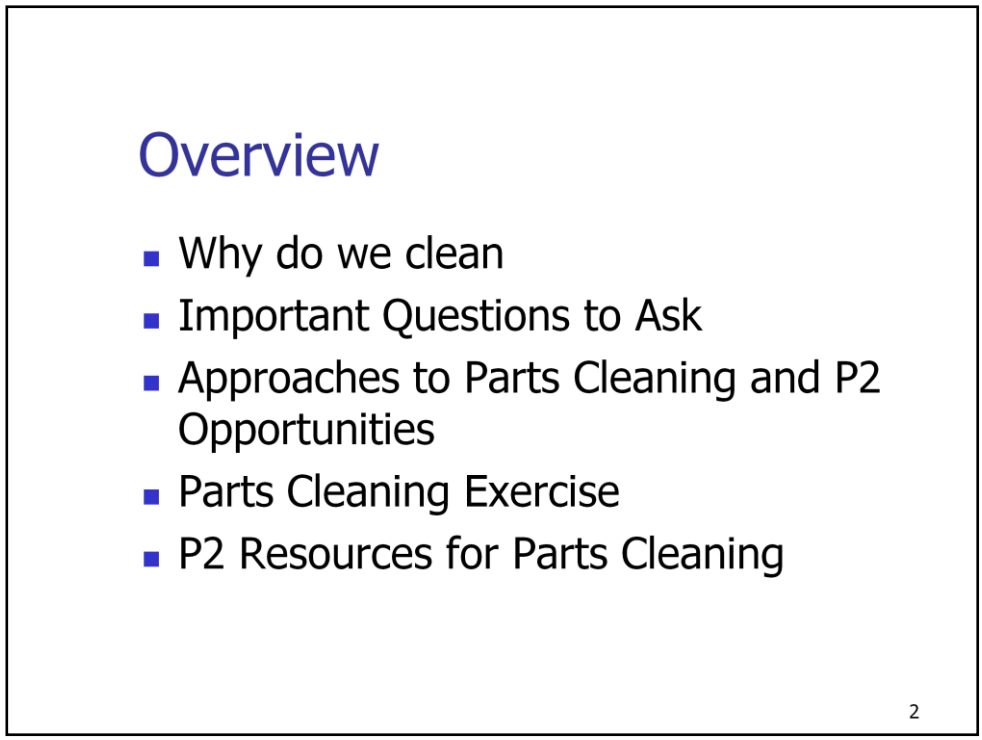
Industrial Parts Cleaners & Alternative Cleaning Solutions – P2 Training

1

Welcome to Industrial Parts Cleaners & Alternative Cleaning Solutions P2 training



First we will look at why you clean and what are the common soils on the the substrate to be cleaned.

Then we will look at parts cleaning solutions and equipment, including potential pollution prevention opportunities

Then we will look at two parts cleaning exercises that examine the true costs of industrial parts cleaning and the cost and waste reduction benefits of changing cleaning solutions and cleaning equipment.

Finally, we will provide a few Web sites with helpful industrial parts cleaning resources, vendor information and case studies.

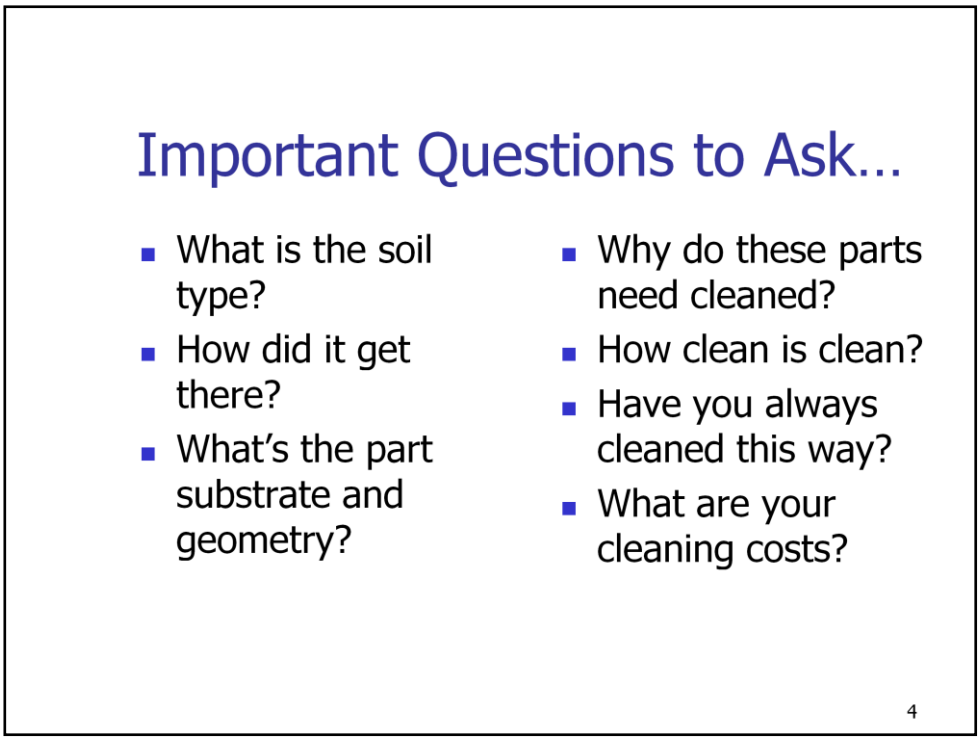


Why do we have to clean parts…

Often, its is necessary as a pretreatment step prior to painting or coating to make sure the paint stays on the part and performs as expected.

Parts are cleaned as a final step after metal fabrication, stamping and assembly to wash off metal working fluids and other contaminants.

Parts cleaning is also routinely occurs as a maintenance step. Most automotive shops use parts cleaning to remove grease, oils and other solids from tools, equipment and vehicle parts.



Whether you are looking to add parts cleaning to a process, or switch to a more environmentally-friendly process, there are important factors that must be considered.

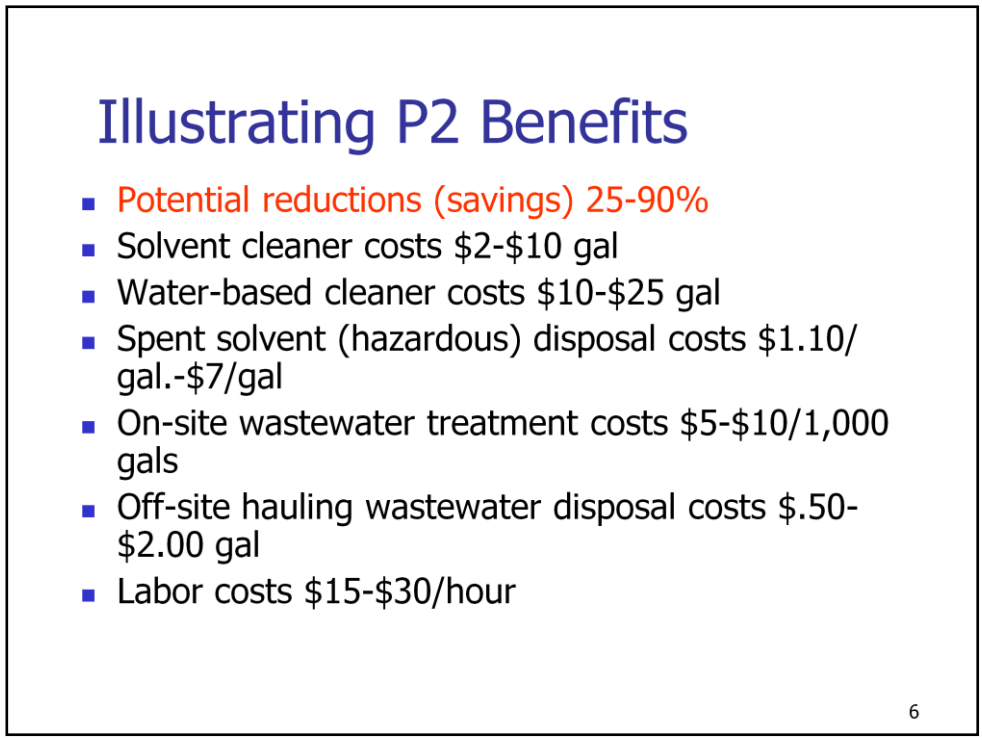
What will be cleaned, what is the contaniment or soil type, how did it get there, what is the typical part (substrate) shape and geometry? Do these parts need to be clean, what is clean, have you always cleaned the way, and what are your cleaning costs?

Common Soil Types

- Oils and greases
- Polishing and buffing compounds
- Metalworking fluids, coolants
- Oxides and rust
- Adhesives, resins, inks and paints

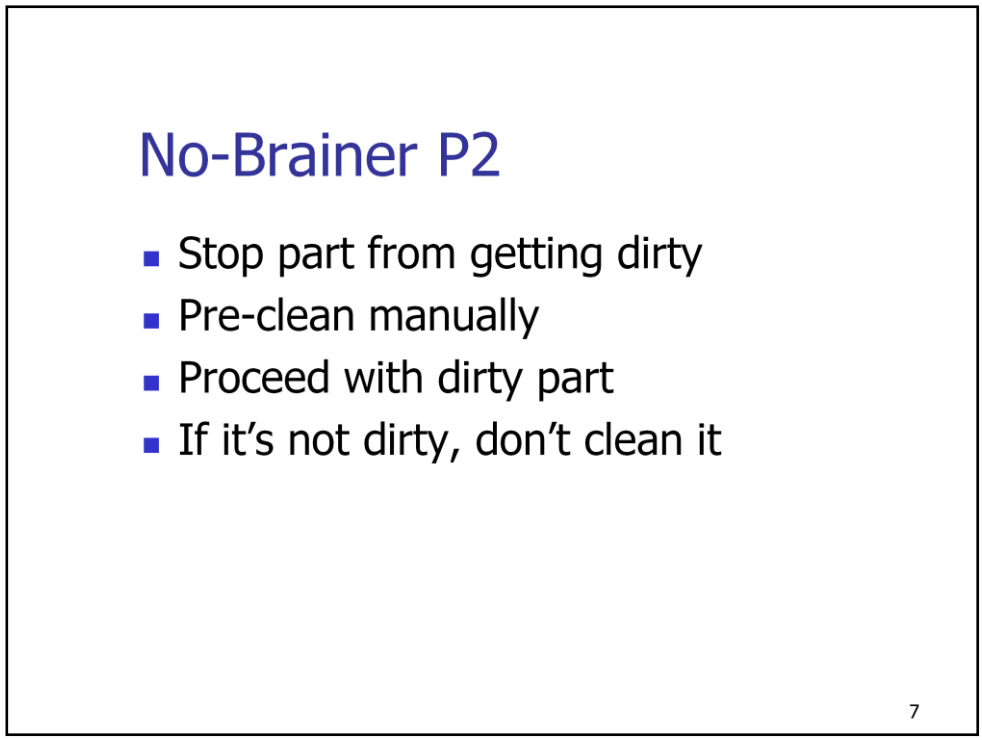
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Here are some coming soil or contaminant types that occur during a pretreatment, final or maintenance step.



As mentioned earlier, it's important to know your parts cleaning associated costs. This is necessary to realize and illustrate pollution prevention benefits.

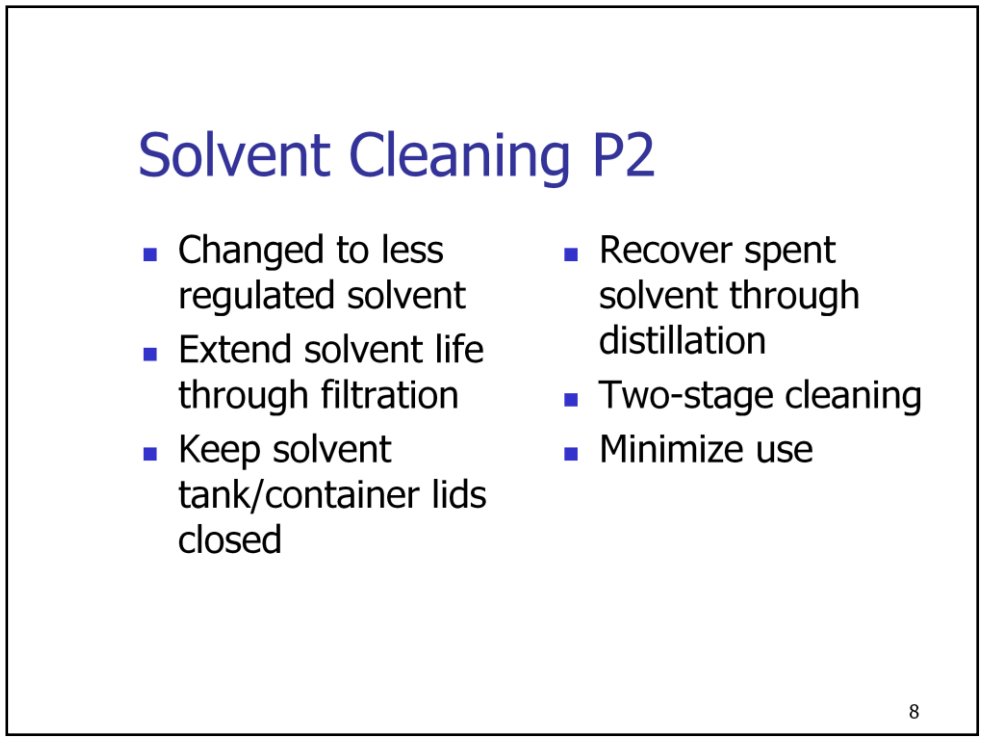
For example, you can see the different costs associated with solvent versus water-based cleaners. These must be considered when making equipment and cleaning purchases and changes.



Before purchases cleaning equipment and solution, you should investigate why the part is getting dirty? Could pre-cleaning take place manually without solvents and energy (utility) input?

Can the part or piece proceed to the next manufacturing step as is without being cleaned.

If a part is not dirty, don't waste resources and time cleaning it.



There are some P2 techniques that can be use to minimize waste created by solvent cleaning.

Changing to a less regulated solvent is on method. Many solvents are available with a higher flash point, lower hazardous air pollutants (HAPs) and less volatile organic compounds (VOCs).

Solvent life can be extended through the use of filtration systems. Cartridge filters can be fitted to an existing system, and some suppliers sell parts washers already equipped with filters.

Air emissions can be reduced from solvent parts cleaners if the lid is kept shut when not in use.

Spent solvent can also be recovered through solvent distillation. A facility can do this on-site or off-site. Most often for on-site distillation, the distillation recovery unit is part of the parts cleaning equipment.

Examine cleaning and avoid cleaning parts when possible. As a preliminary cleaning, use wire brushes, squeegees, or scrapers before a dirty part is cleaned with solvent. Extend the time between solvent servicing. Often periods between solvent change-outs can be extended without any appreciable change in cleaning quality or ability.



This is a picture of a typical sink-on-a drum parts cleaner with a cartridge filter to extend the life of the cleaner solvent.

Add-on Solvent Filtration - Types



Cartridge-type filter unit



Bag filter unit

Source: Kleer-flo

Example of solvent filtration units.

Solvent Distillation Units



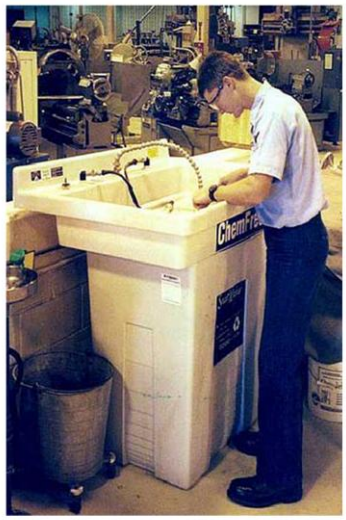
- Cost depends on size
- Good payback common
- 90+% recovery
- Liners ease cleaning

Source: CBG BioTech

Here is an example of a solvent distillation unit. Some things to consider when purchasing a distillation unit:

Cost depends on size, Good payback is common, 90+% recovery, Liners make cleaning easier.

Aqueous-Based Cleaners

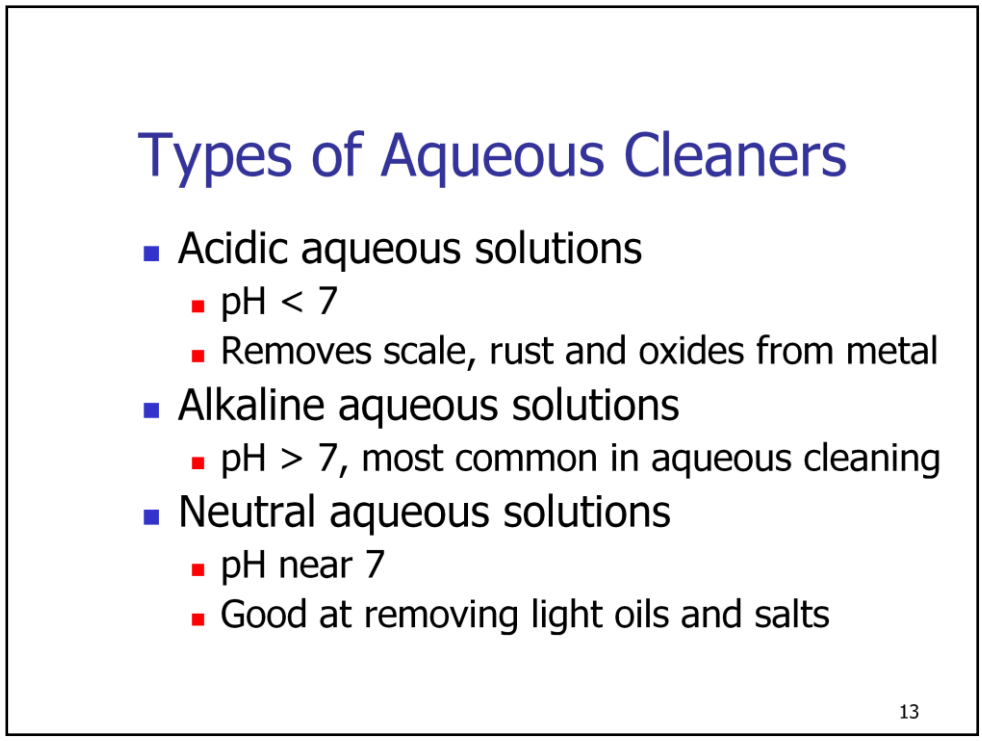


- Water-based solutions
- No/low VOCs
- Non-flammable
- Rely on heat, agitation and soap actions
- Effective for oils/greases

Source: Chemfree

Aqueous-based cleaners are becoming a more popular alternative to solvent cleaning.

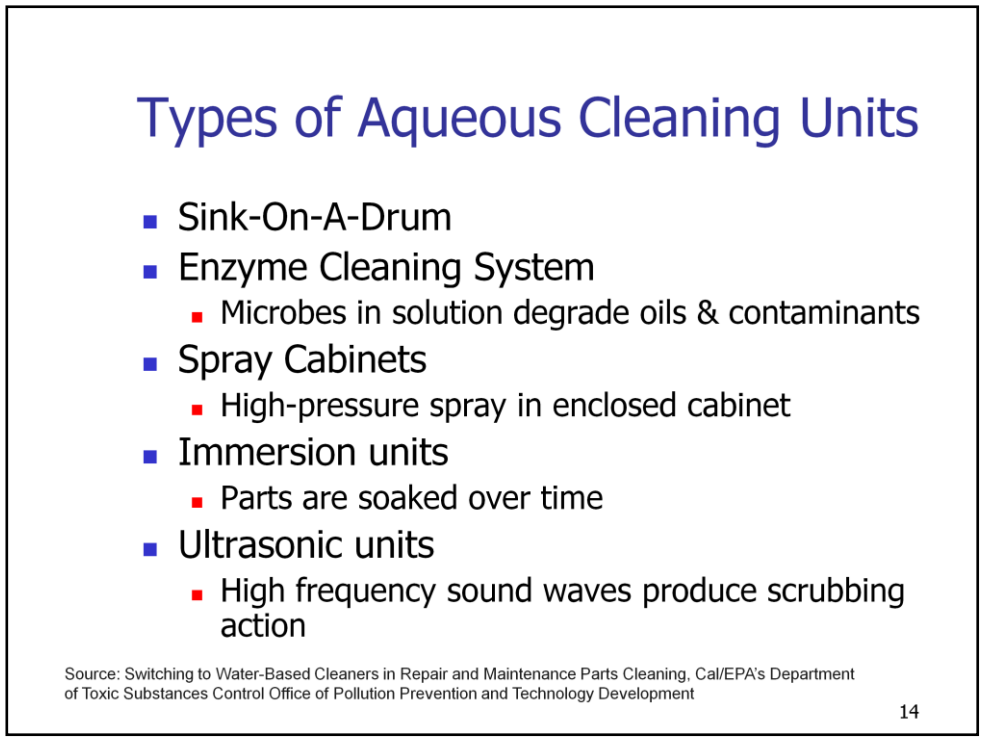
Aqueous cleaners are water-based solutions that, unlike petroleum-based solvents, are typically nonflammable and contain little or no VOCs. Instead of dissolving grease and solids, aqueous cleaners rely on heat, agitation and soap actions to break dirt into smaller particles. Although they clean differently, aqueous cleaners perform as well as solvents.



Acidic aqueous solutions are water-based mixtures with pH less than 7. Acidic cleaning is routinely used to remove scale, rust, and oxides from metals. The cleaners may contain mineral acids (hydrofluoric, sulfuric, phosphoric, nitric), chromic acids, or organic acids (acetic or oxalic). They also may contain detergents, chelating agents, and small amounts of water-miscible solvents. The choice of acid and additives depends on the type of metal to be cleaned and the type of soil to be removed.

Alkaline aqueous solutions are water-based mixtures with pH greater than 7. Most alkaline cleaners range from pH 10 to 14. They are the most common solutions in aqueous cleaning. Alkaline cleaners often contain additives to improve cleaning, such as sequestering agents, emulsifiers, and surfactants. Inhibitors are necessary with some metals, especially aluminum. These compounds can remove greases, coolants, cutting oils, shop dirt, fingerprints, cosmolene, petrolatum, and some water-soluble paints. Parts cleaned with alkaline cleaners include hydraulic valve bodies, fuel injector components, and machined aluminum castings. Alkaline solutions are used with all types of liquid processes, e.g., sprays, ultrasonics, immersion, and power washers. These solutions can clean to very high cleanliness levels with good filtration and rinsing.

Neutral aqueous solutions are mixtures of water and other chemical compounds with a pH near 7. The chemical compounds may include surfactants, corrosion inhibitors, and other additives. Neutral and alkaline



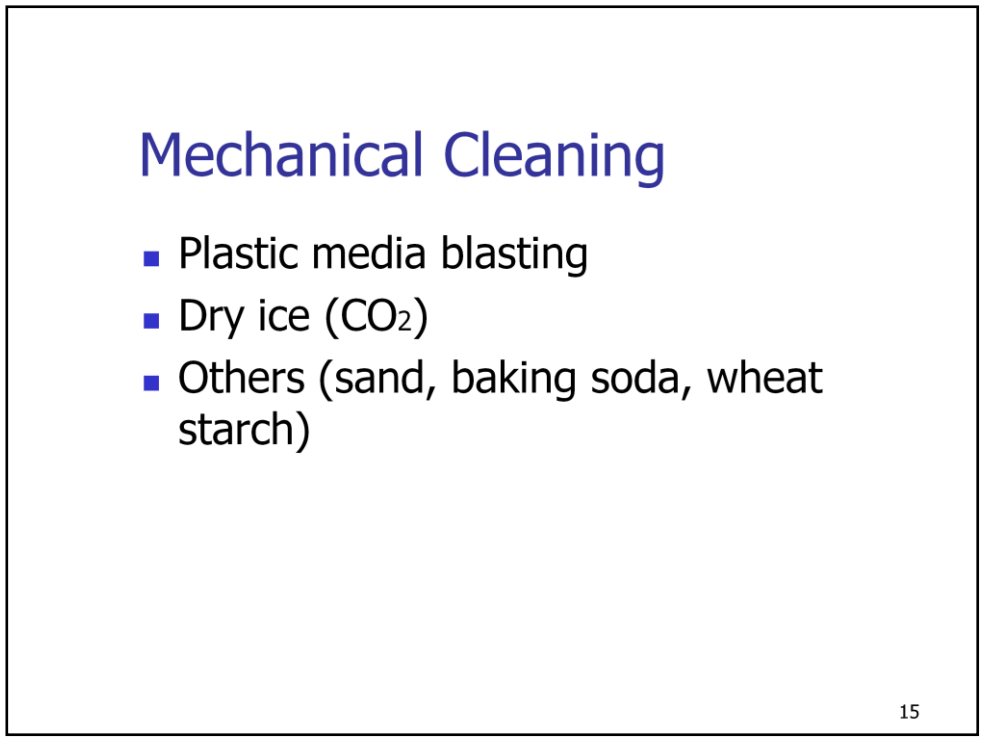
A large variety of cleaning systems can be used with water-based cleaners.

Sink-On-A-Drum

This is the most common type of system. It is a sink mounted on a drum which contains the water-based cleaner. The sink has a drain and contains a faucet and flow brush for cleaning the parts. The water-based cleaner is heated to about 105 degrees F. Many units have filters for removing particulates and oil; some units have oil skimmers. The units are made of metal or plastic. Because the workers' hands contact the cleaner, the formulations used with a sink-on-a-drum must have a neutral pH to prevent skin damage.

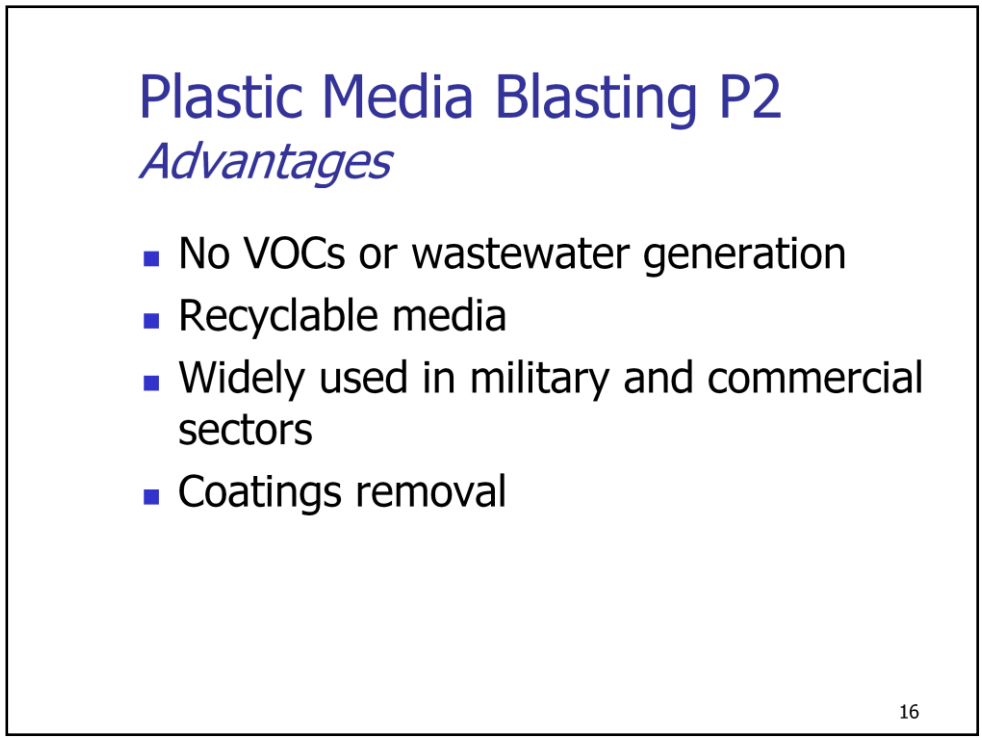
Enzyme Cleaning System

These systems are generally modified sink-on-a-drum units. They are made of plastic and the cleaner is heated to about 105 degrees F. The system includes an enzyme cleaning formulation that supports the growth of microbes which are introduced either directly into the cleaning formulation or in a filter. Because there are microbes, the formulation is of neutral pH. The microbes biodegrade the oil. An advantage of this system is that the bath cleans itself and may last indefinitely without requiring changeout. The majority of debris, oil, grease, and dirt should be removed prior to placement in cleaning unit. Heavily soiled parts may overload the system.



Another method of cleaning part is mechanical cleaning.

This includes plastic media blasting, dry ice (CO2) and other medias including baking soda, sand and wheat starch.



Some advantages to plastic media blasting are:

No VOC or wastewater generation, the media is recyclable into secondary products (e.g. counter tops and plastic garden tools), and has been proven successful in the military and commercial sectors.

Plastic media is effective in removing thick coatings.

Plastic Media Blasting (PMB)

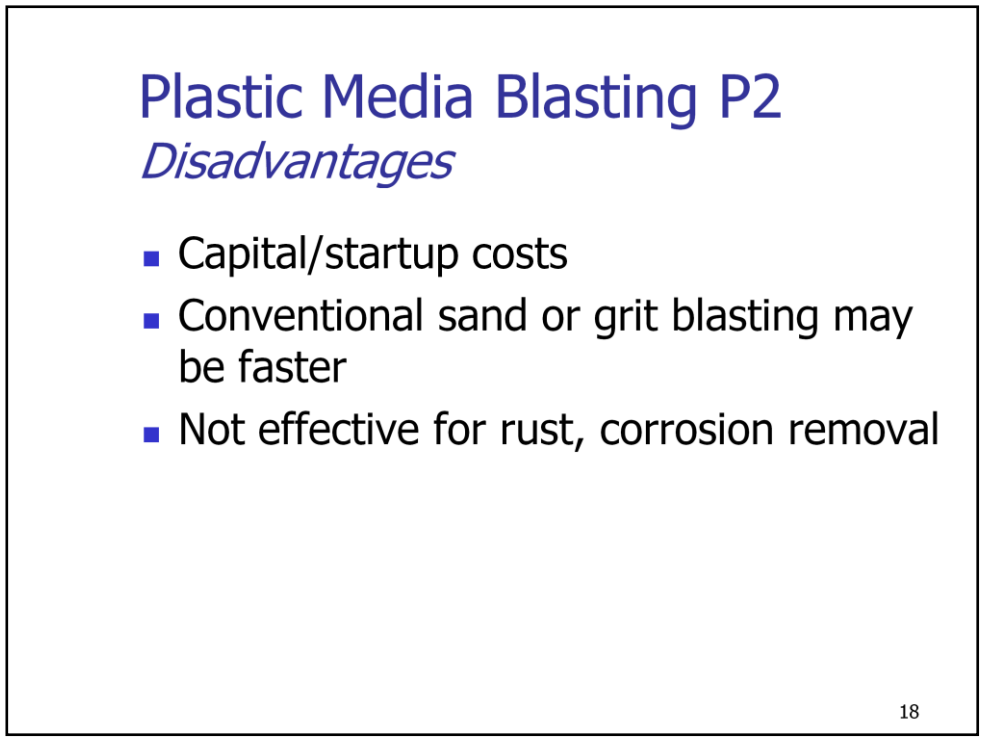
PMB Cabinet



PMB Walk-in Booth



Examples of media blasting equipment.



Some typical disadvantages of plastic media blasting are:

The capital and startup costs with equipment and media, sometimes conventional sand or grit blasting may be faster, and is not effective for rust or corrosion removal.

Dry Ice (CO_2) Blasting
Advantages

- No wastewater or spent media
- CO_2 is nontoxic, non-flammable, non-corrosive
- Applications growing (electronics, rubber, plastics, steel, fiberglass)

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Some advantages to CO2 blasting are:

There are no wastewater or spent media disposal issues;

CO2 is nontoxic, non-flammable, non-corrosive; and

Applications are growing in many sectors, including electronics, rubber, plastics, steel, and fiberglass industries.



Examples of CO2 blasting equipment.

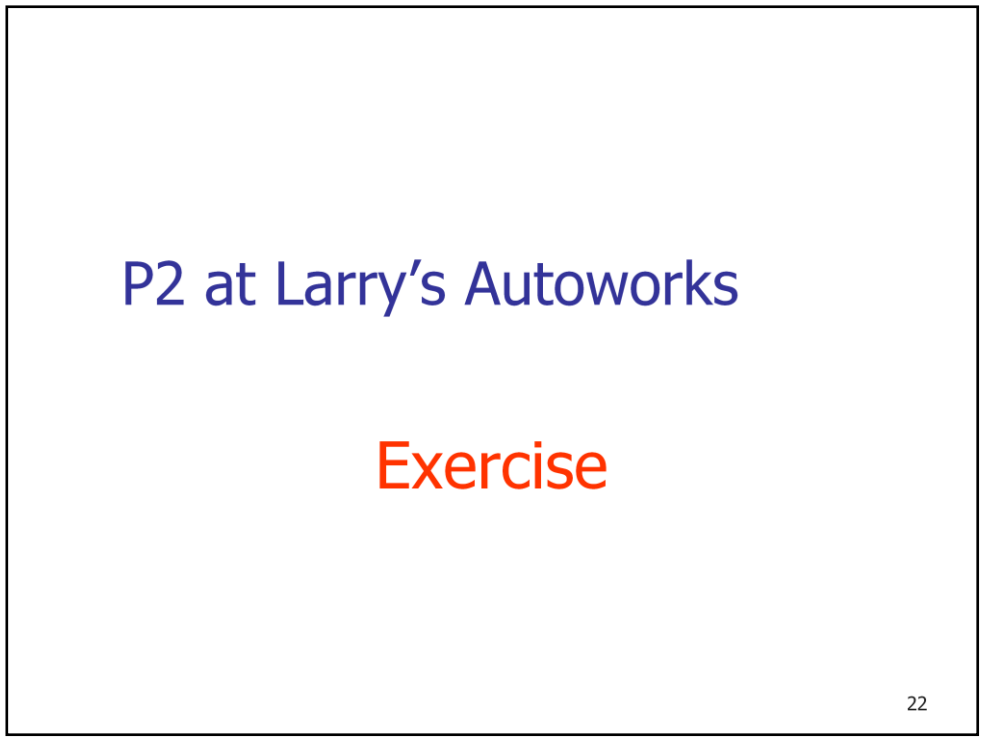
Dry Ice (CO_2) Blasting
Disadvantages

- Capital/startup costs
- Media can not be recycled
- Condensation may occur on some surfaces

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Some typical disadvantages of Dry Ice blasting are:

The capital and startup costs with equipment and media, media can not be recycled, and condensation may occur on some surfaces



This section is a theoretical case study of the waste and cost reductions possible at an automobile repair shop.

P2 at Larry's Autoworks Exercise

- Read site visit information and observations
- Complete "Parts Cleaner Cost Worksheet"
- Answer Questions



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Calculating Parts Cleaning Costs and Savings for an Auto Repair Shop

Larry's Autoworks is a full-service auto repair shop with six auto repair technicians and 14 service bays. Larry's uses two 30 gallon solvent-based (mineral spirits) parts cleaners (washers); one unit is used for quick removal of oils and greases for clean and replace jobs, and a second unit is used for more thorough cleaning.

The units were leased and serviced 6 times a year. The cost for servicing was $159 per unit. Servicing includes filter replacement, spent solvent management and fresh solvent replenishment. Larry's estimates that about 12 total labor hours per week are used to clean parts. Larry's hourly labor rate for technicians is $24. Annual electricity costs (to run pump) are estimated to be about $280 per unit.

OPP and DHWM recently visited Larry's and suggested evaluating aqueous-based parts cleaning. OPP and DHWM's research indicated that other similar-sized auto repair shops have successfully converted to microbial (enzyme-based) units and/or automatic aqueous spray cabinet cleaning units. According to vendor information, capital costs for a 30 gallon enzyme unit is $1,295 and $3,000 for a small spray cabinet unit. According to vendor information, average annual electricity costs (to run heater and pump) for an enzyme unit is $300 and $500 for a small spray cabinet. Cleaner costs for each unit is about $6 a gallon.

Larry's is interested in replacing the two solvent-based units with one 30 gallon microbial unit for clean and replace jobs and one small spray unit for more thorough cleaning jobs. Larry's estimates that 2 labor hours per week for the enzyme unit and 3 labor hours per week for the spray cabinet will be needed to meeting cleaning needs.

Waste disposal considerations include spent filters and spent cleaning solutions. Larry's estimates changing the spray unit cleaning solution twice a year. About 35

Parts Cleaner Cost Worksheet

Current Solvent Cleaning Costs (leased units w/service)	Facility Costs $
A *Number of solvent units leased*	2
B Current cost per service visit per unit	159
C Number of times unit serviced per year	6
D Total annual solvent cost (AxBxC)	1,908
E Cost of electricity used per year per unit	280
F Total cost of electricity (AxE)	560
G Hourly labor rate for cleaning	24
H Total number of cleaning labor hours per week	12
I Total yearly labor costs (GxHx52)	14,976
J **Total Annual Cost for Cleaning (D+F+I)**	17,444

Calculations of cleaning costs.

Parts Cleaner Cost Worksheet

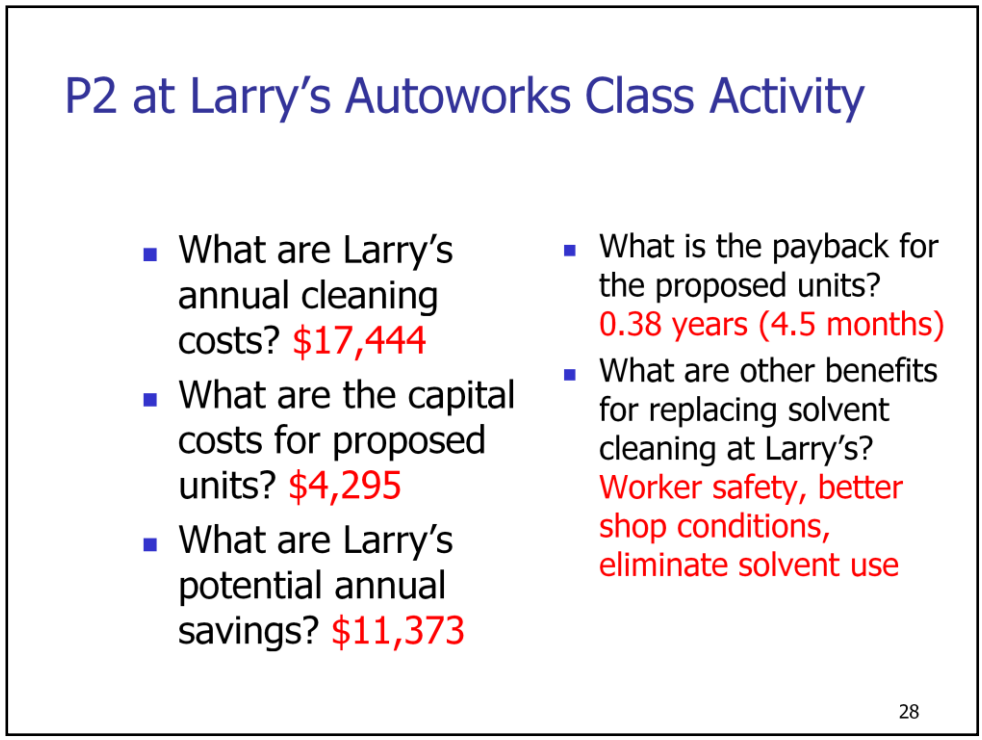
Conversion to Microbial Sink-Top Cleaning Unit	Facility Costs $
K Number of microbial cleaning units to be purchased	1
L Unit purchase price (capital cost)	1,295
M Total capital cost (KxL)	1,295
N Cost per gallon of enzyme cleaner	6
O Estimated annual cleaner use in gallons	30
P Cleaner cost per year (NxO)	180
Q Cost per replacement filter	12
R Number of filter replacements a year	4
S Total annual cost for replacement of filters (QxR)	48
T Cost of electricity use per unit per year	300
U *Estimated total number of cleaning labor hours per week*	2
V Total yearly labor cost (GxUx52)	2,496
W Total Operating Costs to Convert ([P+S+T] x K + V)	3,024

Parts Cleaner Cost Worksheet

Conversion to Aqueous Spray Cabinet Unit	Facility Costs $
X Number of spray units to be purchased	1
Y Spray unit purchased price (capital cost)	3,000
Z Total capital cost	3,000
AA Cost per gallon aqueous cleaner	6
BB Estimated annual cleaner use	70
CC Cleaner cost per year (AAxBB)	420
DD Cost per gallon of spent solution disposal	3
EE Gallons of solution in unit	35
FF Number of solution changes annually	2
GG Total annual cost of spent solution disposal (DDxEExFF)	210
HH Cost of electricity use per unit per year	500
II Estimated total number of cleaning labor hrs. / week	3
JJ Total yearly labor cost (GxIIx52)	3,744
KK Total Operating Costs to Convert ([CC+GG+HH] xX+JJ)	4,874

Parts Cleaner Cost Worksheet

Results	$
LL Total capital cost (microbial unit and spray unit) M+Z	4,295
MM Total operating cost savings (including labor) (J-W-KK)	9,546
NN Payback period in years (LL divided by MM)	.45 (5.4 months)



Answers after completing the Cost Worksheet.

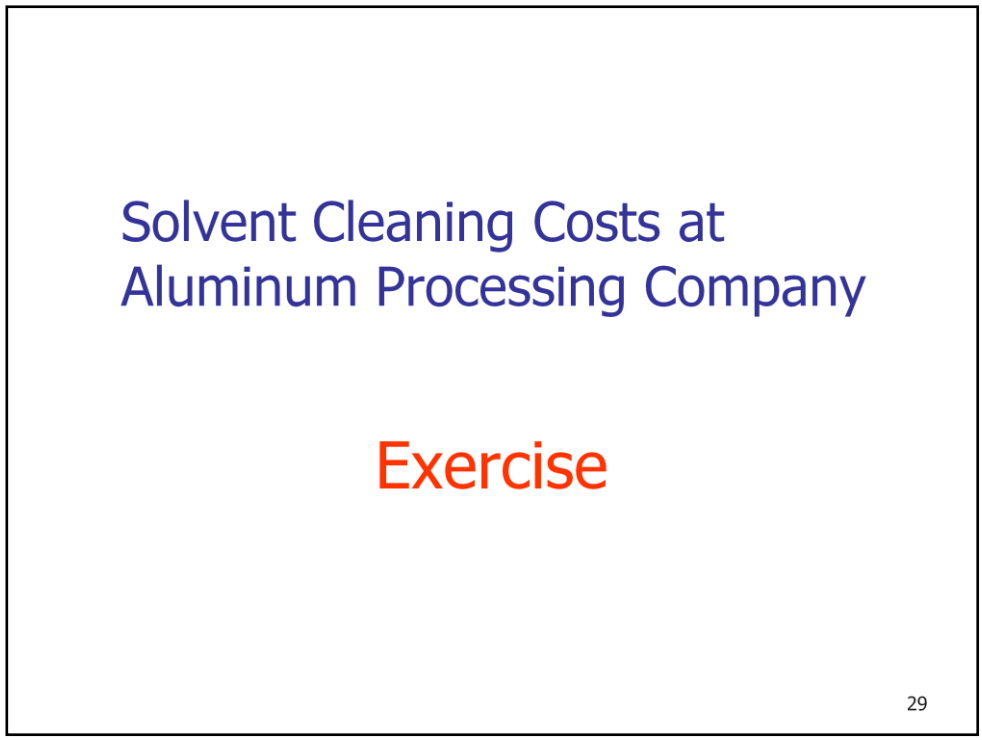
1. What is Larry's current annual solvent cleaning costs? **$17,444**

2. What would be Larry's total capital cost for the enzyme unit and the spray cabinet? **$4,295**

3. What would Larry's annual cost savings be for replacing solvent cleaning with an enzyme cleaning unit and a spray unit? **$11,373**

4. What is the Payback? **0.38 years (4.5 months)**

5. Besides the economic benefits, what may be other benefits for replacing solvent cleaning at Larry's Autoworks? **Worker safety and health, better shop conditions, elimination of solvent use, improved shop image…**



This section is a theoretical case study of the waste and cost reductions possible at an aluminum processing company.

Solvent Cleaning Costs at Aluminum Processing Company Exercise - Instructions

- Review Questions 1-9
- Read "Case History" and highlight cleaning cost data
- Answer Questions 1-9



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Solvent Cleaning Costs at Aluminum Processing Company

Identifying and Evaluating Chlorinated Solvent Cleaning Losses for a Manufacturer of Aluminum Lighting Fixtures

Instructions: Read the "Case Study" below and answer the following questions involving chlorinated solvent cleaning losses for Aluminum Processing Company (APC).

Aluminum Processing Company Case History

Company Profile

Location: Falls River, Ohio

Standard Industrial Classification Code (SIC): 3646 Commercial, Industrial, and Institutional Electric Lighting Fixtures

Product Description: aluminum reflectors and fixtures for track and recessed lighting products

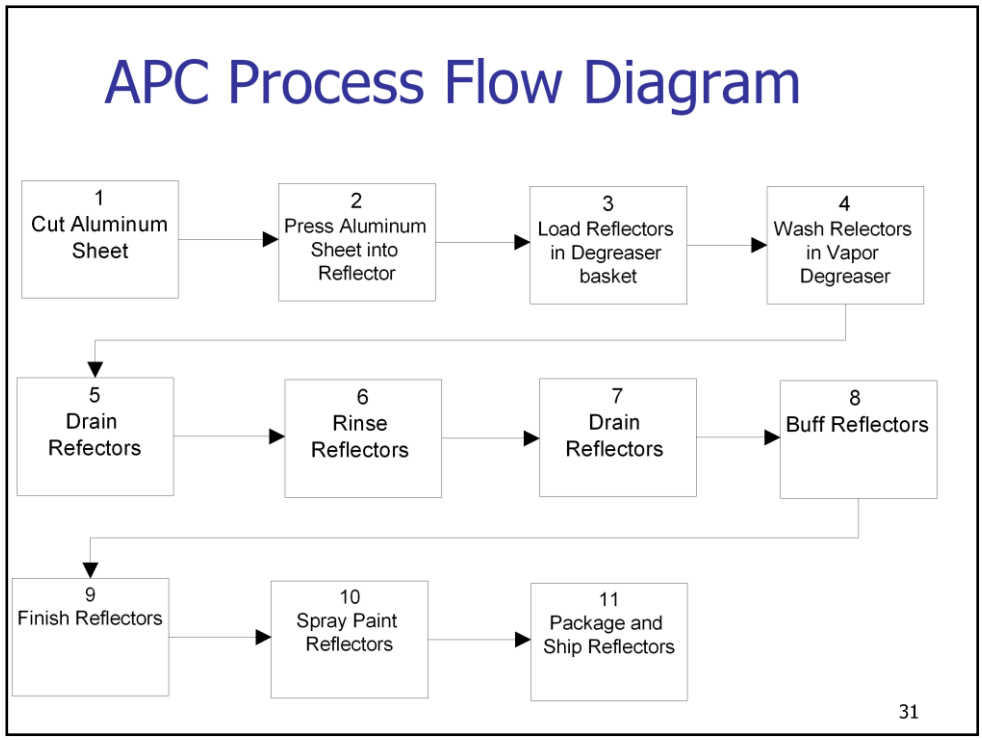
Size: 500 employees

Year Established: 1961

Annual Revenue: $150 million (1995)

Facility: Built in 1980. 250,000 ft² (two buildings).

Certifications: ISO 9001 (1996); ISO 14001 (planned for 2002).



Process Overview

Aluminum Processing Company (APC) is a subsidiary of a national manufacturer and distributor of lighting products and accessories. APC fabricates aluminum reflectors and fixtures for track and recessed lighting customers.

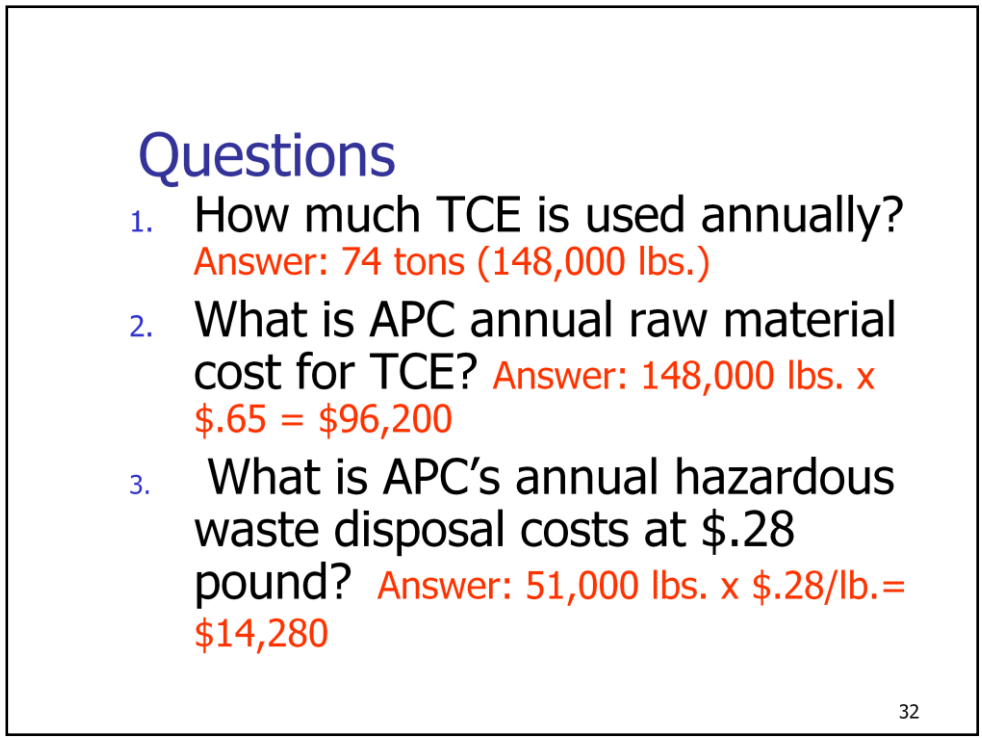
The manufacture of aluminum reflectors involves several steps. First thin aluminum sheets are cut to a specific diameter and passed to hydroform machines where they are pressed into a reflector shape. The aluminum is coated with oil prior to the pressing step. The formed relectors are then cleaned by vapor degreasing to remove the oils and other contaminants. The reflectors are then buffed and finished for high reflectivity. The relectors are spray painted for a high grade finish. The reflectors are then packaged and shipped.

Sources and Costs of Pollution

The costs associated with TCE use has risen over the years. In addition, TCE use triggers a number of environmental requirements including TRI reporting and NESHAP for halogenated solvent cleaning coverage.

APC records indicate 74 tons (148,000 pounds) of TCE are used annually. TCE cost is $.65 pound. Using this volume of TCE took a significant amount of staff time due to monitoring and record keeping for RCRA, NESHAP and TRI compliance reporting. Employees also receive annual training on TCE use and vapor degreasing. Preventative maintenance costs on the vapor degreasing equipment has risen due to the age of the system. These annual costs have been identified (spill/leak reporting - 50 hrs/yr. @$30 hr.=$1,500; monitoring, record keeping 200 hrs./yr. @$30 hr. = $6,000; Right-to-Know Training 30 hrs.yr. @$30 hr. =$900; Labeling 150 hrs./yr @$30 hr. =$4,500; maintenance 660 hrs.yr. @$30 hr. = $20,000; annual permit fees = $1,155).

APC TRI and operational records indicate that 80% of all TCE used is released through



Questions

1. How much tricholorethylene (TCE) does APC use in vapor degreasing annually?

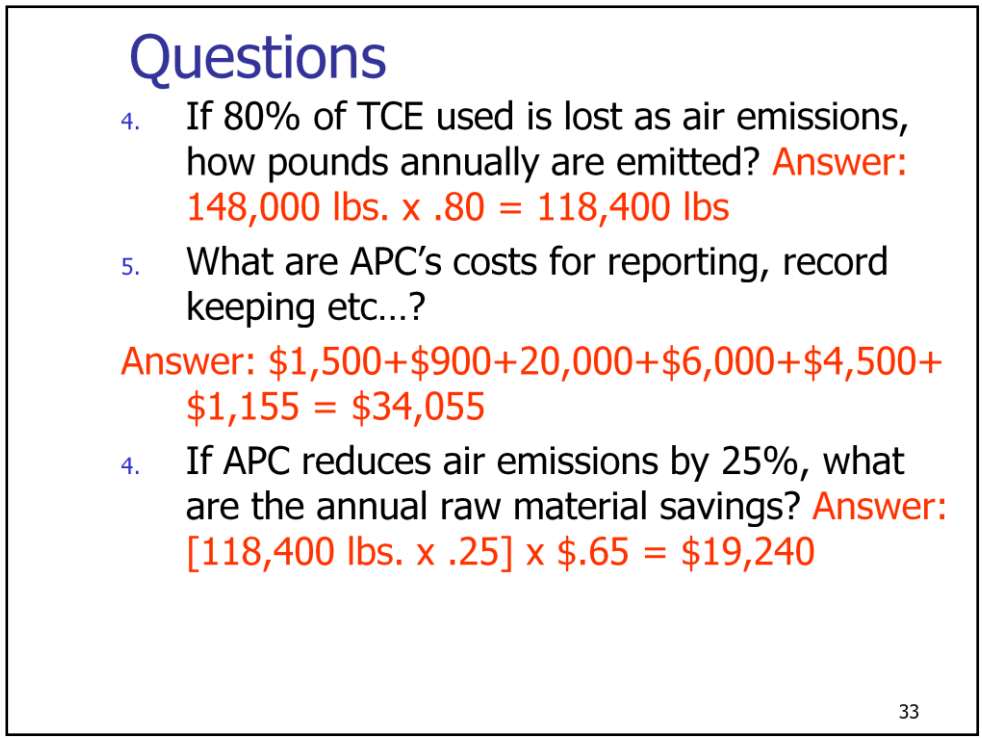
74 tons (148,000 lbs.)

2. What is APC's annual raw material cost for TCE at $.65 pound?

148,000 lbs. x $.65 - $96,200

3. What is APC's annual hazardous waste disposal costs for spent TCE (RCRA F001 waste) at $.28 pound?

51,000 lbs. x $.28 = $14,280



Questions

4. If 80% of TCE used is lost as air emissions, how many pounds of TCE are emitted annually from vapor degreasing?

148,000 lbs. x .80 = 118,400 lbs.

5. What are APC's annual costs for reporting, record keeping, maintenance, training labeling and permitting related to vapor degreasing?

spill = $1,500 training = $900 maintenance = $20,000

records = $6,000 labels = $4,500 permits = $1,155

TOTAL = $34,055

6. If APC reduces air emissions (evaporative losses) by 25% through improved operating practices and equipment modifications, what would the annual raw material savings for TCE at $.65 pound?

118,400 lbs. x .25 = 29,600 lbs. x $.65 = $19,240

Questions

7. What is APC's annual operating cost for the vapor degreaser? Answer: (Q.2+Q.3+Q5) = $144,535
8. What is the Simple Payback for the "Least Cost" Proposal? Answer: 1.3 years ($147,205/$144,535-$32,115)
9. What is the Simple Payback for the "Highest Cost" Proposal? Answer: 2.0 years ($232,735/144,535-32,115)

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Questions

7. What is APC's annual operating cost for the vapor degreaser?

(#2 + #3 + #5)

$96,200 (raw material) + $14,280 (disposal) + $34,055 (operating cost) = $144,535

8. If APC selected the least cost vendor proposal for an aqueous cleaning system to replace vapor degreasing, what is the simple payback?

(Payback = Capital cost /Operating cost savings)

Operating cost savings = Current operating costs - projected operating costs

Current operating costs = (#7) $144,525

Projected cost for aqueous - $13,500 (cleaner) + $4,400 (maintenance) + $14,215

(treatment/disposal) = $32,115

Operating Cost Savings = $144,535 - $32,115 = $112,240

Payback = $147,205/$112,240 = 1.3 years

9. If APC selected the highest cost vendor proposal, what is the simple payback?



The following Web resources are available to provide more information, vendors, case studies, and research regarding parts cleaning and other alternatives.

Ohio EPA's Office of Pollution Prevention has a Parts Cleaning Web page at www.epa.state.oh.us/opp/parts-cleaning.html

SAGE is a comprehensive guide designed to provide pollution prevention information on solvent and process alternatives for parts cleaning and degreasing. SAGE does not recommend any ozone depleting chemicals. http://clean.rti.org/

Waste Reduction in Metal Cleaning - From the North Carolina Office of Waste Reduction. Information on solvent, aqueous and other parts cleaning systems. Web sites, manuals, articles, reports, fact sheets and case studies are provided.

http://wrrc.p2pays.org/industry/metalclean.htm

Suppliers of Low-VOC Cleaning Materials and Equipment from the From South Coast Air Quality Management District (California).

http://www.aqmd.gov/prdas/water.html

AQUEOUS PARTS CLEANING from the California Department of Toxic