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Designed for high performance— engineered for success

Bayhydrol® A



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Bayhydrol® A



INVENTING VISIONS FOR YOU

As your leading partner for polyurethane chemistry, we know you are competing in increasingly challenging environments: Your customers are becoming more and more demanding in their expectations for quality, durability, sustainability and aesthetics of products. And they have more choices. For you this means that cost pressure is rising – while innovation cycles are becoming faster and faster.

Helping you to turn this challenge into your competitive advantage is the goal that drives our daily work. We call it: INVENTING FOR YOU. But what exactly are the basic values underlying this promise? What principles enable us to improve your productivity, drive sustainability, ensure reliability and co-create future-proof businesses? First and foremost, we are curious. Because only if we listen closely to you and ask the right questions, we can respond to your individual needs with new, creative and unexpected solutions that make a real difference to you. That's why inventing for us always starts with thinking about your unmet business challenges. It requires an in-depth understanding of your needs along the whole value chain. To make sure: What we invent stands the test of time. Living up to this aspiration requires more than competencies – it calls for a corporate culture of being courageous. A culture that is defined and lived by dedicated people who cooperate to push the boundaries of invention founded on knowledge and experience. Our courage permeates our entire business – from partnerships to business models. This is also reflected in our colorful business philosophy. We appreciate partnerships that go beyond traditional black-and-white ways of acting and thinking. An attitude of openness that invites you to co-create new things – rather enabling you than just providing. We are optimistic and resourceful in finding solutions that inspire our customers and partners.

This set of fundamental values adds up to an unrivaled performance orientation to constantly strive for the better, be it through big or small changes. A true sense of business regardless of function. And a deep commitment to delivering our promise everyday. Anywhere. Again and again.

INVENTING FOR YOU.

Building blocks for supply security, efficiency and sustainability

Outstanding quality and supply security – worldwide

Covestro, the world's leading manufacturer of aliphatic and aromatic isocyanates, offers an extensive range of raw materials and services for the coatings and adhesives industry. This allows the very latest technology to be used extremely effectively for a variety of applications. Thanks to its unique setup and worldwide network of state-of-the-art production sites, R&D facilities and customer technical centers, industry-leading supply chain setup, global orientation and local stocks, extremely large product portfolio, highest health, safety and environmental (HSE) standards, as well as tailored supply chain flexibility with short lead times, Covestro offers the coatings and adhesives industry unrivalled supply security and assured quality.

Solutions to enhance your process efficiency

Nowadays, the quality demands made on industrial processes are very high. But at the same time, there is a clear need to cut costs. Both goals can be achieved by increasing process efficiency. At Covestro we have a wide range of solutions designed to enhance your process efficiency. Why not take advantage of our know-how? These solutions will be good for your bottom line.



High coating performance – enabled by nature

Sustainability drives innovation at Covestro. We are committed to optimizing our manufacturing processes, reducing the impact of logistics, and enabling sustainability along the value chains. Renewable feedstocks offer opportunities for developing more sustainable building blocks for coating solutions – with significant potential for reducing the carbon footprint of end products while also reducing our overall dependence on fossil-based resources. But to make more sustainable solutions not just possible but also economically feasible, the performance of all our feedstocks needs to satisfy high industry standards. To this end, we are evaluating the use of renewable raw materials and will enlarge our product portfolio with new bio-based and mid- to long-term cost-competitive products, provided the raw materials become commercially available. In all these efforts we are committed to focusing on products that perform at least as well as established products but are at the same time more sustainable.





Polyurethane chemistry and the environmentally friendly technology platform

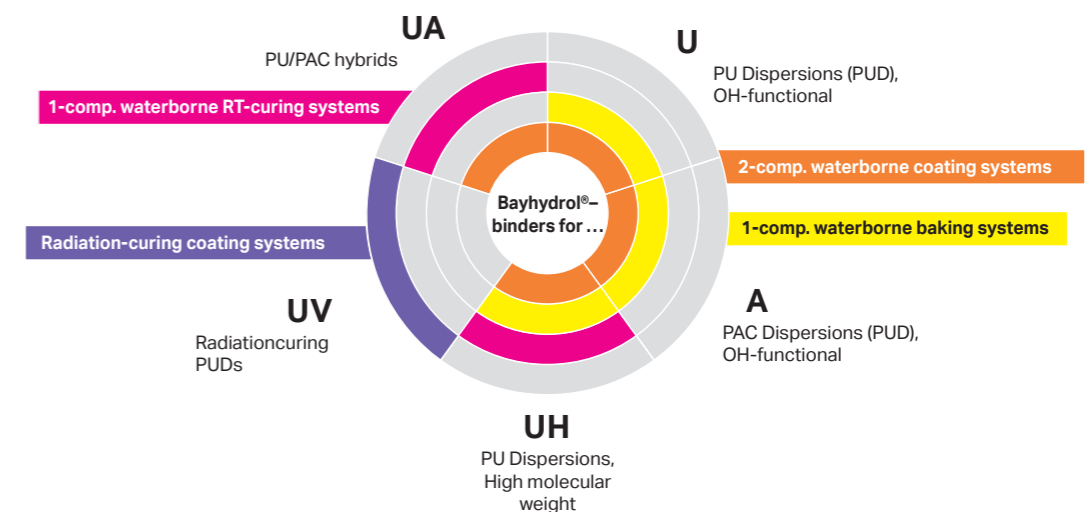
Quality – more than just a feeling

This is certainly true of 2K polyurethane (PU) coatings, as their impressive data and many success stories in a wide variety of applications prove. Since solventborne 2K PU coatings were introduced around 1960, they have become the dominant coating technology wherever quality and efficiency are the main drivers. Outstanding examples include the protective coating of planes, trains, trucks, buses and passenger cars (in manufacturing and refinishing processes), as well as high-performance coatings for industrial applications, corrosion protection, and high-quality wooden and plastic surfaces.

This success story is based on a unique combination of properties ranging from high efficiency during application (high solids content and fast drying even at ambient temperatures) to excellent film appearance, scratch resistance and high resistance to water, solvents, chemicals and weathering. Nowadays, the lower solvent content attainable with PU technology has added to this list of advantages – a particularly important point when looking at future business opportunities.

Our platform for eco-friendly coatings

This platform has been made possible by the development of modern, VOC-reduced 2K PU systems: high solids, very high solids and waterborne 2K PU coatings, which are the fundamental cornerstones of our environmentally friendly technology platform. By using these technologies, it is now possible to satisfy VOC requirements without sacrificing quality. The secret behind the mounting success of these technologies lies in the development of advanced raw materials, e.g. new polyisocyanate crosslinkers with high NCO functionality, low viscosity and easy miscibility in waterborne systems (Desmodur®, Bayhydur®), the development of a new generation of solvent-free PU polyol dispersions (Bayhydrol® U), and the market launch of new acrylic polyol dispersions (Bayhydrol® A).



Polyol dispersions

Whereas PU polyol dispersions provide a film with excellent mechanical properties and optical surface properties, such as high gloss and scratch resistance, as well as a broad adhesion profile (including a variety of plastic surfaces), the main strengths of acrylics are their drying speed, hardness, chemical and weathering resistance.

Bayhydrol® A hydroxyl-functional acrylic (PAC) dispersions are supplied as white or opaque liquids that can be diluted with water. They can be classified into primary and secondary acrylic dispersions, depending on their manufacturing process. Primary dispersions are produced directly in water via emulsion polymerization of acrylic/vinyl monomers using emulsifiers. These dispersions are characterized by high molecular weights and are usually free of any organic solvent. Secondary dispersions, on the other hand, are prepared via polymerization of acrylic/vinyl monomers in a suitable solvent or reactive diluent, followed by neutralization with an amine and dispersion in water. Such secondary dispersions containing emulsifying groups incorporated into the polymer chains are characterized by their

moderate molecular weight and may contain up to 10 % organic co-solvent.

Thanks to their narrow particle size distribution, Bayhydrol® A dispersions remain stable during storage and are not susceptible to creaming or sedimentation. This is essential to achieving perfect paint engineering results in combination with our polyisocyanates.

In addition, the dispersion particles have a distinct core-shell morphology, consisting of a polymer core, which determines the main properties and durability of the final polymer network, and a surrounding, functional shell, which stabilizes the particle, facilitates the docking and compatibility of the polyisocyanate, and in some cases also acts as a co-solvent to promote film formation and proper mixing of the components.

As a result, the core-shell morphology of Bayhydrol® A significantly reduces the amount of organic solvent required for film formation, thus providing an effective tool in the eco-friendly platform for VOC-reduced products.



Internal activation

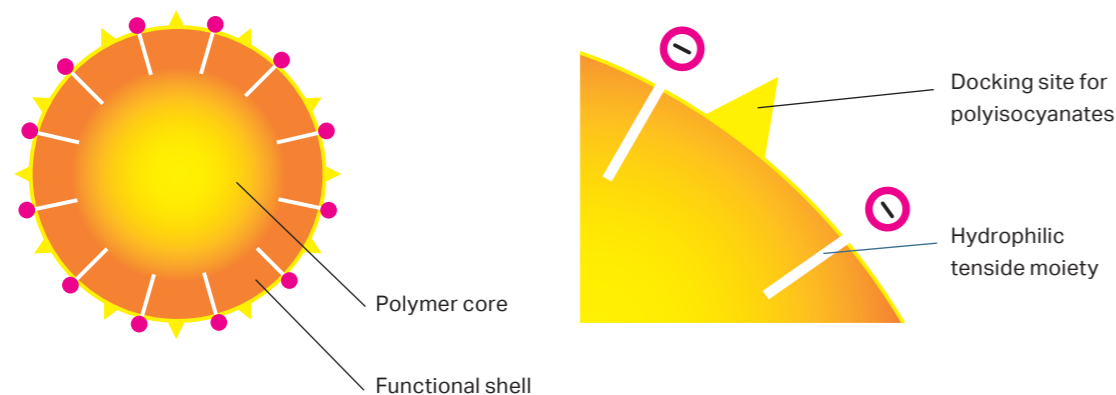
Fast drying – the sum of physical drying and effective chemical crosslinking – is another key feature of waterborne 2K PU coatings based on Bayhydrol® A. Dust-free drying times of less than an hour and tack-free times of 1–3 hours at ambient temperatures are no longer just a dream thanks to Bayhydrol® A dispersions designed using our new internal activation technology. The drying process is even faster with 60 °C oven curing and films are absolutely tack-free after 30 min. or less.

Important benefits of Covestro's internal activation technology:

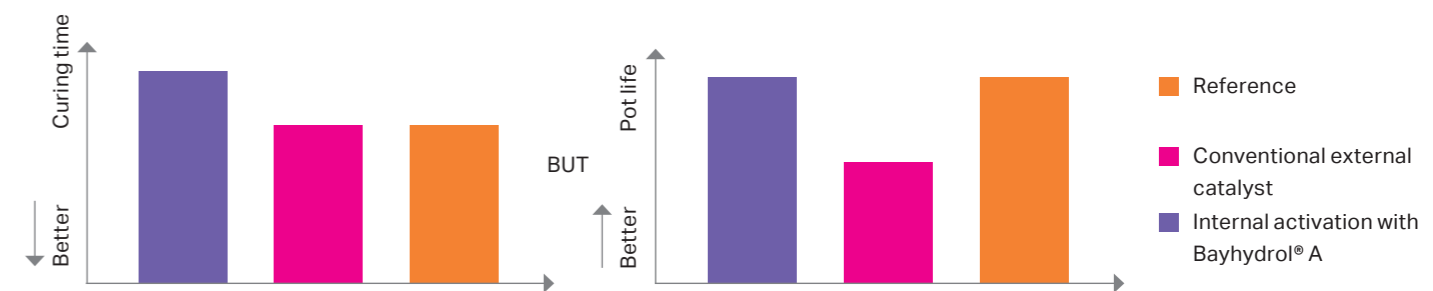
- No need for formulator to use external catalysts, such as tin-based chemicals that are increasingly under discussion regarding their environmental impact.
- No negative effect on the pot life of the coating formulation, as is the case with tin-based and other catalysts.

In other words, internal activation using Bayhydrol® A polyol dispersions is the eco-friendly tool for achieving quick drying and long pot life.

Core-shell technology of Bayhydrol® dispersions



Internal activation technology vs. conventional catalysis





Bayhydrol® A – the products and properties

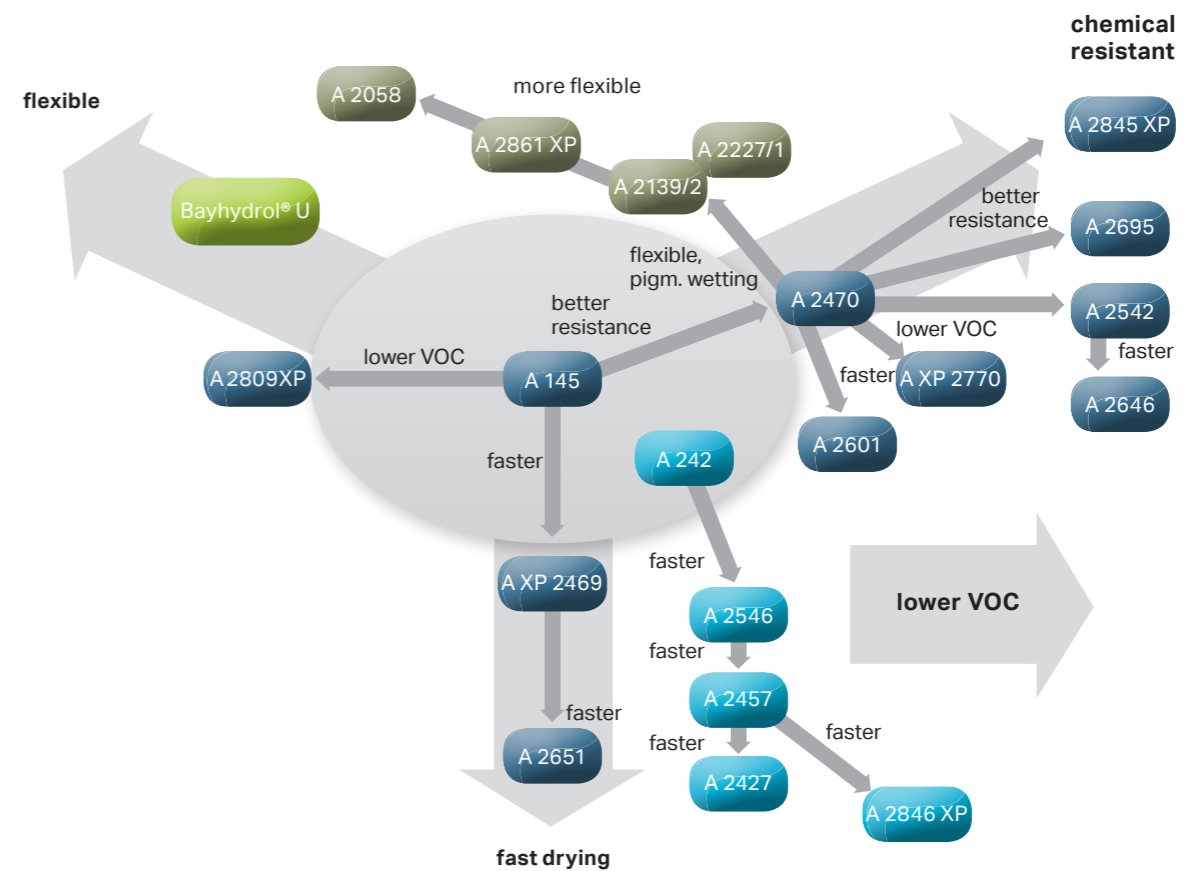
The Bayhydrol® A product portfolio

Waterborne 2K PU coatings split up into a variety of substrates and applications, each characterized by specific requirements on the coatings. Our Bayhydrol® A product portfolio offers solutions to meet most of these needs, by addressing important issues such as:

- Improved flexibility
- Improved chemical resistance
- Improved drying speed
- Reduced VOC in the coatings



Product Navigator Bayhydrol® A polyols



- Primary acrylic dispersion
- Secondary acrylic dispersion
- Bayhydrol® U
- Polyester or polycarbonate acrylic hybrid dispersion

Lengths of the arrows do not correlate to absolute differences in properties.

Bayhydrol® A – the products and properties

Our workhorses

Bayhydrol® A 145

- Secondary polyacrylic dispersion
- OH content 3.3 %

This proven, highly versatile polyacrylic dispersion with a moderate OH content has become established in numerous market segments. Its outstanding versatility makes it suitable for a wide range of applications involving clear coats, topcoats and primers. One of the main characteristics of coating systems based on Bayhydrol® A 145 is a good balance between pot life and drying, good pigment wetting and weather stability. Coating formulations based on Bayhydrol® A 145 are particularly application-friendly. Bayhydrol® A 145 also displays good adhesion properties to various metals and some plastic substrates.

Bayhydrol® A 2809 XP

- Secondary polyacrylic dispersion
- OH content 3.3 %

This low VOC version of Bayhydrol® A 145 has the same OH content but contains significantly less and non-aromatic co-solvent and has no measurable flash point. This gives coating manufacturers greater development scope, e.g. in the type of co-solvent they use. They can also develop waterborne 2K PU systems with very low VOC yet good film quality. The properties of coatings based on Bayhydrol® A 2809 XP are comparable with its sister product Bayhydrol® A 145.

Bayhydrol® A XP 2469

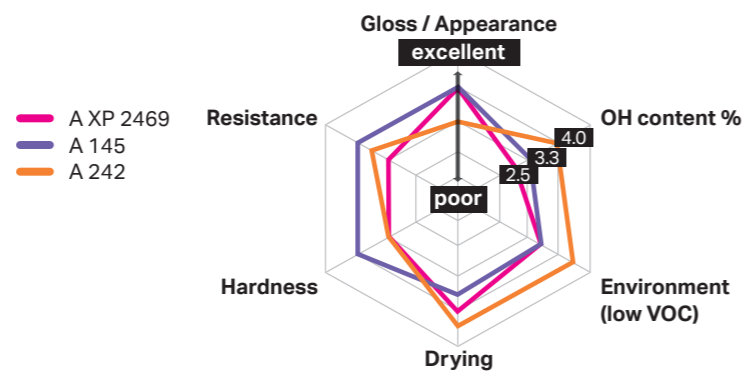
- Secondary polyacrylic dispersion
- OH content 2.5 %

Developed especially for the formulation of less expensive waterborne 2K coating systems with high gloss and adequate water and solvent resistance, Bayhydrol® A XP 2469 dries faster than Bayhydrol® A 145. Its lower OH content means that less polyisocyanate hardener is needed for the crosslinking reaction, which adds up to a better cost-performance ratio.

Bayhydrol® A 242

- Primary polyacrylic dispersion
- OH content 4.0 %

This hydroxyl-functional aliphatic emulsion polymer is co-solvent-free, with moderate molecular weight and glass transition temperature and therefore good film-forming properties. In many waterborne coating formulations, Bayhydrol® A 242 affords much faster physical drying than Bayhydrol® A 145. In combination with Bayhydur® polyisocyanates, Bayhydrol® A 242 can be used universally in primers and topcoats. The coating films display good resistance against chemicals and cleaning agents, as well as high resistance to yellowing. Bayhydrol® A 242 can also be used in primers for anti-knot bleeding of wood coatings.



Bayhydrol® A – the products and properties

Products with ultra-high chemical resistance



Bayhydrol® A 2470

- Secondary polyacrylic dispersion
- OH content 3.9 %

Our solution for coating high-quality metal, plastic or wood surfaces is a secondary polyacrylic dispersion characterized by a higher OH content and higher glass transition temperature than Bayhydrol® A 145. Thanks to its optimized monomer composition and polymer structure, Bayhydrol® A 2470 can be used to formulate coating systems with much higher hardness, faster drying and significantly improved resistance to water, solvents, and chemicals than the standard Bayhydrol® A 145. The good emulsifier properties of the basic polymer make Bayhydrol® A 2470 suitable for combination with Bayhydur® polyisocyanates and with hydrophobic, low-viscosity Desmodur® hardeners for the formulation of high-gloss coating films. Combining Bayhydrol A 2470 with Desmodur hardeners yields coatings with excellent chemical and solvent resistance.

Bayhydrol® A XP 2770

- Secondary polyacrylic dispersion
- OH content 3.9 %

A low-VOC variant of Bayhydrol® A 2470 with the same OH content, Bayhydrol® A XP 2770 contains significantly less and non-aromatic co-solvent and has no measurable flash point. This gives coating manufacturers greater development scope, e.g. in the type of co-solvent they use. They can also develop waterborne 2K PU systems with very low VOC yet excellent film quality. As for the properties of the coating film, Bayhydrol® A XP 2770 is on a par with its sister product Bayhydrol® A 2470, yet dries faster. Another advantage of Bayhydrol® A XP 2770 is the low degree of thermal yellowing displayed by the cured film.



Bayhydrol® A 2542

- Secondary polyacrylic dispersion
- OH content 3.8 %

This reactive polyacrylic dispersion with a very low co-solvent content for glossy, highly resistant coating systems develops its unique properties from its molecular design since it contains various types of OH groups that can be specifically integrated into the crosslinking reaction. This provides additional scope for controlling specific coating properties, such as chemical resistance and hardness, via the crosslinking density. Since Bayhydrol® A 2542 contains no non-reactive volatile components, it has everything it takes to comply with present and future specifications on coating systems for interior applications. Emissions from coatings that cure at room temperature are currently an important issue in the industry. Furthermore, Bayhydrol® A 2542 can also be used as a blending component to reduce the VOC content of waterborne 2K PU coatings with no need to compromise on film appearance or chemical resistance. As a result of REACH restrictions, Bayhydrol® A 2542 is only permitted to be used in non-spray applications.



Bayhydrol® A 2646

- Secondary polyacrylic dispersion
- OH content 3.8 %

Bayhydrol® A 2646 comes with the outstanding overall properties of Bayhydrol® A 2542, but is more reactive and dries faster. This combination is achieved through the special tailor-made design of the dispersion (internal activation) so there is no longer any need to add the usual external catalysts to formulate the coating system. Despite this, Bayhydrol® A 2646 reacts very rapidly with the added polyisocyanates, even at low curing temperatures (e.g. 5–10 °C) and high crosslinking ratios. In addition, the film properties can be controlled via the choice of the polyisocyanate crosslinking agent. Particularly in combination with our sulfonate-hydrophilized Bayhydur® grades, Bayhydrol® A 2646 produces hard films with high chemical resistance. When combined with polyether-modified Bayhydur® hardeners, on the other hand, the topcoats are more elastic and flexible. As a result of REACH restrictions, Bayhydrol® A 2646 is only permitted to be used in non-spray applications.



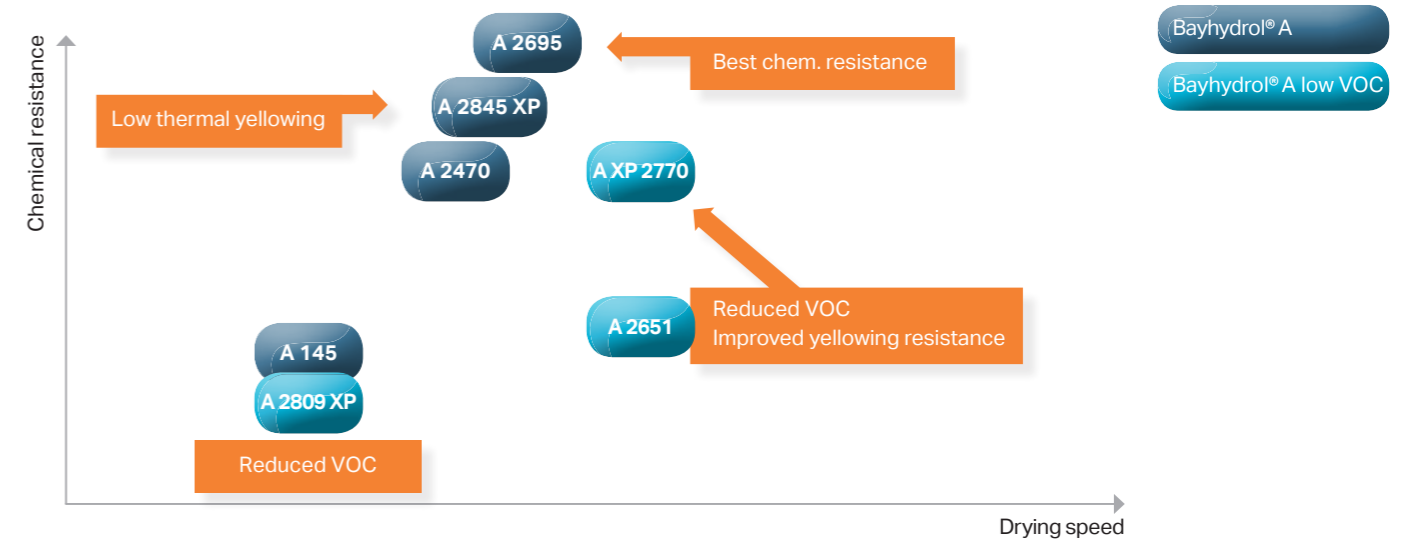
Bayhydrol® A 2695

- Secondary polyacrylic dispersion
- OH content 5.0 %

Originally developed for anti-graffiti topcoat systems with outstanding resistance properties, the 'Mercedes' of polyacrylic dispersions boasts an unparalleled level of resistance to solvents and chemicals in combination with low-viscosity Desmodur® polyisocyanates or sulfonate-hydrophilized Bayhydru® crosslinking agents. Bayhydrol® A 2695 is suitable not only for coating metal and plastics since it is resistant, for example, to diesel, engine oil, hydraulic fluids and Skydrol as well as

aggressive graffiti removal agents, but also for high-quality wood/furniture coatings, where its resistance to household cleaners, mustard, red wine, etc. is particularly appreciated. This dispersion can also play out its additional strengths, such as excellent water resistance, in other key applications, e.g. as a highly corrosion-resistant primer or monocoat on metal, or as a filler or surfacer. Coatings based on Bayhydrol® A 2695 are also scratch-resistant. Under moderate heating, the film regains up to 90 % of its original gloss through what is known as the "reflow" effect, a property otherwise only known from polyurethane dispersions.

Bayhydrol® A 145 family



Bayhydrol® A – the products and properties

Polyols for faster drying speeds

Bayhydrol® A 2845 XP

- Secondary polyacrylic dispersion
- OH content 4.5 %

Bayhydrol® A 2845 XP was developed with the performance of solventborne polyacrylics in 2K PU dispersions for automotive metal and plastic clear or topcoats in mind. It is especially suitable for exterior or interior, hard clear or top coatings on metal or plastics. One of the key benefits is its low yellowing under thermal stress, even if a suitable light protection package is added to ensure the weathering resistance of the paint build-up. Depending on the substrate, it is advisable to flexibilize Bayhydrol® A 2845 XP by combining it with OH-functional and tough yet flexible PU dispersions such as Bayhydrol® U XP 2750. Cross-linking is best achieved with a combination of aliphatic hydrophobic Desmodur® N grades and a sulfonate-hydrophilized Bayhydrol® grade, e.g. XP 2655, using as little of the XP 2655 as is needed to achieve a high-gloss, low-haze coating under the given application conditions.



Bayhydrol® A 2651

- Secondary polyacrylic dispersion
- OH content 3.0 %

Originally developed for the wood/furniture segment, this dispersion stands out in particular for its very good grain accentuation combined with very fast drying characteristics and excellent early hardness – a unique combination of outstanding properties. At the same time, formulation of low-VOC coating systems is possible because, in its supply form, Bayhydrol® A 2651 contains only 3.4 % (non-aromatic) co-solvent. Good resistance properties, for example to household cleaners, mustard, and red wine, as well as good accelerated weathering characteristics round off the property profile of this polyacrylic dispersion and open the door to a broad area of application in clear coats and topcoats – not just for wood.



Bayhydrol® A 2601

- Secondary polyacrylic dispersion
- OH content 3.9 %

In waterborne 2K PU coating systems Bayhydrol® A 2601 combines very fast drying with long pot life. At the same time, this secondary polyacrylic dispersion still has the same outstanding resistance properties and surface quality as Bayhydrol® A 2470 – properties made possible by the special, tailor-made design of the dispersion (internal activation). There is no longer any need to add the usual external catalysts to formulate the coating system. The rapid drying speed also brings benefits in oven drying because either the drying time can be significantly shortened or the oven temperature lowered to save energy. The benefits of Bayhydrol® A 2601 can also be utilized in combination with other products. Its extensive compatibility with other polyacrylic or polyurethane dispersions means that the properties can also be transferred to a variety of waterborne 2K PU formulations. This includes, for example, the specific setting of the drying speed.

Bayhydrol® A 2546

- Primary polyacrylic dispersion
- OH content 4.8 %

Developed for coating systems that can be applied on a building site and cured at room temperature, Bayhydrol® A 2546 uniquely combines rapid physical drying with fast through-curing (internally activated). Consequently, coatings based on this dispersion can also be used under unfavorable application conditions. The OH content and resulting high crosslinking densities of the films give them above-average chemical resistance that is unsurpassed by any other fast-drying primary dispersion. Thus, potential applications exist not only in the construction industry but also in fast-drying or sandable fillers and topcoats in metal finishing. For high-gloss systems, however, a secondary polyacrylic dispersion from the Bayhydrol® A range with a lower molecular weight would be preferable.

Formulated in combination with Bayhydrol® polyisocyanate crosslinking agents, Bayhydrol® A 2546 does not require any organic co-solvent or film-forming agent in the coating formulation. And because the dispersion is also free of co-solvent in the supply form, it is an ideal solution for complying with present and future specifications on coating systems for interior use.



Bayhydrol® A 2457

- Primary polyacrylic dispersion
- OH content 2.5 %

Bayhydrol® A 2457, which could be called the “baby brother” of Bayhydrol® A 2546, combines lower OH content with a correspondingly reduced need for polyisocyanates to make the system not only even more cost-efficient but also even faster in terms of physical drying and curing speed. Here, too, considerable importance was attached to the absence of co-solvents in order to meet present and future requirements on interior coating systems. Film formation is also possible without the addition of a co-solvent. Alone or in combination with other binders, Bayhydrol® A 2457 is particularly suitable for matt to eggshell gloss topcoats and sealers with high blister-free dry film thicknesses in the construction, wood and industrial coating sectors.

Bayhydrol® A 2427

- Primary polyacrylic dispersion
- OH content 2.0 %

This particularly hydrophobic dispersion really displays its strengths on wood and plastic substrates.

The preferred hardeners in waterborne 2K PU topcoats are sulfonate-hydrophilized Bayhydrol® grades such as Bayhydrol® XP 2487/1. Although such finishes are noted for their high level of hardness and outstanding abrasion resistance, their most striking characteristic is extremely fast drying combined with rapid through curing. In pigmented topcoats on wood substrates, this ensures fast blocking resistance and stackability combined with excellent chemical resistance (e.g. against staining liquids). This property profile and the low OH content mean Bayhydrol® A 2427 can also be used in 1K formulations.

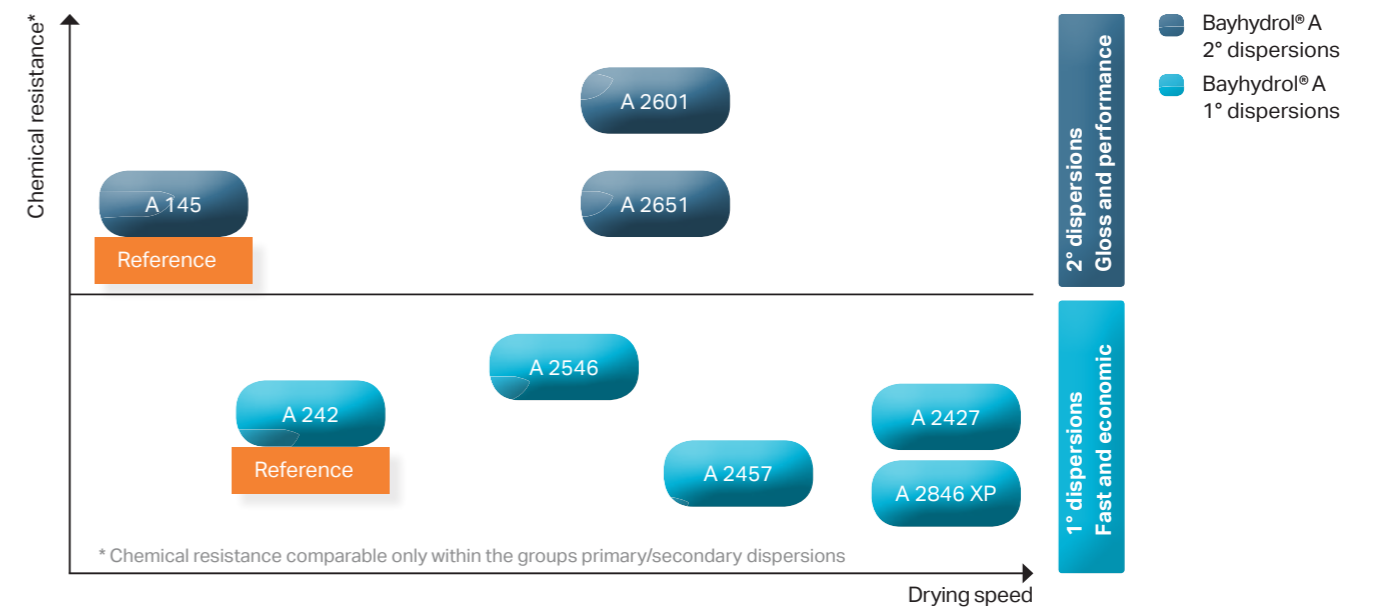
Bayhydrol® A 2846 XP

- Primary self-crosslinking acrylic dispersion
- OH content 1.5%

This OH functional self-crosslinking acrylic dispersion allows the formulation of 1K and 2K systems, offering maximal flexibility to the coating formulator and end-user. The self-crosslinking mechanism present in its structure provides enough resistance to the polymer to reach an

acceptable level of performance in 1K formulations. The addition of our sulfonate-hydrophilized Bayhydrol® types, such as Bayhydrol® XP 2655, upgrades the coating profile to a higher 2K performance, resulting in a good balance between application flexibility and coating properties. Long pot-life and hand mixability simplifies the use of Bayhydrol® A 2846 XP in 2K systems. This dispersion is especially suitable for waterborne wood coatings.

Bayhydrol® A fast-drying acrylic dispersions



Bayhydrol® A – the products and properties

Polyester- or polycarbonate-modified acrylics – the best of both worlds

Bayhydrol® A 2058

- Polyester polyacrylic hybrid dispersion
- OH content 4.8 %

Thanks to its customized polyester content, this hydroxyl-functional polyacrylic dispersion probably has the most universal adhesion profile to a wide variety of plastic substrates. The comparatively low glass transition temperature of this resin also enables excellent low-temperature flexibility to be achieved in coatings. Though suitable for primers, the monomer composition and OH content also make Bayhydrol® A 2058 ideal for weather-stable clear coats, topcoats and mono-coat systems. The films have very good scratch resistance. Since Bayhydrol® A 2058 contains only 2 % organic, aromatic-free co-solvent, it is highly suitable for the formulation of very low-solvent, soft-touch coatings with good resistance properties.

Bayhydrol® A 2139/2

- Polyester polyacrylic hybrid dispersion
- OH content 3.8 %

This moderately hard hybrid dispersion with good pigment wetting is particularly suitable for mono-coat systems on plastics and pigmented top-coats on metal or plastic substrates. The acrylate component ensures good resistance properties. Bayhydrol® A 2139/2 contains only 2.5 % organic co-solvent in the supply form. Coatings based on Bayhydrol® A 2139/2 are easy to apply, in part because of the long open time of the films and their good blistering limit (blister-free dry film thickness).



Bayhydrol® A 2227/1

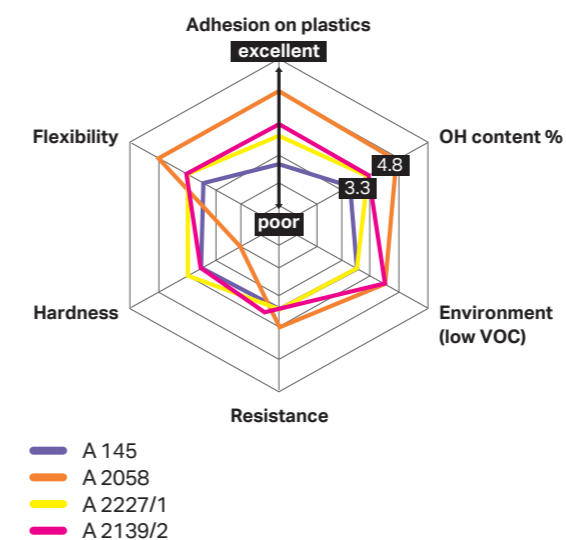
- Polyester polyacrylic hybrid dispersion
- OH content 3.8 %

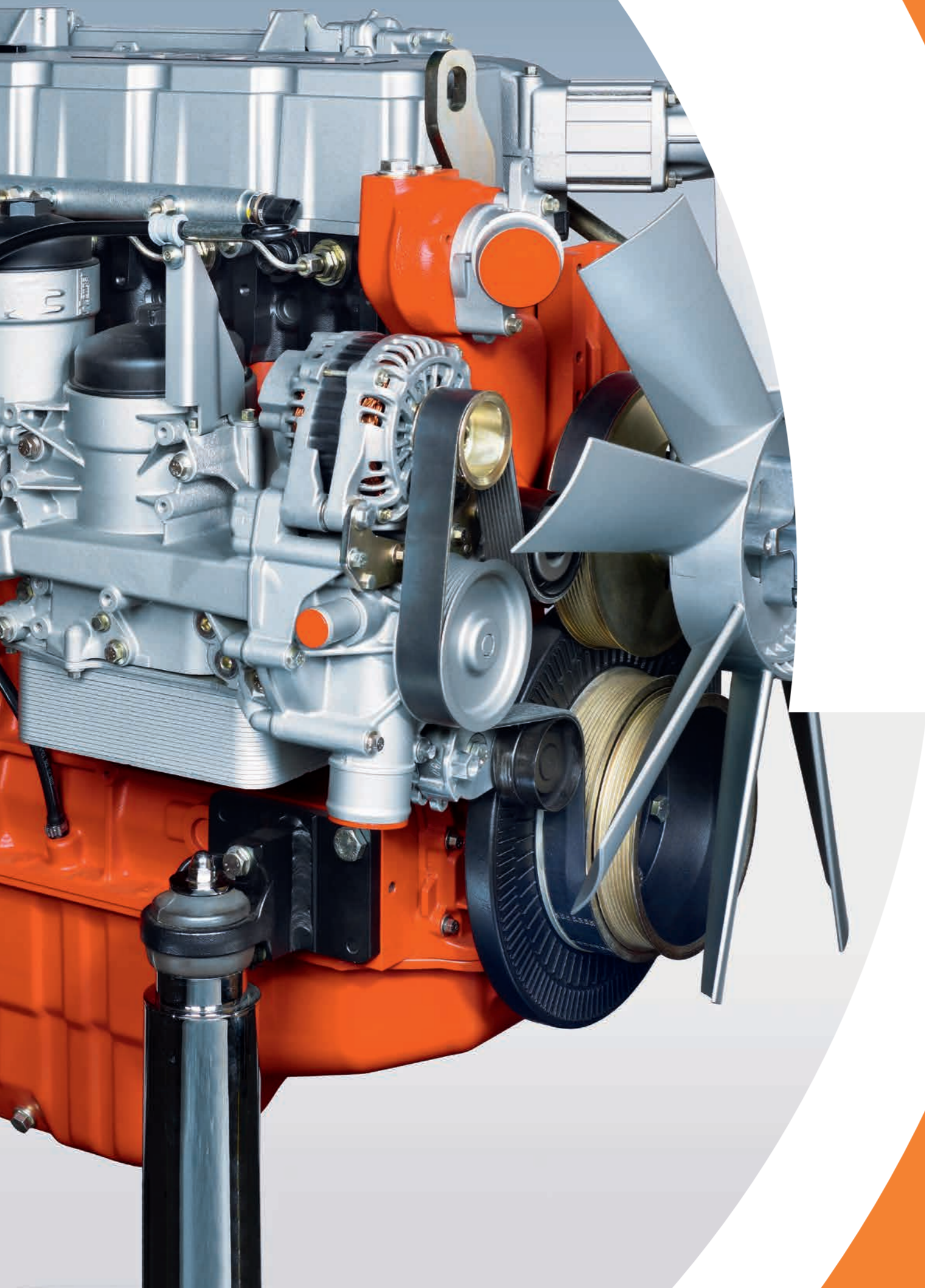
A moderately hard hybrid dispersion with a comparatively high acrylate content, Bayhydrol® A 2227/1 is suitable for pigmented waterborne topcoats, both as a 2K system and as a baking enamel in combination with melamine or blocked polyisocyanate hardeners. Such finishes are highly resistant to yellowing, even during baking. The use of Bayhydrol® A 2227/1 in waterborne 2K PU anticorrosion primers on metal substrates produces an excellent balance between corrosion protection and flexibility. In plastic coatings, the hybrid dispersion is suitable as a co-binder to improve resistance properties.

Bayhydrol® A 2861 XP

- Polycarbonate polyacrylic secondary dispersion
- OH content 3.5 %

The combination of a flexible polycarbonate diol with excellent hydrolytic stability and a secondary acrylic dispersion delivers an attractive combination of flexibility and resistance properties when cured by Desmodur® N or Bayhydur® polyisocyanates. Bayhydrol® A 2861 XP can be formulated to coatings that display semi-haptic and haptic properties at a high level of resistance against suntan lotions. Combination with flexible Bayhydrol® U and UH grades offer the necessary formulation freedom to achieve the desired haptic qualities. With only 1.3 % organic co-solvent content, extremely low VOC formulations are possible.





Coating formulations based on Bayhydrol® A polyol dispersions

Typical coating formulations based on Bayhydrol® A usually contain polyisocyanate crosslinkers, pigments (if needed), and a set of additives developed especially for waterborne coatings. The correct selection of rheology additives and defoamers/air release agents is crucial for the formulation of easy-to-use waterborne coatings. In many cases, small amounts of (selected) organic solvents are also used in the formulation. A combination with other types of binders (e.g. solvent-free Bayhydrol® U polyurethane dispersions) may be helpful in order to obtain or improve additional properties (e.g. scratch resistance, application behavior, etc.). Some general hints on how to formulate a Bayhydrol® A-based waterborne 2K PU coating are given below. However, the most suitable package of additives, solvents and crosslinkers must be evaluated case-by-case and is dependent on the Bayhydrol® type used, the substrate, and both application and drying conditions.

Combination of binders

Bayhydrol® A polyol dispersions offer a wide range of properties, e.g. with regard to drying speed, hardness and gloss. Excellent weather and chemical resistance is a general strength of Bayhydrol® A-based coatings. In order to meet specific property requirements, they can be combined with other binders such as Bayhydrol® U solvent-free PU dispersions, as illustrated by the following examples:

- To obtain outstanding flexibility in plastic coatings or sports floors, for example, Bayhydrol® A polyol dispersions might be combined with PU polyol dispersions (e.g. Bayhydrol® U XP 2757) or with non-functional, high molecular weight

Bayhydrol® UH dispersions (e.g. Bayhydrol® UH 340/1 or UH 650). Thanks to their outstanding flexibility and high number of hydrogen bonds, special PU polyol dispersions (e.g. Bayhydrol® U XP 2750) can also improve scratch resistance. This is due to the so-called self-healing effect when combined with Bayhydrol® A polyol dispersions.

- Selected PU polyol dispersions (particularly Bayhydrol® U XP 2750 or U XP 2766) can be used to attain maximum gloss, wet look and outstanding leveling in clear and pigmented industrial metal and plastic coatings. The resulting surfaces look as brilliant as solventborne films without sacrificing any resistance properties, but have much lower VOC emissions when preparing and applying the coating.
- Grades such as Bayhydrol® U XP 2750 that physically dry somewhat slower can be used in combination with Bayhydrol® A to improve the blister-free dry film thickness of the films.
- For wood coatings in particular, high molecular weight PU dispersions (e.g. Bayhydrol® UH 2593/1) can be used as a combination partner for secondary acrylic dispersions to accelerate physical drying speed, improving down glossing in matt coatings.



Neutralizing agents

Bayhydrol® A polyols are delivered in neutralized form, typically with a pH of 7 to 8.5. In most coating formulations, they do not require additional neutralization. However, some properties, such as the pot life of waterborne 2K PU formulations, are very pH-dependent. Thus, in some cases, e.g. if acidic pigments or additives are used, the pH of the formulation needs to be readjusted towards 7–8.5 with a suitable neutralizing agent. Tertiary amines, and in particular dimethyl ethanolamine (DMEA) or triethanolamine, have proved suitable neutralizing agents for waterborne 2K PU systems based on Bayhydrol® A polyols. The amines should be added in diluted form, e.g. as a 10 wt. % solution in water, rather than undiluted.

Defoamers and air release agents

Waterborne coatings need a carefully chosen antifoam and/or air release agent or package. This is mainly necessary because of the characteristic properties of water as a solvent, and because surfactants, dispersants and other surface-active ingredients have a much higher foaming tendency than solventborne coatings, particularly during mixing/stirring and spray application. The often discussed “CO₂-bubble issue” is also mainly microfoam-related. CO₂ released by a subsidiary reaction of the isocyanate hardener with water is

readily soluble in the aqueous phase of the coating. As water leaves the film during drying, some of the CO₂ will concentrate in the small bubbles of the microfoam that have been formed during application, thus increasing the size of those bubbles. If the film is not too thick, these foam bubbles will be able to escape from the film quickly enough to allow enough time for sufficient film leveling. But if the film is too thick, the bubbles will remain in the film or leave craters, pinholes or imperfect leveling. A very effective defoamer will support the release of foam bubbles from the applied film (whatever gas they may contain), allowing for a higher blister-free film thickness.

Formulation and production of the binder component (A)

A-components based on Bayhydrol® A do not need any special preparation procedure. High-viscosity or solid additives should be pre-diluted and added under mild agitation/stirring. Substrate wetting agents, defoamers and dispersants should be incorporated prior to pigments and extenders. Light stabilizers and shear sensitive pigments should be added after the pigments have been incorporated and ground. A thickener might be added in the final production phase to adjust the viscosity and settlement. Moreover, a second antifoam dosage and leveling agents



should be added in the final phase to allow for high antifoam activity during application. It is advisable to review the product datasheets provided by the suppliers of the additives used for recommendations on dosage level, incorporation recommendations and pH values. During each addition of additives, fillers and pigments, it is important to control the pH and adjust it, as required. Only in the above-mentioned pH range (7–8.5) will the dispersions and formulation be stable and no coagulation takes place.

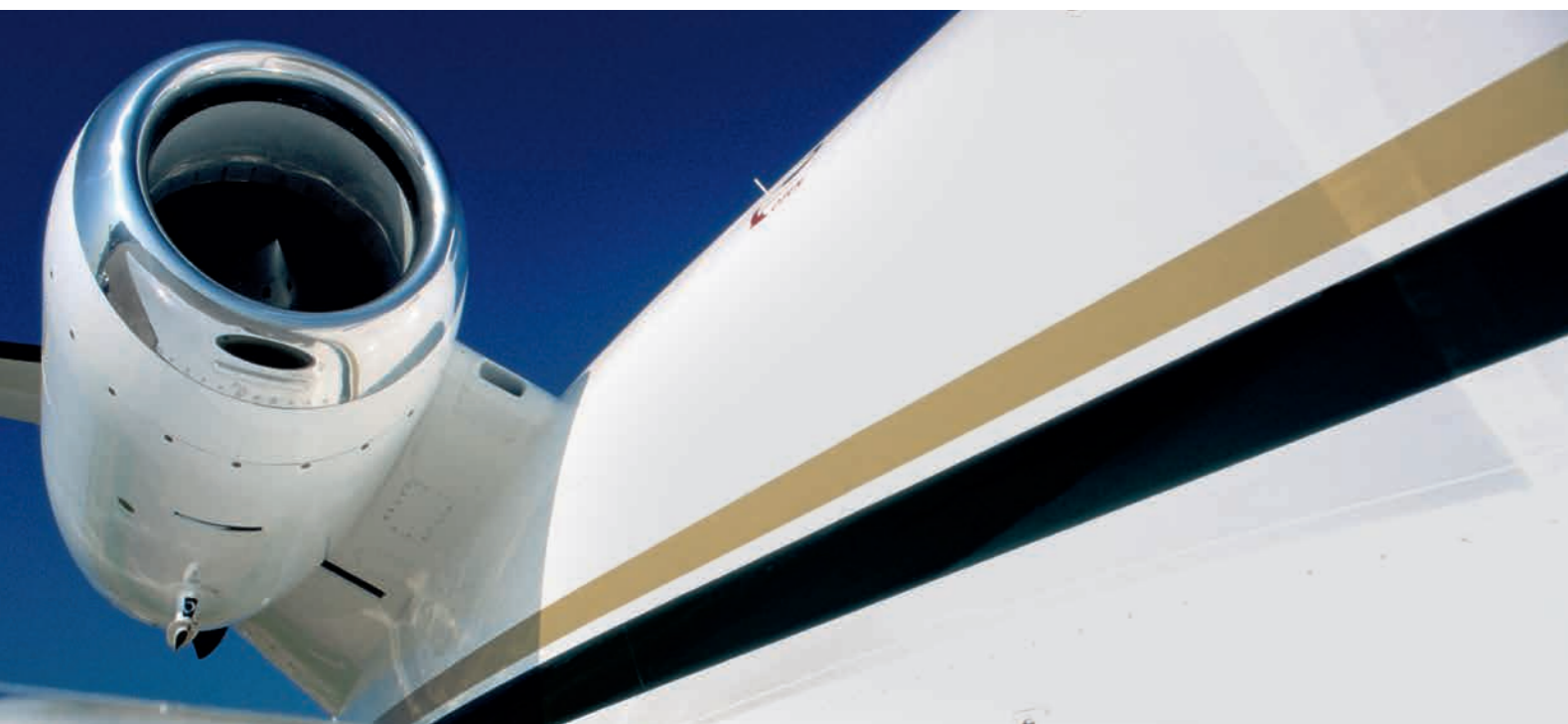
Polyisocyanate crosslinkers

Typical waterborne 2K PU coatings based on Bayhydrol® A may contain different types of polyisocyanate crosslinkers. Hydrophilically modified polyisocyanates (Bayhydur®) are readily water-dispersible and commonly used to obtain transparent and glossy films. Such polyisocyanates may be based on non-ionic internal hydrophilization (e.g. Bayhydur® 3100, Bayhydur® 304, Bayhydur® 305) or ionic internal hydrophilization (e.g. Bayhydur® XP 2487/1, Bayhydur® XP 2655). Their main benefit is easy incorporation into polyol dispersions (A-component) without the need for high-shear stirring equipment. High gloss is easy to achieve with both types. In addition, ionically modified Bayhydur® crosslinkers produce films with improved hardness and resistance levels.

As an alternative, low-viscosity hydrophobic polyisocyanates, such as Desmodur® N 3600, Desmodur® N 3900 or Desmodur® XP 2860, can be used as crosslinkers for Bayhydrol® A secondary emulsions. The resulting films are less hydrophilic and exhibit improved chemical resistance. Depending on the specific formulation and mixing equipment, such low-viscosity Desmodur® N hardeners can be used alone or blended with Bayhydur®. Emission-free systems are required in some special application areas (e.g. coatings for indoor floors). In such areas, very low-viscosity polyisocyanates, such as Bayhydur® XP 2547, should be used since they do not need to be diluted with an organic solvent.

Besides HDI-based hardeners, IPDI-based hydrophilic polyisocyanates, such as Bayhydur® 401-70, Bayhydur® XP 2759, Bayhydur® XP 2858 or Desmodur® XP 2565 (IPDI allophanate, hydrophobic) can also be used in combination with HDI-based ones in order to formulate faster-drying 2K PU coating systems based on Bayhydrol® A. The use of IPDI polyisocyanates in hardener blends can additionally increase the blister-free film thickness of waterborne 2K PU coatings.

Apart from the solvent quantity, the type of solvent used for the dilution of the polyisocyanate has a surprisingly large influence on the blister-free dry film thickness. As a general rule for the coating developer, it can be said that a hydrophobic co-solvent has a favorable effect on blister-free film thickness.



Co-solvents

Although waterborne 2K polyurethane coatings basically work without organic solvents, some organic co-solvent is often added to the polyisocyanate component in order to support the dispersibility of the polyisocyanate in water. The other reasons for adding organic solvent are the same as for solventborne or 1K waterborne coatings, e.g. to control drying and open time, reduce minimum film formation temperature, and improve leveling and film appearance. The type and amount of organic co-solvent also have a substantial influence on the pinhole sensitivity of the coating.

To provide perfect miscibility of the hardener into a waterborne 2K PU system, the viscosity of the hardener should be as similar as possible to the A-component. Most polyisocyanates for waterborne 2K PU systems are thus diluted with organic solvents. Such organic solvents should not contain any functional groups that react with NCO, e.g. hydroxyl or amine groups. The polarity of the solvent must determine its miscibility with water. Some examples of commonly used solvents

in waterborne 2K polyurethane coatings are methoxypropyl acetate (MPA), methoxy butyl acetate (butoxyl), dipropylene glycol dimethyl ether (DMM) and propylene glycol diacetate (PGDA).

Hydrophilically modified hardeners, in particular, require a careful choice of co-solvents, as they have a significant influence on the dispersibility of the polyisocyanate in water or waterborne polyol dispersions.

Production of polyisocyanate component (B)

Like all polyisocyanate hardeners for 2K polyurethane systems, including those for Bayhydrol® A-based waterborne 2K PU systems, production must be moisture-free. Besides the exclusive use of PU-grade raw materials (e.g. solvents with a moisture content of less than 0.05 wt. %), the production process should avoid contact with humid air. Production and processing in a closed system and/or under dry protective gas (dry nitrogen or air) are therefore essential, particularly in areas with humid climatic conditions. In such areas, the use of small amounts of moisture scavengers is also recommended.



Mixing, application methods, equipment and handling

The binder and polyisocyanate components are produced and supplied separately and have to be mixed homogeneously before application. The mixing process of component A and B depends on the formulation and the application. For waterborne 2K PU coatings not applied in industrial processes, the coating must be formulated in such a way that low shear forces (stirring with a rod or using a drilling machine) are sufficient to achieve perfect mixing. In these cases, either hydrophilic Bayhydur®-type polyisocyanates or Desmodur® polyisocyanates diluted with somewhat higher amounts of co-solvents are used. The use of hydrophobic polyisocyanate hardeners with a low amount of organic co-solvent (resulting in a higher viscosity of the B-component) requires high-shear mixing equipment, e.g. dissolvers or 2K mixing/spraying equipment. The ready-to-use coating can be applied within its pot life by various application techniques, such as rolling, brushing or spraying (HVL, air-mix or airless).

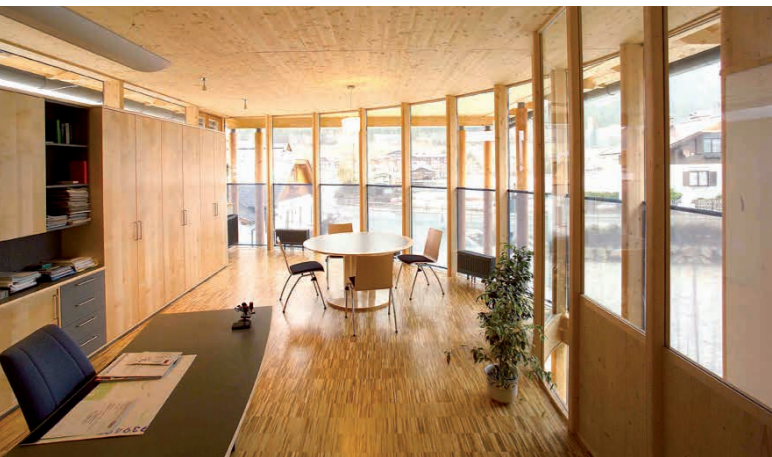
Waterborne PU coating systems based on Bayhydrol® / Bayhydur® / Desmodur® raw materials can be handled safely if appropriate measures are taken. Workplace ventilation, skin and eye protection are good practice today. Special care is required when handling polyisocyanate hardeners or mixed products containing polyisocyanates. When handling such products in non-spray applications at room temperatures and in adequately ventilated workplaces, occupational workplace exposure limits for diisocyanates are normally not exceeded. Respiratory protection is required in insufficiently ventilated working areas and during spraying and may possibly also be required when working at elevated temperatures. Please refer to the safety data sheets for more detailed information.



Product and application guide

	CHEMISTRY	TYPE	NON-VOLAT. CONTENT [%]	NEUTRAL AGENT	OH CONTENT ON SOLIDS [%]	INDUSTRIAL METAL		PLASTIC AUTOMOTIVE		WOOD		
						CO-SOLVENT [%] IN SUPPLY FORM	REFINISH, ACE, LARGE VEHICLES	CORROSION PROTECTION	PLASTIC INDUSTRIAL	CONSTRUCTION FLOOR/WALL		
Bayhydrol® A 242	PAC	Primary dispersion	42	NH ₃	-	4.0	○	○		○	●	●
Bayhydrol® A 2427	PAC	Primary dispersion	42	NH ₃	-	2.0	○	○		○	●	
Bayhydrol® A 2457	PAC	Primary dispersion	41	NH ₃	-	2.5	○	○			○	●
Bayhydrol® A 2546	PAC	Primary dispersion	41	NH ₃	-	4.8	●	●	○		○	●
Bayhydrol® A 145	PAC	Secondary dispersion	45	DMEA	SN 4/BG 4	3.3	●	●	●	○	●	
Bayhydrol® A XP 2469	PAC	Secondary dispersion	45	DMEA	PnB 7.9	2.5	●	●	○		○	○
Bayhydrol® A 2470	PAC	Secondary dispersion	45	DMEA/TEAOH	SN 4/PnB 4	3.9	●	●	●	○	●	○
Bayhydrol® A XP 2770	PAC	Secondary dispersion	44.5	DMEA	PnB 3.6	3.9	●	●	○	○	○	●
Bayhydrol® A 2542	PAC	Secondary dispersion	50	TEAOH	PnB 1.1	3.8			○			●
Bayhydrol® A 2646	PAC	Secondary dispersion	50	TEAOH	PnB 1.1	3.8						●
Bayhydrol® A 2601	PAC	Secondary dispersion	45	DMEA/TEAOH	SN 4/PnB 4	3.9	●	●		○	●	○
Bayhydrol® A 2651	PAC	Secondary dispersion	41	DMEA	PnB 3.4	3.0	○	●			●	
Bayhydrol® A 2695	PAC	Secondary dispersion	41	DMEA/TEAOH	PnB 7.6	5.0	●	●	●	○	●	●
Bayhydrol® A 2058	PES – PAC	Hybrid dispersion	42	DMEA	BG 2	4.8	○	○		●	●	
Bayhydrol® A 2139/2	PES – PAC	Hybrid dispersion	47	DMEA	BDG 2.5	3.8	●	●		○	●	
Bayhydrol® A 2227/1	PES – PAC	Hybrid dispersion	42	DMEA	BG 8	3.8	○	●	●	○	●	○
Bayhydrol® A 2809 XP	PAC	Secondary dispersion	48	DMEA	PnB 2.2	3.3	●	●	●	○	○	○
Bayhydrol® A 2845 XP	PAC	Secondary dispersion	40	DMEA	PnB 3.2	4.5	●	●		●	●	
Bayhydrol® A 2846 XP	PAC	Primary dispersion	40	NH ₃	-	1.5		○			●	
Bayhydrol® A 2861 XP	PC-PAC	Hybrid dispersion	53	DMEA	PnB 1.3	3.5	○				●	

PC = polycarbonate
 PAC = polyacrylate
 PES = polyester
 BG = butyl glycol
 BDG = butyl diglycol
 PnB = propylenglycol-n-butylether
 SN = solvent naphtha
 DMEA = dimethyl ethanol amine
 TEAOH = triethanol amine
 ● = especially suitable
 ○ = suitable





Fast-lane access to polyurethane innovations

At Covestro innovation is in our DNA. Ever since Otto Bayer discovered polyurethanes in 1937, we have been driving polyurethane innovations in coatings and adhesives as well as in other application areas. As our partner you enjoy fast-lane access to polyurethane innovations, and can help us in developing the next generation of polyurethanes to meet the industry's upcoming challenges and needs. What can we offer you?

- Powerful know-how on both established and new polyisocyanates, as well as on new polyurethane hybrid technologies.
- The prospect of new application technologies to enable efficient processes.
- More sustainable, biomass- or CO₂-based materials that do not sacrifice high performance.

Join us to shape the future!

