

Atlac resins moving on to new markets and applications

This issue of Global Solutions clearly shows the dynamic progression of our Atlac vinyl ester resins into new markets and new applications. Increasingly, Atlac anti corrosion resins are finding their way into the South-East Asian market, especially in China where demand is growing rapidly. The floor protection case (page 3) is a good example of the possibilities we see over there. Not only this, but the case described on page 2 also demonstrates the innovative power of our customers in Europe, finding

new possibilities in constructing huge storage tanks.

Last but by no means least, the Expertise Centre together with the local Technical Service specialists, continue to provide corrosion solutions for new systems alongside well documented chemicals like hydrochloric acid. This issue gives details of considerations when dealing with changes in concentration, or in situations where cleaning is required.



Soybean oil storage tanks in China.

Growth in anti corrosion resins Chinese market wants more!

The above picture, showing many large, well constructed storage tanks, precisely tells the story about what is happening in the Chinese market right now. The high quality anti corrosion resins of DSM Composite Resins are gaining recognition as the choice material for solving challenging corrosion problems and are therefore selected for projects in this demanding segment.

As well as Synolite and Palatal UP resins, since mid 2004 the vinyl ester resin Atlac 430 has also been produced in the modern production plant of DSM in Nanjing, to serve the south-east Asian market. Local production according to the high DSM quality standards, combined with dedicated local technical support, provide the foundations for future growth in the Chinese market.

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Dear Reader,

DSM's Global Solutions is enjoying an increasing level of interest. We receive more and more Atlac case histories for publication in this newsletter. Our goal is to group them as much as possible around a certain theme. In this issue you'll find two case histories from China. DSM Composite Resins Asia is serving the rapidly growing market of tanks and pipes as dedicated as in Europe, and in close cooperation with the anti-corrosion centre in Zwolle. Our recently expended resin manufacturing facilities in Nanjing produce the same high quality Atlac resins as in Europe. DSM is ready and well equipped to serve the enormous need for anti corrosive materials in the Asian process industry. DSM is dedicated to anti corrosion composites and we will keep on working together with you to make GRP the material of choice in corrosive environments.

Happy reading

Jan Lodewijk Lindemulder - Business Manager Tanks Pipes & Relining

Atlac 430 for the storage of biological waste. On-site production of bulk tanks.

When something is too large to transport, it must be built on site. Following this philosophy, Tunetanken A/S in Denmark has developed a new on-site production facility making it possible to build fibreglass reinforced silos and tanks with a volume of up to 2,000 m³; much larger than those currently available. The new construction technique allows tanks and silos of this type to be used in many more applications than previously possible – and on a much larger scale.

The first bulk tank built on-site according to this concept was for Green Farm Energy A/S at the GFE-Dammen biogas plant near Hjørring. The vessel is used as a digestion tank at the plant, holding just under 700 m³ of biological waste at a temperature of up to 80°C.

To secure the required chemical resistance performance, Atlac 430 was selected for the liner of the tank, while the structural part was produced with Palatal P69-02. Both resins show good temperature resistance.

The digestion tank at Green Farm Energy's Dammen plant is equipped with connectors and flanges. The tank also contains a so-called mammoth pump that utilises air to agitate the medium. In addition, the tank is fitted with mechanical agitation equipment, and baffle plates inside the tank prevent the medium from merely rotating. Hot-water heating coils allow the ammonia-rich medium to be heated to the required 80°C.

The liner resin, Atlac 430 - standard bisphenol A based vinyl ester -, was selected to give optimal protection against this aggressive media at elevated temperatures.



Biological waste storage according to the new Tunetanken concept

Storage tanks for Hydrochloric Acid The challenges of diffusion

GRP materials based on Atlac vinyl ester resins show extremely good chemical resistance performance against a wide range of chemicals, including strong acids like hydrochloric acid. This is shown in our chemical resistance corrosion guide. However, besides corrosion resistance against specific chemicals, other factors also have to be considered during the lifetime of storage vessels. One consideration is the procedure for cleaning for inspections, another is the ability to

switch to the storage of other chemicals. This article focuses on diffusion of HCl, the risks from osmosis and how to proceed when cleaning is required.

OSMOSIS & DIFFUSION

Hydrochloric acid as a small molecule (HCl) easily diffuses into Glassfibre Reinforced Plastic (GRP) laminates. In a GRP laminate (pipe or tank) hydrochloric acid can attack the reinforcing glass fibres over a prolonged period of time. Locally this can result in the formation of water-soluble salts, which will form salt solutions through diffusion of water molecules. These salt solutions will, essentially, try to dilute themselves with water diffusing from a salt solution with lower concentration. As salt ions are rather large, they probably will not diffuse in the other direction. This effect is called osmosis, the driving force for the diffusion of water into these water-soluble salt solutions.

Of course this extra water coming in by diffusion needs extra space, resulting in (osmotic) pressure build-up in the local area of the salt solution. This increased pressure can result in blister formation in the GRP causing delamination of the resin and glass fibres and a resulting loss in mechanical properties.



HCl - not always easy to handle

Hydrochloric acid and osmosis.

To summarise the described osmosis mechanism for the occurrence of osmotic failures in a GRP laminate, the following conditions must be in place.

- diffusion of HCl in the GRP laminate
- attack of glass by diffused HCl
- diffusion of water from area with lower salt concentration to locally higher salt concentration
- prevention of diffusion of salt ions (from high

concentrated to low concentrated areas)

- build-up of osmotic pressure

Osmotic effects are mainly based on concentration differences. Therefore there's a real concern in the market over lowering the concentration of the stored HCl. This is also expressed in the following statements, which can typically be found on GRP storage tanks for hydrochloric acid:

- only for storage of hydrochloric acid of the same concentration
- do not clean with water

CLEANING TANKS AND VESSELS

It is clear that producers of tanks & vessels follow the philosophy that any risk should be prevented to ensure the maximum service life for their products. But reality is more complicated and for inspection reasons, or for the need to change the medium, cleaning of the equipment is necessary. Unfortunately, the above statements do not deal with these circumstances and only hydrochloric acid, in general is mentioned, without considering specific concentrations and/or temperatures. Furthermore no valid recommendations are given about cleaning.

Based on many DSM Composite Resins laboratory tests with optimal cured laminates, and many decades of experience with our customers, a more specific recommendation should be possible. This can be found over on page 4.



Strong acid storage tanks.

Vinyl ester floor coatings in China Atlac tackles spillage problems

The application of vinyl ester resins is not exclusively limited to the construction of vessels and pipes. Another interesting application for these types of resins is the protection of industrial areas where spillage of all kinds of aggressive, corrosive chemicals can occur. In many plants in the chemical industry, the concrete floor is covered by a polymer concrete or FRP membrane to increase the corrosion resistance and to prevent leakage to the environment.

A good example is shown in the picture (right) at BASF-YPC Company Limited in Nanjing, China. To give the necessary protection against spillage

of formic acid, a polymer concrete floor protection layer has been applied in the main operation area of the formic acid workshop. The resin used is Atlac 590, DSM's novolac vinyl ester resin with extremely good resistance against organic and inorganic acids.

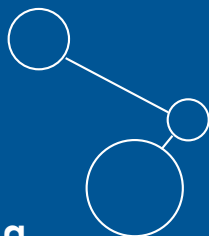
At the same site in Nanjing, another FRP floor covering was applied based on Atlac 430, standard bisphenol A vinyl ester. In this case the secondary operation area of formic acid was involved, which was considered to be less critical in respect of formic acid attack. Both types of protective coatings were installed by Nanjing Lianshuang Scientific Engineering Company in close cooperation with the technical service



Atlac 590 floor coating at BASF in Nanjing

engineers of DSM Composite Resins Asia.

Vessel cleaning



Concentrated hydrochloric acid resistance testing in the Expertise Centre corrosion laboratory.

The picture above shows that the diffusion of small hydrochloric acid molecules not only complicates the service and cleaning of HCl storage tanks, but it also affects test equipment. Standard chemical resistance tests can only be executed with special neutralisation of HCl vapour to prevent corrosion of the test equipment.

CLEANING RECOMMENDATIONS

The following are general recommendations. For specific information contact our Expertise Centre.

HCl, 0 - 20%, Temperature < 50°C

For storage of hydrochloric acid below 20% to a maximum 50°C, using a suitable Atlac vinyl ester resin, diffusion as described in the article on page 2 and 3, plays a very limited role and can be classified as non-critical in respect of osmosis. For cleaning, our recommendation is to use low concentrated sodium hydroxide solution (1%) for neutralisation of HCl residue followed by cleaning with water.

HCl, 21 - 25%, Temperature < 40°C

Under these conditions, diffusion is of limited concern. For cleaning operations our recommendation is to use a slightly alkaline salt solution – 10% NaCl + Sodium hydroxide (1%) – for neutralisation of HCl-residuals followed by

10% NaCl. According to our experience, concentration changes between 10 – 25% and temperature fluctuations between room temperature and 40°C, in respect of osmosis can be considered as non-critical.

HCl, 26 - 30 %, Temperature < 30°C

Here diffusion plays an important role. For cleaning operations the recommendation is to use a slightly alkaline salt solution – 10% NaCl + Sodium hydroxide(1%) – for neutralisation of HCl residuals followed by 10% NaCl. In our experience, concentration changes between 20–30% and temperature fluctuations between room temperature and 30°C in respect of osmosis can be considered non-critical.

Concentrated HCl, 31-37%, 23°C

Here diffusion is extremely active. HCl diffuses easily into the GRP laminate, even at room temperature, within one year's exposure. For GRP vessels containing concentrated HCl, it is recommended not to clean.

EVENTS

COMPOSITES PROCESSING 2006	27 April 2006, St. Helens, UK	www.composites-proc-assoc.co.uk
SAMPE 2006	30 April-4 May 2006, Long Beach, USA	www.sampe.org
COMPOSITES AFRICA 2006	17-18 May 2006, Durban, South Africa	www.compositesafrica.co.za
INT. SYMP. ON COMP. MANUFACTURING	17-18 May 2006, Marknesse, the Netherlands	http://iscm.nl
PLASTEX 2006	16 - 19 May 2006 - Czech Republic	www.bpf.co.uk/bpftools/Plastex.cfm
REINFORCED PLASTICS 2006: INT. CONF.	23-25 May 2006, Balatonvilágos, Hungary	www.emsz-kompozit.hu

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