CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2021

DateRun: 03/03/2021

Experimenters: Zoe Lawson, Justin Kiander

ClientType: Chemical Company

ProjectNumber: Project #1

Substrates: Stainless Steel

PartType: Coupon

Contaminants: Lubricating/Lapping Oils

Cleaning Methods: Immersion/Soak

Analytical Methods: Gravimetric, Visual

Purpose: The purpose of this experiment was to determine the effectiveness of cleaners under heated immersion conditions and verify unheated immersion performance.

Experimental Procedure: Cleaners were prepared to the following concentrations: Dimethyl Glutarate 100%, Water Works Heavy Duty 7:1, Mirachem 500 20%, Citranox 2%. Water Works and Mirachem 500 were heated to 100°F while Dimethyl Glutarate and Citranox were kept at room temperature. Three stainless steel coupons were obtained and weighed for each of the cleaners being tested. Coupons were then soiled with the lubricating oil provided by the company and a dirty weight was recorded. Once solutions reached the proper temperature, coupons were submerged into their respective cleaners for 15 minutes. After 15 minutes had passed, coupons were dried with a heat gun to remove all excess solution, then allowed to finish drying in air for 24 hours. Following the drying period, coupons were weighed again and a clean weight was recorded. Effectiveness of the cleaners was determined.

Results:

Cleaner	Initial wt of cont	Final wt of cont	%Cont Removed	%AVG
Dimethyl Glutarate	0.0268	0.0005	98.13	98.45%
	0.0566	0.0005	99.12	
	0.0680	0.0013	98.09	
Water Works	0.0889	0.0090	89.88	89.33%
	0.0937	0.0101	89.22	
	0.0890	0.0099	88.88	
Mirachem 500	0.0740	0.0079	89.32	89.71%
	0.0683	0.0084	87.7	
	0.0786	0.0062	92.11	
Citranox	0.0712	0.0014	98.03	98.39%
	0.1044	0.0010	99.04	
	0.0786	0.0015	98.09	

Dimethyl Glutarate was the most effective cleaner removing an average of 98.45% of the lubricant from stainless steel coupons. Citranox was the second most effective removing an average of 98.39%. Although, the same wetness was observed after cleaning and drying as in the previous trial. This was originally believed to be left over solvent from an insufficient drying step. However, it was determined that this was actually a slight residue of the lubricant. Coupons cleaned with Water Works and Mirachem 500 also possessed the same residues as in the previous trial. It was determined that when removing coupons from their respective solutions, the lubricant would coat the coupon again producing the observed residue.

A separate test was done to determine how to prevent the lubricant from re-coating the coupons. A swab was used to add the lubricant to a beaker of water. A clean stainless-steel coupon was immersed into the beaker. It was observed that the oil began to build at the surface of the solution against the metal coupon, and when the coupon was removed a coating was reapplied. A stir bar was added for agitation to reduce the build-up of the lubricant against the metal. However, a coating still appeared after removing the metal from the agitated solution. Finally, a heat gun was tested to immediately dry the coupon while removing it from the rinse beaker and blast away any potential residue build up. This method was successful in preventing a re-coating of the residue.

Therefore, it is necessary to add an agitated rinse step with deionized water, and to immediately dry the coupons with a heat gun while removing them from the rinse bath. Percent removals for Water Works and Mirachem 500 were not significantly impacted with the addition of heat. Next steps would be to test all cleaners under unheated immersion with the new rinse step added to the process.

Summary:

Substrates:	Stainless Steel
Contaminants:	Lubricating/Lapping Oils

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Company Name:	Product Name:	Conc.:	Efficiency:	Effective:	Observations:
Fisher Scientific	Dimethyl glutarate (CAS: 1119-40-0)	100%	98.45	☑	
Keteca USA	Water Works Heavy Duty Degreaser	7:1	89.33	☐	Adding heat did not improve results, reverting back to unheated immersion for future testing.
Mirachem Corporation	Mirachem 500	20%	89.71	☐	Adding heat did not significantly improve results. Reverting back to unheated immersion for future testing.
Alconox Inc	Citranox	2%	98.39	☑	

Conclusion:

Upon completion of testing, it was determined that Dimethyl Glutarate was the most effective cleaner in removing the lubricant from stainless steel coupons. However, a residue still remained on all cleaned coupons. An ideal rinse step was determined to ensure the lubricant did not reapply to the coupons after removing them from solution. Next steps would be to test the cleaners in unheated immersion conditions with the new rinse step added to the process.