Composites UK Trade Association

Fire Performance

Overview

The behaviour of a Fibre Reinforced Polymer (FRP) component or structure when exposed to a fire is complex and consequently the knowledge base is constantly growing as new products arrive in the market place in response to growing demand. There has also been a trend increasing the required level of performance of fire standards over recent years. With the appropriate choice of gelcoats, coatings, resin, reinforcement fabrics and core materials, FRP materials can be used to make structures that satisfy the relevant regulatory requirements and also provide clear performance benefits over many other materials. In addition, FRP composites are good thermal insulators with low emissivity, limiting fire spreading in the way that can occur with uninsulated metals. FRP also affords the designer a high level of design liberty compared to more traditional materials.

When considering fire issues, it is important to understand fire performance terminology:

Fire Reaction

This is the response of a material to a fire, such as flame spread, heat release, flammability and release of fumes and smoke. These are specific characteristics for each material; For FRP composites these characteristics will vary considerably between different types of resins, reinforcements and additives used. The smoke density and toxicity of fumes released during a fire event can be a significant concern, and so careful choices need to be made for internal applications.

Fire Resistance

Generally speaking, this is the ability of the material to retain its functionality during and after a fire, such as the ability to retain structural strength (e.g., for a supporting beam) or to provide fire protection for a specific length of time (e.g., a bulkhead).

Improving Fire Performance

The main method of improving fire performance is by the inclusion of additives in the resin at the time of manufacture. These work in different ways, but are effective in reducing flammability, flame spread and heat release for most resins including the most common types such as Polyester, Vinyl Ester, and Epoxy. Various types of additives are available, with improvements being made all the time to increase performance and reduce smoke and toxic emissions.

Some intrinsically fire-resistant resins such as furan and phenolic are also available. The most commonly used, due to its availability over several decades, has been Phenolic. Its high fire performance has some trade-offs in processing complexity and structural performance, but Phenolics have been extensively used in mass transit and offshore engineering.

Coatings can also be used on FRP components to further enhance its fire performance to delay ignition, lower the rate of heat release, suppress lateral flame spread, and extend the duration of fire resistance.

Testing and Standards

Major developments in standards often come about after a disaster, such as the International Convention for the Safety of Life at Sea (SOLAS), an international treaty originally adopted in 1914 in response to the Titanic disaster[1], the Offshore Installations (Safety Case) Regulations which came into force in 1992 after the Piper Alpha disaster[2], and the recent UK government review of building regulations and fire safety to make recommendations on the future regulatory system following the Grenfell Tower fire.

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Fire Performance

There are a great many standards, codes and regulations pertaining to the performance of materials and products in fire situations. These come in four categories:

- Regulations and codes defining requirements which must be adhered to – usually sector specific
- Standards which describe test methods – sometimes sector specific, but often sector agnostic.
- Standards which describe how to categorise fire performance based on the results of tests.
- Standards which provide more general guidance.

A comprehensive list of standards applicable to different sectors and/or products is included as an appendix in the below referenced Good Practice Guide. However, always check to ensure you are using the most up-to-date version of any standard and consult the materials manufacturer for detailed information.

Summary

Fire performance is a key part of the design process of an FRP product or structure which should be considered early on alongside other considerations such as structural performance, environmental issues and the like. But there are many FRP materials with proven fire performance and case history evidence which are immediately available to meet most project requirements.

Composites UK and members of The Construction Sector Fire, Smoke and Toxicity Working Group can be contacted for specific queries regarding fire performance of FRP materials.

References

The information contained in this document is necessarily short and if you require further information, we recommend you read the more comprehensive document ‘Fire Performance of Fibre-Reinforced Polymer Composites - A Good Practice Guide’ which may be found here:

https://compositesuk.co.uk/system/files/documents/Good%20Practice%20Guide%20to%20Composites%20Fire.pdf

1. History of SOLAS: http://www.imo.org/en/KnowledgeCentre/ReferencesAndArchives/HistoryofSOLAS/Pages/default.aspx
2. Piper Alpha: Lessons Learnt, 2008 https://oilandgasuk.co.uk/wp-content/uploads/2015/05/HS048.pdf