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Low styrene emission and low styrene content resins

Introduction

Emission prevention and reduction in the workplace is fundamentally important to the health and safety of individuals working with unsaturated polyester resin. By minimizing exposure to harmful vapours such as styrene monomer, the FRP workshop becomes a more pleasant, safer and more attractive environment to work in. As well as controlling emissions by using modified resins, it is also essential to maintain safe working practices, to keep process equipment in optimum working condition and to generally maintain good housekeeping standards *(see Technical Bulletin 5).*

This information bulletin deals with the use of resins and gelcoats, which are modified in such a way, that the degree of styrene emission during processing is reduced. Low Styrene Emission (LSE) and Low Styrene Content (LSC) systems do not completely eliminate emissions but they help in situations where open mould processing is essential. When closed mould processing is used, then the only emission of styrene comes from the gelcoat – which, of course, still needs to be applied whilst the mould is open.

Dynamic and static emission

The emission of styrene during the processing of UP resins takes place in two stages: the dynamic phase and the static phase. During the dynamic phase the resin or gelcoat is sprayed or brushed onto the mould and consolidated. In this phase the surface of the resin is constantly being refreshed which leads to the highest emission of styrene from the working surface.

As soon as the lay-up work is finished and the moulding is left to cure, the static phase of the process begins. The degree of styrene emission from a resin can be influenced in the dynamic as well as in the static phase.

Low Styrene Emission (LSE) Resins

LSE resins are produced by adding vapour suppressant additives to the resin formulation. These additives form a film over the resin surface once the moulding is left to stand. LSE additives are essentially only effective during the static phase of the process.

Low Styrene Content (LSC) Resins

Another way to reduce the emission of styrene from UP resins is to reduce the styrene content of the resin.

Over recent years resin producers have achieved a consistent reduction in the styrene content of standard resins or gelcoats without compromising handling or performance.

Reducing styrene emission by lowering the styrene content is most effective in the dynamic phase of the laminating process when most volatiles are released. If vapour suppressants are added to an LSC resin, a further lowering of the styrene emission can be achieved.

Due to their chemical nature, resins based on DCPD (Dicyclopentadiene) or vinyl ester have an inherently lower styrene content.

LSE and LSC resins have a major influence on the emission of styrene. In the graph on page 2 the differences in emission between both types of resin is schematically shown. The graph shows the comparative differences in emission of the various resin types when used during spray lamination. LSE/LSC resins may reduce the total emission by 30-50%, depending on application process used. And a combination of both technologies may further reduce emissions by 10 - 20%.

These boat hulls are produced by vacuum infusion with an LSC gelcoat first applied to the open mould.

Alternative monomers?

Styrene is a very efficient, effective and inexpensive cross-linking monomer. There is a limited choice of alternative reactive monomers to styrene and a widespread replacement of styrene by these alternatives is unlikely to prove an economically viable option. Another factor is that styrene has a 50-year track record in FRP so its toxicological properties are well known, whereas for many of the alternatives there is insufficient information available about the possible health risks.

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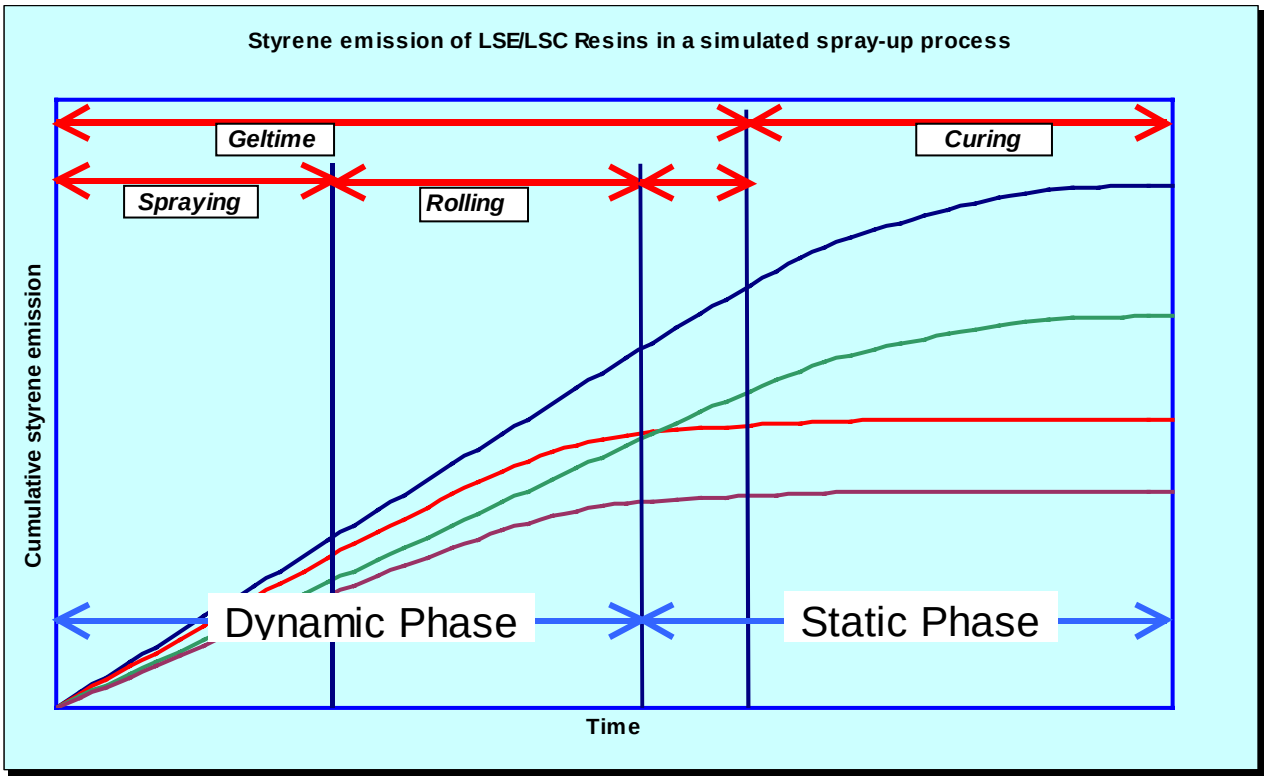


Gelcoats

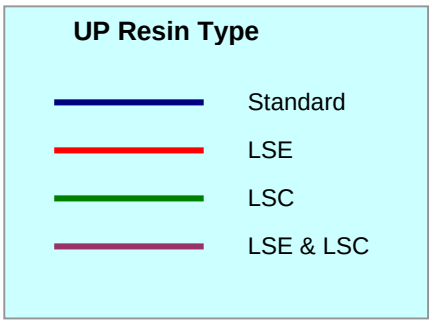
Gelcoats do not contain vapour suppressing additives as this may lead to a reduction of the inter-laminar bond between the gelcoat and the laminate - which would increase the risk of the gelcoat peeling away from the laminate over a period of time. Hence there are no Low Styrene Emission gelcoats on the market.

However, it is possible to reduce the styrene level in a gelcoat by changing the unsaturated polyester resin base of the gelcoat. Less monomer is then required to achieve the desired liquid properties and acceptable handling characteristics. These Low Styrene Content gelcoats can also give other benefits such as increased yield and improved yellowing resistance.

Spray gelcoats contain higher monomer levels and are thus lower in viscosity than their brush equivalents. The spray process itself and the higher monomer content leads to higher emissions from spray gelcoats compared to brush gelcoats. Optimisation of spray equipment can also help to reduce these levels.

Topcoats

Topcoats are basically gelcoat formulations to which film forming additives have been added. The topcoat is applied as the last layer on a ready and cured laminate to give a resin-rich and tack-free inner surface finish. Vapour suppressant is added to the topcoat resulting in much lower emissions compared with gelcoat application. Using LSE and LSC resins and gelcoats can therefore play an important part in the overall emission reduction strategies of FRP moulders, especially those working with large open moulds.



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