Vinyl esters

Introduction

Vinyl esters find their main use in highly acidic environments where epoxy coatings cannot provide the required protection. These coatings cure by a chemical reaction initiated by an organic peroxide catalyst (component B). This is supplied separately to the base (component A) and added just prior to the application. The reaction is exothermic, and temperature increases quickly, so pot life is limited. It is therefore very important to keep storage and application temperatures within the recommended range stated in Product Data Sheet (PDS) of the relevant product(s), as well as in this Application Instruction.

Performance of a vinyl ester lining scheme depends upon surface preparation and application. Inadequate surface preparation and/or paint application can negatively impact the protection provided by the lining system, independently of its suitability for the service.

Safety

Use adequate personal safety equipment and follow sound procedures. Apply only in well ventilated areas. Observe safety labels on packaging and paint containers and consult Hempel's Safety Data Sheets for the products to be applied.

Scope

The purpose of this Application Instruction is to provide specific advice on surface preparation and application of vinyl ester linings to supplement the general knowledge of the skilled professional applicators, as well as the information in the relevant Product Data Sheet (PDS) and Safety Data Sheet (SDS). Specific safety precautions are also highlighted due to the nature of vinyl esters.

Typical Hempel products for this usage include:

- Hempaline Prepare 120
- Hempaline Defend 740
- Hempel's Vinyl Ester GF 35910

Specific hazards related to the peroxide catalyst (component B)

- The catalyst (component B) is an organic peroxide which is supplied separate to the base (component A) in small plastic bottles.
- It is highly reactive, combustible and thermally unstable.
- It is a powerful oxidising which can violently react with organic substances.
- Heating or contamination with other substances (at ppm level) can initiate the decomposition of the peroxide, which is an exothermic reaction. The heat released accelerates the reaction itself, generating more heat which continues speeding up the reaction. Release of hot flammable gases can occur, then, and these may spontaneously ignite, leading to an explosion in the container if they are unable to escape.
- If spilled onto combustible materials (paper, wood), a fire may be initiated.

Besides what it is described in the SDS, the following safety precautions must be followed:

- **Store and handle the peroxide catalyst (component B) at temperature between 5ºC and 25ºC**; this must be strictly observed and also applies for the base (component A).
- Keep the catalyst in its original container.
- Keep it in dedicated storage rooms.
- Avoid contact with other chemicals and materials. Keep the workplace and floor area clear of organic paint, which will react with the catalyst.
- Reduce to the minimum the amount of catalyst at the workplace, so just only the quantity needed for the job is present.
- As indispensable individual protection equipment, always wear face shields and gloves suitable for chemical liquids.
- Use spray hoses which can handle high application pressure (indicative range further forward in this Technical Guideline).

Specific safety measures when handling and applying vinyl esters

Never use hydrocarbon solvents as diluent
As mentioned, when the peroxide catalyst reacts, heat is generated, the temperature increases and this accelerates the exothermic reaction. As the temperature rises the solvents evaporate and at some point the temperature will be high enough for vapours to ignite.

Only add catalyst to the base under stirring
If added without stirring, there is a localised high concentration of peroxide catalyst and the before mentioned runway reaction can take place, ending in auto-ignition.

Never add more catalyst than indicated in PDS
If more peroxide catalyst than strictly necessary is added to the base, the reaction takes place faster and auto-ignition temperature is also reached faster.

Do not allow mixed material to stand in the equipment
The pot life of the mixed material is short, and it will easily gel in the equipment and block it.

Never dispose empty or part empty catalyst containers in waste skips with organic matter or empty pails of vinyl esters
There would be a high concentration of peroxide catalyst at the point of contact and the before mentioned runway reaction can take place, ending up in auto-ignition.

Disposal

Unmixed base
Dispose of as “special waste”. It does not pose greater risk than other types of paint.

Mixed paint
Once the mixed material has fully reacted and cooled (usually overnight would be sufficient) it may be disposed of as “special waste”.

Full or part full bottles of peroxide catalyst
The content of full and partly full bottles of peroxide catalyst should be poured into a waste container with clean water, as the water deactivates the catalyst. The volume of peroxide added must not exceed the volume of clean water initially in the container. The wastewater should be disposed of as “special waste - water containing di-isobutyl phthalate”.

Empty used bottles of peroxide containing “dregs”
These bottles should be washed with clear water and the washings must be poured into a “special waste” container and dispose of as indicated above.

Spillage of the base
It must be collected with a non-combustible material (e.g. vermiculite), placed in a suitable container and disposed of as “special waste”.

Spillage of the mixed paint
It must be collected with a non-combustible material (e.g. vermiculite) and placed in a suitable container. Do not close the container with a tight fitting lid. Immerse the waste container in a “bath” of cold water; the water shall almost come to the top of the pail but not cover it. Once cooled disposed of as “special waste”.

Do not use paper, rags, etc to soak up the spillage, as these will react with the catalyst and may spontaneously ignite.

Spillage of peroxide catalyst
Action must be taken quickly.

Use water to deactivate the peroxide (please ensure there is sufficient amount of clean water available at the workplace to deal with any potential spillage of peroxide catalyst).

If the floor is non-absorbent, it may be more appropriate to collect the spillage with a non-combustible material (e.g. vermiculite) and place this in a suitable container. Do not close the container with a tight fitting lid. Thoroughly soak the contained waste with clean water to deactivate the peroxide catalyst, leave overnight in a safe place and dispose of as “'special waste - containing di-isobutyl phthalate”.

If the floor is absorbent, the peroxide catalyst may quickly penetrate into the surface, so the use of vermiculate is not applicable. Pour large volumes of water to deactivate the peroxide, being aware of any hazards such as those related to electrical equipment. Do not allow the waste to enter the drains. Collect the waste and dispose of as “special waste - containing di-isobutyl phthalate”.

Do not use paper, rags, etc to soak up the spillage, as these will react with the catalyst and may spontaneously ignite.

Summary of safety precautions for vinyl esters: Do’s and Dont’s

Table 1: *Safety Do’s and Dont’s for vinyl esters*

DO’S	DONT’S
• Plan your work schedule in advance. • Store within the indicated temperature range. • Keep in original containers. • Keep in dedicated stores. • Reduce to the minimum the quantity at the workplace. • Avoid contact of peroxide catalyst with other chemicals and materials. • Always wear face shield and gloves suitable for chemical liquids. • Only add catalyst to the base under stirring. • Use non-combustible materials such as vermiculite to handle spillages. • Use water to de-activate catalyst left in part full bottles or to handle peroxide catalyst spillages (together with non-combustible materials such as vermiculite). • Use water bath to cool pails with mixed paint. • Use spray hoses which can handle high pressure (indicative range further forward in this Technical Guideline).	• Do not use hydrocarbon solvents as diluents • Do not add more catalyst than indicated in the PDS • Do not contaminate unused peroxide. • Do not allow mixed material to stand in the equipment. • Do not re-seal containers with mixed, unused excess of paint. • Do not dispose of empty or part empty catalyst bottles into containers with organic matter or empty pails of vinyl esters. • Avoid spillage of peroxide catalyst onto combustible materials such as paper, cardboard, wood or similar. • Do not soak up catalyst spills with paper or rags. • Do not seal-off containers with waste. • Do not mishandle catalyst or mixed product – combustion may occur.

Storage

It is a must to keep storage temperature of base (component A) and peroxide catalyst (component B) between 5ºC and 25°C (41-77°F). Never store in direct sunlight.

Application of the product before the stated expiration date is critical.

Tank lining work with vinyl esters

When addressing a lining work which involves vinyl ester systems, please refer to Hempel's Tank Lining Work Technical Guideline. All indications and procedures detailed are applicable and hence shall be strictly observed, together with the information in the PDS and SDS of the relevant product(s) and other additional recommendations made by Hempel.

Besides the above mentioned Tank Lining Work Technical Guideline, the additional specific information in the following sections shall be observed.

Substrates
Please note that vinyl esters are not suitable for zinc containing surfaces, including inorganic zinc silicates, zinc rich epoxies, zinc metal sprayed coatings or galvanised steel.

Application equipment
Vinyl esters are applied using standard single piston airless spray. Below please find the recommended equipment parameters, which are indicative and subject to adjustment:

Table 2: *Recommended equipment parameters for vinyl esters application*

Pump ratio	Min. 60:1 *
Pump output	12 litres/minute (theoretical)
Input pressure	Min. 6 bar/90 psi
Spray hoses	Always use hoses as short as possible. Max. 15 metres/50 feet, 3/8"internal diameter, nylon lined. Max. 3 metres/10 feet, 1/4" internal diameter, nylon lined.
Gun	Large bore mastic type (e.g. Graco Hydra-Mastic Golden) fitted with swivel connector to allow free movement of the hose
Nozzle size	0,035"-0,049", reversible tip
Nozzle pressure	Min. 200 bar (2900 psi)
Fan angle	60º

**If longer spray hoses are necessary the pump ratio should be min. 65:1. Specific pumps for vinyl esters are recommended for larger jobs*

Both surge tank filter and tip filter should be removed.

Avoid the use of a suction hose. Use an interchangeable pipe, which makes removal of cured paint possible.

The pump should preferably be fitted with leather seals although polytetrafluoroethylene (PTFE, "Teflon") seals are acceptable for small jobs.

New, appropriately pressure rated, airless spray lines are recommended to avoid blockages during application.

Paint temperature
The optimal paint temperature for proper mixing, pumping and spraying is 20-25°C/68-77°F, so the reaction can proceed in a controlled manner. Cooling the paint drum in ice buckets can help on this regard.

The temperature of the material should be monitored during mixing and application to avoid introducing excess heat which will reduce the pot life.
If the paint temperature is below 15°C/59°F, the viscosity will be too high for application. If it is above 25°C/77°F when mixing there is a substantial risk of shortened pot life and thus curing in-can and/or in the spray equipment.

When working in warm climates a "bath" of cold water can be used for cooling the paint during application. The mixed paint is immersed in this "bath" of cold water in such a way the water come as close to the top of the pail as possible without risk of water going inside the pail.

The suggested procedure to achieve good mixing of paint is:

- at least one day prior to application, turn the paint drums upside down and keep them turned until starting up the application
- stir the base for some minutes before adding the curing agent
- add half of the curing agent to the base
- stir 1 minute
- add the other half of the curing agent
- stir until full homogenization

Paint application
Apply the material in accordance with the specification and observe the overcoating intervals in the relevant Product Data Sheet (PDS). If exceeded, it may be necessary to abrade the area to be overcoated.

For stripe coating, if proper application with brush is not achievable it can be useful to make the hairs of the brush stiffer by cutting them shorter.

Do not allow material to remain in the airless spray equipment, hoses, lines or gun, as it will block them due to fast gelation of the product.

Before starting application, pump, hoses and gun must be flushed.

The temperature of the piston must be checked during spraying. If it exceeds 27ºC, application must be stopped, the equipment and lines must be flushed and spraying must be resumed with fresh mixed paint. A way to control the temperature increase in the piston is using at least the minimum pump output recommended in this Technical Guideline and keeping the paint temperature within the recommended range, using ice buckets if needed.

Flush with Hempel's Thinner 08960 or styrene after every 3-5 drums, depending on temperature (flush more frequently in warmer conditions). Remember also to flush out the drain.
After flushing ensure all solvent has left the system and the gun is producing undiluted paint before resuming spraying.
If possible, use two airless spray pumps, one for spraying and the other one ready for switching, approximately every hour. This

set up helps to prevent possible blockage of equipment with gelled material.

Note: the requirement for periodic flushing of spray pumps increases paint consumption and this should be considered when calculating the material requirements for a project. A figure of around 10-20% is recommended in addition to the normal loss factor.

If needed, up to 2% of styrene can be added to ease application. **Please keep in mind no other thinner can be added to the paint**.

Styrene is not in Hempel's assortment and hence shall be supplied separately.

Retarder 99190 can be added in hot climates (above 20-25ºC) if needed to avoid early gelling.
Add the content of 1 bottle (50 ml) of Retarder 99190 to 1 unit (20L) of the base (component A) and mix thoroughly by mechanical agitation. After mixing Retarder 99190 with the base it is essential that at least 5 minutes are allowed before adding the peroxide (component B). Add half of the curing agent to the base and stir 1 minute. Then add the other half of the curing agent and stir until full homogenization. Do not add any retarder after adding the peroxide.
The addition of the retarder prolongs the pot life 10-15 additional minutes.

Cleaning of equipment
On completion of spraying clean the pump thoroughly with Hempel's Thinner 08960 or Hempel's Thinner 08510 and finally flush with an epoxy thinner such as Hempel's Thinner 08450.

Application of glass flake reinforced vinyl esters on press faced flanges
Surface shall be abrasive blasted as described in the Hempel's Tank Lining Work Technical Guideline. The primer and first coat of the specified system shall be applied also observing the Guideline mentioned and the PDS of the relevant product(s).

A 16 mm thick melamine-faced chipboard shall be cut to the size of the outside flange face to be lined. This chipboard shall be drilled in such a way that the holes match with the bolt holes in the flange, so fixing to the flange is feasible later in the application process. Only in case of small flanges G clamps can alternatively be used.

The fixed chipboard shall be thoroughly waxed and polished 3-5 times using a suitable mould release wax.

Approximately 100 microns dry film thickness of the specified glass flake vinyl ester shall be applied on the waxed surface and allowed to cure.
The chipboard shall then be coated again with the same glass flake vinyl ester, freshly mixed. The flange face shall be coated simultaneously. The two surfaces shall be fixed together with nuts and bolts (or G clamps if the flange is small) while the coating is still wet.

Excess material from edges, bore, and bolt holes shall be removed using a rasp or file taking care not to penetrate through to the steel.
In case of raised face flanges a spacer can be incorporated into the wet material on the chipboard to make sure the minimum thickness is achieved.

This document is intended for professional use and provides generic advice in respect of the subject matter only. It is not intended to be used as a comprehensive guide. The buyer/applicator should always read the relevant Product Data Sheet ("**PDS**") and Safety Data Sheet ("**SDS**") relating to the Products ordered which are available for download on www.hempel.com. If in doubt, please contact your local Hempel representative for further advice. To the extent relevant, the disclaimer set out in the relevant PDS(s) applies to this document.