



LET'S TALK / DURABILITY

5 DECADES OF RELIABLE
PERFORMANCE WITH
ATLAC® RESINS IN
CHEMICAL PROCESS
EQUIPMENT

Benny Luijsterburg

FRP Unlimited 2018
February 6-7, 2018

aliancys
QUALITY RESINS

LET'S TALK / INVITATION FOR COLLABORATION

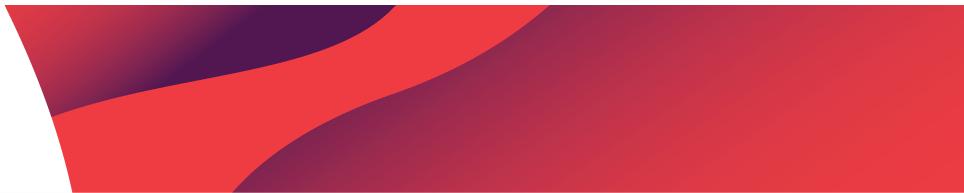
YOU CAN BUILD ON US FOR YOUR BUSINESS TODAY

- Aliancys is quality resins, service, trust and reliability

TOGETHER WE CREATE A SUCCESSFUL BUSINESS FOR TOMORROW

- Truly understanding your markets and business drivers

SO ... LET'S TALK /



END-USE PERFORMANCE REQUIREMENTS

- Resistance to chemicals
- Heat resistance
- Low maintenance
- Strength, stiffness, toughness
- Light weight, easy installation
- Design flexibility
- Food contact (when required)

Exposure determines resin choice

Different solutions available for heat and chemicals involved. Good chemical resistance means low maintenance and peace-of-mind on performance

High mechanical strength

Selection of right resin, reinforcement, and their interaction is key

Key benefit vs. steel

Enabling technology for light weight constructions in corrosive environment

Optimized design

Shaping flexibility and part integration possibility is a key composites benefit.

Food contact

Resins made in line with GMP for good food quality and consumer safety

PROCESSING REQUIREMENTS

- Fiber wetting
- Process robustness and stability
- Low peak exotherm for making thick laminates
- Predictable cure
- Pot life

Great laminate properties

Excellent fiber wetting and resin/ fiber adhesion is key for obtaining the right laminate strength and stiffness, and for achieving the right chemical resistance

Process consistency

Chemical resistance of the finished part is highly dependent on achieving the right and consistent level of cure. In some case post-cure may be required.

Pot life

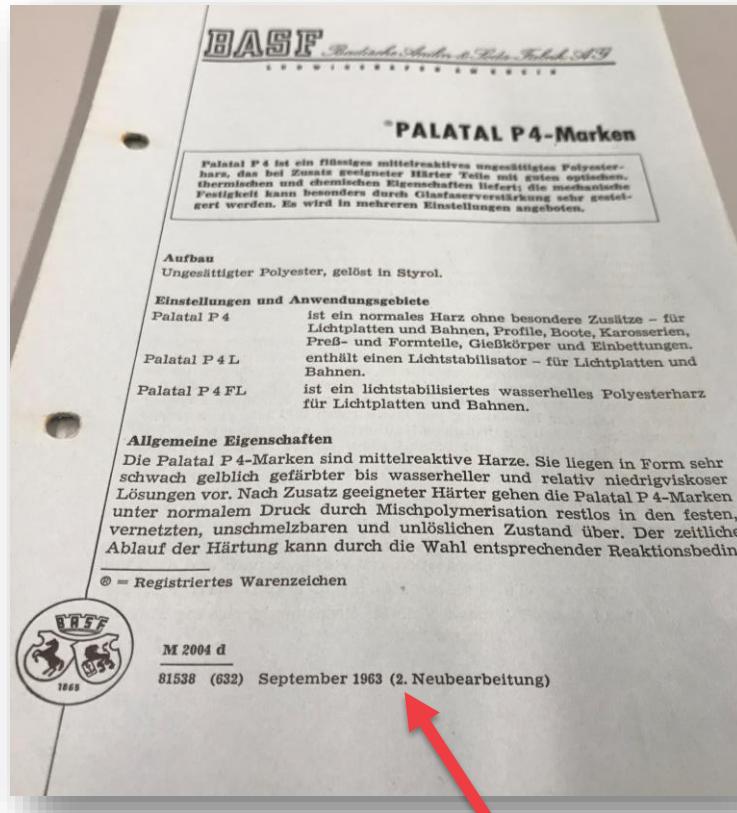
Particularly when working with open bath, resin pot life has to enable laminate production to the desire thickness before gelation

ATLAC® RESINS BRING GREAT CHEMICAL RESISTANCE

Description	Vinyl esters, Vinyl ester urethanes, Epoxy Novolac resins
Key applications	Tanks and pipes for industrial, building & infrastructure, water management, power
Benefits	<ul style="list-style-type: none">• Chemical resistance• Continued process operation• Resisting elevated temperatures• Low cost of ownership• Extensive expertise from Aliancys

	Atlac® 430	Atlac® 580	Atlac® 590	Atlac® E-Nova FW 2045
Viscosity (mPas)	440-500	400-500	208-280	350-500
HDT (°C)	105	115	140	145
Process-ability	Good	Good	Good	Excellent
Fiber wet-out	Good	Good	Good	Excellent
Curing (Shrinkage/ exotherm)	Good	Good	Good/ Fair	Good

ALIANCYS CHEMICAL RESISTANCE EXPERTISE DATING BACK TO 1962!



Chemische Beständigkeit

Ausgehärtetes Palatal P4, P4L, P4FL ist sowohl gegen die Einflüsse der Witterung als auch gegen Wasser, verdünnte Säuren, Mineralöl, Benzin und höhere ein- oder mehrwertige Alkohole ausgezeichnet beständig.

Ausgehärtet sind die Palatal P4-Marken unlöslich in allen Lösungsmitteln; dennoch sind sie mehr oder weniger empfindlich gegen Benzol und chlorierte Kohlenwasserstoffe, niedermolekulare Äther, Ester und Ketone; diese Stoffe bewirken allmählich eine Quellung und eine anschließende Zersetzung. Ausgehärtetes Palatal P4, P4L, P4FL ist unbeständig gegen Alkalien und gegen stark oxydierende Substanzen, wie z. B. konzentrierte Schwefelsäure, Chromsäure, Perchlorsäure, unterchlorige Säure und des nasces Chlor usw.

Die folgende Tabelle für ausgehärtetes, füllstofffreies Palatal P4, P4L, P4FL bezieht sich auf eine Lagerung von 1 Jahr bei 20–25°C.

Red arrow pointing to the text 'unbeständig gegen stark oxydierende Substanzen'

Lagerung in	Befund
Wasser (Trink-, Fluß-, See-, Kondens-)	+
Säuren verdünnt	+
Salzsäure, konzentriert	+
Schwefelsäure, konzentriert	-
Salpetersäure, konzentriert	-
Ammoniumsäure, Essigsäure, konzentriert	-
höhermolekularen organischen Säuren	+
Laugen verdünnt (10%ige Natronlauge)	-
Ammoniaklösungen	-
Laugen konzentriert	+
Methanol	-
Athanol	-
Butanol, Glykol	+
Aceton und anderen niedermolekularen Ketonen	-
Essigester und anderen niedermolekularen Estern	-
Dimethylphthalat	-
höhermolekularen Phthalsäureestern und Weichmachern	+
Benzin, Paraffinölen und Fetten	+
Benzol, Toluol	-
Xylool	+
Methylenchlorid, Trichloräthylen	-
Tetrachlorkohlenstoff	+

+= beständig - = unbeständig

Verarbeitung
Die Palatal P 4-Marken werden nach Zusatz der bereits genannten Härter entweder rein oder als Gemisch mit Styrol, Palatal E 210 oder Palatal P 6 T eingefärbt oder in Mischung mit Füllstoffen, je nach Wunsch, zu optisch klaren oder stark gefüllten Teilen verarbeitet. Obwohl die Verarbeitung

7

ATLAC® RESINS SUCCESSFULLY USED OVER 5 DECADES IN CHEMICAL PLANTS

Chlorine dioxide bleaching tower

Kimberly-Clark

It pays to innovate with GRP equipment. The Kimberly Clark Corporation reported, as far back as 1966, success stories on the use of GRP for bleach towers, process piping and other chemical plant, in highly corrosive service conditions at their pulp and paper mill in Anderson, California.

THOROUGH ANALYSIS OF CORROSION PROBLEMS

Kimberly-Clark engineers needed to establish the proper specification for a reinforced plastic that would suit their structural needs and stand up to the corrosive chemicals used in their bleaching processes.

After extensive lab tests with various resin systems, they decided on Atlac 382 bisphenol A polyester resin. The application would be two high chlorine dioxide bleaching towers and their related process piping, chlorine, chlorine dioxide, hypochlorite washing hoods, fans, ducts, tanks, absorption tower for chlorine dioxide, reactors, scrubbers and other equipment.

TENFOLD SERVICE LIFE INCREASE

One dramatic example of saving in the case of these identical towers. Constructed entirely of reinforced Atlac, the main tower coverflow section is 3.30 m in internal diameter, and about 13.5 m high. The pre-tension section is 2.10 m diameter and length is 7.5 m. Laminate thickness is around 12.5 mm for the pre-tension section, reducing towards the elbow section. The man

tower tapers from 25 to 10 mm at the top. The design was based on wind loading exceeding 100 km/h and Zone 2 seismic stresses.

SUMMARY

- Chlorine dioxide bleaching towers
- Chlorine dioxide adsorption
- OPERATING CONDITIONS
- Chlorine gas, chlorine dioxide
- Atlac 382 bisphenol A polyester resin
- IN SERVICE
- 1966 - 1967 November 1964

BENEFITS

- corrosion resistant
- light weight
- durable

REMARKS

- Installed outdoors, the tank needed atmospheric corrosion and never needed painting.
- They also withstood four decades of corrosive attack.

HUGE SAVINGS FROM THE OUTSET

Kimberly-Clark (K-C) tested a double-walled steel tower for chlorine dioxide process piping. For the pulp bleaching stages (both pulp and white liquor systems), they expected longer life than the three years or so obtained with type 317 stainless steel. This certainly proved the case, with the GRP tanks lasting more than ten times longer than steel. K-C also doubted that installation costs with "plastic" pipe would be lower, mainly because the installation techniques

KOPPARFORS PULP MILL

The Kopparfors pulp mill with an annual production of 180,000 ton bleached and unbleached paper annually, had to replace Atlac 382 GRP tanks in 1965, manufactured by MIL, which failed.

After evaluation of the findings, a plan was made now best to proceed.

THE NEXT STEP

In 1977 the entire scutcher made of steel was replaced by a GRP construction based on Atlac 382, supplied by Röglen & AB.

Scutcher width: 4.4 m, height: 8.35 m, thickness: 1.65 m. Back on these days, MIL had to take part of the plant down and start over again.

For example in 1972, Grönberg installed an Atlac water lock on top of the original scutcher to prevent possible vacuum shocks in the stock and wash water.

THE ATLAS SOLUTION

Atlac 382 bisphenol A polyester resin

IN SERVICE

The plant is in service since the early sixties. In 1987 the company became a part of the StoraEnso group.

BENEFITS

- Corrosion free
- High temperature resistance
- Easy workability

REMARKS

- The proven corrosion resistance performance history, has lead to an extensive use of Atlac for various applications.

SUMMARY

The pulp industry in Scandinavia, faced with severe corrosion problems from the

OPERATING CONDITIONS

- Grönberg processing solutions and tributaries, were among the first users of Atlac GRP tanks, pipes and ducting in the early sixties.

MANUFACTURING CHLORINE

Chlorine manufacturing is carried out in cold hydrochloric acid of brine solution made soluble in water. The acid is then dissolved in water and then passed through a series of pipes and valves to the final product.

That is why Atlac is used for all the pipework for wet gas and chlorinated brine in the IC plant. Furthermore, coil headers and covers for mercury cells, pipework and venturi scrubbers are also manufactured using Atlac resin.

THE ATLAS SOLUTION

Atlac 382 is a propylene bisphenol A unsaturated polyester resin, and the mainstay of the Atlac product family with more than 35 years of proven performance in the field of chemical reactor FIP applications. The cured resin combination exhibits high temperature behaviour with resistance to temperatures in the broad range of aqueous, acidic, alkali and alkaline solutions. In particular, its resistance to strong inorganic acids and oxidising media is superior. Atlac GRP is also readily available, easy to maintain, low in weight and offers great design freedom.

MATERIAL OF CHOICE

The IC engineers and maintenance staff recognized that the use of GRP equipment in chlorine/alkaline plants lead to many benefits. The service life of GRP is significantly longer than traditional rubber-lined steel. And due to its non-conducting behaviour, GRP minimises static

SUMMARY

For more than a quarter of a century, corrosion had been causing severe problems in chlorine/alkaline plants. The IC engineers recognized the use of GRP equipment in chlorine/alkaline plants, and therefore specified that all the pipework for wet gas and chlorinated brine should be constructed using Atlac resin.

OPERATING CONDITIONS

- Chlorine piping system
- Operating conditions
- > 90 - 100% Chlorine at 90°C working temp pressure: 5 bars
- Atlac 382 solution
- Atlac 382 bisphenol A polyester resin
- IN SERVICE
- 20.000 hrs
- BENEFITS

 - Corrosion free
 - Chemical resistant
 - Heat resistant
 - minimized static currents

REMARKS

 - All the pipework for wet gas and chlorinated brine in the IC plant is Atlac.
 - Further on coil headers and covers for mercury cells, pipework and venturi scrubbers are manufactured of Atlac.

Solving corrosion problems

Kopparfors pulp factory, Sweden

The pulp industry in Scandinavia, faced with severe corrosion problems from the

OPERATING CONDITIONS

- Grönberg processing solutions and tributaries, were among the first users of Atlac GRP tanks, pipes and ducting in the early sixties.

SUMMARY

Vertical venturi scrubbers installed in the plant were replaced by Atlac 382 GRP tanks.

OPERATING CONDITIONS

- Various aggressive environments
- Temperature range up to 87°C

MANUFACTURING CHLORINE

Chlorine manufacturing is carried out in cold hydrochloric acid of brine solution made soluble in water. The acid is then dissolved in water and then passed through a series of pipes and valves to the final product.

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High temperature Chlorine pipe

ICI Mond Division, Runcorn UK

For more than a quarter of a century, corrosion had been causing severe problems in chlorine/alkaline plants. The IC engineers recognized the use of GRP equipment in chlorine/alkaline plants, and therefore specified that all the pipework for wet gas and chlorinated brine should be constructed using Atlac resin.

OPERATING CONDITIONS

- Chlorine piping system
- Operating conditions
- > 90 - 100% Chlorine at 90°C working temp pressure: 5 bars
- Atlac 382 solution
- Atlac 382 bisphenol A polyester resin
- IN SERVICE
- 20.000 hrs
- BENEFITS

 - Corrosion free
 - Chemical resistant
 - Heat resistant
 - minimized static currents

REMARKS

 - All the pipework for wet gas and chlorinated brine in the IC plant is Atlac.
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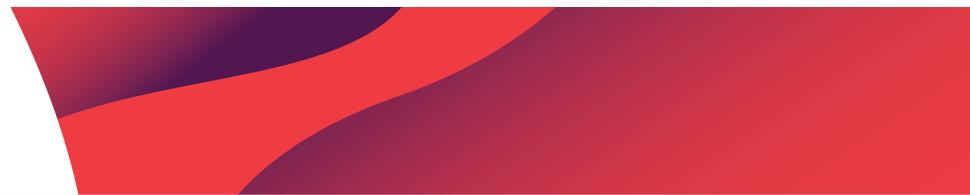
ATLAC RESINS WITH
PROVEN PERFORMANCE

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QUALITY RESINS

ATLAC® RESINS HAVE A TRACK-RECORD OF PERFORMANCE

SEVERAL RECENT CASE STUDIES PRESENTED TODAY

- Atlac® 5200FC Food-contact tank containers
- Atlac® 430 Wet electrostatic precipitators
- Atlac® New Firewater pipe system
- Atlac® 580 Pressure-filters for sea water filtration
- Atlac® 430 + Atlac® 580 *In-situ* chemical storage tank installation



INCREASED PAYLOAD AND LOWER
FUEL COST IN COMPOSITE TANK
CONTAINERS (ATLAC® 5200 FC)



MANUFACTURING TANK THROUGH
FILAMENT WINDING IN ONE GO
(NO SEPARATE END-CAPS)

INTEGRATION OF STAINLESS STEEL COMPONENTS INTO COMPOSITES



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QUALITY RESINS

OVER 250 UNITS SOLD, 200+ IN
USE BY BASF THROUGH HOYER



ATLAC® 5200 FC RESIN INCREASED PAYLOAD AND REDUCED FUEL COST

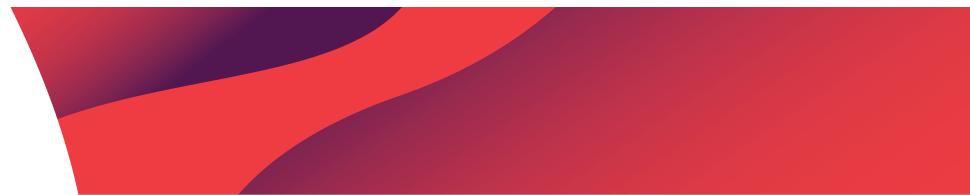
- 31 m² container weighs only 2200 kg (40 % reduction)
- Allows for 2 m³ extra payload
- Freight cost reduced by 5-10 %

- ADR, RID, CSC and IMO4 approved

Additional benefits

- 40 % better thermal insulation
- Improved smoothness of inner tank surface (no pitting)

Manufactured by Tankwell



AIR POLLUTION SERIOUS ISSUE

- Beijing on a bad day
- Major problems with smog and haze



QUICK FIX NOT
AVAILABLE



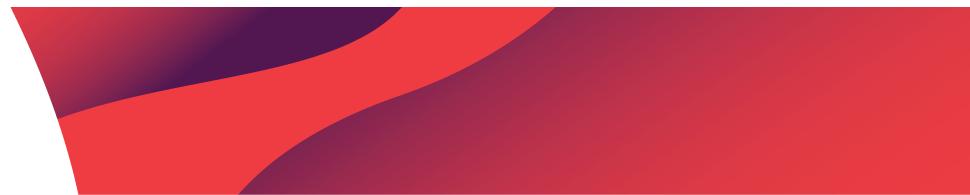
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QUALITY RESINS

ATLAC® 430 FOR REDUCING SMOG IN CHINA



TOUGH SERVICE ENVIRONMENT

- Saturated wet flue gas, 50~80 °C
- Containing SO_2 , SO_3 , NO_x , Cl^- , F^- and other corrosive media.
- Highest concentrations in flue gas:
 - SO_3 is 100 mg/m³
 - HCl (Cl^-) is 10 mg/m³
 - HF (F^-) is 10 mg/m³
- Composition of collected liquids
 - Highest concentration of Cl^- is 20000 ppm, pH: 1-3
- Service life: designed for 30 years

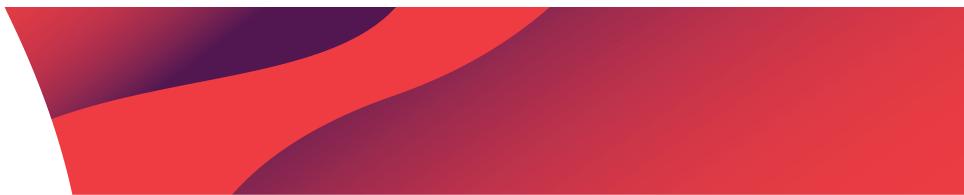


HONEYCOMB USED IN EQUIPMENT CORE



ATLAC® 430 RESINS USED IN WESP FOR REDUCING SMOG IN CHINA

- Wet Electrostatic Precipitators (WESP)
- Typically installed after wet flue gas desulfurization system
- Honeycomb used in equipment core
 - Sub-micron aerosols captured
 - Using electrically conductive composites



NEW TWO-LAYER TUNNEL PROJECT IN NETHERLANDS



FAST INSTALLATION OF
RELIABLE FIREWATER
PIPE SYSTEM



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QUALITY RESINS

CUSTOMER-SPECIFIC ATLAC® RESIN FOR ROAD TUNNEL FIREWATER PIPE SYSTEM

- Installation in new tunnel construction underneath Maastricht (Netherlands)
- DN 125
- Length of 4.2 km
- Installation by Versteden in 2015
- Reliable supply of firewater
- Increased reliability, cost-effectiveness, availability vs. stainless steel

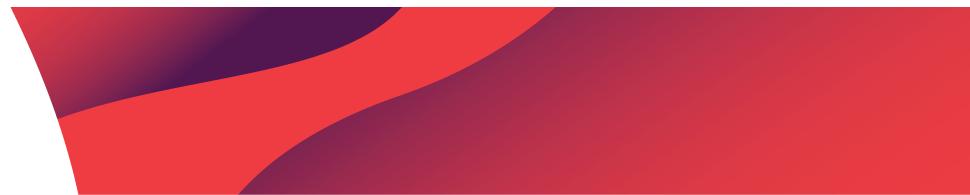


HORIZONTAL PRESSURE CARTRIDGE FILTERS (ATLAC® 580)



ATLAC® 580 FOR HORIZONTAL PRESSURE CARTRIDGE FILTERS

- Installation at sea water desalination plant in Iraq
- Working pressure 10 bar, tested up to 15 bar
- Design temperature 50°C
- DN 500 and DN 600
- Installation in 2015
- Manufactured by Selip

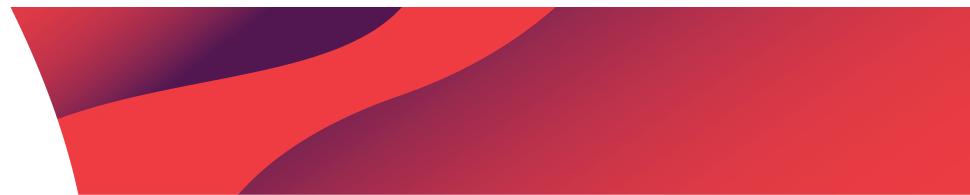


VERTICAL PRESSURE BACKFLUSHING FILTERS (ATLAC® 580)



ATLAC® 580 FOR VERTICAL PRESSURE BACKFLUSHING FILTERS

- Installation at sea water plant in Middle East
- Working pressure 10 bar, tested up to 13 bar
- Operating temperature 45°C
- DN 1200, H 2.9 m
- Installation in 2008
- Manufactured by Selip



ATLAC® 430 AND ATLAC® 580 PERFORMING WELL IN THE HEART OF GERMAN DEMOCRACY



EASY INSTALLATION IN EXISTING BUILDING (ATLAC® 430 AND ATLAC® 580)

- 10 m³ double-wall chemical storage tank for AdBlue® chemicals
- Part of back-up power supply system in cellar of Reichstag building
- Limited accessibility in existing building infrastructure requires *in-situ* installation by Haase



5 DECADES OF RELIABLE
PERFORMANCE WITH ATLAC® RESINS
IN CHEMICAL PROCESS EQUIPMENT



NOVEL ATLAC® 610 ACT RESIN FOR REDUCED STYRENE EMISSION

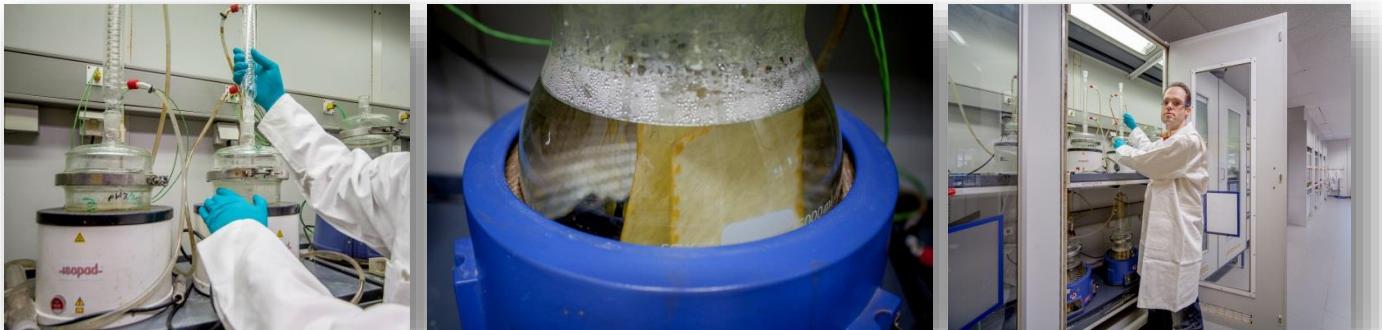
LOW STYRENE VINYL ESTER RESIN



Description	Low styrene vinyl ester resin with easy processing
Key applications	Tanks and pipes, tank repair
Benefits	<ul style="list-style-type: none">• 90 % lower styrene emissions vs. styrene-containing equivalents (contains only 4 % styrene, as well as LSE system)• Better working environment for operators• Continued process operation in confined areas• Easy application through fast surface cure, fiber wetting• Low cost of ownership though material durability, because of high chemical resistance and mechanical properties

ALIANCYS PROVIDES ADVICE ON CHEMICAL RESISTANCE TO CUSTOMERS

- Excellent track record of use Atlac® resins in Industrial markets
- Extensive experience in chemical resistance testing, laminate build-up for maximizing chemical resistance
- “Chemical Resistance Advice” as official document for reference
- Experienced Technical Service team to support in troubleshooting and continuous process improvement



CHEMICAL RESISTANCE ADVICE SERVICE

- Aliancys can help in making the best resin selection for your application
- To make accurate recommendations we need to know:
 - Chemical environment, composition, concentrations, pH values, storage conditions
 - Service temperature, temperature profiles, maximum temperatures
 - Mechanical exposure, pressure, static and cyclic loading
 - Type of composite material/ build-up used (fiber volume, chemical resistance layer)
 - Equipment and process
- Available in several languages

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Technical advice

To	ABCD	From	Ronald Uitterdijk
For the attention of	S. Cole	Phone	+3138 4569241 
Fax		E-mail	Ronald.Uitterdijk@dsrm.com
Your Reference		Our reference	1200145
E-mail	scole@abc.com	Date	2012/04/13

Dear Mr. Cole,

Find hereby our advice regarding your question about resin suitability for Nitric acid.

Kind regards,
Ronald

Information

Working temperature 40 °C

Chemical(s)	Information	Concentration
Nitric Acid		15 %

Advice

Based on the above data and on the information currently available, on behalf of DSM Composite Resins AG, we suggest the following product(s) for the mentioned application

ATLAC 382
ATLAC 4010
ATLAC 430
ATLAC 580
ATLAC 590
Atlac E-Nova FW 1045
Atlac E-Nova FW 2045
PALATAL A 410-01

A prerequisite of this recommendation is that the product must be well fabricated, well designed and properly cured. The recommendation is derived from data generated from the testing of fully post-cured composite materials; further information on post-curing is available in the product data sheet or by contacting your local technical service.

Additional notes

Acid resistant glass should be used in chemical resistant barrier

Signed by Ronald Uitterdijk
Date 2012/04/13

MORE INFORMATION

- Product and case study information on www.aliancys.com
- Please contact your Aliancys Technical Service representative for more detailed information and for our Chemical Resistance information service



ACKNOWLEDGMENTS

- Thomas Falkenbach & Heike Pohl (Haase Tank)
- Carlo Romani (Selip)
- Casper Willems (Tankwell)
- Peter Bogers (Versteden)



The background features a minimalist design with three overlapping circles. A large circle in the center is filled with a bright red color. It overlaps with two other circles: one to its left and one to its right, both of which are filled with a dark purple color. The overlapping areas create soft, blended transitions between the red and purple.

LET'S TALK /