SP Systems

Composite
Engineering
Materials

# Protective Coatings for Wood

## Introduction

This guide has been written specifically with wooden boats in mind. However, the rationale for the various coating schemes and the techniques employed can be applied to any wooden structure.

Being an absorbent fibrous material, wood has traditionally meant constant high maintenance, particularly for the marine user, where the cycle of moisture uptake-and-loss brings about seasonal dimensional changes.

With traditional designs, the oil-based coatings employed were able to be flexible and withstand a certain amount of movement without cracking. However, deterioration inevitably occurred, particularly on seams and joints, which often lead to more serious structural deterioration. Intensive annual maintenance was the only answer. Today, new wood building methods have been widely adopted to create structures far lighter, yet stronger and more rigid, than their predecessors. These new methods, which can be traced back to the advent of glued wooden aircraft structures, take advantage of modern adhesive technology and, more specifically in recent years, to the development of marine epoxy systems for glueing and coating.

Building in plywood, cold-moulding with thin veneers, or strip-planking with longitudinal rectangular section timbers, are the basic methods which can be used to build today's 'minimum maintenance' wooden components and structures.

Whereas the above methods of build lend themselves well to epoxy glues and coatings there are obviously some older methods which do not. In general, epoxies should not be used to completely coat boats where movement between adjacent 'planks' may be expected. This includes traditional clinker and carvel construction.

The control of moisture is central to the success of these techniques if they are to be considered as long term viable boatbuilding methods. Excessive moisture degrades wood both structurally and biologically. Wood is strongest and stiffest when it is dry (under 15% moisture content is the practical limit). With wood/epoxy building methods, wooden boats can be built which are stiff, light and durable and which, with the correct coating scheme, can remain almost maintenance-free for years.

## Coating Wood - a Two-Stage Process

**Stage 1 - Primer Schemes**

Most people will be familiar with the concept of primer, undercoat and topcoat in painting. The primer serves to provide an improved bonding link between the paint and the surface to be covered (substrate). It also helps to fill in any imperfections in the substrate - this provides a smoother surface for the subsequent paint coats, which in turn allows faster and better quality finishing.

The undercoat and topcoat then work together to provide a barrier to anything which may attack and degrade the surface to be coated. Protection is therefore afforded against moisture, pollution and biological entities such as rot, mould, boring insects, etc. The barrier is provided by a combination of the chemistry of the paint (acrylic, polyurethane, oil based, etc.) and the thickness of the coating. The undercoat provides the build up of thickness and the final topcoat provides the 'cosmetic' finish required - colour, gloss, texture, etc.

Epoxy provides a coating with the best possible adhesive qualities and some of the best possible protective qualities, particularly against water and aggresive chemicals. For these reasons it is the preferred protective coating for the oil industry, to protect steel from attack by seawater (offshore rigs), aggressive chemicals (oil refinery tanks and pipes), and physical damage. However, epoxy also bonds extremely well to both concrete and wood surfaces.

Because of the excellent adhesive and protective nature of epoxy, it is ideally suited to the primer stage of a coating scheme. In this role, the number of layers of 'cosmetic' topcoat can be reduced and it is possible to eliminate the undercoat altogether, giving just a two-stage process.

In the SP range the choice of 'primer' falls into two basic groups, either the solvent-free epoxy types (SP 106 and SP 320 ), or the solvent-based epoxy type SP Eposeal.

**Solvent-Free Epoxy Coatings**

Solvent-free epoxy coatings are noticeably more demanding than conventional paints in terms of temperature requirements (though not particularly as sensitive as adhesives) and their handling procedures require more attention. For instance, accurate metering and mixing of resin and hardener components is essential and the dissipation of heat generated by the reaction demands careful handling in order to gain adequate pot-life and working time.

The specific advantages that a solvent-free epoxy system such as SP 320 provide are judged by many to make them irreplaceable for certain applications. For example, because of the greater coating thickness possible, fewer coats are required. This reduces the labour content necessary to achieve a given dry thickness. Furthermore, fibre reinforcement can easily be incorporated into the coating to provide additional strength - this is not possible with solvent-based coatings.

In addition, solvent-fee epoxies exhibit no noticeable shrinkage on curing and can contribute significantly to the stiffness of thin plywood panels (2-6mm thick). The term 'wood epoxy saturation' is commonly used to describe their use though it is strictly a misnomer as only the surface fibres become 'saturated', the extent of saturation rarely extending more than 0.5-1.0mm. Typical dry film build is 100 microns.

Rev: UKPCWB-4-998-1

### Solvent-Based Epoxy Systems

The solvent based epoxy systems such as SP Eposeal, behave in a manner more familiar to the average user. On application these products are more like a two-part paint or varnish, benefitting from longer pot and working life and greater tolerance to poor conditions such as low temperature (less than 15°C) and high humidity (more than 75% RH).

However, at least three times as many coats are required for equivalent dry film thickness (typically 25 microns per coat). This is the thickness after the solvents have evaporated since such coatings characteristically shrink at least 50% on curing.

Solvent-loss, although detrimental to film build, does permit a flatter finish per coat. The higher number of coats which are required and the time which must elapse for the release of solvents before re-coating can result in longer finishing times where high build, i.e. complete filling of wood grain, is required. The need for the evaporation of solvents means that solvent-based epoxies cannot be used as glues.

### Choosing the most appropriate sheme

| Factor | Solvent-based System | Solvent-free System |
|---|---|---|
| Skill and/or experience required | low | moderately high |
| Importance of warm conditions during application | not so important | very important |
| Dry coating thickness (build) | low to moderate 25 μ/coat | very high - up to 100 μ/coat |
| Added stiffness to panels | low | very high |
| Shrinkage | moderate | very low |
| Special conditions or equipment necessary | none | localised heating may be required |
| Odour level | very high | very low |
| Durability performance | high | very high |
| Ability to fill surface imperfections | poor | [1]very good |
| Most appropriate marine craft parts to coat | mainly used on decks & interiors | hulls, decks & interiors |

[1] Solvent-free epoxy can repair surface splits in plywood and be used as a general construction adhesive

### Stage 2 - Finishing Schemes for clear or painted finishes

After the application of the epoxy coating 'primer' either clear or paint finish products will be required.

For a clear finish, two-pack polyurethane varnishes, such as SP Ultravar 2000, will give a very hard wearing, protective finish. They will both reduce the deterioration of the surface of the underlying epoxy (caused by ultra violet in sunlight) and give a high gloss surface finish.

When a painted finish is required, SP Hibuild 302 is the ideal undercoat, both to obliterate surface blemishes and to give a good colour base. Overcoating with a two-pack polyurethane paint is the best scheme for long term durability and protection, but single component polyurethane or oil-based paint can equally be used.

### 2a. Clear Finish Products and Procedure

**Clear Finish Option 1**

a) Clean wood surface with SP Solvent A.

b) Apply 2-3 'primer' coats of solvent-free epoxy system SP 320[2]. Wet sand after the first coat has cured with 80-120 grit paper. Wet sand after the last coat has cured with 120 grit then 280-320 grit grades to obtain a fine finish.

c) Remove sanding dust and clean surface with Solvent E.

d) Apply a minimum of two coats of two-pack polyurethane varnish, such as Ultravar 2000. If abrading between coats use 320-400 grade paper (wet).

[2]SP 320 is superior to SP 106 for clear coating in almost every respect. However, this product requires consistent room temperature (15°C minimum) during application and cure. The benefits of ideal conditions for SP 320 (20-25°C) are the noticeable improvements in speed of cure, quality of cure and ease of subsequent sanding.

**Clear Finish Option 2**

a) Clean wood surface with SP Solvent A.

b) Apply six coats of SP Eposeal 300. This should be more than sufficient to fill the grain of most wood surfaces. Abrade after the first or second coat with 80-120 grit paper and after every one or two coats with 120-180 grades. Finally abrade with 320 grade (wet) prior to using a varnish.

c) Remove sanding dust and clean surface with SP Solvent E.

d) Apply a minimum of two coats of two-pack polyerethane varnish, such as SP Ultravar 2000.

### 2b. Painted Finish Products and Procedure

**Painted Finish Option 1**

a) Clean wood surface with SP solvent A.

b) [3]Apply 2-3 'primer' coats of solvent-free SP 106 or SP 320. Abrade after first coat (after it has cured) with 80-120 grit paper and after last coat using 120-180 grit paper.

c) Remove sanding dust and clean surface with SP Solvent D.

d) Apply two coats of SP Hibuild 302, suitably thinned with either 10% SP Solvent D (if brush applied) or SP Solvent G (if spray applied). The percentage addition will vary but may be up to 20%. Abrade between coats if necessary with 120-180 grit paper and after the last coat with 320 grit paper (wet). When a smooth blemish-free surface has been obtained, a paint can be applied.

e) Clean surface with the appropriate solvent for the chosen paint system.

f) Apply at least two coats of a good quality marine paint. If the final paint scheme is white, then by using white (instead of grey) SP Hibuild 302, the undercoat stage maybe unnecessary. The gloss paint may be applied directly onto the white SP Hibuild 302 surface.

[3]If the surface is to be painted then SP 106 is usually preferred as it is more tolerant to low temperatures, cures faster and is slightly cheaper on a per kilo basis than SP 320.

**Painted Finish Option 2**

a) Clean wood surface with SP Solvent A.

b) Apply six 'primer' coats of SP Eposeal 300. Abrade after first or second coat with 120-180 grades. After last coat use 180-220 grit paper.

c) Remove sanding dust and clean surface with SP Solvent D. Thereafter follow the procedure for Painted Finish Option 1 (d-f).

## The Cost Effectiveness of Coating with Epoxy

The highest quality finishes are usually those with a sufficiently high build up of coating to give the wood protection against both moisture ingress and against abrasion and knocks.

Obviously solvent-free epoxies are ideal for this application and the necessary thickness can be achieved in only three or four coats. This protective layer is then followed by either varnish or paint in a relatively thin surface coating. For varnished finishes, material cost savings of over 50% can be made using SP 320 epoxy and SP Ultravar 2000 two-pack polyurethane varnish, compared with using only a two-pack varnish to achieve the same build. For painted finishes the savings are less (only about 10%) since, with using SP Hibuild 302 epoxy, there is a higher proportion of solvent-based product included in the scheme.

## Notice

The policy of SP Systems is one of continual development and improvement. Therefore the right is reserved to alter specifications and prices without prior notice. Any information or advice contained in this publication or obtained from SP Systems by other means and whether relating to SP Systems' materials or other materials, is given in good faith. However, it remains at all times the responsibility of the customer to ensure that SP Systems' materials are suitable for the particular process used and purpose intended.

SP Systems therefore strongly recommend that representative test panels and component sections are built and tested by the user in order to define the best process and materials to use for the desired component. This should be done under conditions as close as possible to those that will be used on the final component.

SP Systems' guides are being continuously reviewed and updated. Please ensure that you have the current version before using the product, by contacting SP Systems' Marketing Services and quoting the revision number in the bottom left-hand corner of this page.

**Structural Polymer Systems Limited**
St Cross Business Park . Newport . Isle of Wight . PO30 5WU . United Kingdom
Tel: +44 (0)1983 828000 . Fax: +44 (0)1983 828100
E mail: info@spsystems.com . Web site: http://www.spsystems.com

**SP Systems (Australia) Ltd**
4b Wilmette Place . Mona Vale . Sydney . NSW 2103 . Australia
Tel: +61 2 9979 7248 . Fax: +61 2 9979 6378
E mail: simongrosser@compuserve.com



Rev: UKPCWB-4-998-4