Vinamul® Elite 15 and Elite 25: next generation *Vinyl Acetate Ethylene* copolymer dispersions for nonwoven construction

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Introduction

Aqueous based polymer dispersions have been used to bond nonwoven fabrics for many years, to either consolidate the basesheet (thereby creating strength and durability), control linting and reduce "pilling", or add specialised surface treatments. Binder users within the Industry are all aware of the powerful effect that such products can have on nonwoven properties, primarily due to the basesheets ability to inherit the properties of the consolidating resin, thereby impacting:

- Fabric handle (very soft to stiff)
- Control of fluid management (absorbent to water repellent)
- Elongation and stretch
- Permeability, burst and tear
- Pleatability, heat seal
- Compression recovery
- Flammability
- Surface properties (smooth / anti slip / abrasive / printability)
- Carrier of specific functional additives e.g. anti-microbial / pigment / flame retardant / anti-slip

These characteristics are controlled by the monomers, or rather "building blocks" used to assimilate the polymer, the nature of the water phase surfactants and the molecular weight of the polymer itself. Self cross – linking dispersions of *Vinyl Acetate Ethylene* (VAE) offer a high standard of performance and can be considered the primary construction tool for chemically bonded Nonwoven products, due to the accurate control of Glass Transition Temperature (T_g) that can be achieved with such systems together with the highly absorbent character that can be engineered into the dispersion.

Commercially available products from the Celanese binder portfolio presently service a broad range of segments including hygiene, apparel, medical, filtration, automotive, geotextiles and industrial. Since their introduction in 2000, the *Vinamul*® *Elite VAE* copolymer range has been synonymous with high performance fibre bonding with two distinct products, one offering medium to firm hand - Elite Ultra with a mid-point Tg of + 11 °C with the other - Elite Ultra-soft, having a Tg of zero °C thereby delivering softer handle. Both grades are pre-catalysed and ready-for-use, and offer the benefit of being free of any post added preservative without compromising product shelf-life.*

Both dispersions offer higher bonding strength than existing VAE technology which can be utilised by the Industry as follows:-

- By the *Roll goods* producer, developing stronger fabrics whilst retaining absorbency or maintaining performance with lower cost by reducing the binder content
- By the *Fabric user*, allowing more choices for substrates requiring higher strength with greater flexibility for balancing performance and economics in existing configurations.

Celanese® Emulsion Polymers is a global leader in developing products and application technology to improve performance, create value and drive innovation in a broad range of industrial and consumer end-use applications. The business has manufacturing facilities worldwide and is supported by expert technical service regionally. Our goal is to drive value into our customers' products, all the way through the value chain.
We would like to introduce our newly improved *Vinamul® Elite VAE binding systems* focusing on their benefits through **lower odour** combined with **increased wet dispersion solids** (and associated reduction in carbon footprint), all without compromise to the existing standard of application properties evident with both Elite Ultra and Ultra-soft.

Physical properties – next generation products
Technical specifications for the current binders and next-generation products are tabulated below combined with their new product codes:

Figure 1

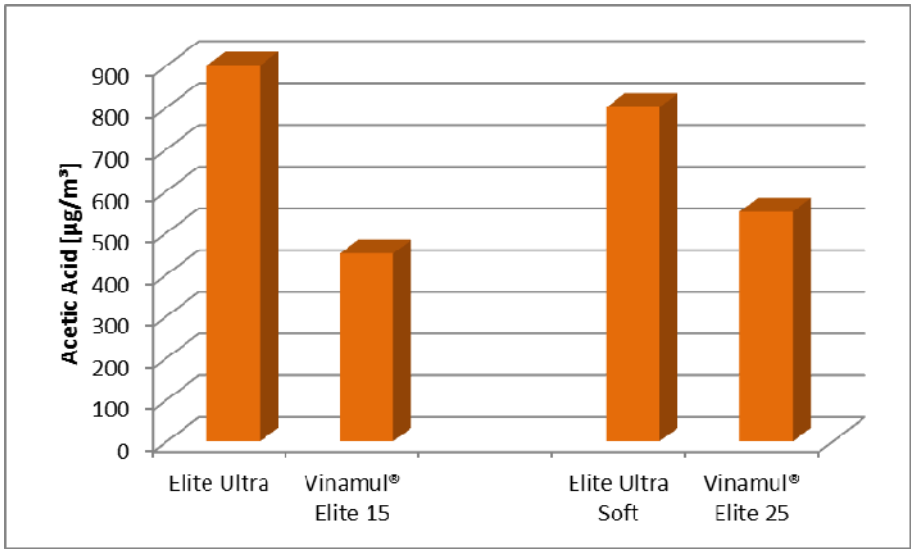
	Elite Ultra	Vinamul® Elite 15	Elite Ultra-soft	Vinamul® Elite 25
Polymer	x-link VAE	x-link VAE	x-link VAE	x-link VAE
T_g [°C]	+ 9	+ 9	-1	-1
Hand	Medium/Firm	Medium/Firm	Soft	Soft
Stabilisation	Surfactant	Surfactant	Surfactant	Surfactant
Solids [%]	50	55	50	55
Viscosity [mPas]	10 -1000 mPas (maximum)	10 -1000 mPas (maximum)	10 -1000 mPas (maximum)	10 -1000 mPas (maximum)

Glass transition temperature (T_g) – The temperature at which the polymer transforms from a hard glassy state to a soft rubbery state. Mid-point T_g has been quoted within the text according to ISO 16805.
mPas – the selected unit of viscosity measurement (quoted using a Brookfield RVT viscometer @ 25 °C / 20 rpm)

Improved feature – reduced odour and lower TVOC considerations
Today's business arena places ever challenging demands on the roll goods producer to manufacture more "environmentally-friendly" products. Both Vinamul® Elite 15 and 25 have been developed to deliver on this target with reduced Total Volatile Organic

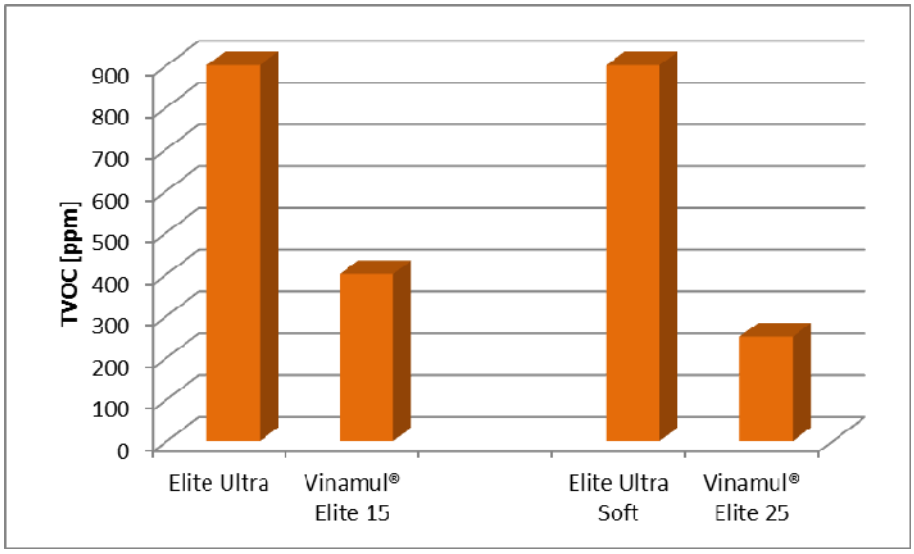
Compounds (TVOC) in the wet dispersion when compared to their Elite Ultra and Ultra-soft predecessors'. This is advantageous during use in the production hall and offers the benefit of lower odour in the final, consolidated nonwoven.

Figure 2 - Chamber method on acetic acid for fabric odour



Test method: CELANESE internal
Nonwoven test pieces of pre-determined weight and dimensions are normalised after enclosure in aluminium foil for 24 hours at 23°C and 50% RH. Sample swatches are subsequently transferred into emission chambers for a period of 3 days with air capture through Tenax TA tubes utilising a pump with 120 m .min^{-3} flow rate for 30 minutes. Vials are analysed using GC-MS/TD for VOC's according to DIN 16000.

Figure 3 – TVOC from latex



Test method: ISO 11890-02

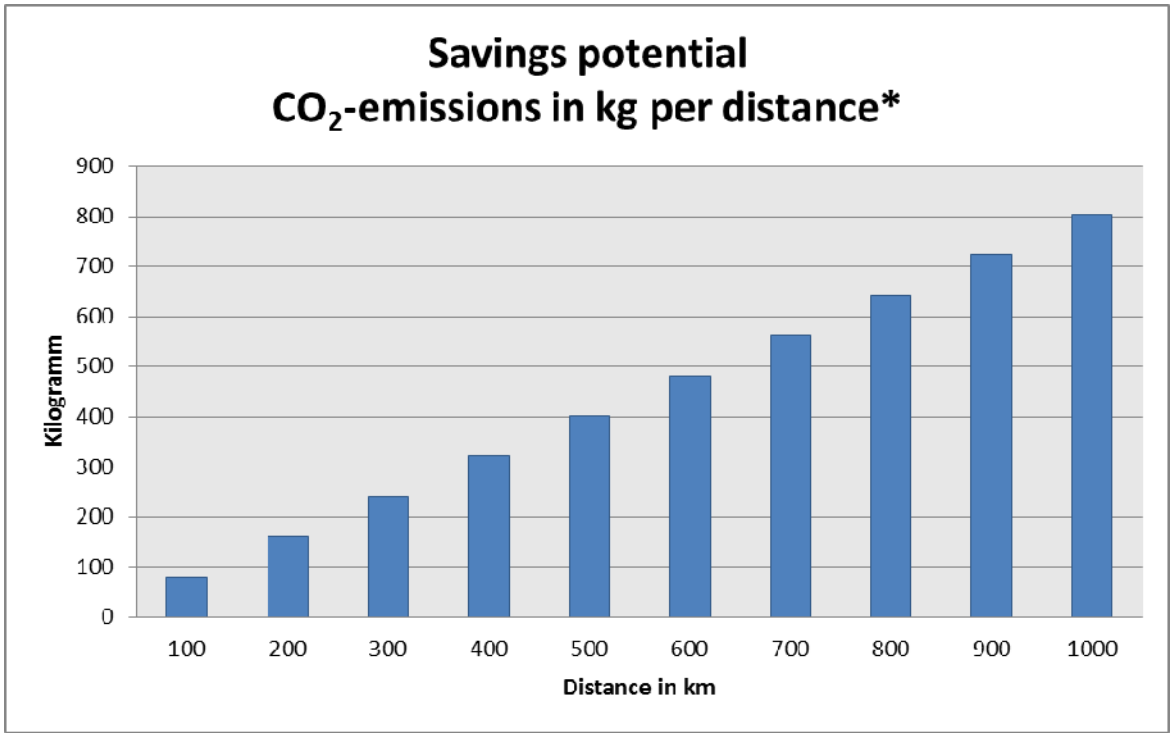
Figures 2 & 3 clearly illustrate significant reductions for Vinamul® Elite 15 and 25 not only in total volatile organic compounds, but specifically for Acetic Acid supporting reduced odour during use when compared to the parent products.

Improved feature – higher solid content

Worldwide climate change is currently one of the biggest challenges around the globe. Reducing and offsetting carbon emissions (or greenhouse gas emissions) is one of the most powerful ways to address global warming and to improve said carbon footprint [total amount of greenhouse gases produced directly or indirectly by an activity or organization, expressed in equivalent tons of carbon dioxide (CO_2)].

Due to higher solids production, both Vinamul® Elite 15 and Elite 25 support the reduction of CO_2-emissions through transportation of reduced water and higher polymer where fewer tanker trucks would be required to transport the same weight of product. In the graph below, the potential savings of CO_2-emissions in kg per distance is displayed.

Figure 4 – Savings potential on CO_2-emissions



**Assumptions: full truck load (24t), 30l/100km, diesel conventional,*
*Formula: **EMTTW = FC x FEM_TTW** (Source: DSLV-Leitfaden*
Berechnung von THG Emissionen in Spedition und Logistik)

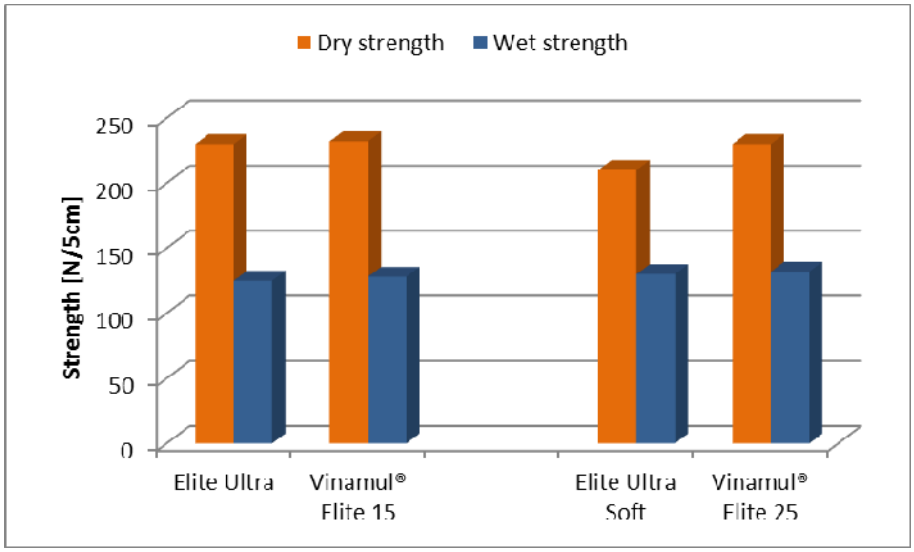
Another benefit of higher solids dispersions is reduced handling costs (i.e. lower storage capacity, lower total freight costs and lower order of administration costs).

Performance specifics: the Elite series of VAE dispersions

There are a tremendous range of variables associated with nonowoven fabric design including for example, the forming process itself, fabric basis weight and caliper, fibre type

(natural and synthetic), embossing character, binder level and application method to list but a few. There is no "universal" substrate to cover all aspects so in the interests of reproducibility and consistency, the selected test substrate for each set of application tests is referenced accordingly. Based on these guidelines, comparative performance data is illustrated below with the adopted Industry test procedure:

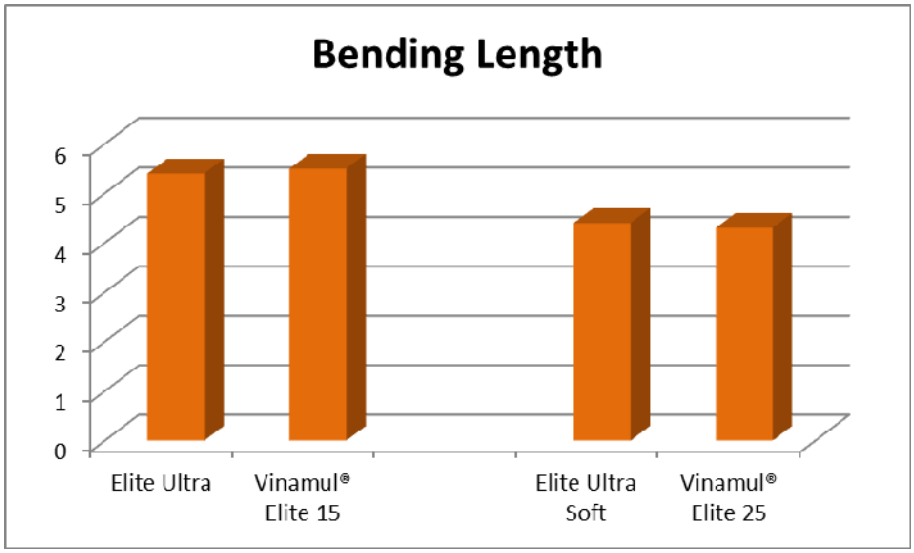
Figure 5 – Dry and wet tensile strength



Test method: EDANA 20.2-89 using a short fibre, 88 gsm cellulosic structure consolidated with approximately 20% dry binder add-on and corresponding web density of 0.3 g cm^{-3}.

Data clearly confirms no change in tensile strength between the existing and next generation products, also confirmed by comparison of wet/dry tensile relationships.

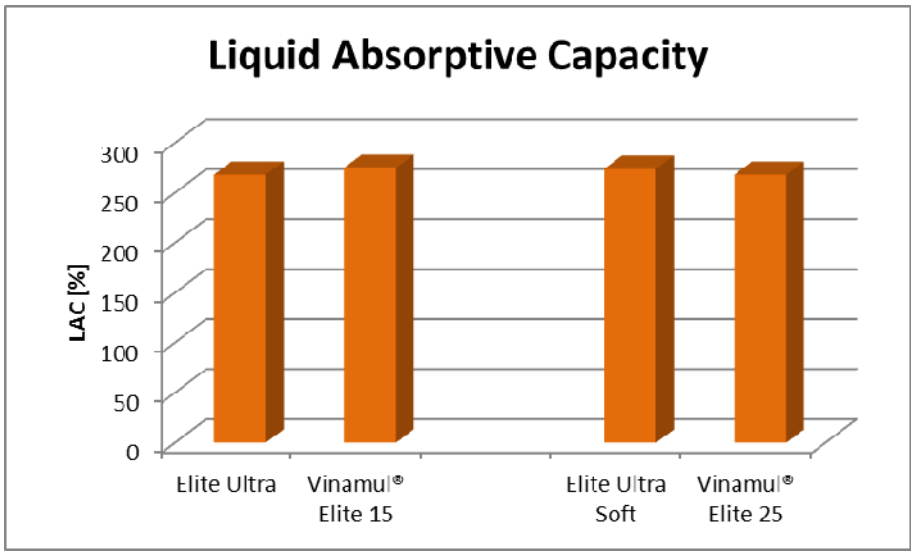
Figure 6 – Handle



Test method: EDANA 50.6-02 (Bending length) using 55 gsm cellulosic substrate @ 30% dry binder content

Bending length values illustrate no variation in handle when comparing the series of products.

Figure 7 – Absorbency



Test method: EDANA 10.4 (02) *(Liquid absorptive capacity) using 55 gsm cellulosic substrate @ 30% dry binder content*

The existing Elite series and the successor products can all be classified as highly absorbent.

Summary

Nonwoven fabric performance is governed by a variety of construction parameters including the manufacturing process, the nature and density of the fibres in the base-sheet plus the latex binding component as part of the design.

There are many different, commercially available dispersions for use in nonwoven fabrics, where the new Celanese® Vinyl Acetate Ethylene emulsions under the Vinamul® Elite trade-name can be utilised to introduce additional features and benefits to the roll goods producer (and ultimately the consumer) when compared to their predecessor products.

Whilst retaining all the previous characteristics of the original binders including high tensile strength and, control of fabric handle combined with absorbency, the next generation products represented by Vinamul® Elite 15 and Elite 25 support environmental matters surrounding reduced carbon footprint and lower odour in use through production at higher solids and reduced TVOC.

Celanese® Emulsions are globally active in supplying bonding chemistry to the nonwoven Industry, with product portfolios covering North America in addition to the EU countries.

Further product details for our nonwoven grades can be obtained through the Celanese web-page –

http://www.celanese-emulsions.de

Appendix ***Requires good housekeeping to be adopted throughout the value chain; Celanese can offer guidance and hygiene audits on relevant best practises.***