GLOBAL SOLUTIONS

The Newsletter from DSM Composite Resins > October 2006 > No. 11

TANKS, PIPES AND RELINING

Corrosion know-how for Atlac resins keeps on growing

This issue of Global Solutions clearly focuses on our Expertise Centre R&D activities for vinyl esters used in the tanks and pipes industry. We've highlighted the result of a fundamental corrosion study, which shows how a new test approach provides us with more detailed information about the corrosion process of FRP materials in contact with alkaline solution. It shows how all components (resin, glass and surface veil) have significant influence on final corrosion performance. These new test results question old beliefs and assumptions.

Knowledge gained from these types of studies will help us to serve the anti-corrosion industry more effectively. This, together with our activities on an engineering level and our participation in standardization committees (see page 2 and 3), shows our commitment to increasing the acceptance of FRP material. We always look forward to solving ever more challenging vinyl ester applications like the one shown below.

IN THIS ISSUE

Atlac FRP piping at powerplant

New corrosion study on alkalines

Vinyl ester resins have been used for many decades to produce glass fibre reinforced pipes and tanks for the storage and transport of all different kinds of chemicals.

Therefore, thousands of corrosion tests have been undertaken to form a complete picture of the corrosion resistance properties of these resin types. The detailed results are presented in the guide to chemical resistance produced by DSM Composite Resins. New insights mean that our testing program is ongoing; not only concentrating on the different resin types, but also studying the effect of reinforcement in the final chemical resistance performance of the component.

This philosophy was behind a fundamental alkaline corrosion study together with the Swedish Corrosion Institute.

(Continued on page 2).

Dedicated to increasing the acceptance of FRP

Dear reader, as from August I have taken over business responsibility from Jan Lodewijk Lindemulder, who has moved on to a new challenge within the DSM Resins group. His focus over the years has certainly been directed towards an increased acceptance of FRP in the tanks, pipes and relining segments. This is something I will continue to do. Additional corrosion resistance tests, support for FRP standardization and our upcoming corrosion resistant FRP symposium, all underscore our commitment to increasing the acceptance of FRP in the corrosion resistance market.

I hope you will enjoy reading this latest edition of global solutions.

Jan Coerts

Business Manager Tanks, Pipes & Relining

CE marking & standarisation

With the European market maturing fast, the questions about CE marking are increasing. We will, therefore, try to throw some light into the dark depths of standardisation. CE marking is a kind of trade passport: it is obligatory for every product placed on the European Market as soon as all conditions are fulfilled to enable this. The CE mark is not a quality-mark but a conformity mark; it refers to fitness for use in relation to safety, health etc. It is also mandatory, as opposed to the voluntary quality marks. The intention is to establish an open Internal Market through technical harmonisation, thereby removing technical barriers to trade.

In reality this means that a harmonised technical specification (hEN or ETA) for FRP products must be available and enforced. Unfortunately, the process of determining which CE Marking applies to a product is very complex. For piping systems there are two directives applicable, the CPD (Construction Product Directive) and the PED (Pressure Equipment Directive).The Harmonised technical specifications are replacing all national standards, certification and approval systems (Kiwa/komo, WRC, BS, TÜV/DIN/DiBT,etc..) and other systems which can constitute technical barriers to trade in a single European system. Conflicting national specifications must be withdrawn once the harmonised European versions are available.

Standards come from the voluntary work of participants representing all interests concerned - industry, authorities and the public at large. At the moment, several specifications on glassfiber reinforced plastics are being prepared by CEN TC155 WG 14. Draft standards are made public for consultation at large. The final, formal vote is binding on all members. It is, therefore, vital that you make sure your interests are also taken into account!
For additional info: contact DSM Composite resins.

Production of Atlac storage tank for sodium hydroxide

Systematic study with Atlac resins into alkaline resistance

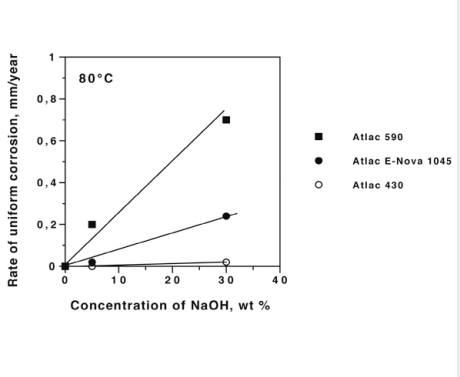
It is becoming increasingly clear that, in FRP structures - as well as the choice of resin - the type of fibre reinforcement and surfacing veil are very important factors in determining the chemical resistance of the laminate.

CHEMICAL BARRIER LAYER

Typically, a chemical barrier layer is used to protect the reinforcing fibres in the structural laminate from any possible contact with acids or any other corrosive media. The barrier is typically a minimum of 2.5 mm thick and is built up using one or two layers of a non-woven tissue called surface veil, which is followed by two or more layers of glass fibre chopped strand mat (CSM). The veil is usually of C-glass fibre, boron-free E-glass fibre or a synthetic material such as thermoplastic polyester or a polyacrylonitrile fibre.

NEED FOR CORROSION DATA

An essential step towards the correct specification of FRP materials in various corrosive environments, is to have specific corrosion resistance design data. But due to the many laminate combinations, corrosion resistance studies of FRP material can be quite expensive. Corrosion studies on FRP material are seldom carried out in a systematic way, so as to determine the resistance of the resin matrix alone, and of laminates with just surface veil, or just CSM reinforcements. Usually, the tests are performed with laminates representing a complete corrosion barrier - including a combination of resin, veil, and CSM. This complexity makes it difficult to correlate the corrosion resistance of the laminate to the different constituent material. (Continued on P3)



Uniform corrosion in pure resin

Scope and methods of the alkaline study

Recent studies by DSM Composite Resins on the chemical resistance performance of vinyl ester based composite materials in alkaline environments, have shown that variable results can be obtained depending on the type of resin, type of CSM and type of surface veil. There was a clear need to carry out a systematic corrosion study to evaluate the importance of the type of resin, type of surface veil and type of CSM. The corrosion resistance of the composite in alkali environments was evaluated using sodium hydroxide of two different concentrations at three different elevated temperatures. The Swedish Corrosion Institute was contracted to carry out such a study.

The following materials have been evaluated:
Resins: Atlac 430, Atlac 590 and Atlac E-Nova FW 1045.
Surface veils: Advantex glass veil (OC), Nexus 100-10 and 039-10 (Precision Fabrics Group Inc.), Viledon T 1773 (Freudenberg Vliesstoffe KG).
CSM mats: M 123 (E-glass) and Arcotex (developing grade) – (Saint Gobain Vetrotex), Advantex (OC).
Exposure conditions: 30% caustic soda – 40°C, 60°C and 80°C, 5% caustic soda – 60°C and 80°C.
Exposure period: 1,2,3,4,5,6 and 12 months.

Alkaline corrosion problem at flange due to caustic soda attack

DETERMINING THE CORROSION RATE

The corrosion resistance was evaluated by determining the depth of alkali attack/penetration in the composite wall by studying polished and dye-stained cross sections of the materials under an optical microscope.
Conclusions of this study are summarized on page 4.

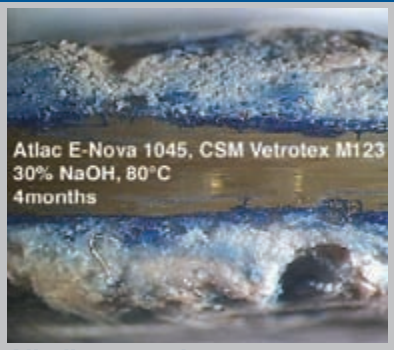
'If it ain't steel, it ain't real'

We find it surprising that there are still some pipe specifiers who believe this. Of course carbon steel pipelines are the workhorses in the industry. That's why 95% of installations are carbon steel - combining low material cost and the excellent performance properties in NON-corrosive environments. But in corrosive environments, the useful service life of carbon steel is limited. Fortunately for these applications there is an alternative: a non-corrodible material that has proven itself over the last 30 years - fibre reinforced plastics (FRP). The inherent qualities of FRP ensure a corrosion-free and maintenance-free pipe system.

One drawback that has limited the wider use of FRP is that confidence has been dented by a small number of widely reported failures. But whereas system design gets the blame for failing metal piping, in the case of FRP it's the suitability of the material itself that is questioned. Detailed information on the FRP used is rarely available and the composition is largely unknown. Unfortunately, to many people FRP is just FRP - even though there are huge differences in materials, design and production techniques in the FRP composition. Such a generalization ignores the unique qualities and versatility of FRP. A successful FRP pipe system contract is a well managed combination of product design, system design, fabrication and installation. FRP pipe systems deliver optimised, fit-for-purpose solutions for all pipeline challenges in corrosive environments.

FRP pipe lines

Alkaline study



Alkaline attack

This picture shows a cross section of a Vetrotex M123 CSM based, 4 mm thick laminate with Atlac E-Nova FW 1045. It can be clearly seen that around one third of the material has remained unaffected by the alkaline solution - which, in this case, was sodium hydroxide, 30% at 80°C. This results did not come as a surprise. It is in line with our corrosion recommendations for a maximum exposure temperature of 60°C for these conditions, with this resin.

Conclusions of alkaline study

Here, briefly, are some of the most important conclusions of the alkaline study:

- Alkaline attack gives rise to a uniform corrosion of the material. The rate of corrosion/alkali penetration depends very much on the type of reinforcement.
- Resins: The corrosion resistance of Atlac 430 seems to be excellent, even in 30% NaOH at 80°C. Atlac 590 and Atlac E-Nova FW 1045 are less resistant (up 40°C and 60°C respectively).
- The clear castings show linear relationship between rate of corrosion and concentration of the alkaline solution (see small picture page 2).
- The corrosion/alkali penetration rate may be drastically enhanced by a veil reinforcement when compared to clear casting (up to a factor 10).
- The negative effect of the veil reinforcement of enhancing the alkali penetration seems to be typically even more pronounced at a low alkali concentration (5%).
- It is difficult to make a general ranking of different types of veil, however, in most of the cases, the Advantex veil laminate performed better than the other synthetic veil laminates. This questions the general belief within the FRP community worldwide which says that a corrosion barrier with a synthetic veil performs better than that of a glass-fibre veil when exposed to alkaline conditions.
- Similar to veil reinforcements, CSM reinforcements improved the corrosion penetration rate substantially. No major differences could be observed between M123 and Advantex CSM laminates. Arcotex performed less well.

The report containing all test results, including pictures & graphs, is available via the expertise centre in Zwolle. A presentation will also be given at the FRP symposium, October 17-18, 2006. A parallel study to verify the results of the alkaline study at SCI, on laminates based on surface veil and CSM mats is almost finalized. The implications of this study for corrosion recommendations will be communicated as soon as possible.

EVENTS CALENDAR

DSM FRP SYMPOSIUM	October 17/18, 2006 - Geleen (Netherlands)	jan.coerts@dsm.com
SAMPE FALL TECHNICAL CONFERENCE	6-9 November 2006, Dallas, Texas, USA	http://www.sampe.org
FEIPLAR COMPOSITES 2006	7-9 November 2006, São Paulo, Brazil	www.feiplar.com.br.
DEWEK 2006	22 and 23 Nov 2006 - Germany	dewek@dewi.de
EUROMOLD 2006	29 Nov - 2 Dec 2006, Frankfurt am Main	www.euromold.com
CICE 2006: FRP IN CIVIL ENGINEERING	13-15 December 2006, Miami, Florida, USA	mirmiran@fiu.edu

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