CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	1997
DateRun:	02/02/1997
Experimenters:	Jay Jankauskas
ClientType:	Optical Manufacturer
ProjectNumber:	Project #1
Substrates:	Aluminum, Glass/Quartz
PartType:	Part
Contaminants:	Resins/Rosins
Cleaning Methods:	
Analytical Methods:	Visual
Purpose:	Report on the testing performed

Experimental Procedure:

The purpose of this trial was to find an alternative cleaning method for Optical Manufacturer that will effectively remove Pexalyn and Hercolyn D resins from optical lenses attached to aluminum holders. Three different options to achieve the desired cleanliness was tested. The first option was test out the possibility of aqueous or semi-aqueous cleaning to perform the cleaning. The second was to find a replacement that will perform the necessary cleaning while minimizing environmental and worker exposure concerns. The final option evaluated was to find a replacement adhesive that would work just as effectively as the Pexalyn and Hercolyn D resins but be easier to remove.
The first option tested was to use a water-based chemical to remove the resins. Normally a water-based chemistry is not appropriate when cleaning tough adhesives like this in a short amount of time, but both the Hercolyn D and Pexalyn resins are rosin based. Although rosin cannot be removed by water and surfactants alone, they can be reacted with alkali and a water miscible solvent to produce a water-soluble soap by the following reaction:

Base + C19H29COOH ==> H/Base + C19H29COO- (1)
Insoluble Resin Water Soluble Rosin Soap

Three different saponifiers were tested to see if they would be effective. All chemicals were diluted to 20% and tested in a 25 kHz Crest ultrasonic unit at 130 F. Cleaning was performed until the glass lens would dislodge from the aluminum holder or 30 minutes, whichever came first. Chemicals were noted on the effectiveness of the resin removal as well as any cavitational damage that occurred to the lens.

A couple problems were encountered when searching for a new solvent. The first problem was finding a solvent that had no flash point and a boiling point around 250 F. The no flash solvents that are acceptable to be used in cleaning operations are few and far between. The no flash solvents that exist that I found were AK-225, HFE 7100, Vertrel, 3M's perfluorocarbons. There are two problems with the solvents listed previously; 1) They are very expensive (up to $10,000 per 55-gal drum), 2) They mostly tend to have low boiling points (less than 150 F), 3) They are not to effective on tough contaminants (low KB values). Due to this an appropriate mixture was not found that would successfully operate in the vapor phase.
Solvents that could possibly be used in an immersion system at 250 F were also sourced out. The one downfall that would occur from this is that drying time would take longer and certain low vapor pressure solvents would need some sort of rinse stage. Also, there was a concern for flashpoint.
Seven solvents were compared to perchloroethylene in dissolving the resins. Resins were melted on several 2" x 2" glass plates and allowed to cool and solidify. One plate was immersed in each solvent at room temperature for five minutes. The effectiveness of each solvent was compared to perchloroethylene and noted below in Table 2:

Results:

Table 1: Test Results for Saponifiers
1-Chemical Description
2-Cleaning Effectiveness
3-Cavitation Effects
1-Kyzen Corp. Ionox FCR A proprietary, low vapor pressure, water miscible alcohol in an alkaline solution.
2-After 15 minutes, the lens was separated from the holder, a few slight traces of resin were noticed on the lenses.
3-Some slight scratching of the glass lens.

1-Brulin Corp. 815 PCX Alkaline based solution coupled with monoethanolamine.
2-After 30 minutes, enough of the adhesive was removed so that the lens could be manually removed from the holder.
3-Glass lens looked pretty scratched due to cavitational erosion.

1-Church and Dwight Armakleen E-2001 A buffered solution of inorganic salts and low levels of surfactants.
2-Not much effect in removing the adhesive after 30 minutes.
3-Not much effect on the resins.

Table 2: Solvent Test Results

1-Description
2-Boiling Point (F)

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3-Flash Point (F)
4-Pros & Cons
5-Test results

1-Perchloroethylene, Current solvent Used At Optical Manufacturer
2-250
3-None
4-HAP, carcinogenic.
5-A small amount of adhesives still remained

1-Citra-Safe Highly distilled d-limonene terpene
2-340
3-132
4-Low flashpoint will need a rinse.
5-Dissolved the same amount as the PERC

1-Oxsol 100 Parachloro-benzeotrifluoride
2-288
3-228
4-Not listed as a HAP or VOC but has a 25-ppm exposure limit and not the greatest odor.
5-Removed all traces of the adhesive within 3 minutes

1-Methyl Ester Solvent naturally derived from soybeans
2->400
3->300
4-Very safe and non-flammable, very tough to rinse off.
5-Was not that effective

1-Glycol Ether DPM Propylene based glycol ether from Dow Chemical
2-338
3-138
4-Has a low evaporation rate, but will not leave non- volatile residue
5-Dissolved about the same amount as the PERC

1-Propylene Glycol Monomethylether Acetate A commodity propylene-based glycol ether
2-
3-
4-High boiling point, has a pretty bad odor.
5-Was not that effective

1-AK-225 Low Boiling HCFC blend.
2-126
3-None
4-Low boiling point, very expensive.
5-Dissolved the same amount as the PERC

1-HTF-85B Terpene derived from turpentine
2-470-650
3->200
4-Great solvency, also would need a solvent rinse.
5-Was not that effective

Summary:

Substrates:	Aluminum, Glass/Quartz				
Contaminants:	Resins/Rosins				
Company Name:	**Product Name:**	**Conc.:**	**Efficiency:**	**Effective:**	**Observations:**
Kyzen Corporation	Ionox FCR (For Comparison Only)	100	0.00	☐	
Brulin Corporation	Formula 815 MX	20	0.00	☐	
Church & Dwight Co Inc.	Armakleen E 2001	20	0.00	☐	
Inland Technologies Inc	Citrasafe	20	0.00	☐	
Occidental Chemical Corporation	OXSOL 100	20	0.00	☑	
Twin Rivers Technologies	Methyl Ester 1618	20	0.00	☐	
Dow Chemical Company	PnB Glycol Ether	20	0.00	☑	
AGA Chemical	AK 225	20	0.00	☐	
Tarksol Inc	Tarksol HTF 85 B	20	0.00	☐	
Ashland Specialty Chemical Company	Perchloroethylene	20	0.00	☐	

Conclusion:

Due to part configuration and contaminant type, ultrasonics would be the only possibility for a water-based solution to work. A few problems would exist from using a water-based system for Optical Manufacturers' application:
1) Cavitational erosion - This will increase with the amount of immersion time. The Kyzen Ionox FCR seemed to be the only effective chemistry in removing the lens from the holder, but there was evidence of

cavitational erosion. The one way to solve this would be to raise the frequency of the ultrasonics. Although this will reduce cavitational erosion, it will also increase the amount of time needed to clean off these parts.
2) New Equipment- Although Optical Manufacturer's vapor degreasing equipment could be converted into an ultrasonic cleaning/rinse system, a drying system will still be needed to remove the rinse water. Since the aluminum holders need to be at 250 F to attach new lenses for polishing, a convention heat oven would be appropriate. This would require initial capital expenditure and additional floor space.

From the above results, probably the best solvent for Optical Manufacturer's needs would be either OXSOL 100 or Glycol Ether DPM. The one problem that would be encountered with these two solvents is the flash point. In order for these solvent to be used safely, they would need to be operated in a closed system with some form of fire-suppression (nitrogen blanketing or
reducing oxygen level with cabon dioxide). The OXSOL 100 can also be mixed with OXSOL 10 (Monochlorotoluene) and Perchloroethylene to make a nonflammable blend. Although perchloroethylene would still be used at Optical Manufacturer, a blend with the OXSOL solvents would reduce Perchloroethylene usage by 50-70%.

Sourcing out Replacement Adhesives:
Although some possibilities were found from the above testing, it might be more worthwhile for Optical Manufacturer to look into changing their resin to something that is easier to remove. When talking to a sales rep from Crest Ultrasonics, he informed me that Gerber Optical (a company that design systems to make optical lenses) uses a wax with a melting point of 140 F to attach lenses to the holders during polishing. This wax can be removed by cleaning in a warm ultrasonic bath with an aqueous detergent.

Summary:
From the testing conducted, it appears that Optical Manufacturer's best bet would be to look into the alternative polishing process from Gerber Optical. A switch in adhesives would allow for a water-based cleaning system to be used effectively. From the lab tests, the second-best alternative would be to use the OXSOL 100 in an immersion cleaning process with adequate fire
suppression or use a mixture of OXSOL 100, OXSOL 10 and Perchloroethylene to achieve a non-flammable solvent immersion cleaner. Contact names and numbers from appropriate companies that Optical Manufacturer may want to contact are listed below in Table 3.
Table 3: Contact Names & Numbers
Company Name-Contact name--Phone Number
Gerber Optical-Kurt Brey--860-648-6600 x 6652
Gerber Optical-Jeffrey Eisenberg--860-648-6600
Occidental Chemical Corp.-Michael Leathem--800-578-8880, 3, 7253#
Kyzen Corp.-Eric F. Bromley--603-622-2900
Dow Chemical Corp.--1-800-447-4369