NEUTRAL pH AQUEOUS CLEANING

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To date, there are only two technologies which have been developed specifically to replace the ozone-depleting solvents used for industrial cleaning: semi-aqueous cleaning and the Advanced Vapor Degreasing (AVD™) process. Of course, other cleaning methods which existed prior to the concern over the use of ozone-depleting solvents have been adopted to replace these solvents in some instances. For example, one such process, aqueous cleaning, has been applied to a variety of applications.

All or almost all of the aqueous cleaners available today are alkaline in nature. Alkaline aqueous cleaners function well for many tasks. However, there are a number of applications, such as cleaning aluminum substrates, in which alkaline conditions may not be acceptable. Under some conditions, aluminum is damaged by exposure to caustic solutions. Further, alkaline conditions can damage certain surface coatings on a number of metals including aluminum, particularly at higher temperatures. For these and other reasons, it would be advantageous to have a neutral pH aqueous cleaner for a variety of industrially important applications.

Another disadvantage of many available aqueous cleaners is that most are only effective over a narrow range of soils. As a result, a typical alkaline cleaner product line capable of handling a wide range of soils must include several different materials, from which a specific product would be chosen to clean any particular soil.

*AVD is a trademark of Petroferm Inc.
Because of the desirability for an aqueous cleaner with both neutral pH and wide applicability to different soils, we undertook a program designed to identify a composition with these specifications. This task was successfully completed, and two versions of the material are now available: one for spray-in-air applications and one for other types of applications, including ultrasonic and spray-under-immersion.

Both compositions can be used in conventional aqueous cleaning equipment. Both are used in water dilution. Both are used at temperatures typical of those at which alkaline aqueous cleaning is conventionally undertaken. The ultrasonic/spray-under-immersion formulation (tradenumed BIOACT® 50 Aqueous Cleaner) is generally used for heavy duty applications, while the spray-in-air formulation (tradenumed BIOACT 40 Aqueous Cleaner) is ordinarily used for medium or light duty applications.

While much of the following information is applicable to both BIOACT 40 and BIOACT 50, it will be discussed with particular reference to BIOACT 50. The cleaning data presented were obtained with BIOACT 50, and may or may not also apply to BIOACT 40.

Properties of BIOACT 50
Neutral pH (7 ± 0.5);
Applicable to a variety of soils, especially oils and buffing compounds;
Typically used at 10% concentration in water;
No inorganic residues.

Experimental
The following experimental procedure was used to test the efficacy of BIOACT 50.
A steel coupon was coated over a designated area with a prescribed weight of oil. It was then immersed in a beaker of BIOACT 50 solution and placed in an ultrasonic bath

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for a period of time. Following this wash, the coupon was rinsed, dried and examined visually for cleanliness. In subsequent experiments, the wash time was increased until the coupon was completely cleaned by this procedure.

Once a cleaning time was found, it was reproduced three times before it was accepted, insuring an accurate number. The following parameters were set and maintained throughout the experimental program to further insure consistency in the experimentation with different oils.

1. Ultrasonics Consistency
   A. Beaker used
   B. Location of beaker in ultrasonic bath

2. Physical Parameters Consistency
   A. Temperature
   B. BIOACT 50 concentration
   C. Oil thickness on plate (approximate weight per unit surface area)

Observations
With BIOACT 50, oily soil removal occurs in two visually different manners. In one, the soil is emulsified into a "cloud" of small droplets which then disperse in the sonicated fluid. The droplets either remain emulsified or slowly rise to the surface of the fluid. A graphical representation of the process is depicted in Figure 1.

Under some temperatures and BIOACT 50 concentrations, the final portions of oil removed tend to ball up on the plate.

Figure 1: Emulsification of oil
and emulsify slowly. In these cases, the emulsified oil did not disperse but rather remained in a ball and adhered to the plate. This emulsified soil was then easily removed during the rinse portion of the process. A graphical representation of this series of events is depicted in Figure 2.

In the other form of soil removal by BIOACT 50, the soil is separated from the oily metal part in the form of relatively large droplets. These droplets then rise rapidly to the surface of the liquid and either spread on the surface or migrate to the sides of the vessel. A graphical representation of this process is depicted in Figure 3.

In this experiment, BIOACT 50 was effective at removing the following types of soils.

1. Stamping oil
2. Quenching oil
3. Lubricating grease

Conclusion

The neutral pH cleaner performed well and did not oxidize metals such as aluminum or tin. It was also successful at effectively removing a wide range of soils. Many oils did
exhibit the effect shown in Figure 2. Although, for these oils, most of the oil was removed from the plates very quickly, the last few spots required time to be cleaned. This step can be greatly accelerated by the use of mechanical agitation, either simultaneously or alternately with ultrasonics. This has been proven industrially, where a suggested regimen of alternate sonics and spray under immersion greatly reduced the cycle time to eight minutes for a heavy quenching oil.