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Clean Room Wiping Liquids

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KCP-613-4529

Published December 1991

Topical Report

Prepared for the United States Department of Energy Under Contract Number DE-ACO4-76-DP00613.

Allied-Signal Aerospace Company

Kansas City Division

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KCP-613-4529
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KCP--613-4529

DE92 004793

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CLEAN ROOM WIPING LIQUIDS

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Prepared by W. B. Harding

A water-based liquid containing isopropyl alcohol, ammonium hydroxide, and surfactants was developed to replace 1,1,2-trichlorotrifluoroethane for the dampening of clean room wiping cloths used to wipe clean benches, clean room equipment, and latex finger cots and gloves.

CONTENTS

Section	Page
SUMMARY	4
DISCUSSION	5
SCOPE AND PURPOSE	5
ACTIVITY	5
<u>Formulations</u>	5
<u>Testing</u>	6
<u>Results</u>	7
ACCOMPLISHMENTS	9

TABLE

Number	Page
1 Meseran Measurements	8

SUMMARY

The CFC 1,1,2-trichlorotrifluoroethane has been used to dampen wiping cloths for the daily wiping of clean benches and equipment in the Allied-Signal Inc., Kansas City Division's (KCD) Miniature Electromechanical Assembly Department. The wipers used were urethane foam sheets that had been found to contain solvent extractable oil. The solvent has also been used to rinse finger cots. As part of the KCD elimination of CFC use, suitable alternate liquids were sought. At the same time, a knit polyester wiper was evaluated as a clean replacement for the urethane.

Requirements of the replacement were (1) to be effective, (2) to evaporate quickly, (3) to leave no residue, and (4) to be neither a health nor a fire hazard. Water-based liquids have these characteristics.

Review of information sources led to the two following formulations.

Isopropyl Alcohol	5 vol %
Ammonium Hydroxide	2 vol %
Triton N-101	0.05 vol %
Water	Balance

Isopropyl Alcohol	6.4 vol %
Ammonium Hydroxide	2 vol %
Surfynol 61	0.8 vol %
Aerosol OT-75	0.024 vol %
Water	Balance

All of the ingredients are volatile except Triton N-101 and Aerosol OT-75. Neither formulation should leave a residue, either because of volatility or, in the case of Triton and Aerosol, because the material is present in a very low concentration. Even so, although Surfynol is described as volatile, its volatility is moderate (boiling point = 150-151°C). To ensure that it did evaporate quickly, its effect on contact loop resistance (CLR) was determined. The CLR of a Switch Rotor and Housing Assembly was measured. The rotor was dipped into the Surfynol formulation, allowed to dry, and retested. The CLR was unaffected.

A greasy mirror was cleaned with polyester cloths dampened with the liquids.

Clean aluminum panels were wiped with dampened polyester wipers and then tested for residues by the Meseran evaporation rate technique. No residues were found.

Departmental procedures were followed.

DISCUSSION

SCOPE AND PURPOSE

Clean benches and their contained equipment in the Miniature Electromechanical Assembly Department at Allied-Signal Inc., Kansas City Division are routinely cleaned each shift. For many years this was accomplished by wiping the surfaces with a polyurethane foam wiper dampened with high-purity 1,1,2-trichlorotrifluoroethane. The clean room operators also used the solvent to rinse finger cots after they were put on and whenever they became contaminated.

The solvent is a chlorofluorocarbon (CFC), an ozone depleter, which is being phased out of production in accordance with international agreement (Montreal Protocol). It was necessary, therefore, to find a replacement for it in the production department. Acceptable replacements were evaluated. At the same time, alternate wiping cloths were evaluated.

ACTIVITY

Formulations

The clean benches and equipment in the production department normally are only lightly contaminated because of the frequent cleaning and because the clean bench operations only produce minor amounts of contaminants. Therefore, a wiping liquid is not required to be a strong cleaning agent. It should have some solvency and detergency, it should evaporate rapidly leaving no residue, and it should be ES&H-acceptable. In addition, it should not affect latex finger cots and gloves. Mixtures of isopropyl alcohol, water, and ammonium hydroxide have these characteristics.

The first formulation that was evaluated was composed of the following:

Isopropyl Alcohol	49 vol %
Deionized Water	49 vol %
Ammonium Hydroxide	2 vol %

It performed satisfactorily, but its use was discontinued because it has a low flash point (74°F).

Two modified formulations were developed. Each is water-based and contains a safe level of isopropyl alcohol as well as ammonium hydroxide. The wetting powers of the formulations were enhanced by small amounts of surfactant (wetting agent).

The formulations are

Isopropyl Alcohol	5 vol %
Ammonium Hydroxide	2 vol %
Triton N-101	0.05 vol %
Water	Balance
Isopropyl Alcohol	6.4 vol %
Ammonium Hydroxide	2 vol %
Surfynol 61	0.8 vol %
Aerosol OT-75	0.024 vol %
Water	Balance

The major constituents are volatile and of high purity. They will not, therefore, leave residues on wiped surfaces. Surfactants, generally, are of low volatility, but their presence in very low concentrations should result in only traces of residue at most. Surfynol 61 has a moderate vapor pressure; its residues can be expected to evaporate. A study was made to determine if residues remain.

A wiping cloth evaluation was made also. An earlier study of clean room wiping cloths found that urethane wipers contain solvent-extractable material. Some of this material may transfer to a wiped surface. No product contamination from this source has been detected; however, use of a cleaner cloth could upgrade the cleanliness of the department and provide a marginal improvement in the control of contamination. To this end, an alternate type of cloth was included in the study.

In the preceding wiping cloth study, it was found that the cleanest cloth was a filamentary, knit polyester. These cloths are not inherently clean but are capable of being laundered to a high level of cleanliness. Laundered cloths are marketed by vendors of clean room supplies. Two such cloths are stocked and were used.

Testing

Two types of tests were performed to determine if the liquids left a residue.

In one, contact loop resistance (CLR) measurements were made of a Switch Rotor and Housing and Header Assembly. The Switch Rotor was removed, soaked in a quantity of the Surfynol/Aerosol formulation, allowed to dry for an hour, and then blown dry with nitrogen. The unit was reassembled and CLR measurements were again made. No significant difference was seen between the two sets of measurements. From this it was concluded that the wiping liquid will not leave a harmful residue on clean bench and apparatus surfaces.

In the second test, wiped surfaces were examined. First a simple screening test was conducted. A greasy mixture was applied to a mirror and then removed by wiping with a polyester wiper dampened with one of the liquids. Both liquids restored the clarity of the mirror.

A more quantitative test for residues was made by the Meseran method. Meseran is specific for organic residues. The rate at which a small amount of a volatile

organic liquid evaporates from the surface is measured. The evaporation rate is affected by organic contaminants on the surface and can be correlated with the amount and type of organic contamination.

The urethane foam and the two polyester knits and CFC and the two low-alcohol liquids were used. The CFC was included because of years of its successful use. It provides a baseline to which the others can be compared.

Twenty approximately 3-in. square aluminum panels were ultrasonically cleaned in a mild alkaline cleaner, ultrasonically rinsed in deionized water, and air dried. The cleaning procedure is the same as defined by departmental procedures except the final vacuum bake was not done.

The panels were numbered, and each was selected for its specific treatment from a random number generated by a calculator. Two panels were left in the as-cleaned state to serve as blanks. Two panels were wiped with each combination of wiping cloth and liquid. The investigator wore freshly cleaned latex gloves.

Results

Meseran measurements were made on each panel, and the visual appearance of each was noted. The arithmetic means, population standard deviations, and coefficients of variation for each pair were calculated. Results are in Table 1.

Meseran numbers for the two blank panels were 83 and 95, giving a mean of 89, standard deviation of 8, and a coefficient of variation of 9%.

The magnitude of the Meseran number corresponds to the amount of contaminant present, but other factors also influence the value, so the values are useful as indications of degree but not of absolute levels of contamination. Based on the blank values, the two polyester wipes with all three liquids leave no detectable residues and are comparable to the results with CFC and urethane foam. The very high values with the urethane foam dampened with water-based liquids suggest that the foam wipers contain a substantial amount of water soluble material.

Both of the low-alcohol, water-based liquids are suitable for the wipe cleaning of surfaces in clean rooms where devices such as those in the production department are assembled.

The prior practice of cleaning finger cots was to slosh the finger-cot covered fingers in a container of the CFC solvent and then to hold them pointing up while the solvent evaporated. The new water-based liquids are now used; however, they do not evaporate quickly enough. Therefore, the cots are wiped dry with a polyester cloth. Alternatively, the cots are cleaned by wiping with a dampened cloth.

Table 1. Meseran Measurements

WIPER	CFC	TRITON	SURFYNOL
Urethane Foam			
Panel Number	4	10	8
Appearance	Clean	Dirty	Dirty
Residue Type	Non-Polar	Slightly Polar	Slightly Polar
Meseran Number	34	765	655
Panel Number	7	11	13
Appearance	Clean, Etched	Dirty	Dirty
Residue Type	Non-Polar	Slightly Polar	Slightly Polar
Meseran Number	25	281	405
Mean Number	30	520	530
Std. Dev.	6	340	180
C. V.	20%	65%	34%
Alpha Wipe			
Panel Number	2	12	3
Appearance	Clean, Sl. Etched	Clean	Clean
Residue Type	Non-Polar	Non-Polar	Non-Polar
Meseran Number	47	44	53
Panel Number	15	16	5
Appearance	Clean	Clean	Clean
Residue Type	Non-Polar	Slightly Polar	Slightly Polar
Meseran Number	51	26	33
Mean Number	49	35	43
Std. Dev.	3	13	14
C. V.	6	37	33

Table 1 Continued. Meseran Measurements

WIPER	CFC	TRITON	SURFYNOL
Anticon 100			
Panel Number	1	14	6
Appearance	Clean, Sl. Etched	Clean, Etched	Clean
Residue Type	Non-Polar	Slightly Polar	Polar
Meseran Number	36	48	28
Panel Number	17	18	9
Appearance	Clean	Clean	Clean
Residue Type	Non-Polar	Slightly Polar	Polar
Meseran Number	26	27	44
Mean Number	31	38	36
Std. Dev.	7	15	11
C. V.	26	39	31

ACCOMPLISHMENTS

CFC solvent was replaced in the production department for cleaning clean benches, equipment, and finger cots with water-based solutions, resulting in a reduction in solvent use of approximately 1000 lbs/month.