



Beckers Magazine

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Racing towards the future

2019 started well for the Beckers Group, with the highest sales ever in our 154-year history. Our innovative research work and the unrivalled customer-focused technical support have resulted in the “pole position” for our coil coatings segment: we have become the global leader. Accordingly, I would like to thank all of our customers and suppliers for their strong partnership and our Beckers teams for their outstanding contribution to this achievement.

To cater to demand for even greater local access to Beckers' expertise and production capacity, we have further expanded our Asian network, establishing a second site in Vietnam and constructed a brand new plant in Bangladesh. Operations in North and Central America are well established, with sites in Chicago, Fontana and Monterrey, Mexico. Close cross-border cooperation is ensuring the fast, reliable and prompt delivery of better and more innovative products and services to our customers. To address the industry-specific challenges of global climate change, we are focusing on innovative solutions that promote sustainability by reducing the environmental footprint of our production processes and end products.

Sustainability the key

Beckers' belief in a brighter future derives from a firm conviction that industrial sustainability is attainable. In this context, we are proud to have been awarded a Gold rating by the CSR collaborative rating platform EcoVadis – for the second year in succession. This commitment to sustainable solutions is central to the Beckers vision, expressed in the many product innovations and development strategies described in the following pages.

Here you will read how Asian demand for more environmentally acceptable solutions is driving a shift towards waterborne coil coatings. This issue also features the latest on self-stratifying and two-coat self-cleaning coil coatings, as well as describing the growing popularity of Super-Durable Polyester (SDPE) resin coatings on the North American market. Elsewhere in this magazine, we cite progress in aspartic technology that combines extremely high solids with very fast drying performance, and note new developments relating to our In Mold Coating (IMC) technology, which promise dramatic reductions in process time and fewer VOC emissions. And there's more: Thanks to all this creativity, the high score achieved for innovation in a customer survey conducted earlier this year came as no surprise. Not that we're content simply to rest on our laurels. Quite the opposite: we will keep working harder, to be the industrial paint company of choice.

This summer, Beckers' staff from around the world gathered at the Beckers Global Conference in Berlin to celebrate the theme "Shaping the future". The Conference invited the participants to consider themselves on a road trip where they were challenged to think outside the box, to think ahead, to anticipate and develop strategies for dealing with the challenges and opportunities of the future. Extending the metaphor, Beckers was to become a racing team, exploring the latest technology, implementing the most innovative strategies and refining the split-second timing and communication skills demanded of a Formula One pit-stop team, focused on nothing less than pole position. Despite the sweltering heat of midsummer Berlin, the Conference generated plenty of highly creative ways to ensure that you – our customers – stay ahead of the game. Together we *will* shape the future.



Dr. Boris Gorella
CEO Beckers Group





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*EHS and Energy Coordinator
Beckers France, Anne-Eva Noyel*



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New two-coat self-cleaning coatings – another step toward sustainability

Shane QUEK, KW TEH and Dr. Paul DAVIES

A coil coatings' primary function is to protect the metal substrate from corrosion and other external physical strains and stresses. Its secondary yet equally important function is the enhanced aesthetic value it imparts. Which is why Beckers offers such a broad palette of colours - from the brightest blue to the fiercest red. Ensuring that these colours maintain their freshness over prolonged periods, however, poses an equally broad range of challenges.

Our coatings are constantly exposed to the harsh outdoor environment, especially demanding in tropical climates. The combination of high humidity levels, intense UV radiation, fluctuating temperatures and polluted air causes paint to attract dirt and deteriorate over time. Before long, the coating can start to look dull, dirty and unsightly.

Deterioration caused by exposure to the outdoor environment was an unwillingly accepted fact, until the invention of hydrophilic coatings on glass, introduced in 2001¹. This raised the question whether this technology might be applied to other surfaces?

Nothing ventured, nothing gained: the race was on. Beckers wasted no time and started on the development of a self-cleaning coating almost immediately. The goal was to create a coating offering good long-term outdoor durability and – more importantly – dirt resistance. This new coating should require low-to-no maintenance, while keeping the colour vibrant and fresh, even after many years.

Fundamentals of dirt pick-up

For coil coatings, dirt pick-up may be explained by the interaction between the surface of the coating and air-borne particulates, such as dirt, dusts and other pollutants. It appears that the dirt particles adhere to the surface of the coating through a combination of Van Der Waals, electrostatic and capillary forces².

Once the dirt sits on the coating surface, other factors come into play, mainly the environmental conditions and the glass transition temperature (T_g)

of the coating. It was observed that when the coating surface temperature rose above its T_g , the coating became soft, allowing dirt to penetrate the polymer matrix of the coating.

These processes can be repeated, whereby more and more dirt and dust accumulates on the coating surface and penetrates the coating polymer matrix. These accumulated and embedded dirt particles are difficult (if not impossible) to remove, having a dramatic effect on the colour, gloss and general appearance of the coating.

Current market product

So far, the most successful self-cleaning product for coil coating is a three-coat system, featuring a very thin hydrophilic layer of inorganic coating, applied to the conventional primer and topcoat. Most conventional coil coating lines, however, can apply just two layers in one pass. So this system requires two passes of the coil coating line.

This has resulted in pressure to develop a two-coat system that can deliver almost comparable or at least similar performance to a three-coat system³.

New two-coat self-cleaning system

A new revolutionary two-coat self-cleaning product has been developed at the Beckers Malaysia Centre of Excellence. The system comprises a primer and a high surface-hardness topcoat, featuring a hydrophilic ►

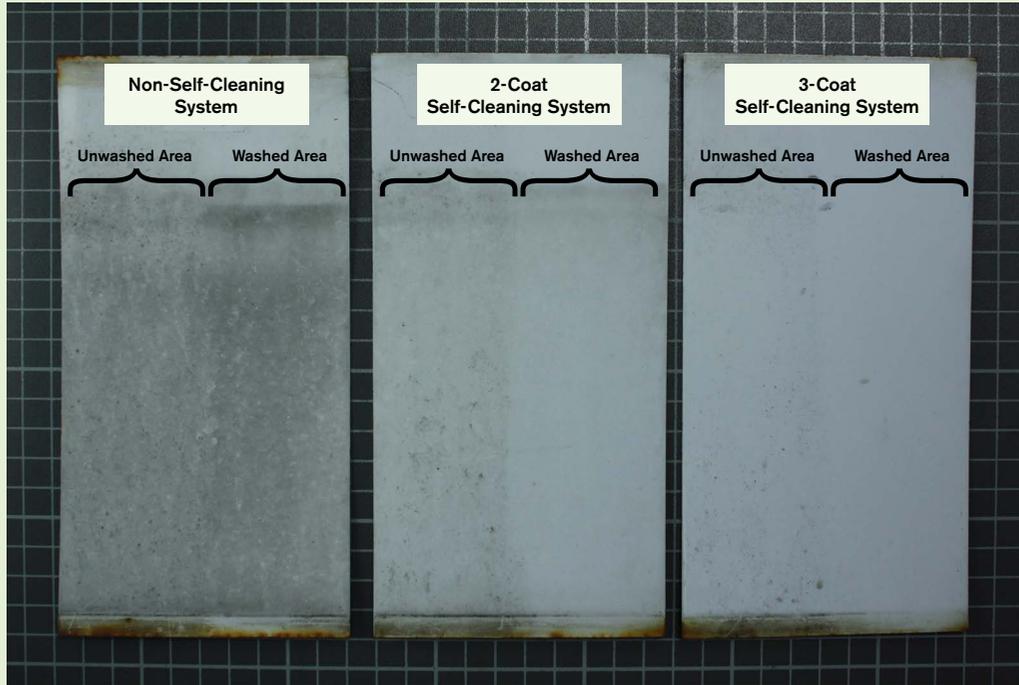


Figure 1a: Twelve-month outdoor exposure at Kuala Lumpur site, Malaysia



Figure 1b: Dirt pick-up performance over twelve-month outdoor exposure period

function. The hydrophilicity and high surface-hardness of the coating combine to provide self-cleaning and resistance to dirt pick-up. The hydrophilic coating surface attracts atmospheric moisture and forms a fine film of water onto which the dust particles fall. The coating is also designed for a high coating T_g, to ensure higher surface-hardness, preventing the embedding of dirt particles in the surface when a building's roofing or cladding is subject to elevated temperatures. Consequently, dirt particles have difficulty in adhering to the coating's surface, enabling them to be rinsed off by the next rainfall.

Coating performance

Natural dirt pick-up exposure is conducted at the Kuala Lumpur site. Featuring a tropical climate with relatively high levels of industrial pollution, this site is ideal for real-life dirt pick-up studies. The panels shown in *figure 1* were exposed for twelve months in Kuala Lumpur. It is clear that the self-clean coatings are performing much better than the standard polyester coatings, with the two-coat system achieving

results similar to the three-coat system. These panels are also exposed at other sites in Jakarta, Guangzhou and Shanghai, where the results are similar.

The hydrophilicity of the coating surface was also closely monitored by utilizing a drop-shape analyzer. A low water contact angle was observed, a desirable trait for hydrophilicity. This facilitates the even removal of loosely held dirt particles during rainfall, similar to the three-coat system. The coating surface demonstrates consistent hydrophilicity during real-life long-term outdoor exposure.

In general, all paint film properties of both systems are comparable. The two-coat system is observed to be harder, while maintaining the desired flexibility for profiling and fabrication design. It also features a higher coating Tg, specifically designed to withstand the challenges of warmer climates in tropical countries. This will prevent dirt from penetrating the coating's polymer matrix. ▶



Figure 2a: Drop Shape Analyzer

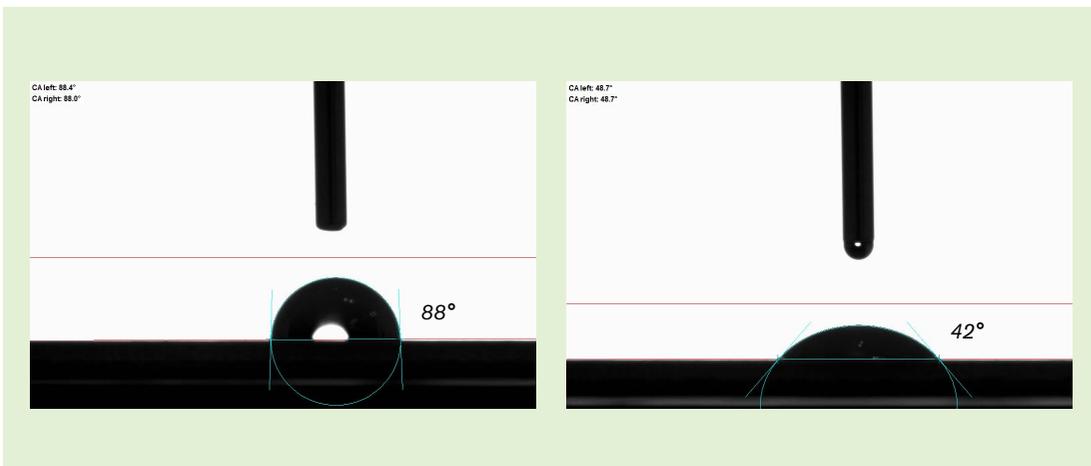


Figure 2b: Water Contact Angle of Standard Coating

Figure 2c: Water Contact Angle of 2-Coat Clean System

Comparison between a three-coat and two-coat self-cleaning system

Test	Three-coat self-cleaning system	Two-coat self-cleaning system	Testing method
Pencil Hardness (Faber Castell)	2H	3H	ASTM D3363
T-bend	2T No tapeoff, 3T No crack	2T No tapeoff, 4T No crack	ASTM D4145
Slow draw adhesion (6 mm)	No tapeoff	No tapeoff	ASTM D3359
Reverse impact (10 joules)	No tapeoff	No tapeoff	ASTM D2794
Solvent Resistance (MEK)	>500 double rubs	>500 double rubs	ASTM D5402
Coating Tg	36° C	57° C	ASTM E1356

Remark: Application parameter: Substrate: HDG, Primer DFT: 5 µm, Topcoat DFT: 18 µm

Sustainability potential

Overall, the two-coat system is a well-balanced coating that addresses all the drawbacks of current market offerings, in a conventional one-pass coating system. The slight increase in cost over a high performance, non-self-cleaning system is minimal and, when compared to a three-layer or two-pass product, it reduces cost, making it significantly better

value than other self-cleaning product offerings in the market.

The development of two-coat self-cleaning systems marks yet another important innovative step forward in Beckers' commitment to greater sustainability in coil coating, contributing to a generally more sustainable future for the industry and wider environment. ■

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You say SMP – we say SDPE!

Eddie BARON

The US coating industry has enjoyed a decades-long love affair with Silicone Modified Polyester (SMP) coatings, which continue to account for a high percentage of market sales, especially for building panels. But the times they are a'changing. The multiple benefits of Super-Durable Polyester (SDPE) resin coatings such as Beckry[®]Tech, long recognized in Europe, are starting to attract the attention of US coil coaters. The US market seems poised to embrace the SDPE coating. ▶

The silicone modification of polyester-resin technology has been around for decades in the coil coating industry. This modification process improves the UV-durability of the polyester resin and increases its hardness upon final cure. Both these properties increase the longevity of the final coating and allow for high-end building products to be made more cheaply than when using high-end fluorinated resins. Unfortunately, there are downsides too. Silicone is an expensive material and the cost of Silicone Modified Polyesters (SMPs) can be much higher than other polyester products. The hardness of these products also inevitably reduces flexibility. To combat these issues, many coil coating manufacturers have either moved away from SMPs or dramatically reduced the level of silicone in their products.

Markets like the EU have moved almost entirely from SMPs to Super-Durable Polyester (SDPE) resins, while a major segment of the US market is still in SMP coatings, with the remainder of the market spread out between polyesters, polyurethanes, fluorinated resins and polyvinyl chlorides (PVCs). So why has the US stayed with SMP products, when other parts of the world have moved on? The answer lies in a combination of two key factors.

Money talks

The first is the sheer size of the marketing investment US coil coating companies have made in the phrase “Contains Silicone” and the “SMP” acronym. Major players in the US market have devoted years and millions of dollars in ensuring that the end-user customer base associates these terms with quality, and this same customer base has accumulated decades of experience, confirming that these products meet their expectations. These customers are far down the value chain from the paint manufacturers and, as such, have little exposure to new educational materials or changes in paint technology. Consequently, there is

little impetus for these customers to change – “SMP” is so engrained in their thinking. US coatings manufacturers also ensure that claims and issues are resolved quickly and to customers’ specifications, helping maintain faith in SMP, even when failures occur.

Old habits die hard

The second key factor prolonging the US market’s belief in SMP derived from events in the ‘90s and early ‘00s. As SDPE resins became increasingly popular in other markets around the world, some companies did express an interest in trying something new. Unfortunately, their initial experience was of cheap imports to the west coast of the US, imports which performed poorly both at the coater and in the field. This left a bad taste in the mouths of US manufacturers – and the coil industry has a long, long, memory. As Beckers entered the American market, flushed by the considerable success of Beckry®Tech in other markets, the company was surprised to confront such resistance to a transfer from SMP to SDPE in the US. This might sound a bit discouraging for Beckry®Tech and SDPE’s prospects in the US – far from it! During more than a decade on the American market, Beckers has learned a lot. This comprehensive pool of experience, combined with recent changes to market dynamics in the US, suggest that SDPE’s future in this huge market looks highly promising.

New market, new opportunities

Understanding the unique challenges of a new market is critical to success, no matter the size of the organization. In the European coil coating market, where the majority of companies are almost fully integrated, from steel mill to coater to end-part manufacturer, Beckers has been extremely successful. In contrast, the US market is extremely segmented, where coaters, steel mills and formers are distinct and independently

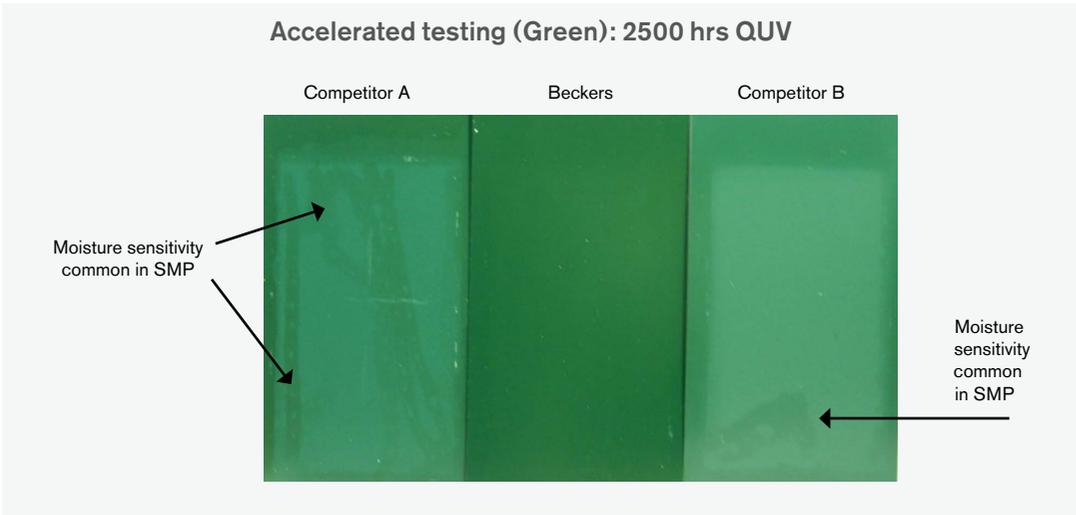
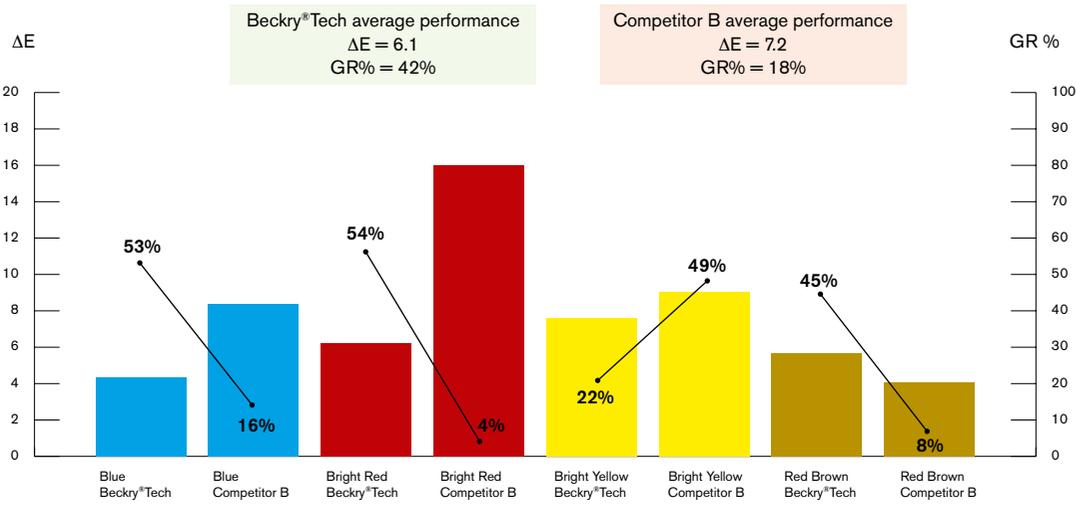
operated entities. Furthermore, metal service centers add complexity to the market, requiring any sale to be made to several parties before any paint can be manufactured. We now know that, to ensure customers have immediate access to products like Beckry®Tech and other SDPE products, service centers must have the capacity to hold them in stock. This will enable Beckers’ end customers to purchase Beckry®Tech almost anywhere, as compared to earlier, when they were limited to a small number of sparsely distributed service centers.

New kid on the block

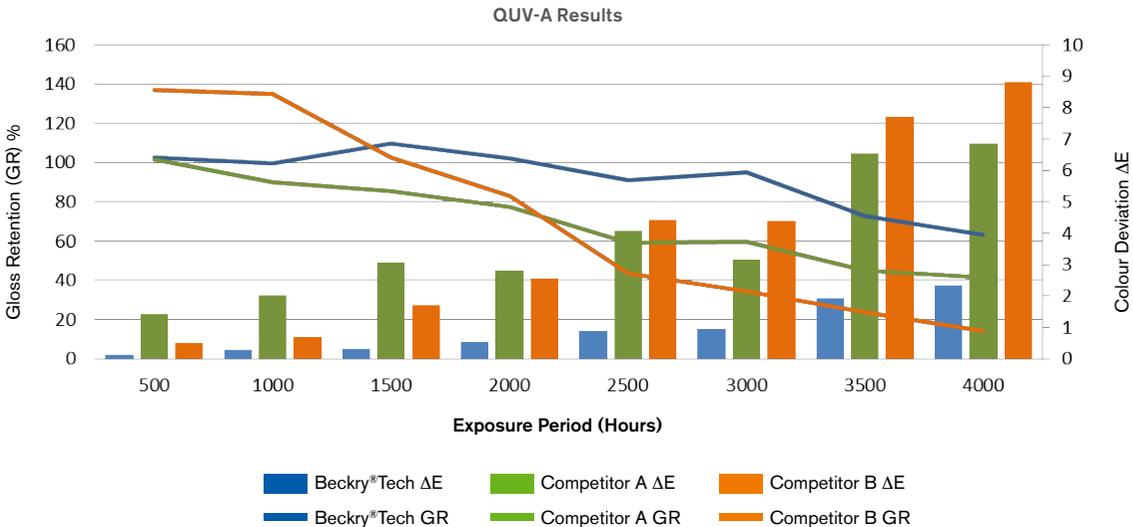
Market consolidation has also had a huge impact on the US market. With fewer and fewer suppliers available, end customers are looking for new ways to differentiate their products. This gives Beckers the ideal opportunity not only to offer customers another option, but a “new” technology as well. America’s coil coaters are keen to see another player in the market, to keep the biggest hitters on their toes. Further down the value chain, the smaller and mid-tier end customers want to be able to market something new, which can compete with the SMP products on offer from the major players. Beckry®Tech satisfies both needs and the consolidation of the US market has created the opportunity to have these conversations.

Years of testing has shown that Beckry®Tech outperforms SMP products in terms of durability, flexibility and, in many cases, cost. It can’t be “cheapened” by reducing levels of a critical material, as has been done with silicone levels in SMPs. This assures customers that the quality of the Beckry®Tech system is not threatened by market pricing considerations. Looking ahead, the greatest challenges are market acceptance and education. Fortunately, as noted above, the time is now ripe for Beckers to move forward on the US market – to champion the multiple benefits of SDPE! ■

Six year Florida outdoor testing: Beckry®Tech



Accelerated testing (Green): 4000 hrs





Proximity is key in South Asia's fastest-growing economy

Rajesh MEHROTRA

Although geographically a relatively small country, Bangladesh has a considerable population of 170 million people, being rated the thirtieth largest country in the world in terms of Purchasing Power Parity (PPP). The Bangladesh economy is undergoing transformation from an agricultural to an industry based economy, with a steady inflow of foreign investment in power utilities, deep water ports, expanded manufacturing capacity and key infrastructure projects.

Posting GDP growth rates of more than 7 % over the past few years, Bangladesh was rated the world's third fastest growing economy by the World Bank in 2018. Looking ahead, the Asian Development Bank predicts that Bangladesh's GDP will continue to grow by some 8 % during 2019 and 2020, which will make it the highest growth rate in South Asia.

Alert to opportunity

Determined to adopt an active role in contributing to this lucrative growth, Beckers formed joint venture Berger Becker Bangladesh Limited (BBBL) with market leader Berger Paint Bangladesh Ltd, towards the close of 2011. Within twelve months, BBBL had established the country's first ever coil coatings production facility, providing the capacity (initially almost 1 000 tons) long sought by Bangladesh's steel and construction industry. Since that time, demand for coil coatings has grown steadily, fuelled by a per capita increase in steel consumption of 25 kg in 2012 to 45 kg in 2018.

Growing demand

Beckers Bangladesh has proved a huge success. To keep pace with the country's rapid growth and increased market demand for coil coatings, the company has consequently upgraded and streamlined its existing in-country production capacity, opening an ambitious and larger cutting-edge production facility at its new Dhaka site this year.

In line with Beckers' policy of improving sustainability, this new hyper-modern plant is a vertical design, constructed to follow the Beckers Loss Prevention Standard (BLPS) and all local safety regulations. As well as its state-of-the-art pre-mixing, grinding and mixing equipment, the new plant boasts advanced R&D and Quality Assurance laboratories, including

facilities for accelerated tests and natural exposure: all this to ensure that customers always receive the highest quality products in the shortest time. The innovative and environment-friendly vertical design minimises land use and is highly energy-efficient. Featuring several floors, gravity is utilized to facilitate material flows, reducing the pumping requirement and ensuring greater plant sustainability. The site is certified to the ISO 9001:2015 standard and we are also gearing up to meet all the requirements of ISO 14001:2015 and ISO 45001:2018.

At your service

Operating since March 2019, the new plant has already dramatically enhanced our service to customers. Backed by the global resources and innovative technology of Europe's leading developer of advanced coil coatings, Beckers Bangladesh has the expertise, capacity and professionalism to contribute to our customers' success in a fiercely competitive market. We feel confident in sharing a bright future! ■



Industrial Coatings R&D focus on more sustainable coatings

Cécile BERRY

Beckers is focused on developing products that feature improved environmental performance and reduced health impact. Although mainly driven by our determination to become “the most sustainable coatings company”, this is also a consequence of regulatory pressure (Air Pollution Prevention and Control Action Plan in China, REACH, waste reduction and more) and customer demand (isocyanate-free, sustainability).

Compliance with VOC control policies is a prime driver in developing new technologies. There is growing demand to commercialize high-solids and waterborne technologies, particularly in China, where new regulations will be enforced. This trend will continue over the coming year.

- In the Automotive Plastics Exterior (APE) business line, we shall continue to implement our new waterborne basecoat technology, Beckqua® Color. This range is NMP-free (N-Methyl-2-Pyrrolidone) and has high solids content. We shall also be introducing our new waterborne primer and new high-solids clear coat.
- For the Agricultural, Construction and Earthmoving (ACE) business line, we have achieved approval by major OEMs of a full range of Ultra High Solids (UHS) primers, topcoats and waterborne systems. We are focusing on the subsequent introduction of aspartic technology, which combines extremely high solid content with very fast drying performance.
- For the Railway business line, Beckers offers a complete product range from primers to 2K PU topcoats and specialty coatings, available both in conventional and waterborne variants. We are now working to improve customer productivity and efficiency with new sustainable-technology platforms.



- The Consumer Design Finishes (CDF) business line already features a range of products compliant with new regulations to be implemented in China. We are now working intensively to complete the portfolio for the next generation of waterborne coatings. At the same time, we are also exploring ways to introduce higher-coverage products.
- Our In Mold Coating (IMC) technology is undergoing additional trials and new development projects are in progress, greatly reducing process time and VOCs.

Besides, some customers are also looking to further reduce health impact, by eliminating isocyanate. We have qualified a new isocyanate-free topcoat and

plan to scale up the isocyanate-free fast-cure technology in 2019.

Meanwhile our Long Term Research Group is also working to deliver more sustainable coatings in the future. It is investigating biobased materials and developing a new technology platform for high-solids products.

The R&D conducted by Beckers Industrial Coatings will continue to be driven by increasing regulatory complexity and the need for more sustainable products. The ability to develop these solutions will be crucial in securing Beckers long-term competitiveness and that of our customers around the world. ■



Customer
focus



Shape and
adapt



Trust and
integrity



Team
spirit



Values-driven for a sustainable future

A company's focus is shaped by its corporate vision, business goals and development strategy – but what ultimately determines the actions and choices of its employees? Shared values. Clearly established values provide a secure platform, creating a framework within which each employee has the flexibility to assess and adjust to any given situation, contributing to the broader resilience and success of the overall organization. In the following interview for Beckers Magazine (BM), Judith Jungmann, Chief Human Resources Officer (CHRO) at Beckers Group, addresses why and how shared values are critical in determining Beckers' long-term viability and business focus.

BM: How do Beckers' values support the brand?

JJ: A brand represents a promise to the customer, about the quality, innovation and service, and the customer experience must be consistent with this promise. Trust and integrity is essential for all stakeholders who need to know that we will deliver on their expectations. For sure, customer focus means constantly canvassing customers to establish that our brand promise is being delivered in full.

BM: How do Beckers' values enhance the quality and relevance of our products and services?

JJ: Our values guide us in our day-to-day activities, impacting on all aspects of our business operations. Understanding customers' needs, combined with a relentless will to deliver, really proves that our customer focus is etched into our corporate DNA. Our values demand that we challenge and reinvent the status quo, while at the same time driving innovation, based on our long accumulated knowledge and experience.

BM: How do Beckers' values help drive innovation?

JJ: Shared values enable us to establish an environment that fosters creativity and independent thinking – a safe space, where people are encouraged to think outside the box and feel confident in challenging accepted wisdom or colleagues' assumptions. To maintain our reputation as the leader of innovation in our industry, we must engage the power of a culturally, intellectually and disciplinarily diverse team to ensure a steady flow of new solutions.

BM: Beckers is determined to become the most sustainable industrial coatings company. How do our values promote this ambition?

JJ: We know that our employees take great pride in this ambition, a commitment that impacts on every aspect of operations. Sustainability is about much more than commercial foresight, ground-breaking research and innovative marketing: it's about the long-term survival of our planet! Facing multiple and demanding scientific and social challenges, we will develop new solutions and new technologies to ameliorate the downsides of industrial progress. For me, shape and adapt is the name of the game.

BM: Can Beckers' corporate values help recruit and retain young talent?

JJ: All studies on employee motivation and commitment point toward that hygiene factors such as status, job security, salary, fringe benefits, insurance, vacations etc., are not the primary source of job satisfaction. Commonly, the motivation for joining or remaining with a company involves softer values – such as clear ethical and social standards, proven corporate integrity, a positive approach to diversity and an organizational openness that encourages independent thinking. Our recruitment interviews are structured to attract and identify those who subscribe to and share our values, values against which we constantly rate our own performance as Group employees. We take our values very seriously.

BM: In what ways do the values promote our social sustainability roadmap?

Our team spirit determines the direction. An approach that thrives on diversity, collaboration and open communication, based on mutual respect and recognition of individual talents and strengths.

BM: Finally, which of our values would you say supports our relationship with suppliers and the downstream markets?

JJ: I believe trust and integrity are essential throughout the entire value chain, and that clear rules are established to govern business conduct in interaction with suppliers and other partners. Naturally with the expectation that they in their turn are acting in the same way and are committed to compliance. We want to deliver on the ambitious brand promise to all stakeholders. ■

Self-Stratifying Coatings

Chris LOWE, John F. WATTS and Zi Seng OOI

A coating system, by definition, comprises more than one coating. A primer, which at the very least assures adhesion to the substrate and prepares the surface for a second coat, is applied first. This may be followed by one or more layers, all of which are optimised for the desired performance.

Coil coatings are applied to a range of metals, often as a two-coat system (primer and topcoat), although mono-coat systems are fairly common, especially in Asia. There is also at least one example of a three-coat system that can be applied in a single pass¹. Primers deliver superior adhesion to the pre-treated metal substrate as well as corrosion resistance, especially for ferrous metal substrates. However, the resin technology employed may not be very durable to UV light, and such primers therefore require topcoats offering greater UV resistance.

High build (thick) systems are consistent with better corrosion resistance and thereby better quality, in the vernacular sense. The coating systems with highest build are PVC Plastisols (200 µm), followed by polyurethane coatings (40–50 µm, including primer) and the more standard polyester melamine systems, which normally deliver between 20 and 25 µm. If two layers could be applied in a single operation, this would enable mono-coat lines to produce two-coat systems, with the implied advantage of a primer. This would also enable two-coat lines to produce three layers, with the associated benefits of greater

durability (final clear-coat separating pigments from the environment) or special effects. This makes a convincing business case for a system that stratifies into two discrete layers, featuring a strong interphase region delivering good inter-coat adhesion. Of course, the technical difficulties posed must be surmounted.

Required properties

Recently, self-stratifying systems have again become the focus of both academic and industrial research^{2,3,4}. The mechanisms that underlie the self-stratification process have been subject to debate, with differences in density being a favourite hypothesis. Another hypothesis concerns the difference in surface free energy (the term surface tension is allowed for liquids), strongly supported by the work presented by S. Zahedi et al², which reveals how stratification of a low surface free energy fluorinated polymer creates the exterior surface, whereas its higher surface free energy counterpart seems more attracted to the substrate. Other examples were presented by A. Beaugendre et al⁴, but most seem to consist of at least one thermoplastic component, together with a thermosetting counterpart. For the pre-coated metal market, however, it is preferable to have both components based on thermosetting technology, as they tend to be more robust (plastisol and PVDF excluded), and they must be cost effective, given the competitive nature of the market.

The ability to self-stratify is of course very obvious, but the speed at which the process occurs is a key parameter in the coil coating process. Line speeds in some of the more developed markets are often

in excess of 100 m/min (1.66 m/s). With distances between the coater and the entrance to the oven often in the region of five metres, the time scale of the self-stratifying process is restricted to around three seconds. This might be slightly extended, as stratification could be completed during the first few seconds in the oven, before the solvents start to evaporate and possibly change the surface free energy differences.

The final performance criterion to be addressed is the homogeneity of the mixed counterparts in the paint tray of the roller coater used on most, if not all, coil coating lines. If inhomogeneities occur, this will cause variations in the final painted surface, leading to poor quality (in terms of reproducibility).

Technical studies

Initially, these involved the Centre of Excellence in Malaysia alone. However, as will become obvious, developments have taken on a more global character, with input from the Beckers Resin Laboratory in the UK and the University of Surrey.

Early experiments combined a polyester melamine primer containing strontium chromate with a Polyvinyl Butryal (PVB)-based topcoat that harboured a phthalocyanine blue pigment. *Figure 1c* displays a cross-section obtained from a panel to which a combination of the two paints (made separately) has been applied. The desired self-stratification phenomenon is discernible. Unfortunately, the durability of the system, as defined by gloss retention after a period of accelerated weathering, was insufficient for

the demands of a modern day coil coating. Titanium dioxide was also used to pigment the PVB and self-stratification was still evident, but the durability along with the cost forced the technologists involved to seek alternatives.

Even so, this melange was tried on the pilot line of the Beckers UK Coil Coating Laboratory. The two coatings were churned in the tray after mixing and applied to pre-treated hot-dip galvanised steel, employing a two-roll technique. The line speed was 60 m/min and a five metre run-off was used between coater and oven. The self-stratified nature of the end product may be clearly discerned in *figure 1*. The success of this pilot line trial provides strong evidence of the viability of our innovative patent, entitled "Rapid stratifying composition for coil coating application" ¹¹.

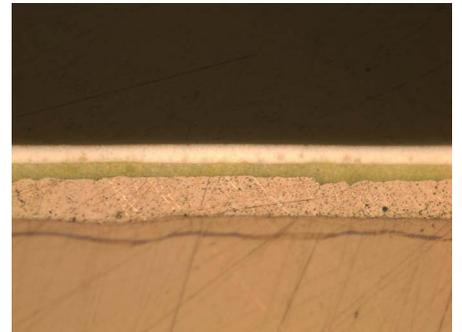
Figure 1: Proof of PVB-polyester stratification on the pilot line trial at the Beckers UK Coil Coating Laboratory.



1a) Mixing of PVB topcoat and polyester primer



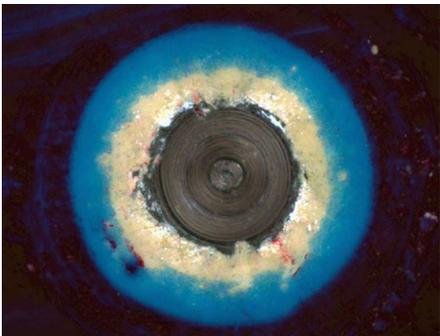
1b) Pilot line trial in Beckers UK Coil Coating Laboratory



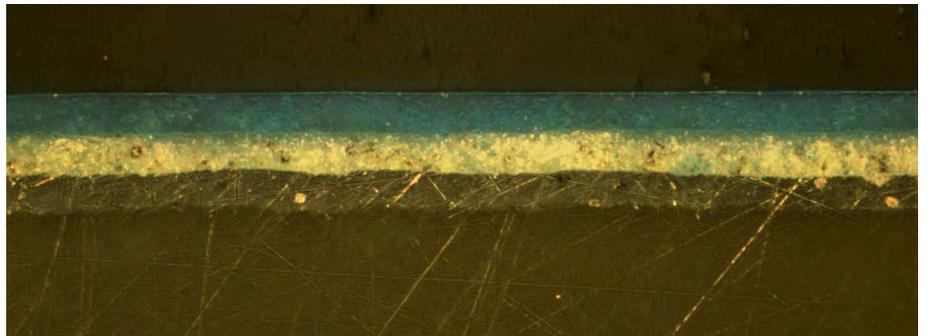
1c) Cross section image of stratified coating

The second generation formulations combined a polyester-melamine-based primer with topcoats based on thermoplastic acrylic topcoat. Again, self-stratification was evident (*figure 2*) and, although durability was much improved, solvent resistance was non-existent and the costs were still very high. Attempts to use coatings based on thermosetting acrylic resins with a melamine cross-linker failed to deliver different layers.

Figure 2: Second generation thermoplastic acrylic-polyester shows "almost perfect stratification"



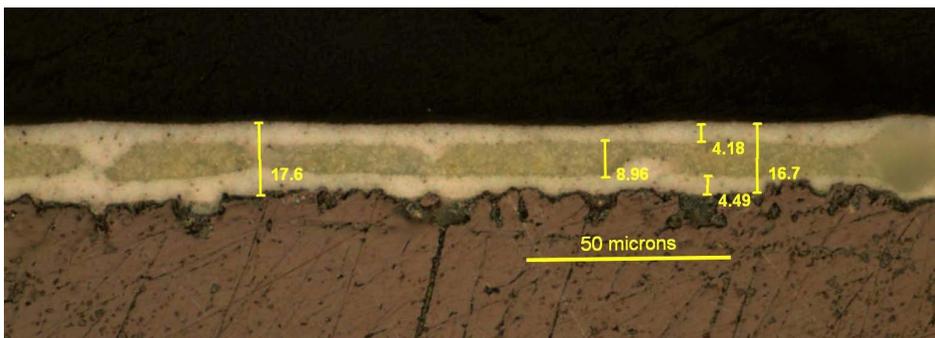
2a) Coating drill image



2b) Cross section image at 500 times magnification

In order to keep costs under control and to improve the robustness of the system, polyester-melamine technology was selected for both primer and topcoat. *Figure 3* presents a cross-section obtained from a panel coated with a mixture of a primer based on high molecular weight polyester, containing strontium chromate, and a topcoat derived from a medium molecular weight polyester, containing titanium dioxide. It appears that the primer prefers to sit in the centre of the coating, surrounded by the topcoat. This arrangement is not optimal, but this assessment relies on the assumption that the pigments do not migrate from one resin to another.

Figure 3: Cross-section of three-layer polyester-polyester stratified coating at 500X magnification



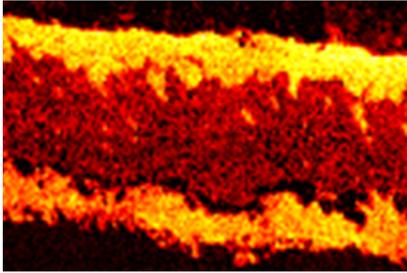
Differentiation

Resolving the issues of whether or not migration between phases was occurring required the application of some sophisticated analytical techniques. The University of Surrey has collaborated extensively with the Beckers LTD UK laboratory since 1994. Together, they have assembled a methodology for determining whether or not interphases form between primer and topcoat and, if so, their strength.

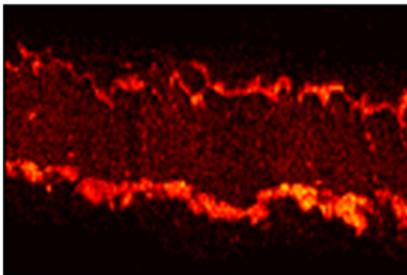
The original technique⁵ was developed for polyurethane primers under PVDF topcoats. It involved micro-toming through the organic phases at a very shallow angle using a histological micro-tome. This reveals a much larger surface area than the standard cross-section, facilitating analysis by techniques such as X-ray Photoelectron Spectroscopy (XPS) and Time-of-Flight Secondary Ion Mass Spectroscopy (ToF-SIMS), which are specialities of the University of Surrey.

The XPS technique proved incapable of differentiating between the different polyesters but ToF-SIMS offered the opportunity to extract the information, once it was realised that it was ions with masses greater than 200 Daltons that were the discriminators. The low intensity of these ions in spectra obtained from cross-linked samples added an extra level of complexity. It was however possible to apply learnings from neat resins, which allowed assignments to be made for ions with particular masses. The low intensity of the peaks ►

Medium molecular weight Polyester



Barium Sulphate



High Molecular weight Polyester

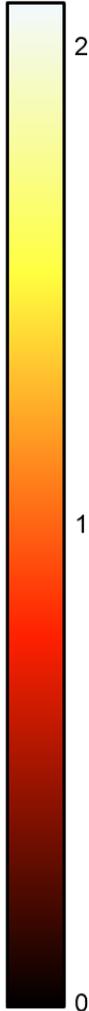
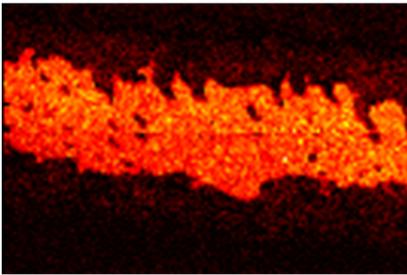


Figure 4. ToF-SIMS analysis on three-layer polyester-polyester coating at University of Surrey

in the mass spectra was overcome using Principle Component Analysis coupled with Non Negative Matrix Factorisation ⁶.

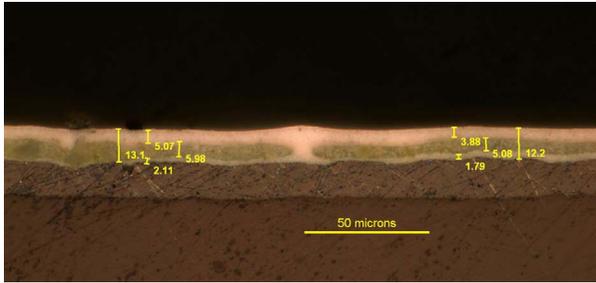
The results of this analysis indicated that the pigments stayed with the resin into which they were dispersed, whether or not the strontium chromate was dispersed into the topcoat resin and vice versa for the titanium dioxide (figure 4). It was apparent, however, that a barium sulphate filler tended to find the interface between primer and topcoat the most comfortable position. The migration of melamine during cure has been investigated by several researchers in the past^{7,8,9}, with some authors arguing for a depletion in the crosslinker concentration in the outermost surface, due to reaction with the resin driving more melamine into the outermost environs of the coating.

Other authors have indicated that nitrogen-containing moieties preferentially adsorb onto metal surfaces¹⁰, where they react with the pre-treatment, bestowing the excellent adhesion for which coil coatings are known. In this particular case, it was demonstrated by incorporating the crosslinker into only one phase that melamine has a preference for the topcoat resin, which has a higher hydroxyl value. This provides a possible clue as to how the self-stratification occurs.

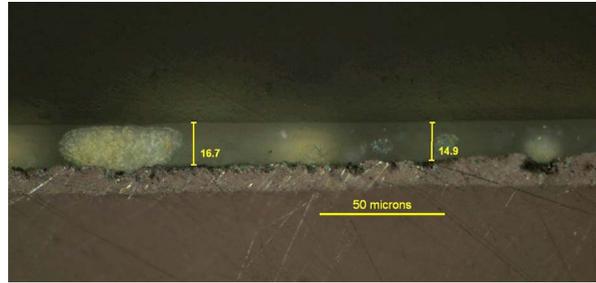
Bespoke resin design

Attempts to change pigment volume concentration in topcoat and primer yielded different distributions of the primer in the volume of the topcoat (figure 5), but no combination produced the desired configuration of primer close to the metal, with the topcoat presenting a pristine finish. Consequently, the Beckers Resin Laboratory has synthesised many different variations in polyester-resin architecture for incorporation into paints. Almost 1 000 combinations have been evaluated to assess incompatibility. One particular resin has indicated a tendency to self-stratify in the presence of a primer. However, it demonstrates an even stronger affinity to the substrate than the primer resin, resulting in an undesirable inverted configuration.

Figure 5: Effect of pigment volume concentration on stratification of three-layer polyester-polyester coating



5a) High TiO_2 loading in topcoat paint gives three-layer structure



5b) Low TiO_2 loading in topcoat paint causes primer to agglomerate

Conclusion

It is possible to put together a combination of different paints that will self-stratify into discreet layers, even in the short time between application and the oven entrance on a coil coating line. The issue is that the systems that form two distinct layers do not deliver a suitably robust system. It is possible to mix two thermosetting polyester melamine coatings, apply and cure them and find that they have segregated, if not stratified. There are some instances of different polyesters self-stratifying but the primer and topcoat end up inverted. The process of stratification is governed by pigment type and concentration as well as resin type and solvent identity. It is clearly a complex process that still needs to be understood and then mastered. Beckers continues to research the parameters that influence the stratification process and will ultimately develop a pair of coatings capable of forming two distinct layers after a single application event. ■

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In keeping with the Group's long commitment to innovation and sustainability, the theme chosen for the 2019 Global Beckers Conference was unapologetically ambitious and confident in tone. During two bakingly-hot days in late June, some 100 Beckers employees from all over the world converged on Berlin to participate in "Shaping the Future".

Annika BERGMAN

Shaping the future





Embracing a topic as hot as the weather, the Berlin Conference was perhaps a sign of the times? The event kicked off (literally!) with Beckers CEO Dr. Boris Gorella's dramatic entry on an electric scooter, prior to giving his opening address. What better way to illustrate the nature and speed of current change?

groups reconvened at the Conference to pitch "their" start-up ideas to their fellow Beckers colleagues. Conceived as a means of stimulating the creation of new business models and "out-of-the box" thinking, the teams' innovative presentations produced an electrifying atmosphere as they championed their business ideas.

Paradigm shift

Are we aware of paradigm shifts while they are in progress, or can we only define them with the benefit of hindsight? What is undeniable is the breakneck speed of digitalization.

The sheer volume of data amassed by companies and organizations is increasingly obvious, but how can it best be deployed in the context of Artificial Intelligence (AI) and machine learning? The ultimate aim is the seamless exchange of information via multiple platforms with external as well as internal parties. To achieve this, data must be controlled, categorized and validated. How can Data Management Systems (DMS) help ensure the control of data from creation via validation to application? The 2019 Conference allowed us to take an in-depth look at where digitalization can take us.

Day Two

On day two, the digital journey continued with an exercise more directly connected to the day-to-day development, production and supply of more sustainable industrial paints. Each team was tasked with thinking like a start-up and challenged to present a bold new idea. The enthusiasm was no less infectious than the previous day, generating a mass of daring and exciting ideas.

Ideas generator

The Conference gave birth to many bold yet pragmatic ideas on how best to apply digitalization in shaping not only Beckers' future, but that of its partners and stakeholders. The dynamic and optimistic atmosphere of the event was neatly expressed by one participant's sticky note in the words "Embrace change – it will come". This optimism was reinforced by CEO Dr. Boris Gorella, when asked to comment in an interview at the close of "Shaping the Future". His response was immediate and unequivocal: "High energy, super-engaged and really open to explore new ideas. That's what I call the Beckers spirit!" ■



Day One

The first part of day one featured a general update of Beckers' current status on sustainability, innovation and other key issues. Beckers' owner Jenny Lindén Urnes, as well as Lindéngruppen's CEO Paul Schrotti, contributed some insights on their expectations and expressed their support as the company moves forward. During the second half of the day, participants were divided into groups, embarking on a digital journey that involved visits to eight small Berlin digital start-ups.

Once briefed by these start-ups on their individual business concepts, the





Expanding capacity in Vietnam

Hua Hin ZOW

Anticipating demand for increased capacity in the growing Vietnamese coil coating market, Beckers opened a second production unit in late 2018. Based at Nghe An, in the north of the country, the new unit operates out of the Vietnam-Singapore Industrial Park.



This major strategic investment will ensure outstanding customer support throughout North Vietnam, complementing the Group's existing Binh Duong facility in the south, near Ho Chi Minh City, which has been in operation since 2007.

The Nghe An unit features comprehensive production and laboratory facilities, as well as full spectrum technical, financial and HR functions. Operating four mixers with an annual capacity of over 1 000 tons, the new unit will initially focus mainly on serving Vietnam's largest coil coater, which has established a new facility close by in the same province. Naturally, at a mere eight hours by road from Hanoi, the new unit is also ideally positioned to serve our expanding range of important customers based in the Vietnamese capital.

One of the best-managed industrial parks in Vietnam, featuring facilities such as a waste-water-treatment plant, excellent vehicle access and plenty of green space, the Vietnam-Singapore Industrial Park (VSIP) provides generous room to cater for anticipated

growth in the Vietnamese coil coating market. Just fifteen minutes from Vinh airport and the city centre, the location of the new site will also ensure enhanced service to Beckers' customers in the north of the country, cutting lead times from their earlier one-and-a-half/two weeks to between just three and five days.

Additional benefits include proximity to the Cuu Lo deep-sea port (greater flexibility concerning incoming raw materials and shipping of finished products) and the soon-to-be-completed Hanoi/ Nghe An province/ Laos highway, offering considerable potential for new market opportunities in Laos.

Beckers Group's strategy for local growth is straightforward: to focus on operational excellence and establish outstanding technical support, spearheaded by Beckers' comprehensive and globally respected range of coil coating systems – Beckry®Fluor, Beckry®Tex, Beckry®Pol, Beckry®Coat, Beckry®Prim, Beckry®Deck, Beckry®Tech and more. Beckers Vietnam is gearing up for continued success! ■



Beckers Stakeholder Workshop 2019

Painting a brighter future together

Nicklas AUGUSTSSON



We live in rapidly changing times. Global challenges are building at an unprecedented pace and have profound implications for all businesses and segments of society. Many leading experts consider the period up to 2030 as critical, and the UN Sustainable Development Goals signal the direction in which we need to head.

We can already see that the business of sustainability is changing, as both pressures and expectations rise. The next decade will witness the emergence of new markets, radical legislation, innovative business models and greener production techniques.

Beckers has already achieved some considerable success in the field, but it is time to move to the next level. We want to position our company as part of the solution for a sustainable world. This will require new ideas and approaches. What is clear, however, is that we cannot act alone to become successful.



Sustainability think tank

This awareness of the need for cooperation was what triggered the decision to hold our first multinational stakeholder workshop. A collaborative, creative and future-focused event, the workshop gathered participants from within our own company and from our value chain, customers and suppliers, as well as NGOs, UN bodies, sustainability experts on key topics and representatives from the academic world.

Held at Färgfabriken* (The Paint Factory), located in the Swedish capital, the workshop ran over two days at the end of May 2019. This venue was not just anywhere. Färgfabriken is of important historic and symbolic significance to Beckers, making it the ideal place to launch a discussion about our joint future.

The stakeholder workshop was convened as a means to stimulate an inclusive, interactive and fruitful dialogue about our future sustainability challenges and how best to tackle them, to explore strategies for refocusing our industry and to define what a future success in 2030 might mean

for Beckers. During two days of intensive discussions, we were able to raise the bar and create an up-to-date understanding of sustainability with the help of all participants.

Roadmap for the future

Together, we envisaged ourselves in 2030, trying to anticipate Beckers' likely role and possible achievements. We drafted visionary ambitions for our company and sketched a roadmap for the breakthrough decade. The outcomes from the workshop will be used to develop not only our plan for the next decade, but also a clear strategy defining the actions needed and milestones to be passed if we are to make the deadline. This will only prove possible with the added expertise and insights of our key stakeholders. We must jointly embrace diverse perspectives and develop even deeper engagement to achieve sustainability. This workshop will naturally also form a basis for our future efforts in furthering collaboration throughout the value chain.

These two days together proved extremely valuable to Beckers. This unique opportu-

nity to gather so many different external stakeholders around the same table at the same time, freely expressing their opinions and sharing their valuable insights with true engagement, great enthusiasm and boundless energy, was profoundly inspiring. With such support, we feel truly empowered to paint a brighter future of sustainable growth. ■

**Färgfabriken (The Paint Factory), located in Stockholm, is the iconic building that originally housed Beckers' paint manufacturing operations in the early 20th century. Owned by Lindégruppen, the building now provides an elegant venue for numerous art exhibitions – and the perfect setting for Beckers' recent Stakeholder Workshop.*

The tides of change

Dr. Paul DAVIES

A pioneer of innovative technologies for the coil coating industry, Beckers is focused on improving the technical performance and visual appeal of coil coatings, while observing strict compliance with the current and future legislative requirements imposed on the global industry. Since the report in last year's Beckers Magazine on the progress of waterborne (WB) coatings worldwide, the Asian market has seen some significant developments. The following hopes to provide an update on the current status of and prospects for waterborne technology.

The initial impetus behind the market introduction of waterborne coatings came from Sweden more than 40 years ago, catalysed mainly by environmental considerations. At the time, due to difficulties concerning product performance and engineering constraints, this innovative product failed to gain industry acceptance. In the current global climate, however, where environmental concerns top the industrial agenda, regions such as China and New Zealand find themselves at the bleeding edge of radical and fast-changing environmental demands. These demands are directing market priorities from traditional solventborne (SB) coatings to waterborne (WB) systems.

On a waterborne high

When we examine technologies from sister coating industries, we find repeating patterns¹. The largest segments for coating are home applications and wood finishing. Naturally, coating systems and processes are dissimilar. The wood finishing sector has focused on waterborne coatings for many years, often using UV and EB curing technologies, while the switch for home applications has occurred within the last 20 years, the priority being air quality and safety in the home, as well as the need to reduce fugitive emissions of solvents outdoors. The automotive sector is perhaps closest related to the coil coatings sector in terms of products, substrates and processes. Around 75% of global automotive manufacturers

have switched to waterborne coatings, with the remainder of users expected to swap inside 10 years. This involves a switch in engineering technology from RTO (Regenerative Thermal Oxidizers) used to incinerate solvents and return the energy, to water capture and recycling systems.

Focus on air quality

With solventborne coil coatings, in-process solvent emissions can be recycled as a supplementary fuel source for curing ovens. Waterborne systems, however, due to the non-recovery of solvent energy, consume as much as 20%² more energy in the curing process. This has long been cited as a key argument against changing from solvent to water. It is also worth noting that the current choice of raw materials for coil coatings means that solventborne paint offers better performance. However, Chinese legislation is undergoing a transformation³. The authorities are less concerned with process details and more interested in total solvent usage.

In particular, air quality in industrial areas and zones, and their immediate environments is now subject to intense scrutiny. The Chinese Government will have no hesitation in instantly closing any industrial sites (including those used for production of paints) found to be contravening this new legislation. Furthermore,

it is possible such areas may be re-zoned (constraining the acceptable commercial options) or that current zone controls might be tightened as urban residential areas spread beyond the periphery.

Urban growth and its subsequent encroachment on industrial zones has also focused local authorities' minds on air quality in many other countries too.

Two steps closer to a cleaner world

To address these challenges, Beckers China is adopting a two-step approach. We are currently working on systematically reducing the Volatile Organic Compound (VOC) content of all our paints by developing new resin systems and are also in the process of launching innovative new waterborne systems, aimed directly at tackling the perceived solvent issues. Progress has been steady. We have developed new low-VOC products, reducing the VOC demand by some 15%, directly benefiting our production site and customers. This has been achieved without compromising product performance or costs. At the same time, close collaboration between our Malaysia Centre of Excellence laboratory and China development team has enabled us to fine-tune our waterborne product. ►

Paint characteristics	Solventborne	Waterborne
Performance	High	Acceptable
Coated cost	Low	Decreasing as market grows
VOC level	Decreasing but always present	Virtually zero
Solids content/coverage	High	Generally lower
Sustainability	Moderate (energy recuperation)	High
Line compatibility	High	Care regarding water recovery

Characteristics of solventborne paints v. waterborne paints

We are currently discussing market needs with key customers and are ready to act as soon as a rise in customer demand or change in local legislation dictates.

Closing the benefit gap

The previous table illustrates the extent of the gap between these two key forms of coating. It has long been accepted that there are genuine differences in terms of technology and sustainability. However, within just the last year, this gap has been closing and any perceived disparity in technical performance has now been nullified by the clearly defined and well understood benefits deriving from greater sustainability.

In the 2018 review, the challenges involved in switching to the new technology were clearly defined. However, the debate about the relative efficacy of these rival technologies is still focused on just two key issues: energy consumption and sustainability. In terms of energy, the challenges for waterborne coatings are maintaining a suitable curing temperature and higher energy requirements (due to a lack of energy recovery).

As for sustainability, the issue of rogue solvent emissions during paint production and the coating process with solventborne paints must be balanced against the benefits of waterborne coatings, concerning waste recovery and recycling processes.

Performance and price certainly affect the choice, but beyond this constraint, the debate is fundamentally about the relative benefits of lower energy consumption against long-term sustainability. As already noted, this is increasingly subject to local considerations and the policies adopted by local authorities.

The tides of change

Given the steady improvements in technology, the increasing demands on environmental acceptability, particularly from local governments and the switch of sister technologies to waterborne systems, the arguments for continuing with solventborne systems are becoming weaker all the time, as they have been in sister coatings technologies. There are clear expectations that the market will migrate towards waterborne technologies and we are seeing signs of this already in the forms of greater public pressure and direct government legislation. Beckers is poised to spearhead this change towards greater sustainability with its Beckry®Aqua range of waterborne coil coatings. ■

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Top rating in innovation survey

Catherine VINCENT

Innovation – in services as well as products – is crucial to success in any business. This is especially true of the industrial coatings sector, where aesthetic as well as technical and functional innovation is a key market requirement.

In 2018, to determine how customers rate the company's innovative talents, Beckers launched a comprehensive international opinion survey that sought feedback from our coil coatings customers across the globe.

To ensure strict impartiality, both in the way questionnaires were formulated and how phoned interviews were structured, the survey was designed and conducted by an independent market research specialist. We naturally hoped for plenty of positive feedback, but also sought creative criticism and suggestions as to how and what we needed to improve.

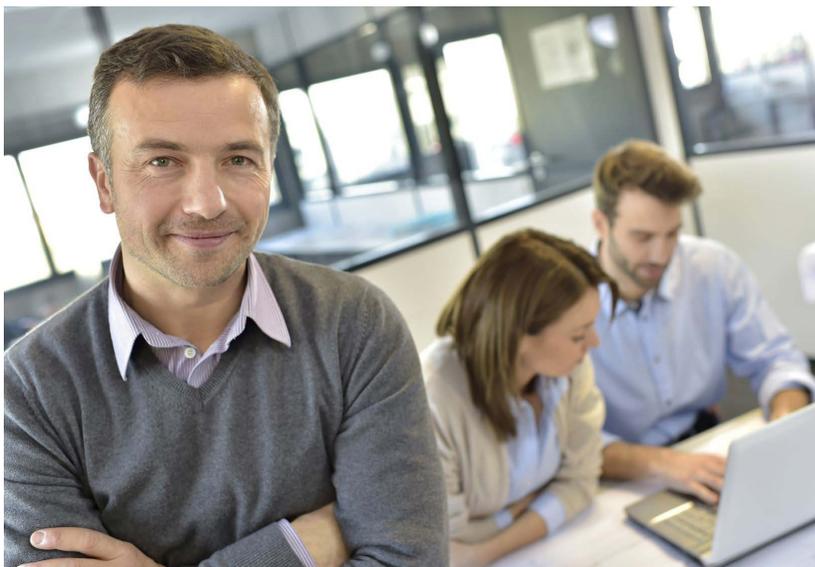
First, we contacted key partners via an online questionnaire. Those who agreed to go beyond this initial questionnaire were subsequently contacted by phone, involving in-depth interviews to provide a more

detailed understanding of their needs and concerns. We would like to share some of the key information elicited by this survey:

1. Beckers' rating

Coil coatings represent a highly specific, concentrated and mature market. A technically critical component of the sheet metal process, as well as of key aesthetic and life-cycle importance to the end product, each coated coil is itself a complex and technically advanced product. The quality and functionality of a coating adds significant value to the end product.

Operating on a fiercely competitive market, Beckers enjoys a very favourable corporate image, with 93% of customers awarding it an 'excellent' rating. Overall, ►



- ▶ 81% of respondents were satisfied with Beckers, considering it a leading company in the sector. Today, only a few key suppliers develop and distribute these highly specialized products around the world. In Europe, the market is increasingly consolidated.

According to coil coaters, the market is fairly static and innovation is hard to quantify, being largely incremental: specific innovative inputs are not that obvious. Furthermore, innovation in this industry is somewhat constrained by certain factors. These include:

Volume requirements

Quantity requires stability. Processing large volumes on complex production lines demands extended

set-up procedures and stable long-term production. This can lead to a degree of inertia, constraining innovation.

Cost concerns

Although quality is critical, the market is subject to fierce price competition which, due to cost considerations, can adversely affect investment in innovation. Despite these market constraints, Beckers has managed to maintain its enviable reputation in the coil coatings sector, with 84% of respondents rating it as a leading innovator. Moreover, 62% of customers consider our rate of innovation has increased and is evolving faster than that of our competitors.

2. Leading innovation

The survey confirms that Beckers' coil coatings product range maintains a high degree of innovation (*Table 1*).

Solar-reflectant topcoats, high-solids coatings, bio-sourced materials and energy-saving coating systems also enjoy high ratings.

Sheet coaters necessarily adopt a product-driven approach when purchasing materials from sub-suppliers, focusing on quality, cost and support. Innovation naturally forms a key element of the quality equation.

The ability to tailor the product to end-customers' needs is also a key driver of innovation, enabling the

Table 1

Products and/or performances	Perceived innovation (% of respondents)
Textured coatings	74%
Mechanical properties	72%
Durability	70%
Corrosion resistance	69%
Chromate-free primers	69%
High build coatings	63%

complex forming of coated coil and the provision of technically challenging aesthetic effects.

3. Sustainability and support

Generally speaking, innovation and sustainability are perceived as being closely interrelated. These days, coil coating is considered the more environmentally friendly alternative to other painting methods, such as post-painting. Sustainability certainly remains an important priority for coil coatings stakeholders, but is not currently a primary concern (Table 2).

The business relationship and support services are what make the difference: customers appreciate working closely with suppliers. In this particular

respect, Beckers has developed a strong, positive and industry-leading relationship with its customers (Table 3).

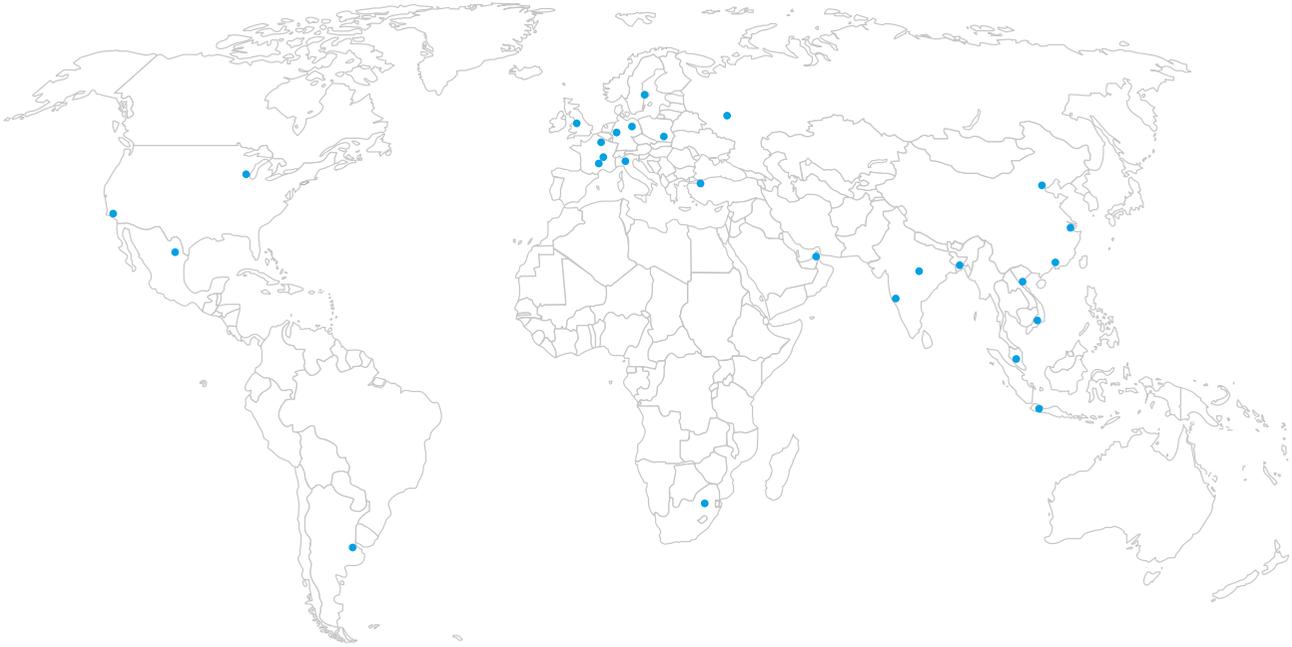
Even so, we're not perfect! There are still areas for improvement, of course, such as in communication and marketing. The Beckers team will be focusing on these areas too – but innovation rules! ■

Table 2

Product ranges	Perceived sustainability (% of respondents aware of the product range)
Beckry®Low-e (low-emissivity system)	100%
Beckry®Therm (thermo-control topcoats)	94%
Beckry®Mix (smart production solution)	87%
Beckry®Prim (chromate-free primers)	83%

Table 3

Description	% of agreement
I have a trust-based relationship with my contacts	88%
I have developed a strong and lasting relationship with my contact	88%
My contact adapts him/herself to my needs	86%
I would describe my relationship with Beckers more as a partnership	85%
I feel appreciated as a customer, Beckers understands my company's needs	81%



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Dear Readers!

2019 was – actually still is as I am writing this – an exciting year. We have experienced many new developments, making it yet again difficult to provide a truly representative selection of the many great innovations achieved during the year. As a previous recipient of Beckers Magazine, you will recognize some familiar patterns, such as Beckers' focus on sustainability or innovative development in a rather conservative market. Innovation is crucial in fulfilling customers' expectations about the key properties of our coatings, such as durability, and our research departments strive constantly to improve the excellent performance of existing technologies by developing new systems that offer still better performance.

What may perhaps be surprising to many of you is the growing degree of innovation coming out of Asia. Not only is Beckers expanding its already broad footprint in Asia (this latest issue features our new plants in Nge An, Vietnam, and in Dhaka, Bangladesh), but we are also developing new technologies in Asia which have worldwide relevance. Asia is also pushing to the forefront in VOC avoidance. China in particular is finally addressing this topic, with an enthusiasm that we have not seen in more mature markets. Reduction or even elimination of VOC emissions during paint production or application is becoming an operating requirement for paint companies as well as their customers. Waterborne coatings are already mainstream in several coatings segments and are now even staging a comeback in the coil coatings segment. Of course, there are no free lunches, and higher energy consumption does affect the CO₂ footprint – for now. But our scientists are working resolutely to resolve this problem too!

We are seeing an increase in functional coatings. Colour and gloss are and will always be primary features, but coatings must satisfy many other requirements. As I have already mentioned, durability is a key quality. The durability of robust, well-proven



coatings, able to withstand the impact of weather and particularly sunlight over many years, must be considered as added functionality. But end-users also want the colour to remain unspoiled by atmospheric dirt, making self-cleaning coatings a highly popular functional development. Self-stratifying systems provide a further example of less visible but extremely valuable functional properties. Here, the functionality is demonstrated during the manufacturing process, where two coating steps are combined into one. The examples presented this year are currently based on binder systems that are non-standard in the coil coatings industry. Nevertheless, they clearly demonstrate the great potential of this technology.

Another trend affecting industries worldwide is digitalization. We have debated the idea of moving this magazine into the digital world or continuing to print it. The magazine in your hand clearly indicates the outcome of these discussions! Even so, I would welcome feedback as to your preferences: printed or digital? I am sure the question will come up again. For now, however, I hope you will enjoy reading this latest issue of Beckers Magazine!

Your COO,
Dr. Karsten Eller



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