Improved vinyl ester technology for anticorrosion and high performance laminates/GRP structures

Stefanie Römhild

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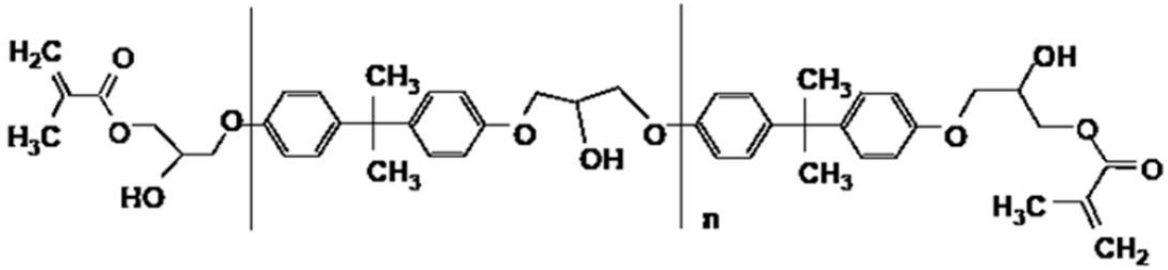
DION® IMPACT 9133

- **Premium bisphenol A epoxy based vinyl ester** resin designed to give additional benefits in comparison with standard vinyl ester resins
- Chemically modified to achieve better heat resistance, ie **higher HDT** than standard vinyl ester resin
- Chemically modified to be a **low foaming system** with standard MEKP
- **Impact grade** with high reactivity, light color



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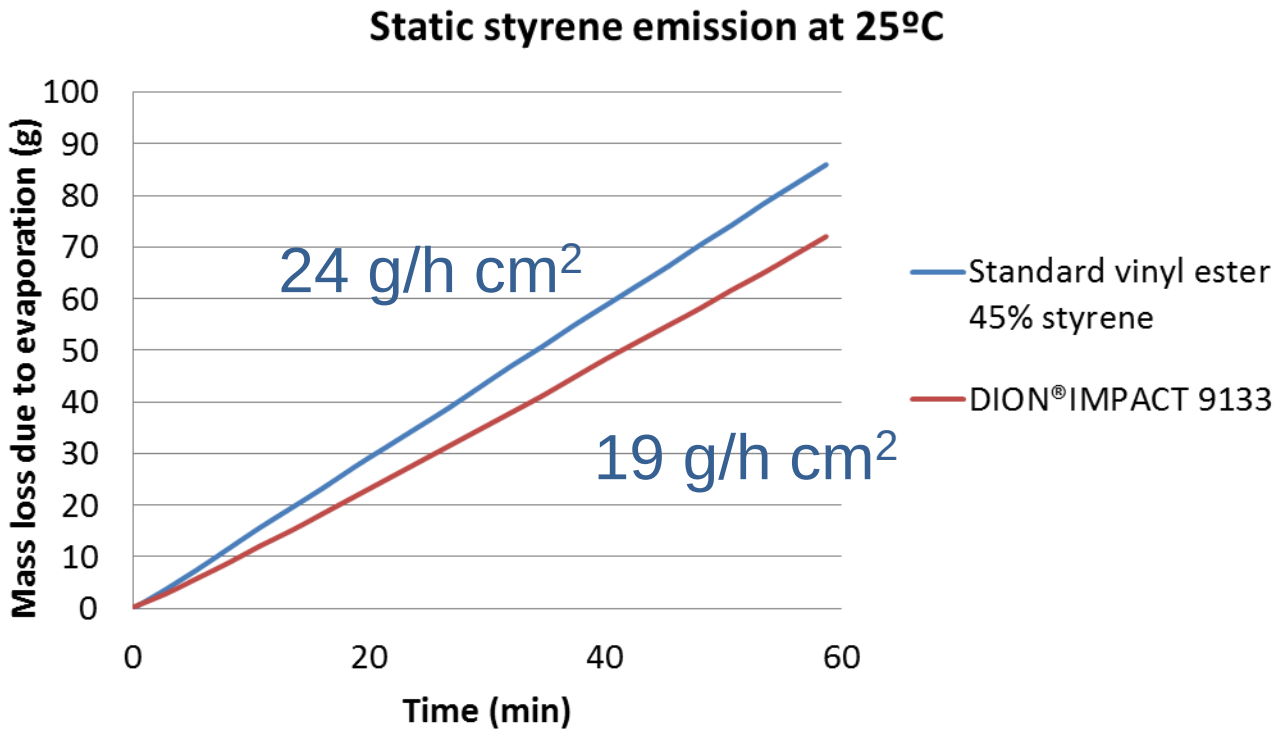
Comparison DION® IMPACT 9133 with standard VE

	Standard VE, AVERAGE	DION® IMPACT 9133
Foaming	Mostly yes	Strongly reduced
HDT	102ºC	112ºC
Tensile strength (MPa)	82	80
Tensile modulus (MPa)	3300	3350
Tensile elongation (%)	4-6	4-6
Flexural strength (Mpa)	140	135
Flexural modulus (MPa)	3300	3400
Styrene content (%)	45	36-39

- Good chemical resistance, particularly towards acids, some solvents and oxidizing agents
- Good adhesion to glass, aramide and carbon fibre giving good toughness and fatigue properties
- Good crack resistance
- KTW certificate, suitable in contact with drinking water

Reduced styrene emission



- Styrene emission reduced by 18-20% when comparing DION®IMPACT 9133 to standard VE with 45% of styrene

Curing of DION® IMPACT 9133

- Can be cured with standard MEKP and MEKP recommended for VE, ie Butanox M50 and LPT type, respectively
- Can be cured using low Co-levels
- Good resin color gives lighter laminates

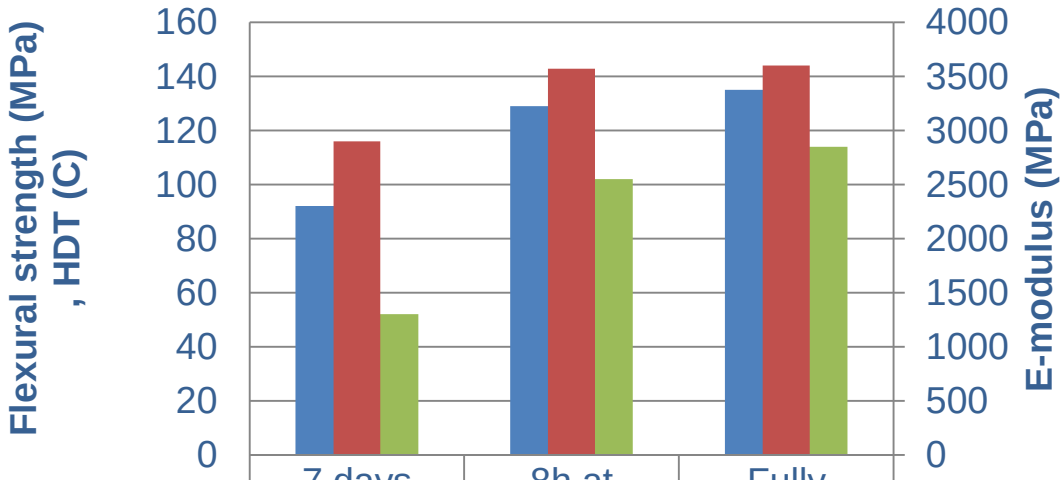
	DION® IMPACT 9133	Standard VE, non Impact grade
Co 1%	0.6%	3%
Geltime 23ºC	2% Butanox M 50 20-30 min	2% Butanox LPT 20-30 min

DION® IMPACT 9133 cured with standard MEKP

Standard vinyl ester cured with MEKP recommended for VE lor lower foaming

Post-curing of the DION® IMPACT 9133

- As known, HDT is function of both curing and post-curing procedures
- With DION® IMPACT 9133, using relatively moderate post-curing temperatures and curing times yields good HDT and mechanical values



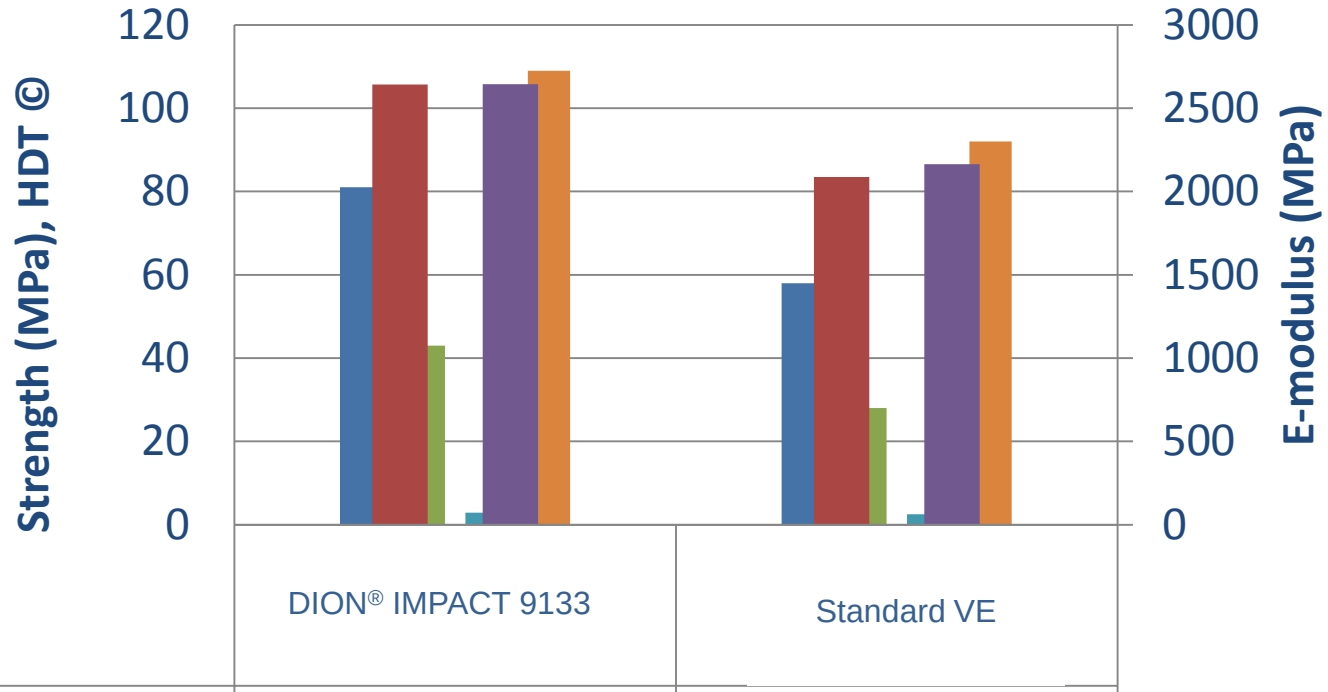
	7 days at RT	8h at 80C	Fully cured
Flexural strength (MPa)	92	129	135
HDT (°C)	52	102	114
E-modulus (MPa)	2900	3570	3600

After 24h at 80°C the resin reaches almost the properties of the fully cured resin (schedule with maximum 120°C)

If not post-curing or curing during service can be applied properties are improved using higher level of Co (1-1.5%) and DMA (<1%)

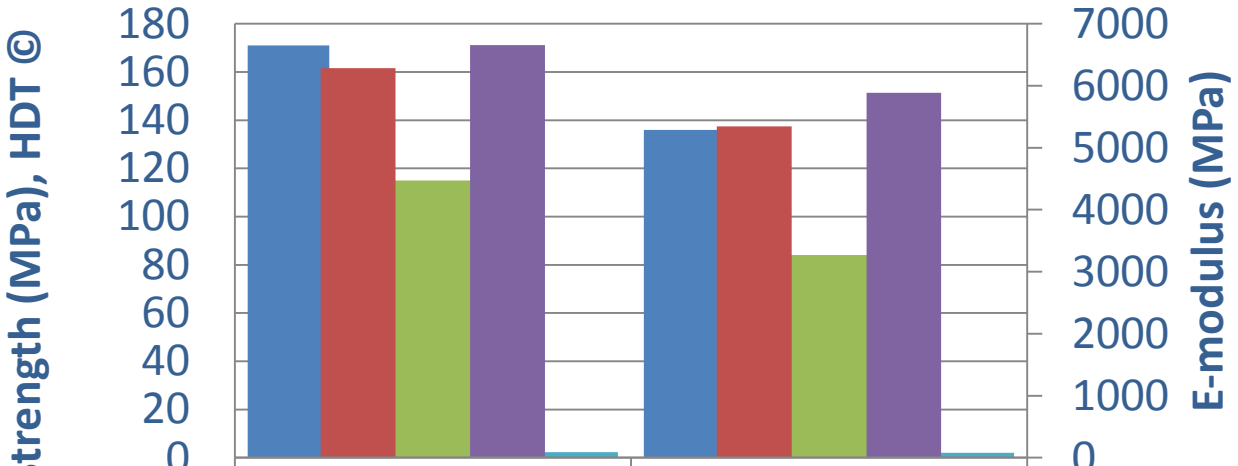
Mechanical properties at 80°C – clear casts

DION® IMPACT 9133 and standard VE clear casts cured with Co and Butanox LPT, post-cured at 80°C



	DION® IMPACT 9133	Standard VE
Flexural strengh (MPa)	81	58
Tensile strength (MPa)	43	28
Tensile elongation (%)	2,9	2,5
HDT	109	92
Flexural modulus (MPa)	2642	2086
Tensile modulus (MPa)	2643	2163

Properties at 80°C – CSM laminate



	DION®IMPACT 9133	Standard VE
Flexural strengh (MPa)	171	136
Tensile strength (MPa)	115	84
Tensile elongation (%)	2,3	2
Flexural modulus (MPa)	6282	5345
Tensile modulus (MPa)	6653	5885

Laminates post cured at 80°C for 24h. 25- 30 wt% glass

Benefit of improved heat resistance at operation temperatures around 80°C
DION® IMPACT 9133 can be used at least 10°-15 °C higher temperatures

Product family

- **DION® IMPACT 9133 base resin**
  - Non-promoted, non-thixed
  - Filament winding, pultrusion, centrifugal casting, etc applications that require fast & efficient wet-out and good reactivity
  - Chemical resistance applications

- **DION® IMPACT 9133-800**
  - Promoted and thixed version of DION® IMPACT 9133
  - Hand-lay-up, spray-up version optimized for large vertical applications, low drain off
  - +2% MEKP geltime 18-30 min

- **DION® IMPACT 9133-200**
  - Thixed version of DION® IMPACT 9133
  - Hand-lay-up, spray-up optimized for large vertical applications, low drain off offering the fabricator to adjust geltime after requirements

- **Customised products** with adapted viscosity and reactivity based on DION® IMPACT 9133

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Application areas for DION® IMPACT 9133

- Processes:
  - Filament wining
  - Hand-lay-up
  - Pultrusion and similar processes
  - Centrifugal casting
  - Polymer concrete
  - Protective coatings

- Application areas:
  - Process equipment, environments requiring excellent chemical resistance
  - Working temperatures in the upper range
  - Applications requiring good mechanical properties

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CASE STUDIES
DION® IMPACT 9133

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DION® IMPACT 9133 for BFRP Minibars™

- ReforceTech BFRP MiniBars™, patent pending and produced in a patented process, are short thin reinforcement bars 30- 60 mm long.
- Made of basalt fibre and DION® IMPACT 9133
- MiniBars™ directly mixed with the concrete in portions of up to 10%
- Designed to improve concrete structural strength in conjunction with alkali resistance and bond strength allowing thinner constructions and new freedom in design
- Application areas: e.g. Submersed concrete, highway slabs, bridge decks, floating infrastructure, agricultural products, etc

ReforceTech™
Basalt Fiber Reinforcement Technology

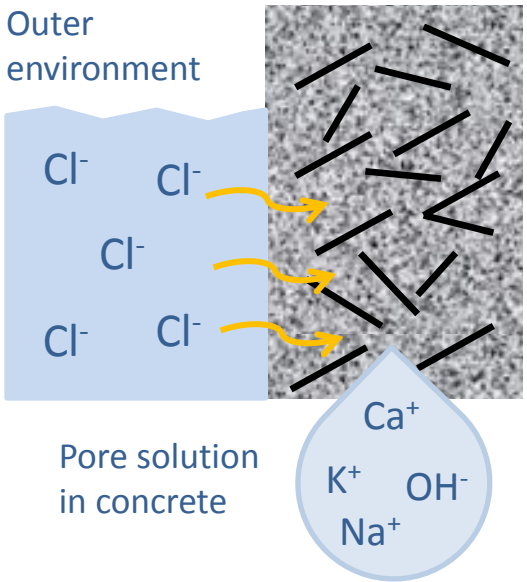
Why basalt fibres and DION® IMPACT 9133?

- DION® IMPACT 9133 shows **optimum reactivity** and the **high temperature properties** required in the production process
- Combination of the **excellent corrosion resistance** of the basalt fibres and the DION® IMPACT 9133 towards the alkaline environment of the concrete giving a **light weight** construction material with improved lifetime
- Higher corrosion resistant to other – for metals – corrosive environments such as salt and acid environments

Marine pipeline Seaweights

With permission by Reforcetech

Concrete with Minirebars



Road environments with high levels of chloride and contamination

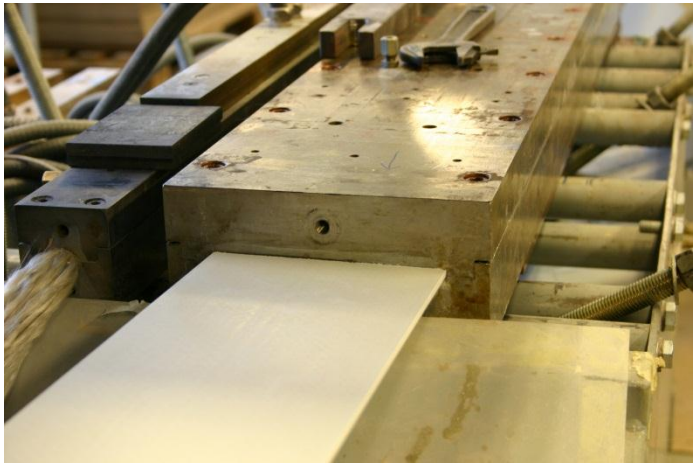
Filament wound GRP pipe

- DION® IMPACT 9133 for filament winding GRP pipe production
- Project: 1100m pipe line for the cooling system for Geothermal Power plant
- Working conditions: 65ºC water with max 80ºC
- Location: Turkey (local project)
- DION® IMPACT 9133 chosen for improved mechanical properties at elevated temperature compared to standard VE

Piping project with GRP piping

Pultrusion

- DION® IMPACT 9133 for pultrusion processes
- Production of pultruded panels intended for use in alkaline environment at elevated temperature
- DION® IMPACT 9133 was chosen due to optimum reactivity and high temperature mechanical properties for pultrusion process and good chemical resistance to alkaline environment



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OTHER HIGH PERFORMANCE VE IN THE DION® FAMILY

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DION® 9400/ DION® IMPACT 9400

- Novolac bisphenol A epoxy-based vinyl ester resin
- HDT 135°C
- Improved high temperature performance
- Retains mechanical properties at elevated temperatures
- Low color and high reactivity for Impact grade
- Resists organic solvents
- Good resistance to many oxidising environments
- An economical alternative to exotic metal alloys

Case study
Transport tanks for chemical industry
Selcotec Norway
Various corrosive environments
Dion 9400 offers good corrosion resistance to different environments and good mechanical properties

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HIGHLY CROSS-LINKED VINYLESTER

DION® IMPACT 9700 Series

- Suitable for production of scrubbers and flue gas ducting.
- Improved glass wet out
- High HDT of 160°C / 320° F
- Well suited for hand lay up, filament winding & pultrusion
- Excellent acid and solvent resistance
- Very good retention of physical properties at elevated temperatures

BROMINATED BISPHENOL-A EPOXY VE

DION® FR 9300

- Non-promoted, flame retardant vinyl ester resin
- Class A flame spread with addition of 1.5% antimony trioxide or 3.0% of antimony pentoxide
- Corrosion resistance similar as Dion® 9100
- User friendly, 10 min. to 18 hour gel time with excellent cure
- Extensively used in field fabrication of Chimney and Stack liners

ELASTOMER-MODIFIED *VINYL ESTER*

DION® 9500

- Non-accelerated, rubber modified
- 9% tensile elongation
- Good impact resistance
- Well suited for dynamic loads
- Low shrinkage
- Low Peak exotherm
- Can be used as primer to enhance bonding of composites to dissimilar substrates such as concrete and metals
- Abrasion

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THANK YOU FOR YOUR ATTENTION!