TRIM WASTE MINIMIZATION AT THE PINELLAS PLANT

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ABSTRACT

Bacteria counts and several methods of slowing bacterial growth in machine trim coolant are suggested to reduce the frequency of coolant replacement without risking employee health or the longevity of the product or machinery. On-site treatment and disposal of waste trim are recommended to further reduce waste volume. This paper discusses the benefits of these efforts, including projected cost savings based on partial implementation at the Department of Energy's Pinellas Plant.

INTRODUCTION

The trim coolant in a machine sump is a fertile medium for the growth of bacteria. Excessive bacterial growth can endanger an operator's health, as well as the longevity of the machine and its product.

The simplest solution is to change the machine trim coolant often. But how often? And on the basis of what criteria?

At the Department of Energy's Pinellas Plant, Waste Management personnel have begun using bacteria counts to determine when a coolant change is necessary. This method and several effective means of slowing bacterial growth have substantially reduced the plant's output of waste trim coolant. As a result, Waste Management has been able to treat and dispose of waste trim on-site.

This paper describes the background, methods and benefits associated with these efforts.

BACKGROUND

Trim coolant is sprayed on a part that is being machined in order to reduce friction between the tool and the part. (The Pinellas Plant uses the coolant Trim** Regular.) Reducing the amount of heat generated during tooling helps prevent a loss of temper in the part or damage to the machinery.

Because it is organic, machine trim coolant is a fertile medium for the growth of bacteria. As the bacteria multiply they break down the coolant, reducing its performance and longevity. At a bacteria count exceeding 10^{12} per cubic meter (10^6 per milliliter), the coolant performs very poorly and places operators at risk of developing secondary bacterial infections and dermatitis.

Numerous factors involved in the use of machine trim coolant affect bacterial growth:

<u>Mixing and concentration control.</u> Machine trim coolant is purchased as a concentrate and must be diluted properly before use.

<u>The quality of the water used to dilute the trim coolant concentrate.</u> Tap water contains minerals that collect in the sump of a machine and encourage bacterial growth. Deionizing the water removes the minerals and eliminates this problem.

<u>Proper and thorough cleansing of the machine.</u> Simply emptying a machine of waste trim coolant and refilling it with fresh coolant does not prevent rancidity. The new coolant is immediately inoculated with bacteria unless all sludge, chips and spent coolant are removed before the new coolant is added.

<u>The presence of "tramp" oil in the machine sump.</u> Tramp oil is oil that has leaked into the sump as a result of the design or operation of the machine. This oil serves as a food source for bacteria.

<u>Stagnation of the sump liquid.</u> If the sump liquid is not agitated or aerated in some manner, it will favor the growth of anaerobic, sulfur-reducing bacteria. The activity of these bacteria produces foul-smelling hydrogen sulfide gas.

RECYCLING AS A SOLUTION

Initially, the Pinellas Plant attempted to clean and recycle machine trim coolant on a regular basis in order to control bacterial growth, save on the cost of buying new coolant and reduce waste. Waste reduction is a primary goal of the plant's Waste Minimization Program, instituted under U.S. Government regulation to limit hazardous waste production.

Waste Management personnel spent an average of three overtime hours per week removing waste coolant from sumps with a "Yellow Bellied Sump Sucker"*** and chemically destroying the bacteria in the coolant. A total of about 0.95 cubic meters (250 gallons) of coolant were processed each week and left in the Machine Shop for reuse.

And each week, Machine Shop personnel returned 0.80 (210 gallons) of those 0.95 cubic meters to Waste Management for disposal! They recycled only 0.15 cubic meters (40 gallons) of the cleaned coolant (in the Jones & Lamson Turret Lathe****) because the cleaned, recycled machine trim coolant had a strong odor and looked dirty. Moreover, the odor and appearance of the liquid caused shop personnel to request changing of the recycled coolant more frequently than was necessary to preserve the coolant's effectiveness or protect the employees' health.

Despite attempts to reduce the volume of waste coolant and save costs by recycling, 3.41 cubic meters (900 gallons) of coolant from the Machine Shop were being delivered to Waste Management for disposal every month.

* GE Neutron Devices operates the Pinellas Plant for the U.S. Department of Energy under contract number DE-AC04-76DP00656.
** Trim is a registered trademark of Master Chemical Corporation.
*** The "Yellow Bellied Sump Sucker" is a product of Master Chemical Corporation.
**** The lathe is manufactured by Jones & Lamson-Vermont Corporation.

RECOMMENDATIONS

Coolant Testing and On-Site Trim Treatment and Disposal

Instead of routinely removing and cleaning machine trim coolant during preventive maintenance (weekly), the Pinellas Plant has begun to measure the bacteria content of the sump liquid to determine if the coolant's removal is necessary. Bacteria growth test strips are dipped into the coolant and the strips are incubated overnight. If the bacteria count on the incubated strips exceeds 10^{10} per cubic meter (10^4 per milliliter), the spent coolant is removed with a shop vacuum to a 55-gallon steel drum, the machine is thoroughly cleaned and new coolant is added. For closed systems such as the Bostomatic,* taking a bacteria count has reduced the frequency of coolant changes to about once per month without endangering employee health or the longevity of the product and machine.

Rather than transport the waste trim to another state for treatment and disposal, Waste Management treats the spent coolant on-site in a Wastewater Treatment System.** Aluminum chloride is pumped into the trim to reduce its pH and float heavy metals and impurities to the surface. The solution is then neutralized with sodium hydroxide to make it safe for later on-site disposal. Next, a polymer is injected. The polymer flocculates the surface material, which is filtered out and placed in a compactor for off-site incineration as non-RCRA solid waste. The liquid is pumped into the drain after being randomly tested to ensure that it meets EPA and RCRA requirements for the disposal of metals into the POTW (Publicly Owned Treatment Works). This on- site treatment and disposal of spent trim coolant is cost-effective and satisfies the regulations and requirements of the U.S. Department of Energy.

In addition to the above example, the Pinellas Plant offers the following suggestions to help minimize waste and reduce costs.

Examination of New Machines

Waste Management inspects the design of all new machines for possible oil leakage. Some machines, like the Bostomatic, have a sash or tray to stop tramp oil from falling into the sump. Its closed-loop system also helps prevent oil contamination.

A well-designed machine requires less frequent changes of machine trim coolant.

Removal of Solids

Pieces of metal or plastic from machined parts should be scooped out of the sump daily, since they provide a surface (or food) for bacteria to grow on. In addition, rusting of the metal fragments encourages the growth of anaerobic bacteria *because it removes free oxygen from the liquid.*

Addition of Fresh Trim Coolant to Sump

One producer of trim coolant, Master Chemical Corporation, recommends adding a five- to ten-percent solution of fresh trim coolant to the sump each day to help stem the growth of bacteria.

Visual Inspection

Oils, greases, and other lubricants that enter the sump liquid encourage bacterial growth. Efforts should be made to minimize the introduction of these bacteria foods, as well as to check the condition of the sump liquid as often as the machine is used or daily (whichever is more frequent). The sump liquid should be replaced if it becomes murky.

Agitation of Standing Waste Trim Coolant

Stirring the sump liquid adds oxygen and slows the growth of anaerobic bacteria. Waste trim coolant that has been removed from the sump should also be stirred (and oil skimmed from its surface) if it must remain standing for more than a day.

Filtration

Filtering the sump liquid as it is used by the machine can remove materials that favor the growth of bacteria.

PROJECTIONS

The Pinellas Plant implemented bacteria counts and on-site trim treatment and disposal in its Machine Shop (Area 104) on a trial basis from August 1985 through July 1986. The data collected during this period was used to project plant-wide savings, based on current production rates and equipment. Of course, an increase in production rates or equipment would greatly impact these figures.

Plant-wide, waste trim coolant production would be reduced from about 5.77 cubic meters (1525 gallons) to fewer than 2.32 cubic meters (613 gallons) per month. Less waste means lower costs for handling and treatment and less potential impact on the environment and human health.

By abandoning its ineffectual recycling effort, the plant would save $23,576 in costs associated with cleaning fluids, virgin chemical, coolant handling, and waste transport and disposal. These savings are offset by the cost of the sampling materials and incubator ($523), for a net savings of about $23,054. (The savings are itemized in Tables I, II and III.) In addition, the plant would eliminate unnecessary overtime pay. The on-site treatment and disposal of waste trim would reduce long-term liability for waste disposal, as well as eliminate time spent on vendor selection.

Employee health would be protected, since bacterial growth would be monitored and waste coolant would be removed before it presented a health hazard.

Despite the less-frequent changing of the coolant, the longevity of parts would be guaranteed and the machinery used to produce the parts would not be subjected to excessive wear because of coolant breakdown. The coolant would be changed as often as required. Of course, the coolant could also be changed after the installation of new machine parts or in the event of accidental contamination.

* Bostomatic is a registered trademark of Boston Digital Corporation.

** The Wastewater Treatment System is designed and manufactured by Beckart Environmental, Inc.

CONCLUSION

Taking steps to measure and discourage bacterial growth in machine trim coolant helps avert job-related health problems and damage to tooled parts and machinery. It also prevents the disposal of coolant that is still performing well.

The resulting waste minimization and on-site treatment and disposal of spent coolant contribute significantly to the Department of Energy's efforts to protect human health and the environment. The numbers quoted in Table I and the projections in Table II are based on data collected in the plant's Machine Shop (about 80 machines) for the period August 1985 through July 1986.

Guide

Machine Trim Coolant, Regular Concentrate, Serial No. 4420110098

1 m^3 Concentrate = 20 m^3 Coolant

$1,944 per m^3 Trim Concentrate = $97.20 per m^3 Coolant

Disposal Cost at Du Pont = $63.40 per m^3 Coolant

Cost of Transportation to New Jersey = $221.90 per m^3 Coolant

Cost of Virgin Chemical for On-Site Treatment = $7.74 per m^3 Coolant

TABLE I

Machine Shop Coolant Costs (per year)

	Annual Generation Rate and Expenses	Bacteria Count/ Off-Site Disposal	Bacteria Count/ On-Site Treatment
Coolant Waste (Dilute)	40.88 m^3 (10,800 gal)	13.63 m^3 (3,600 gal)	0 m^3
Cost of Concentrate (m^3/20 x $1,944)	$ 3,973.54	$ 1,324.84	$ 1,324.84
Cost of Disposal (m^3 x $63.40)	$ 2,591.79	$ 864.14	0
Cost of Transportation (m^3 x $221.90)	$ 9,071.27	$ 3,024.50	0
Cost of Treatment Chemicals (13.63 m^3 x $7.74)	----	----	$ 105.50
Total Cost	$15,636.60	$ 5,213.48	$ 1,430.34
Total Savings	----	$10,423.12	$14,206.26

TABLE II

Projected Coolant Costs for the Entire Plant (per year)

	Annual Generation Rate and Expenses	Bacteria Count/ Off-Site Disposal	Bacteria Count/ On-Site Treatment
Coolant Waste (Dilute)	69.27 m^3 (18,300 gal)	27.82 m^3 (7,350 gal)	0 m^3
Cost of Concentrate (m^3/20 x $1,944)	$ 6,733.04	$ 2,704.10	$ 2,704.10
Cost of Disposal (m^3 x $63.40)	$ 4,391.72	$ 1,763.79	0
Cost of Transportation (m^3 x $221.90)	$15,371.01	$ 6,173.26	0
Cost of Treatment Chemicals (27.82 m^3 x $7.74)	----	----	$ 215.33
Total Cost	$26,495.77	$10,641.15	$ 2,919.43
Total Savings	----	$15,854.62	$23,576.34

TABLE III

Additional Equipment Costs

Hach Incubator	$ 300.00
Cole Parmer Whirl-Pak Sampling Bags (per 500)	35.00
Bacterial Growth Test Kit (per 500)	187.50
Total Cost	$ 522.50
PLANT-WIDE SAVINGS FROM IMPLEMENTATION OF BACTERIA COUNT AND ON-SITE TREATMENT (TABLE II)	$23,576.34
ADDITIONAL EQUIPMENT COSTS	- 522.50
TOTAL SAVINGS	$23,053.84