

Atlac E-Nova Fighting solvents and fires

This issue of Global Solutions concentrates on two interesting yet completely different Atlac topics. Firstly, the question concerning the need for postcure is answered by presenting test results of a recently finalized resistance study with Atlac E-Nova against toluene. Secondly, an interesting case study about the fire fighting line at the Chemelot premises in Geleen is described.

These topics underline the expanding

possibilities of Atlac E-Nova resins. New laboratory studies and experiences of customers and contractors reinforce the unique performance of these special vinyl ester resins: combining high chemical resistance with improved application properties. But don't forget, they are not the only ones benefitting from Atlac E-Nova. The entire industry profits when overall laminate quality is increased through less defects minimizing the risk of unexpected failures.



DSM Site in Geleen - fire water, a very important utility

Atlac E-Nova and solvents: is post curing necessary?

One of the recurring questions related to the chemical resistance of vinyl ester resins is: can the chemical resistance also be guaranteed if no post cure is applied?

To answer this question, an extensive study has been undertaken, focussing on resistance against one specific aromatic solvent: toluene. In this study both Atlac E-Nova filament winding grades, Atlac E-Nova FW 1045 and FW 2045,

were included. These resins were introduced at the beginning of this century, bringing added value to the anti corrosion industry by combining chemical resistance to various types of chemicals including solvents, with easy processing properties. For more details see page 3.

IN THIS ISSUE

- 2 EdeA choose FRP
E-Nova in a fire line
- 3 Added value of E-Nova
Atlac E-Nova and solvents
News
- 4



A new year
full of
opportunities!

Dear reader, first of all I'd like to wish you a happy and prosperous new year. A year of slowly increasing investments in the petrochemical industry and energy sector. For the majority of the investment projects, steel will be the material of choice. However, our anti corrosion center receives more and more enquiries on whether severe corrosion problems can be solved by vinyl ester based GRP. In many cases this can be achieved. With field trials, on site inspections and production support, we will continue to promote GRP as a material with superior corrosion resistance that enables a prolonged service life for vital process equipment. Work with us in 2006 and involve us in your challenges; together we will increase the acceptance of composites as a highly corrosion resistant alternative to steel.

Jan Lodewijk Lindemulder
Business Manager Tanks Pipes &
Relining

EdeA chooses FRP fire line

The recent major fire at a UK petrol storage depot focussed world attention on the essential need for efficient firewater systems. Large industrial sites have a dedicated network of firewater pipelines, mostly steel pipes installed when the site was originally built. After 30 to 40 years of service, these pipes begin to progressively leak due to corrosion and mechanical damage. Most of Europe's chemical sites are over 30 years old and are facing the problem of increasing costs in maintaining the old firewater systems.

The Chemelot site in Geleen the Netherlands, where DSM and Sabic are located, is an established site where the oldest firewater lines were installed 50 years ago. The pipelines are managed by EdeA, a joint venture of DSM, Sabic and the local power company, Essent. The total firewater system comprises 45km of pipeline (diameter 100-500 mm) and 1100 valves. By using Failure Mode and Effect Analyses, a priority replacement schedule was drawn up.

EdeA chose to replace the old steel pipes with GRP pipes made of Atlac vinyl ester. In contrast to the old steel pipes, vinyl ester pipes do not suffer from corrosion and show extremely good long-term resistance to water and many other aggressive chemicals. Atlac vinyl esters have proven themselves highly suitable in applications where chemical and thermal resistance, in combination with excellent mechanical properties, are required.

The first phase of the new fire line project was completed in 2003 and the resin of choice was Atlac 590, novolac vinyl ester resin. For phase 2, which began this year and is now fully operational, the new Atlac E-Nova FW 2045 was used.



Atlac E-Nova pipes just arrived on site.

Fire fighting line: E-Nova benefits both producer and contractor

For the EdeA fire line project, Atlac E-Nova offered real advantages to the pipe producers. This is because the built-in urethane technology means that the resin is much easier to use compared to traditional vinyl ester resins, especially in the filament winding process and in the hand lay up of elbows and fittings. The result is less defects and higher overall laminate quality. Since E-Nova resins have a higher transparency level, quality checking for the contractor is also made easier.

PRE-QUALIFICATION BY UEWS

Pre-qualification of the pipes was achieved using the Ultimate Elastic Wall Stress (UEWS) method, carried out by DSM Manufacturing Center in Geleen. A fast method to predict the long term behavior of GRP Pipes, it utilises the principle that the UEWS point can be considered as the borderline between permissible and non-permissible deformations or stresses. The biggest advantage of the UEWS tests, compared with long term testing, is the speed of the test. Besides pre-qualification, this method can also be used to check the quality and consistency over a prolonged period. Evaluation of new pipe structures or resin types is also much easier. The UEWS method utilises the latest, best available technology so that qualified and informed decisions can be made on optimised pipe specification.



Elbow section ready for installation.

Pipes are supplied by Nsguassero and Sarplast while all the fittings and curves are made by Versteden and Grootint. DSM Composite Resins Anti Corrosion Center performed the chemical exposure test work.

Bringing added value to the anti corrosion industry

The easy processability of Atlac E-Nova means that impregnation and wet-out of glass fibres is simpler and quicker, with reduced foaming using standard MEK peroxide compared to traditional vinyl esters. These resins also show greater tolerance in the production of thick laminates.

To address the post cure issue, standard ASTM

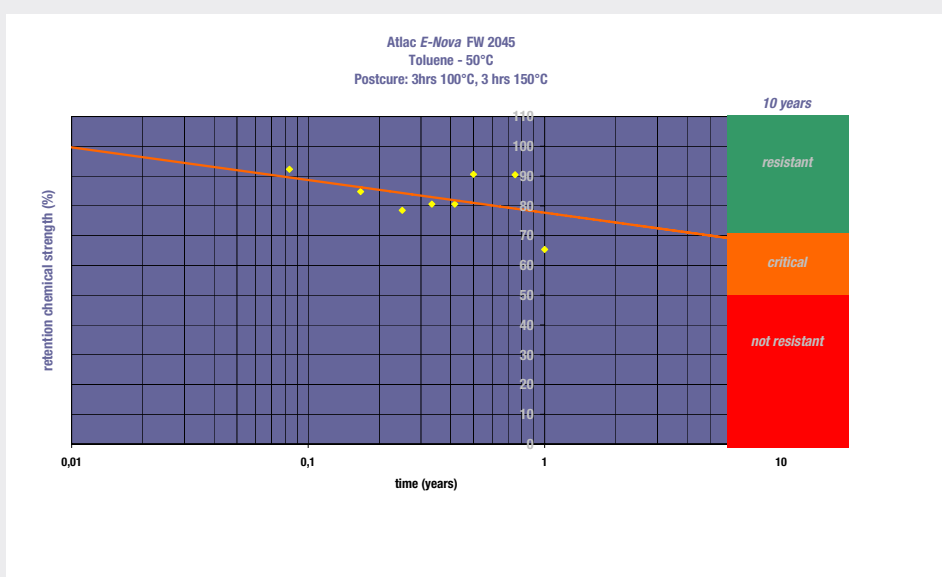
C 581 laminates based on both Atlac E-Nova grades, were exposed for a period of 12 months to toluene at three different temperatures (20°C, 40°C and 50°C). Four separate series from each resin were exposed to different heat treatments after preparing the laminates (post cure): series 1: no post cure at all, series 2: 16 hours 50 °C, series 3: 6 hours 90 °C and series 4: 3 hrs 100 °C + 3 hrs 150 °C. At monthly intervals for the first six months and thereafter at 9 and 12

months, test pieces were removed and tested according a three point bending test (ISO 178).

INTERPRETATION OF TEST RESULTS

For the interpretation of the test results, the retention of chemical strength (the combined value for the retention of flexural E-modulus and the retention of flexural strength) was plotted versus the exposure time on a logarithmic scale (see graph 1). This plot was used to make a service life extrapolation to 10 years. According to this validation method, all points below 50% of chemical strength indicate that this combination is not resistant to toluene at that specific temperature. For retention data between 50% and 70%, as well as flexural properties, other parameters like barcol hardness or blistering are taken into account in determining the chemical resistance.

The data, extrapolated to 10 years, have been compiled in graph 2 (box below) showing the difference between 20°C, 40°C and 50°C exposure temperature for the different series of both resins.



Graph 1 - example of plot with test results including extrapolation to 10 years.

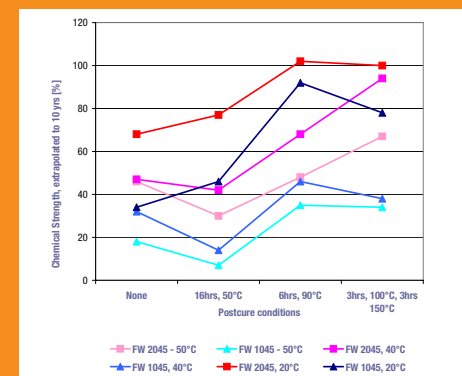
Atlac E-Nova and solvents Lower service temperature without post cure

From the test results of the toluene study, it can be concluded that both Atlac E-Nova grades show good chemical resistance performance at room temperature, when sufficiently post cured for six hours at 90°C. Test results are in line with the data presented in the corrosion guide (Atlac E-Nova FW 1045 – max. 25°C; Atlac E-Nova FW 2045 – max. 45°C).

Secondly, it can be seen that the difference between no post cure and mild post cure at 50°C is small, while higher post cure temperatures immediately improve the chemical resistance performance. In other words, the achieved degree of cure at room temperature is

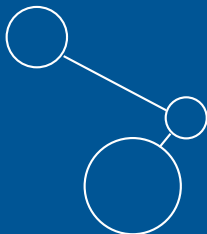
comparable with mild post cure at 50°C. For Atlac E-Nova FW 1045, the results at 90°C are even better, indicating that at this temperature optimal cure can already be obtained. This is understandable since the post cure temperature is not far below the HDT of this resin. Also from an economical viewpoint, 90°C is preferable to much higher temperatures. For Atlac E-Nova FW 2045 the best results are obtained with increasing post cure temperature.

Returning to the question whether post cure is necessary or not, it can generally be concluded that the maximum exposure temperature is decreased by about 20°C when no post cure cycle is used. This means that Atlac E-Nova FW 2045 will be resistant up to 25°C without post



Graph 2 - results of toluene study

cure. Atlac E-Nova FW 1045 can be exposed to the same conditions but than a post cure at a minimum of 90°C is required.



Sandra Klein Nagelvoort
Project Manager

Sandra graduated from the Laboratorium Hogeschool for Chemistry and Physics in Utrecht in 1998. Her career with DSM began when she joined DSM Desotech. In 2002 Sandra moved to the corrosion resistant resins group. As a corrosion expert in the Atlac-team, she is involved in special resistance studies in close cooperation with the Swedish Corrosion Institute. Innovative projects for the relining industry are also within her remit. Sandra recently completed her Masters degree in Polymeric Science.

New features on our internet guide

The chemical resistance search machine on the DSM Composite Resins website has been extended with some new features. In future, besides selecting the chemical name to find chemical resistance advice, you can also now use CAS numbers or commonplace names. Where available in the data base, these can be used to source the right resin for a specific chemical environment. This new feature limits the risk of mistakes, especially for translations from various languages into English, since CAS numbers are unique for every specific chemical. This new feature is only available via the search machine on the internet and is not included in the printed version of the corrosion guide. Either way the internet search machine guarantees availability of the most up-to-date corrosion data. To access the interactive chemical resistance guide, use the following link:

http://www.dsm.com/en_US/html/drs/chemicalresistanceguide.htm

UEWS equipment moved

DSM's Ultimate Elastic Wall Stress (UEWS) test equipment has been moved from the Research Centre in Geleen to the Technical Centre of DSM Composite Resins in Zwolle.

The equipment was completely updated before the start-up and is now fully operational under the ownership of the Expertise Centre Tanks, Pipes & Relining.

The availability of this equipment in Zwolle secures the furthering of know-how related to long term performance of pressure pipes. Furthermore, easier access to this test method enables the expertise centre to continue the R&D program of identifying the optimal raw materials for these type of products. Also the service offered to the industry by measuring UEWS of different FRP pipes, will now be faster and cheaper by having these facilities available in Zwolle.

EVENTS

ICERP 2006-INT CONF & EXH ON RP	23-25 February 2006, Chennai, India	www.frpinstitute.org
2006 COMP. AUSTRALIA & CRC ANN. CONF.	9-10 March 2006, New S. Wales, Australia	www.compositesaustralia.com.au
8TH WORLD PULTRUSION CONFERENCE	23-24 March 2006, Budapest, Hungary	www.epta.nl
27TH INTERNATIONAL SAMPE CONF.	27-29 March 2006, Paris, France	www.sampe-europe.org
4. DEUTSCHER SCHLAUCHLINERTAG	30 March 2006, Nürnberg, Germany	www.deutscherschlauchlinertag.de
JEC COMPOSITES SHOW 2006	28-30 March 2006, Paris, France	www.jeccomposites.com

Headquarters

DSM Composite Resins
Stetterstrasse 28
P.O. Box 1227
CH-8207 Schaffhausen

Switzerland

Phone +41 (0)52 644 12 12
Fax +41 (0) 52 644 12 00

Customer Competence Center

DSM Composite Resins BV
Ceintuurbaan 5
P.O. Box 615
8000 AP Zwolle

The Netherlands

Phone +31 (0)38 456 94 76
Fax +31 (0)38 456 92 30

More Information

For more information, please consult our website: www.dsmcompositeresins.com or contact Kristel van Haaren email: kristel.haaren-van@dsm.com