

Unsaturated polyester resins & the EU VOC Directive*

*(Council Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations).

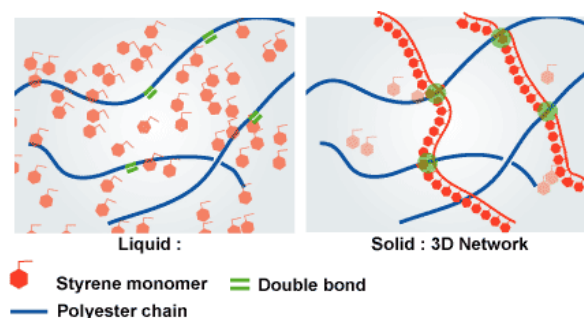
Background

Since the introduction of the European VOC Directive there has been uncertainty about its applicability to the Fibre Reinforced Plastics (FRP) industry, both from legislative authorities in various countries as well as in the FRP industry within the EU. In some EU member States, the FRP industry has been penalised by legislators attempting to enforce legislation that does not apply to the activity in question. Therefore Plastics Europe Unsaturated Polyester (UP) technical group has assessed the position of the FRP industry with reference to the Directive. This position paper provides guidance with respect to the applicability of the Directive to the FRP industry.

The Fibre Reinforced Plastics (FRP) moulding process.

The FRP moulding process is a versatile means of converting an unsaturated polyester resin (a solid polymer at room temperature), dissolved in a volatile, reactive, unsaturated monomer, (usually styrene), in combination with reinforcing fibres (usually glass fibre) into structural materials, generally referred to as fibre reinforced laminates or fibre reinforced composites.

In most processes where solvents are used, all of the solvent is released during the process: and unless emission restriction controls are in place, all of the solvent is released into the atmosphere. However, during the cure of unsaturated polyester resins, styrene - the reactive monomer in which the unsaturated polyester is dissolved - co-polymerises with the reactive sites in the unsaturated polyester chains to form a three dimensional solid: in other words a thermosetting plastic. The diagram below (courtesy SpecialChem), shows the cross-linking mechanism of UP resins.



In some FRP processing techniques, a very small proportion of the reactive monomer may escape into the atmosphere before copolymerisation. Strategies for dealing with styrene emissions are the subject of other Technical Bulletins within this series.

Definitions

The VOC Directive contains terminology that may differ in meaning to what is commonly accepted within the FRP industry. An understanding of the difference in the interpretation of the vocabulary used within the VOC Directive and that used within the FRP industry is essential for a qualified decision to be made on the relevance of the VOC Directive to the FRP industry.

Organic solvents

In the FRP industry, the styrene in the resins is cross-linked with the unsaturated polyester. This means that very little of the volatile monomer is released into the atmosphere during processing.

The VOC Directive defines an organic solvent as follows:

*'A VOC used alone or in combination to dissolve raw materials **without undergoing a chemical change** or as a cleaning agent, dispersion medium, a viscosity adjuster, a surface tension adjuster, a plasticiser, a preservative.'*

Applicability to the FRP industry:

As styrene undergoes a chemical change during processing of the unsaturated polyester resin, it cannot be defined as an organic solvent within the terms of the VOC Directive. Only if styrene were to be used for cleaning purposes (which is rarely the case), would it possibly fall within the VOC directive.

Industrial activities

In Annexe 1 of the Directive, twenty activities are cited for which the Directive is valid. These activities include 'wood and plastics lamination' which is defined as:

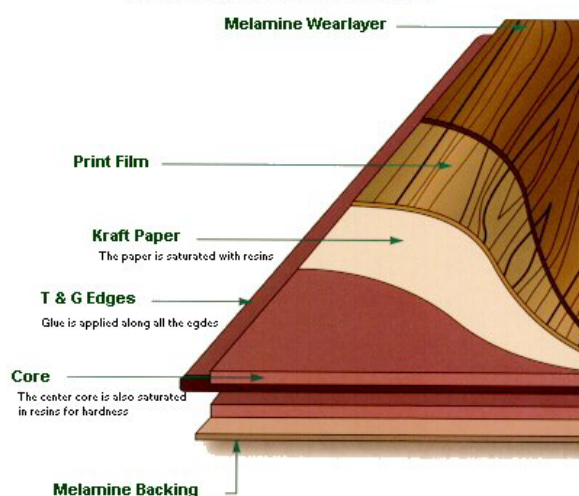
*'Any activity to **adhere** together wood and/or plastic to produce laminated products.'*

Applicability to the FRP industry:

Only this 'wood and plastics lamination' category activity appears to have anything remotely relevant to FRP fabrication. But in the product resulting from the 'wood and plastics lamination' process, the individual layers of which the product is built up, can still be distinguished and recognised. This is not the case in the FRP process since the resulting laminate is homogenous. During FRP fabrication, glass fibres are impregnated with unsaturated polyester resin. After the curing or cross-linking of the UP resin with the styrene monomer, the glass fibres cannot be distinguished as separate layers in the product. Although this process is called 'lamination', it has nothing in common with the 'wood and plastics lamination' as described under Annexe 1 of the Directive.

The term 'laminate' as used in the FRP industry is not defined in the Directive. It can therefore be concluded that the lamination process, as commonly referred to in the FRP fabrication / moulding industry, cannot be classified under the Directive category 'wood and plastics lamination'.

Typical 'wood and plastic lamination' as described in the Directive



The diagram above shows a cross section of laminate flooring and is a good example of 'wood and plastic lamination' as defined in the Directive. Here a melamine resin is used to provide a protective coating to the wood based core in a distinctive build-up of layers. By contrast, in the FRP lamination process (below), the resin completely 'wets out' the glassfibre to form an integrated and homogenous structure.

'Lamination' as it is understood in the FRP industry



Annex II and annex III of the VOC Directive

Annex II of the Directive specifically targets coating activities in the vehicle coating industry. Annex IIB concerns the principles and practices for emission reduction for the activities outlined in the Directive.

Annex III provides details of a plan for guidance on solvent management.

FRP position:

Since styrene cannot be defined as an organic solvent with respect to its use as a reactive monomer for UP resins under the terms of the VOC Directive, and the lamination process as used in the FRP fabrication industry has nothing in common with the process called 'wood and plastics lamination', we must conclude that Annexes II, IIB and III are not relevant for the application of the VOC Directive to the FRP moulding industry. Therefore:

1. The VOC Directive, as it stands today, does not apply to processes where reactive, monomer type, solvents are used.
2. The VOC Directive can therefore not be used to control the FRP moulding industry with respect to emissions of volatile organic material.
3. EU Member State legislators should direct local authorities that the FRP moulding industry does not have to comply with this Directive, in its present form.

Relation to Directive 2004/42/CE:

Directive 2004/42/EC deals with the limitation of emissions of volatile organic compounds arising from the use of organic solvents in certain paints and varnishes and vehicle refinishing. This Directive is more focused on paints and varnishes but may also be referred to in conjunction with UP resin related activities. However, the Directive under Article 2 / Definitions states:

'The mass of volatile organic compounds in a given product which react chemically during drying to form part of the coating, shall not be considered part of the VOC content'.

FRP position:

So once again this directive follows the same pattern: an organic compound which reacts chemically is not considered to be a VOC.

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PlasticsEurope
Association of Plastics Manufacturers

PlasticsEurope
Avenue E. van Nieuwenhuysse 4
B-1160 Brussels, Belgium
Telephone + 32 2 676 1732
Fax +32 2 675 3935
Email info@plasticseurope.org
www.plasticseurope.org