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For Cleaning Process Improvement

Aqueous Shows Its Teeth

Harnessing Oil-Splitting Surfactants to Achieve Pollution Prevention

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Water minimization and surfactant recycling are two major obstacles confronting efficient use of aqueous cleaning technologies. In this article, present philosophies based on strong emulsion forming surfactants are being re-examined.[1]

Figure 1. The system has a parts washing sink for the user.

The engineers at the Illinois Waste Management and Research Center (WMRC) have developed an aqueous parts washing system that offers a potential solution to this obstacle. This system has been used successfully in small parts washing applications, combining the innovations from aqueous chemistry development with separation technology. The system, called the Grease Gator provides a technology that cleans better than mineral spirits, is relatively safe to use and generates little waste.

Aqueous Cleaning Chemistry

The Grease Gator chemistry is an alkaline (pH = 11.3) mixture of surfactants, builders and rust preventative that is capable of removing soils ranging from light oils to bearing grease.

Laboratory and field testing performed by WMRC confirms that the chemistry, used at proper concentration and temperature (about 110^{O}F), outperforms mineral spirits on most major soils encountered in maintenance applications. (See Testing.)

Senior Automotive, (*www.seniorautomotive.com)* a manufacturer of flexible automotive components such as fuel injection lines, oil feed and drain tubes, secondary air systems, exhaust sytem connectors, bellows and seals, and heat exchanges, has been using the Grease Gator. According to Mark Glawe, facilities manager, "One of our goals was to reduce our VOC levels at all of our facilities. [This technology] is working great and [we] are amazed that the cleaning process is easy on the hands with an improvement in cleaning power."

Based upon transient emulsion forming detergents[2], the Grease Gator chemistry is also effective in splitting oil from the cleaning solution. Once the oil phase separates from the detergents, it can be removed, thus extending the useful life of the solution.

Testing

The test procedure consists of the following:

- 1.0 gram Kendall Super Blu high temp bearing grease is applied to 2 in. x 3 in. steel coupons.
- The coupon is submerged in beaker with 400 ml heated solution (45^{O}C).
- Agitation is applied and time recorded.
- Notes are compiled based upon visual observations of amount (%) surface area of grease removed.
- Total time for 100% removal of grease from coupon is recorded.

Testing results* are in Table 1.

What's Different

The Grease Gator parts washing equipment includes a standard steel or stainless steel sink mounted on a 30-gallon vessel (Figure 1). A patented separator system (U.S. Patent No. 60/494,217) is placed in the vessel that continuously splits oil from the solution as it is being used to wash parts. The oil is collected in a separate chamber and can be regularly purged from the system. It can be managed with other waste oil sources.

Figure 2. The "before and after" cleaning solutions appear to be similar from the Grease Gator.

The cleaning solution should normally stay clean for several months (Figure 2), needing only occasional additions of water and chemical to replace evaporation and drag-out losses. The goal would be to maintain the performance of the cleaning solution longer than is usually experienced with traditional solvents.

For example, Dynamic Manufacturing, (*www.dynamicmanufacturing.com*) a company that specializes in the remanufacture of all makes and models of torque converters and transmissions, implemented this technology on its production line to clean large volume of parts.

A torque converter connects the engine to an automatic transmission and serves three primary functions. First, the torque converter transfers engine torque to the transmission. This also allows the vehicle to come to a complete stop without stalling. Not only

Table 1. Test Results.

Cleaner	Concentration	PH	Total Time (hr:min:sec)
Solvent	Na	Na	1:05:50
Grease Gator Cleaner	1:4 (20%)	11.28 to 11.60	0:42:30
Grease Cleaner w/ RP	1:4 (20%)	11.06	0:28:00

**Other cleaners tested at various concentrations, results not listed.*

does the torque converter transfer engine torque to the transmission and the transaxle gear train, but it is also responsible for multiplying that same engine torque to the transmission. This is the torque converter's secondary primary function and results in enhanced vehicle performance. Thirdly, the torque converter provides a direct-drive, or mechanical, link from the engine to the transmission. This is accomplished through the use of a torque-converter clutch.

According to Pedro Caraballo, director of environmental health and safety at Dynamic, the Grease Gator reduces chemical and maintenance costs. Every other day, a five-gallon bucket of oil was decanted from the system's oil separation mechanism. A simple turn of a valve allows the used oil to be drained from the machine keeping the cleaning solution always clean (Figure 3).

Performance

This technology can fit seamlessly into existing applications. The following description illustrates how the Grease Gator separates oil during the course of the cleaning procedure. A typical procedure for the Grease Gator's use would be as follows:

Preparation

- Cleaner 413A-JS
- 30 gallons -20% concentration at 110 ^{o}F
- Elapsed Time.

It should be noted that the cleaning solution remained clear throughout test and the solution was then used to clean glassware used in test. Additionally, the solution did not cause any discomfort to hands or have any foul odors. Finally, the geometry of plumbing for this system prevents complete purging of oil.

The system has been tested in applications including university garages, transmission rebuilders, national laboratories, railroad maintenance facilities and high school shops. Users of the system have identified advantages of the Grease Gator over traditional small parts washing systems, including reduced cost achieved through less chemical usage and reduced waste, and in-process purification. The system makes use of the parts washer's existing vessel and pump, so the fluid is purified as it is being used without additional process steps and with no additional devices.

Consequently, fluid purification is achieved with minimal cost and complexity, as well as an improved safety compliance (the fluid is relatively safer to employees and the environment than traditional solvents and little or no waste is created).

Future Developments

To date, the Grease Gator technology has only been applied in small parts washer applications. However, scientists at WMRC believe that the technology will scale up nicely to large-scale parts washing applications in manufacturing and maintenance. Plans are also underway to apply the principles developed while creating the system to fluid management systems associated with metal working fluids and other industrial lubricants.

Figure 3. A worker is shown purging oil from the collection chamber in the Grease Gator.

About the Author:

Since June 1995, Dr. Nelson has been the Process Evaluation Chemist at the Waste Management and Research Center (WMRC) in Champaign, Illinois, and will be joining the United States Environmental Protection Agency (USEPA) in January of 2005. At WMRC he directed the Alternative Cleaning Technologies Laboratory (ACTL) and the Alternative Chemical Process Laboratory (ACPL). The work in both labs focuses on the evaluation, design and implementation of cleaning and chemical processes, which will lead to pollution prevention. In addition, he is a Visiting Research Scientist in Chemistry at the University of Illinois. He can be reached at wmnelson@uiuc.edu. Additional information is available from Dr. Tim Lindsey at the Illinois Waste Management and Research Center at tlindsey@wmrc.uiuc.edu.

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