REPLACING CFC-113 SOLVENTS IN THE ELECTROPLATING INDUSTRY

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1.0 Introduction

CFC 113 and solvents based on this material are widely used in the United States for many different applications. The uses fall into several categories which include:

- Defluxing
- Precision Cleaning
- Degreasing
- Deposition
- Drying

From the perspective of the electroplating industry, the major use is in drying. Two types of CFC 113 based drying systems are in common use.

- CFC 113/alcohol and
- CFC 113 - surfactant

These are primarily used in a post plating operation to achieve a dry, spot free surface. The CFC 113 alcohol systems are most commonly used where the geometry of the plated part is simple, e.g. a flat disk, and a very clean residue free surface is important. The surfactant type drying solvents are used where the geometry is complicated, e.g. blind holes, and where considerable quantities of water are to be removed.

An estimated 5 Million kilograms of CFC 113 or about 6% of the total U.S. market is used for these drying applications.

2.0 Why Use CFC 113 Drying Solvents?

The reasons for the wide use of CFC 113 based drying solvents are:

- Speed of Drying
- Spot Free Surface
- Safe
- Cost Effective

With the growing concerns regarding CFC's due to ozone depletion potential, there needs to be a careful evaluation as to what other substitute solvents may exist which could replace CFC 113 in drying applications but that retain all the desirable features that prompted its use.

3.0 The Chemistry of Alternatives for CFC's

The long atmospheric lifetimes of CFC's (CFC 113 is over 100 years) allows significant amounts to reach the stratosphere where they decompose releasing chlorine which enters into a series of chemical reactions resulting in the loss of ozone. Any alternative material must in some manner break that chain of events. Figure 1 shows two possible directions. One is the elimination of chlorine from the molecules. We have found, however, that compounds which contain no chlorine have very little solvency power and would have very limited applications as a replacement for CFC 113.

A second approach is to insert a hydrogen atom into the molecule. This allows destruction of the material in the lower atmosphere resulting in much shorter lifetimes. These materials are called hydrochlorofluorocarbons (HCFC's) and represent a class of materials that offer attractive alternatives to CFC 113.

4.0 What are HCFC's?

HCFC's are a class of solvents which contain only carbon, chlorine, fluorine and hydrogen in some combination. Two of these materials, HCFC 123 (CF_3 CCl_2H) and HCFC 141b ($CFCl_2$ CH_3) appear to be especially promising as a replacement for CFC 113. A comparison of some of the chemical properties of these three materials are given in Table 1.

As can be seen these materials have very similar properties to CFC 113. One exception is their normal boiling point which is somewhat lower. The ozone depleting potential (ODP) and the greenhouse warming potential (GWP) of these compounds are substantially lower that CFC 113.

5.0 Use of HCFC's in Drying Solvents

Our preliminary studies have shown that HCFC's will offer an attractive base material for drying solvents of both the alcohol and surfactant type.

It is likely that some modifications to the equipment may be necessary to accommodate the somewhat lower boiling materials but the actual use of these solvents will differ very little from the CFC 113 based materials.

6.0 Conclusions

CFC 113 based drying solvents have found wide usage in the electronic, medical and jewelry industry for drying after electroplating operations. With the environmental concern over CFC 113 and its projected phase out, a new class of drying solvents will be required.

The hydrochlorofluorocarbons (HCFC's) especially HCFC 123 and HCFC 141b appear to offer attractive replacements for CFC 113 for both alcohol and surfactant type drying solvents.