

CYCLODODECANE AEROSOL SPRAY

An Examination Into its Application and Suitability for the Conservation of Glass

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ABSTRACT

Cyclododecane (CDD) is a cyclic hydrocarbon ($C_{12}H_{24}$), (Fig. 1), found as a waxy solid which sublimates readily at room temperature. It is used for a variety of purposes in conservation, such as a temporary consolidant, adhesive, and a sealing barrier layer. The two most common forms of CDD applications are as a melt or in solution. In this research project, a third form of application, the "CDD Aerosol Spray" and its suitability for the conservation of glass will be investigated. The ability of the spray as a sealing barrier layer and as an adhesive for facing materials on glass will be evaluated along with some of its properties: sublimation rate and possible residues.

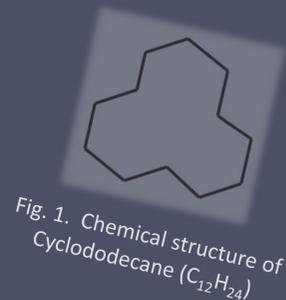


Fig.2. Cyclododecane aerosol spray

INTRODUCTION

Cyclododecane aerosol spray (Fig. 2) introduces a new and promising solution for application of CDD. The spray is kept in the container under pressure in a liquid state while the propellant or solvent used is a mixture of butane and propane. Immediately after spraying, the propellant evaporates and the CDD precipitates onto the surface resulting in a white, hard and waxy film which sublimates at room temperature over time. As opposed to the molten form, it does not require the use of heat, therefore the risk to the substrate is considerably reduced. Its ability to penetrate and fully protect porous surfaces has been debated in the literature; however, its use on non-porous substrates, such as glass, has not yet been investigated. In this research project, the rate of sublimation of the spray was measured by weighing subliming samples over time. Gas Chromatography with a Flame Ionization Detector (GC-FID) was used in order to indicate if any residue remains after sublimation. Subsequently, three experiments were conducted, the suitability of the spray was tested as a sealing agent both for water soluble media and organic solvent soluble media. The spray was also tested as an adhesive for temporarily joining glass substrates to a variety of facing materials for the purpose of consolidation of fragile objects during transportation and handling.

EXPERIMENTAL → RESULTS

1. Sublimation Rate

14 Pyrex® Petri dishes of 9cm and 14cm were prepared. Each was sprayed with either 1gr, or 3gr CDD or left unsprayed. Samples were weighed at different time intervals until fully sublimed (Fig 3).

- Sublimation rate depends on the thickness of the layer and surface area
- The bottom area of the CDD layer is dense, and therefore sublimates more slowly
- Short sublimation time: between 1-14 days depending on various factors

2. Residues

Microscope slides sprayed with CDD before and after sublimation as well as controls were analyzed by GC-FID to determine if any residue remained on the glass substrate

- No additional chemicals were found in the fresh spray
- No residue was detected
- Minute quantities of chemicals found were also detected on the blank sample, therefore, they were attributed to impurities from the environment

3. CDD spray as a temporary protective layer on glass substrates

- Water soluble media: 9X9cm squares of window glass were inscribed with 4:2 parts of LePage® Plaster of Paris: distilled water. The samples were either left uncoated, or coated with a thin ($\pm 1gr$) or thick ($\pm 2gr$) CDD spray layer and then immersed, poulticed or swabbed with distilled water.
- Organic solvent soluble media: Samples were prepared as above only were inscribed with Fine Point Permanent Black Marker (Studio®) which is soluble in organic solvents. The same treatments were done with 1:1 acetone: ethanol solution.

- CDD aerosol spray was confirmed as a good protective layer for water soluble media on glass substrates. Full protection during all cleaning methods tested (Fig. 4)
- Thicker layers were found to be more protective
- CDD aerosol spray failed to protect organic solvent soluble media

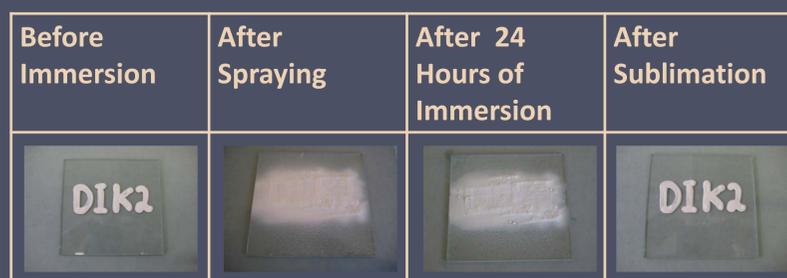


Fig. 4 Glass samples with water soluble media and a thick coating of CDD aerosol spray, before and after immersion in distilled water



Fig. 3 Graph of sublimation rate of CDD aerosol spray. Actual weight loss over time

CONCLUSIONS

Cyclododecane aerosol spray sublimates relatively quickly at room temperature and leaves behind no residue. It is recommended as a temporary water repellent protective layer on glass; however, further research should be conducted with smaller particle size water soluble media. CDD spray does not have adequate strength as a temporary adhesive for facing fragile glass objects, and has to be applied with open weave facing materials. Although, it might be of practical use on very small, light objects when heat cannot be applied.



Fig. 5 Peel Test, Instron Tensile Tester

4. Peel Strength Test for CDD Spray as a Temporary Adhesive and Consolidant for Facing Material on Glass Substrates

Tetex® and a loosely woven cotton gauze were chosen as suitable facing materials. Strips of the fabrics were cut and adhered to glass microscope slides with either spray or molten CDD. A loose edge of the fabric was attached to the Instron tensile tester clamp. The slide was inserted into a special holder designed for this purpose (Fig. 5) and a peel test was conducted

- Molten rather than sprayed CDD was found stronger as an adhesive (Table 1)
- Tetex® and molten CDD appear to be the strongest combination
- CDD spray should be used as a temporary adhesive with open weave facing materials

Sample	Average Peel Strength (N/cm)
Molten/Cotton Gauze	0.62 ± 0.22
Molten/Tetex	0.72 ± 0.28
Spray/Cotton Gauze	0.41 ± 0.11
Spray/Tetex	0.40 ± 0.16

Table 1 Average peel strength for samples