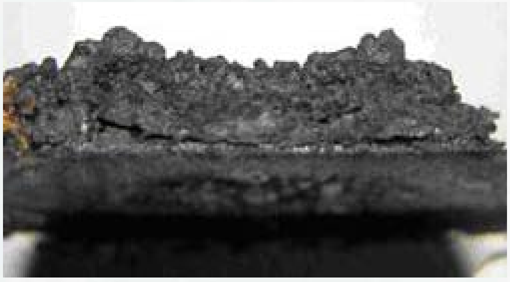
Lapinus' fibres in intumescent coatings

Improved fire rating

Reference: March 2009

Introduction



Passive fire protection of steel and/ or timber structures can be reached by using one of the following two systems:

- Non-reactive systems, such as boards and sprays;
- Reactive systems, such as intumescent coatings.

This paper demonstrates the benefits of Lapinus' fibres when used in simplified intumescent coating formulations and their effect on the performance and hence the protective efficiency of said coatings. It is based on research by the PERF group of the National Graduate School of Engineering Chemistry of Lille (ENSCL).

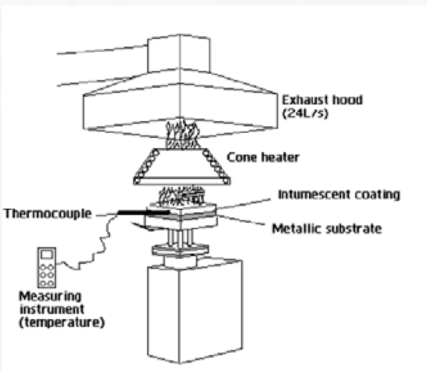
Formulations

The fibres have been tested in two formulations, which mainly differ in the type of binder used (either waterborne polyvinyl acetate (PVA) or 2K epoxy). Besides binder, these formulations contain the standard ingredients used in most intumescent coatings, being a carbon source (e.g. pentaerythritol), an acid source (e.g. ammonium polyphosphate) and a blowing agent (e.g. melamine). A wide range of Lapinus' fibres has been taken into consideration, varying in fibre chemistry, fibre length and surface treatment. They have been compared with a commercially available fibrous mineral (Sepiolite) looking at the following aspects:

- Does the presence of Lapinus' fibres influence the temperature at the surface of the substrate?
- Does the presence of Lapinus' fibres influence the char layer's strength?
- Does the presence of Lapinus' fibres influence the char layer's integrity, and hence its stability?

Test equipment

The following equipment has been used to evaluate the performance of the intumescent coatings.



With the cone calorimeter it is possible to measure both the temperature at the interface between the intumescent coating and the substrate and the temperature at a certain height above the substrate. The position of the latter temperature probe makes it possible to determine the temperature inside the char layer which is formed after intumescence.

Figure 1: Cone calorimeter

The epiradiator test was developed at the PERF laboratory and can be used to evaluate the performance of intumescent coatings. With the results obtained from the epiradiator test, it is possible to predict the performance of the intumescent coating during actual fire.

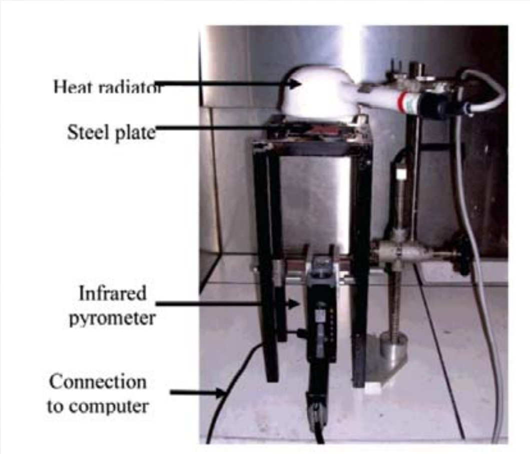


Figure 2: Epiradiator test

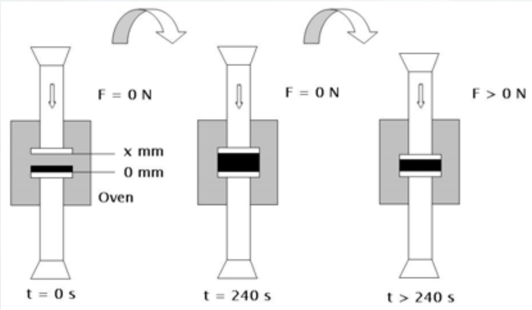


Figure 3: Rheometer (char strength)

With a modified rheometer set-up the char strength is determined.

After the development of the char, the upper plate is forced down linearly. The force is then measured as a function of the distance between to two plates (gap width).

The above mentioned equipment is owned by PERF and used for testing with realistic parameters.

Results

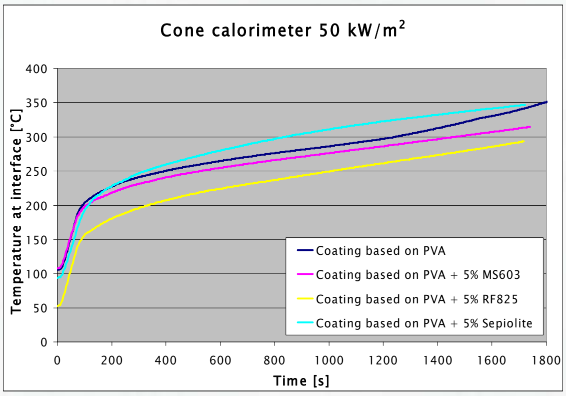


Figure 4: PVA – Cone calorimeter

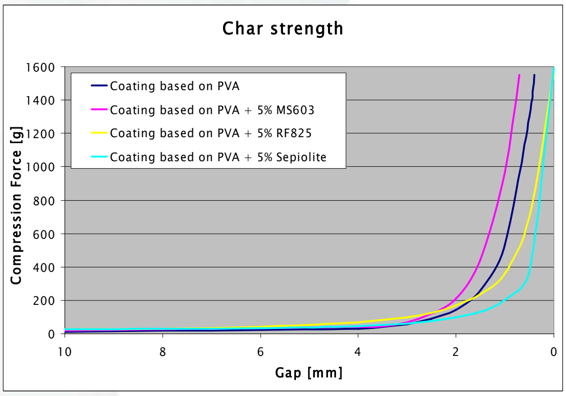


Figure 5: PVA – Char strength

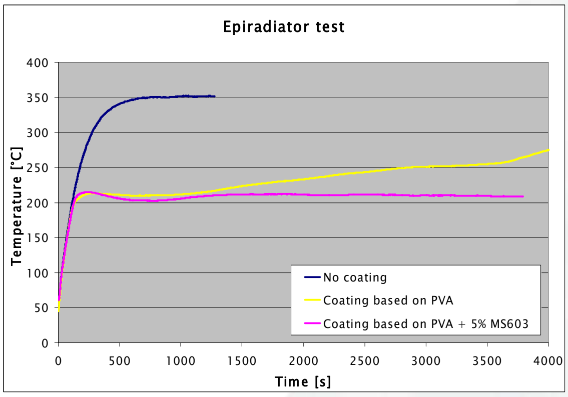


Figure 6 – PVA – Epiradiator test

The figures show the influence of the presence of Lapinus' fibres on the protective properties of the char layer of both PVA based system and a 2K epoxy system. Not only does the temperature of the substrate remain lower for a longer period of time (up to more than 120 min for the 2K epoxy) when fibres are used, but also the strength of the char layer is improved which is beneficial for the performance during raging fire. The results obtained with Lapinus' fibres are better than the results obtained with the competitor fibre type.

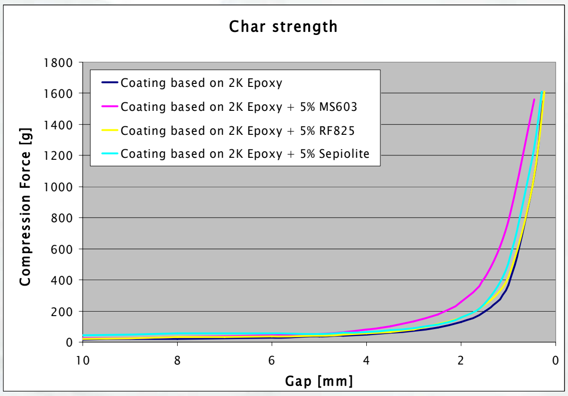


Figure 7: 2K epoxy – Char strength

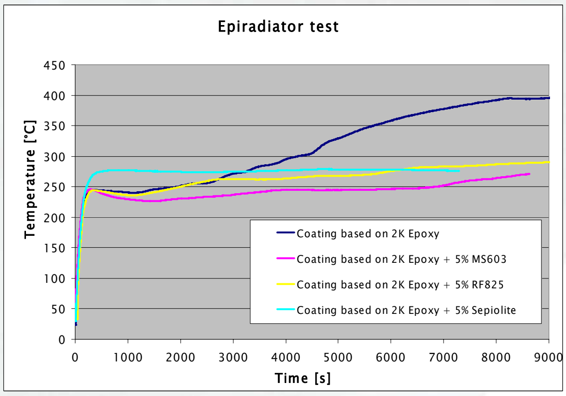


Figure 8 – 2K epoxy – Epiradiator test

Conclusions

It is shown that the performance of both a waterborne PVA and 2K epoxy based simplified intumescent coating can be improved using Lapinus' fibres:

- The temperature reached at the coating/ substrate interface is lower and remains lower when Lapinus' fibres are used. The most suitable fibre grade depends on the binder used;
- The strength of the char layer is increased, while the integrity remains. As a result, the char layer is more stable and longer lasting (> 120 min) compared to the other tested systems.

Depending on the system of choice and/ or more specific requirements, other Lapinus' fibre grades might be more beneficial.

Additional information

For more detailed information, please contact us at www.lapinusfibres.com.