Kaneka MS Polymer™ for every taste!

INTRODUCTION

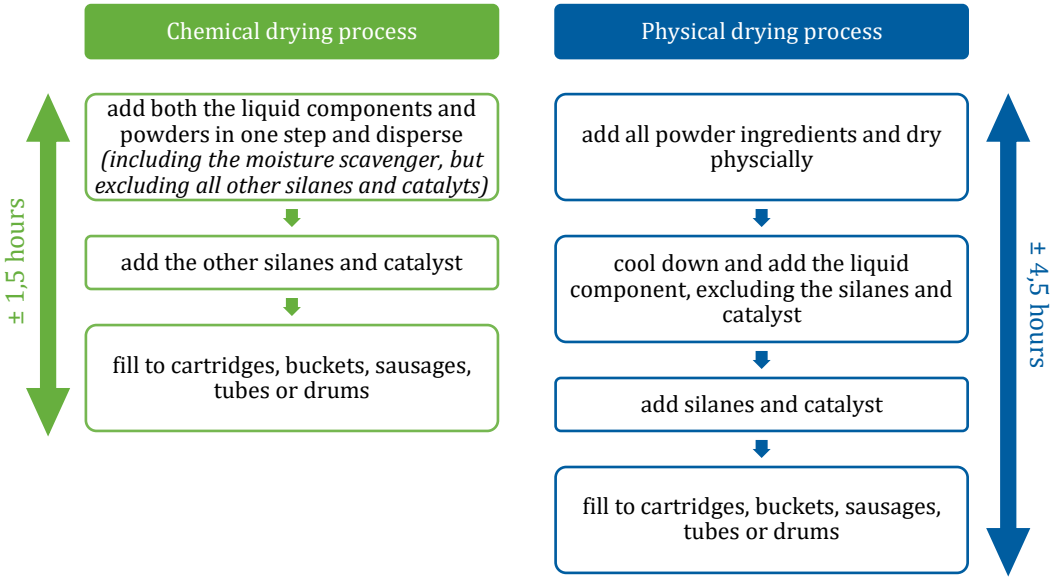
As a pioneer, Kaneka launched the silane terminated polyether's (STPEs) about 40 years ago. The first Kaneka MS Polymer™ grades were launched to be used as highly elastic low modulus sealants. The short comings of the existing silicone and polyurethane sealants, made the market longing for a new innovative technology. The high elasticity, paintability and good UV-resistance made of MS Polymer™ a success story in Japan and far beyond. Kaneka's continuous drive to innovate, results in an extensive portfolio, covering sealant, adhesive and coating applications. This article tries to emphasize on the diversity of the MS Polymer™ in terms of processing, mechanical performance, weather resistance and rheology.

EASE OF PROCESSING

While the MS Polymer™ portfolio is exhaustive, all grades enable the same ease of processing. Both dimethoxysilyl- (DMS-) and trimethoxysilyl- (TMS-) polymers exhibit an excellent stability, despite their differences. Both the more reactive TMS-types and their less reactive DMS alternatives remain stable over an extensive period of time. Since the curing mechanism will initiate only if both the catalyst and water are present, blending MS Polymer™ with only one of these two ingredients will render an unreactive mixture. The latter ensures a very robust and stable raw material stock.

Since MS Polymer™ is a moisture curable reactive technology, the moisture in the final sealant or adhesive should be managed properly. Although the polymer itself contains no significant amount of moisture, other raw materials like inorganic fillers can bring a substantial amount of moisture in the system. To guarantee a proper shelf life and constant quality two different moisture management approaches exist and work both very well with MS Polymer™ based sealants or adhesives (Table 1). The first comprises the dehydration of the product by using chemical drying agents (e.g. moisture scavengers like vinyltrimethoxysilane), while the second uses heat to evaporate the present moisture.

Table 1. Schematic presentation of the production processes for MS Polymer™ based sealants and adhesives



The heating step in the physical drying process ensures an excellent storage stability, but requires a significant amount of energy and time to reach the desired temperatures. Moreover the silanes and catalyst can't be added at these high temperatures, resulting in an additional time-consuming cooling cycle. Recent innovations in the field of rheology modifiers, fillers and machinery have attributed to the improvement of the production process and therefore very short production cycles of about 1,5 hour per batch can be reached.

On top MS Polymer™ grades are miscible with a wide variety of raw materials (Figure1) and enable production with the latest production technologies, like e.g. inline mixing. The latter can be used to add silanes, colour or catalyst to the paste, making the cleaning process of the mixing vessels much more relaxed. The former results in an extended toolbox of ingredients which can be incorporated to match certain specific properties. As an example, both the ground and precipitated calcium carbonate render homogenous matrixes after curing and exhibit excellent wetting properties in the MS Polymer™ matrix (Figure 1).

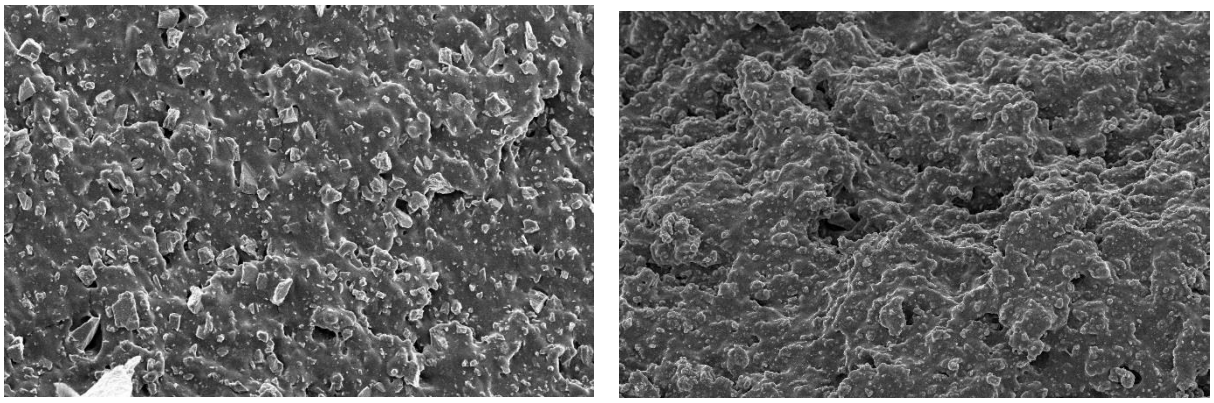


Figure 1. Scanning electron microscopy image of a MS Polymer™ based sealant filled with ground calcium carbonate (left) and precipitated calcium carbonate (right) to demonstrate the compatibility of both, (Secondary Electron Image, magnification 500x, 10kV)

FROM SEALANTS TO ADHESIVES

Kaneka's continuous strive for innovation is reflected in the MS Polymer™ product portfolio. While in the 1970's the polymer portfolio was limited to highly elastic sealant materials, the last decades the trend towards harder adhesive grades was initiated. First by adding acryl modified MS Polymer™ grades and later by the launch of our high strength grades. A broad operation window can be obtained in which both sealant and adhesive grades can be found (Figure 2).

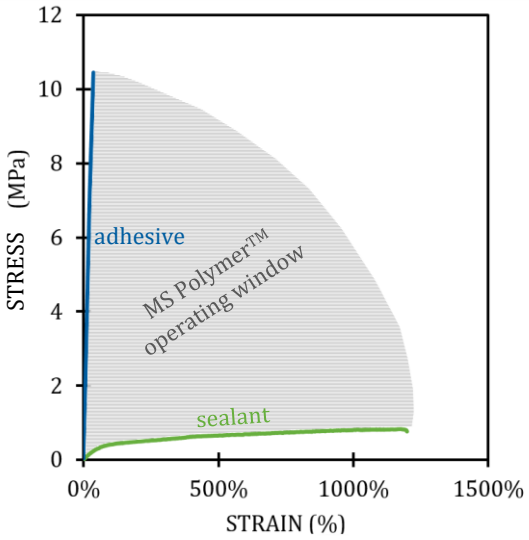


Figure 2. Range of mechanical performance of MS Polymer™ based sealants and adhesives.

Besides the clear versatility in the mechanical performance, also the adhesion performance of MS Polymer™ based sealants and adhesives is famous. While the primer-less adhesion to metals is well-known in the industry, an outstanding adhesion performance to plastics can be obtained as well. Figure 3 shows the lap shear strength of an acryl modified MS Polymer™ to various unprimed substrates.

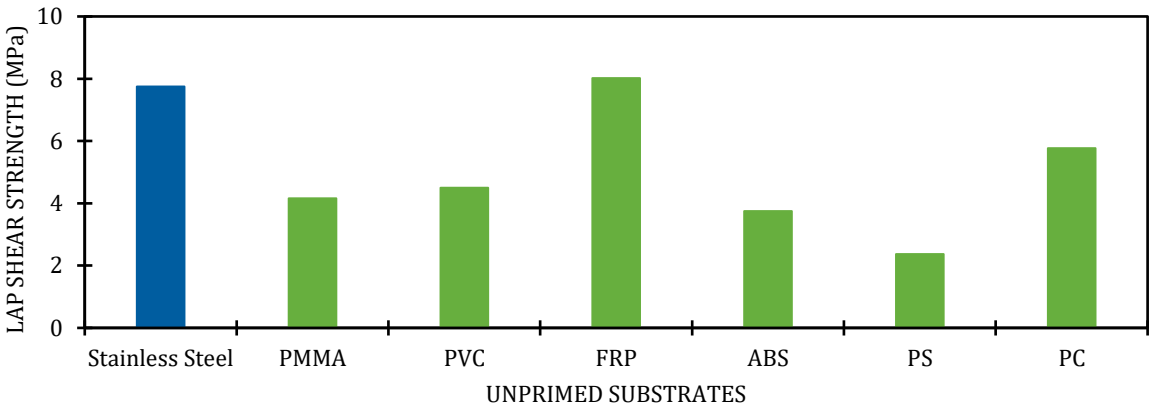


Figure 3. Lap shear strength results of an acryl modified MS Polymer™ based adhesive to unprimed stainless steel, polymethylmethacrylate (PMMA), polyvinylchloride (PVC), fibre reinforced plastics (FRP), acrylonitrile-butadiene-styrene (ABS), polystyrene (PS) and polycarbonate (PC); 0,2 mm adhesive thickness and 14 days curing at 23°C and 50%RH; *Note: test results evaluated by Kaneka Belgium NV*

With the automotive market moving more and more towards lightweight materials, the need for structural adhesives with proper adhesion to plastics and composite materials becomes larger every day. The latest high strength MS Polymer™ grades could be used to serve such high demanding applications.

FOR ANY CLIMATE

Sealants and adhesives based on Kaneka MS Polymer™ exhibit good weather resistance and standard DMS- or TMS- grades would be proper choices for standard sealants and adhesives. Moving to more demanding applications in which high levels of UV-radiation will be present or subtropical climates, the acryl modified MS Polymer™ (MAX and MA) would be the preferred choice. Figure 4 shows the relative hardness decay as a function of the relative irradiation of several MS Polymer™ grades. The exceptional performance of all MAX and MA grades is clear and if high demanding applications are targeted these polymers should be selected.

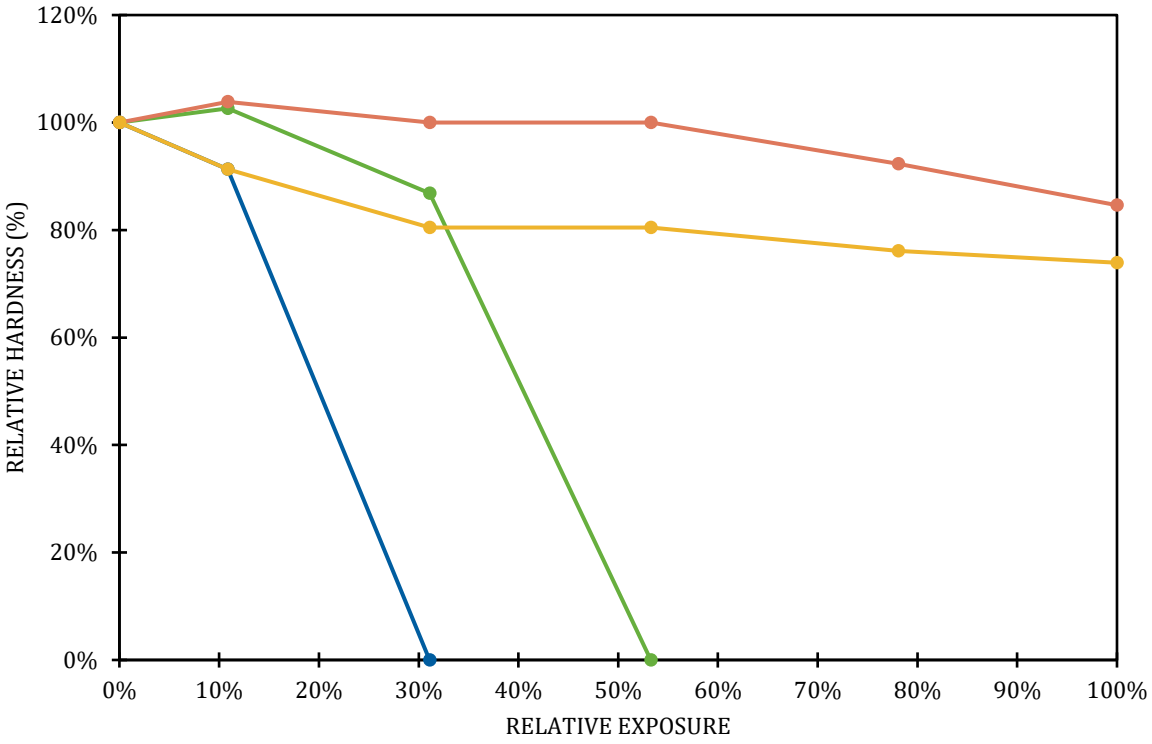


Figure 4. Hardness decay for different Kaneka MS Polymer™ grades, cured as pure polymer, without any additional stabilizers, fillers nor pigment [DMS in blue, TMS in green, MAX in red and MA in orange] exposed in Ci4000 weather-o-meter from Atlas, cycle 1: 102 minutes of 0,51 W/m^2 radiation measured at 340nm and a black standard temperature (BST) of 65°C and chamber temperature (CT) of 38°C; cycle 2: 18 min of spray and 0,51 W/m^2 radiation measured at 340nm and a BST and CT of 38°C *Note: test results evaluated by Kaneka Belgium NV*

RHEOLOGICAL CENTIPEDE

For sealant and adhesives the performance of the final cured joint or bond is decisive, but also the application of the product itself is often one of the main focusses for formulators. Especially if craftsmen need to seal or bond large or difficult surfaces, the ease of processing for them becomes often the number one parameter to evaluate.

The more than 25 different MS Polymer™ grades include very low viscous reactive diluents (± 0,5 Pa.s), low viscous (6 - 8 Pa.s) and high viscous (> 100 Pa.s) polymers. Blending polymers with various viscosities render unique properties for the uncured and cured sealant or adhesive, expanding the formulator's toolbox.

MS Polymer™ grades can be found in applications were the products are applied by extrusion, notched spatula, roller, brush or even spray equipment. All of them requiring specific needs with respect to rheology.

For example, for a sealant the filled joint should stay vertically without slipping or sagging directly after application. Various rheology modifiers can be added to enhance the rheological recovery after extrusion. Figure 5 clearly demonstrates the effect of such rheology modifiers. While the system without rheological agent has a much slower recovery, some slip or sagging may occur. Systems including such agents recover very fast after extrusion, eliminating the possibility for sagging.

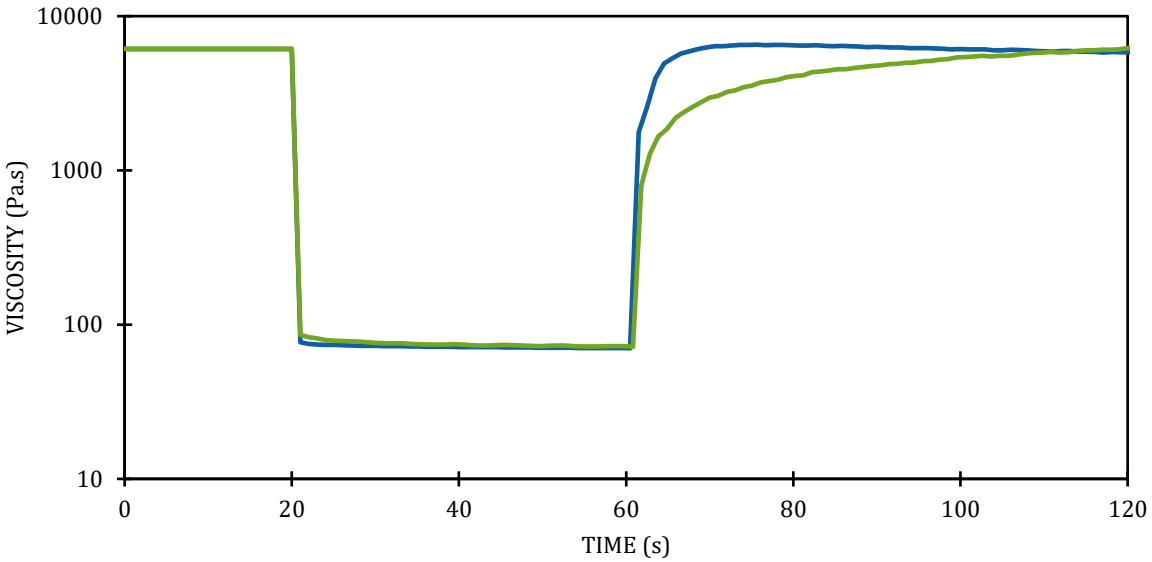


Figure 5. Viscosity recovery of an MS Polymer™ based sealant with (blue) and without (green) polyamide rheology modifier

CONCLUSION

Sealant, adhesive and even coating applications can be covered with the present Kaneka MS Polymer™ portfolio. A technology toolbox is offered, which makes the life of formulators easier and improves the quality of their products. With more than 40 years of experience in the field of moisture curable technology, Kaneka, as The Dreamology Company, puts everything at stake to make your dreams happen.

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