an auto repair shop and found many best practices already in place. One employee reported high chemical sensitivity to some solvents.

This shop actually does not conduct as much parts cleaning as some other shops, but did occasionally use aerosol brake cleaners and several times per year sent larger parts to an outside vendor for cleaning, to avoid solvents in the shop. After learning about Autobahn's ultrasonic cleaner, they purchased a unit and a non-hazardous cleaner, eliminating the need for aerosols, and occasional cleaning of larger parts offsite.

"We have been really happy with the cleaner, no heavy smells and it cleans well. I am still experimenting with how much cleaner to use, but what a great alternative to harsh solvent cleaners. We definitely recommend ultrasonic cleaning to shop owners."

The shop optimized performance of the ultrasonic cleaner at 125°F, and a 12:1 ration of water to all-purpose cleaner concentrate. They turn the unit on about 15 minutes ahead of time to reach temperature. They have found the bath solution stays cleaner longer, if heavy dirt and grease are manually scraped off before putting in the tank. In certain cases, when some residue remains on the part they will pull the part out at about 15 minutes and brush, then continue the cleaning for another few minutes.

Left: Before; Right: After. Source: Oregon Auto Shop #2

The simple payback analysis below demonstrates the value of safer cleaning chemicals and methods, even in a shop that does minimal cleaning.

Comparison of Solvent Parts Cleaning to Ultrasonic

Note: Some values in the cost-benefit analysis are estimates.

Metric (Annual Basis)	Solvent Cleaning (Before)	Ultrasonic Cleaning (After)
Investment in New Ultrasonic Unit	$400	
Annual Operating / Maintenance Costs		
Cost for sending larger parts for cleaning	$1,000	N/A
Cost of aerosol purchase	$50	$0
Staff hours in parts cleaning with aerosols and sending parts out for cleaning	24 hours/year	N/A
Staff hours managing ultrasonic bath management / change-out	N/A	20 hours/year
Labor (staff time)	$1,200	$1,000
Degreaser, absorbent mat purchases, paper towels	N/A	$200
Annual Costs for Part Cleaning	$2,250	$1,200
Simple Payback Period	About 5 months	

Ultrasonic Cleaners

- ❒ Autobahn Moterwerks is using: VEVOR, 30L.
- ❒ Oregon Auto Shop #2 is using: VIVO, 30L
- ❒ Article: 10 Best Ultrasonic Cleaners – February 2021
  (Although not reviewed specifically for performance in application of auto parts cleaning, the user input is useful for overall performance of ultrasonic cleaners).

Filtration Mats (For use in sinks when draining /cleaning the ultrasonic cleaner)

- ❒ New Pig Oil Mats
- ❒ CRC Smartwasher OzzyMat Multi-Layer Fluid Activation Mat

Cleaning Solutions

- ❒ U.S. EPA Safer Choice Products
  - *Search on Degreasers and/or All-Purpose Cleaners*
- ❒ Green Seal®
  - *Search on Degreasers and/or All-Purpose Cleaners*

YouTube Videos from Auto Mechanics Using Ultrasonic Cleaners

- ❒ https://www.YouTube.com/watch?v=c1vEYCW9pTk
- ❒ https://www.TouTube.com/watch?v=iFYS79_foAE

This document was developed under Assistant Agreement No. X9-01J34101 awarded by the U.S. Environmental Protection Agency (EPA). It has not been formally reviewed by EPA. The views expressed are solely those of PPRC. EPA and PPRC do not endorse any products or commercial services mentioned.