PAINT AND VARNISH REMOVER

I. General Composition

By far the most popular paint remover is the solvent type. Early type paint removers were quite simple, but in recent years as paints have become more complex so have the removers - particularly the solvent type. A modern product will have at least five principal ingredients. These basic ingredients will be (1) a prime solvent, (2) a co-solvent, (3) an activator, (4) a thickener, and (5) an evaporation retarder. The prime purpose of the solvent is to dissolve the coating or components of the coating to be removed, or to penetrate the coating and lift it from the surface to which it adheres; the purpose of the co-solvent is to improve the stripping time; the purpose of the activator is to enhance the penetration of the solvents into the protective film; the purpose of the thickener is to increase the viscosity of the remover so that the liquid will adhere to the surfaces from which the paint or varnish is to be removed; the purpose of the evaporation retarder is to reduce vapor losses of the volatile solvents, thus keeping them at work on the surface to be removed.

II. Prime Solvent

Several prime solvents such as methylene chloride, chloroform, and ethylene dichloride, have been used. The most popular and efficient paint remover solvent by far is methylene chloride. It has superior solvent power, is chemically stable, is non- corrosive, has no objectionable odor, and is fast-acting. Methylene chloride appears to dissolve certain resins and oils in the paint, and it permeates the remaining ingredients. The coating swells and lifts off the surface, making such a coating much easier to remove than a coating that has been merely dissolved by the solvent. Methylene chloride removers efficiently strip latex and the new epoxy resin paints.

III. Co-Solvent

When combined with methylene chloride, methanol is one of the less expensive and most frequently used co-solvents. The general principle to follow when adding co-solvents to methylene chloride is that polar solvents improve stripping time, non-polars do not. Small concentrations of polar solvents are more effective than large concentrations, except with air dried phenolic resin paint and shellac.

IV. Activators

Activators function by enhancing the penetration of the solvents into the finish, and by lifting the surface higher so that it can be more easily removed. There are a number of different types of activators; some of these are two-tenths percent glacial acetic acid with water, amines such as ammonia, monomethyl amine, morpholine, mixed isopropyl amine, etc.

Unlike the acids, the amines do not cause a corrosion problem. (Corrosion inhibitors are frequent additives to paint removers designed for use on metals.) The primary disadvantage with the amines if not chosen with care, is that they tend to react with chlorinated solvents, precipitate, and stain wood (most of them are compatible with methylene chloride in combination with methanol).
There is some indication that formic acid is better than acetic acid as an activator. In most cases, it reduced the removal time even further. Formic acid seems to work best at about a level of one percent acid with a methylene chloride-methanol combination. This, of course, as with any combination of ingredients in a paint remover, must be varied for optimum effectiveness with different classes of coating.

Another effective activator mentioned above is 0.2% glacial acetic acid with up to 5% water in combination with the methylene chloride-methanol solvent system.

V. Evaporation Retarders

The retarder prevents the methylene chloride from escaping into the atmosphere and the solvent in the solution actively working on the paint to be removed. The common evaporation retarder is paraffin (122° - 127°F. ASTM).

VI. Thickeners

Thickeners are necessary if the remover is to be used on vertical, curved, or inclined surfaces. Their function is simple - basically to keep the remover from slipping off before it has a chance to operate. You need, essentially, a reservoir of solvent which can
be drawn upon during the course of the removing job. Naturally, the faster the stripper, the smaller the reservoir needed; but there must be sufficient solvent available at all times to keep the coating saturated.

The thickener has four major qualifications to meet. It must impart high viscosity at low solids concentration, be compatible with the blended composition, maintain uniform viscosity during storage, and form a soft non-adhering film upon drying.

A number of substances are used as thickeners. The most important are organic such as methyl cellulose, ethyl cellulose, cellulose acetate and natural cellulose. Although primarily a function of the thickeners' behavior in methylene chloride, viscosity is also influenced by the co-solvent. A hydrophilic thickener, such as Dow Chemical Company's Methocel® 400 cps., increases viscosity with increasing methanol content.

VII. Other Components

Other components sometimes found in paint removers are corrosion inhibitors and wetting agents. Triethylammonium phosphate is sometimes used as a corrosion inhibitor. Wetting agents (primarily amines) not only promote wetting power, but also augment the penetration of the paint film and make rinsing easier. Apart from amines, other agents are used including petroleum sulfonates and ethylene glycol monobutyl ether.

VIII. Paint Stripping Formulations-Examples

All these chemicals are compounded in various proportions in an attempt to make the paint remover meet as many as possible of the ideal criteria. Shown below are some typical formulations which are just a few of the more basic formulas, with many variations possible. Naturally, different paints, surfaces, and working conditions require different strippers.

1. Standard formulation for most household type paints including alkyd, chlorinated rubber, polyvinyl acetate, air-dried phenolic, shellac, varnish and lacquer.

Methylene Chloride	90.0%
Methanol	6.5%
Paraffin (122°-127°)	2.2%
Methyl Cellulose	1.3%

2. Vinyl Coating Remover

Methylene Chloride	75.0%
Methanol	6.0%
Paraffin (122°-127°)	2.0%
Methyl Cellulose	1.2%
Potassium Oleate	2.2%
Methyl Ethyl Ketone	13.6%

3. Remover Formulations Effective for Some Epoxy Coatings

a.

Methylene Chloride	79.0%
Methanol	7.5%
Cresylic Acid	6.0%
Water	3.0%
Cyanoacetic Acid	1.3%
Paraffin (122°-127°)	2.0%
Methyl Cellulose	1.2%

Most effective for Epoxy-Malamine, Epoxy Esters and Amide-Epoxies.

b.

Methylene Chloride	71.0%
Tert Butyl Alcohol	0.7%
Formic Acid	7.3%
Dichlorobenzene	3.0%
Water	6.5%
Paraffin (122-127°)	2.0%
Ethyl Cellulose	1.5%
Triton X-100 (Rohm & Haas)	4.0%
Dodecylbenzene Sodium Sulfonate	4.0%

Most effective for straight amine cured epoxies.

c.

Methylene Chloride	65.0%
Phenol	14.0%
Water	11.5%
Formic Acid	7.0%
P-toluene sulfonic acid	2.5%

Formulation for immersion stripping.

Note: The above formulations are somewhat corrosive due to acid and water content. Testing is advised to determine compatibility with base surfaces.

General Mixing Procedure

The procedure for mixing the basic formulations would be to add the melted paraffin to methylene chloride while agitating, then add the thickening then the methanol, all while agitating the solution. Any other components may be added subsequently, and agitation should be continued until a uniform solution is obtained.

X. Testing of Formulations

The following is a typical test procedure which has been used for evaluating paint removers. Tests can be designed to meet a particular application with a procedure similar to the test outlined below.

Panels of brightened and degreased SAE 1010, low carbon, cold rolled steel, 3" x 6" x 1/6" were dip-coated with an oleo-resinuous type of enamel paint. Panels were dried in air and aged seven days at 50% relative humidity and 75°F.

Edges of the coated panels were built up with tape to 10 mils to form a shallow trough 2" x 5". Films of the test stripper were drawn across the panel with a straight edge.

Trial tests were made to establish the approximate time for extensive wrinkling. The coating was tested and checked every five seconds to determine if it had been removed from the base metal.

XI.

While methylene chloride is one of the least toxic of the commonly available solvents for paint and varnish removal, it is likely to present health hazards not characteristic of methylene chloride alone when used in combination with other chemicals. It is thus recommended that a warning label be used on all methylene chloride based formulations. An example of a suitable label might be:

INJURIOUS TO EYES
IRRITATING TO THE SKIN

1. Do not get into eyes.
2. Avoid contact with the skin, clothing and shoes
3. Avoid breathing vapors.
4. Use an adequately ventilated area.
5. Do not take internally.

FIRST AID

In case remover gets into eyes, wash immediately with flowing water for at least 15 minutes, then get prompt medical attention.

In case of contact with skin, wash contaminated area promptly with soap and water.
Remove and clean contaminated clothing before re-use.
If swallowed, induce vomiting and call doctor.
In some states, poison labels are required for formulations containing more than 5% methanol.