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Sustainable product developments
WorléeKyd VP SD 7500
WorléeThix VP S 6550
WorléeKyd VP S 6103

Sustainability
SARA Project
Ecovadis Rating
Unity digging

Bruno Bock
Thiocure in radiation-curing systems

Dear Customers, Partners and Friends,

the year is coming to an end and the Christmas time is right around the corner. With the last issue of 2021 we would like to introduce to you three new product developments in the field of bio-based alkyd resins for sustainable coating systems. The WorléeKyd VP SD 7500, WorléeThix VP S 6550 and WorléeKyd VP S 6103. Our partner Bruno Bock is writing about Thiocure in radiation-curing systems and you get interesting insights in our Chinese market.

Our sustainability report just launched this month and is available on our website. Furthermore, we report about the SARA project und we again planted trees to contribute to the climate protection.

We hope you enjoy reading the 17th issue of the Worlée Journal and we wish you a good start into the new year.

Your sincerely
Joachim Freude,
Managing Director

New bio-based alkyd resins for more sustainable coating systems

The transformation to more sustainable products

The transformation to a more sustainable world will also challenge the coatings and raw materials industry in the coming years. We also want to make our contribution here and are therefore developing more sustainable binders and additives for a wide range of formulations. Improvements can be achieved, for example, in terms of their durability, hazardousness. But the proportion of renewable raw materials can also be increased.

The product group of alkyd resins, in particular, is by definition already produced on the basis of larger proportions of mostly bio-based, renewable raw materials. These are used in high-quality paints and glazes, but also in industrial coatings. Their use extends across all different paint systems, from primers to top coats and clear coats. The wide range of modification options, such as modification with vinyl monomers, silicone resins or even isocyanates, allow the control of a wide range of properties.

Already today, the proportion of renewable raw materials in this product group can be increased significantly, without achieving inferior properties.

A high-quality paint system does not only consist of a binder, but this usually defines the properties of the system. A long oil and solvent-free alkyd resin is often used as the basis. This binder is the largest component and must have good properties, such as broad compatibility with other binders, basically good drying properties, an optimum open time and good outdoor resistance. To optimize the rheological properties, thixotropic alkyd resins are usually used. These products allow the formulation of coating systems with a high thixotropy during storage and a strong shear thinning, i.e. reduction of viscosity when applied by brush and roller, for example. After application, the viscosity increases again to the original value within a certain time. This thixotropic property enables easy application and prevents run-off on vertical surfaces while ensuring good flow. Appropriately modified alkyd resins are suitable for further optimization of a wide range of properties. For example, urethanized alkyd resins are often used, which improve in particular the drying properties, hardness development and also mechanical load-bearing capacity.

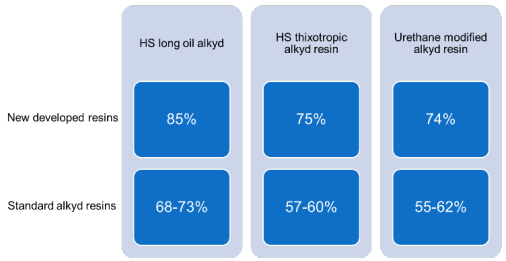

figure 1 – proportion of renewable raw materials

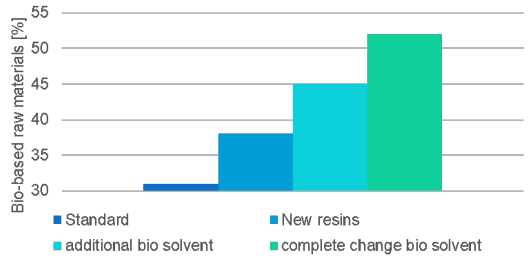

figure 2 – proportion of renewable raw materials on full formulation

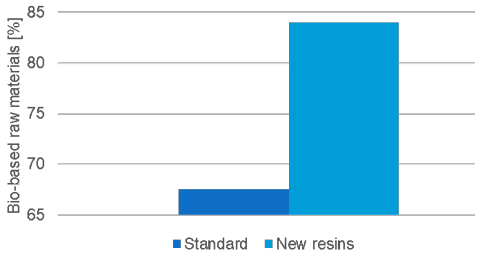

figure 3 – proportion of renewable raw materials on solid resin

New improved products

The alkyd resins mentioned below represent this binder package. Here, the proportions of renewable raw materials were significantly increased, if possible without deteriorating the properties of the coatings produced from them. Figure 1 compares the proportion of renewable raw materials in the respective alkyd resin systems. The content indicates how much renewable raw materials we have used per 100 % solid resin. Compared to conventional products, the newly developed products have a significantly higher proportion of renewable raw materials.

In particular, the adjustments in the area of modified.

Alkyd resins cause a significant increase in the proportions. Long-oil alkyd resins usually also have a higher proportion of renewable raw materials due to their higher proportion of vegetable oils. In order to increase the proportion of renewable raw materials, optimizations were made in large parts of the monomers, i.e. where appropriate in the area of polyfunctional alcohols, carboxylic acids and also other components. Table 1 shows the newly developed products and their partially used modification.

	WorléeKyd VP SD 7500	WorléeThix VP S 6550	WorléeKyd VP S 6103
Delivery form	100 %	70 %	50 %
Modification	-	Polyamid	Urethan
Oil lenght	75 %	65 %	60 %
Renewables on solid resin	85 %	75 %	74 %
Renewables on delivery form	85 %	53 %	36 %

table 1 – product overview new alkyd resin system

According to the desired properties, these can be used in different ratios for the formulation of readily sandable primers, fast-drying painter's top coats (high and silk gloss), permanently elastic wood stains or even high-quality clear coats.

Significant increase in the proportion of renewable raw materials

In addition to the binder, the solvents used can of course also have an influence on the proportion of renewable raw materials in the complete coating formulation. For example, lactates, some alcohols or even fatty acid esters can be used alone or in combination as alternatives to the usual petrochemical solvents.

In the following, we compare high-gloss paints with about 30 % titanium dioxide and a VOC content of less than 300 g/l with each other. Figure 2 shows the influence of the various measures on the proportion of renewable raw materials. A maximum of 70 % can be achieved here, since the system contains 30 % inorganic pigment. Conventional binders are already increasingly being replaced by binders with a higher content of renewable raw materials. This increases the proportion by 7 % to a total of 38 % of renewable raw materials used in the overall formulation. If the part of the solvents is replaced by renewable products, which are added to the formulation of the coating, the total content can be increased to 45 %. Our binders, which are still partially dissolved in solvents, can also be produced in principle in bio-solvents.

This procedure would increase the proportion of renewable raw materials to about 52 %. If the pigment portion is included, the total formulation would thus contain less than 18 % petrochemical raw materials. If we consider the organic content in the solid resin and thus also in the subsequently cured paint film [Figure 3], this also contains only about 16 % petrochemical raw materials when the new binders are used, compared to a conventional paint system with about 32 %. These remaining 16 % petrochemical raw materials are currently still needed to make the products more durable, among other things.

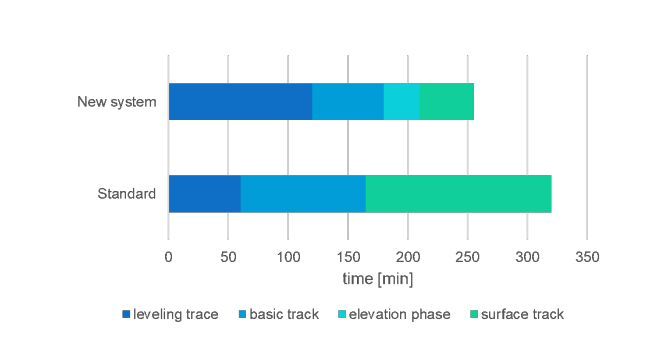

figure 4 – drying properties with drying recorder

...and still good paint properties.

Even with an increasing proportion of renewable raw materials, it must be possible to process the products into high-quality coating systems that exhibit good or perhaps even better properties.

In Figure 4, we have looked at the drying properties of comparable silk gloss coating formulations using the different binder systems. The coating system based on the new alkyd resins exhibits a longer wet phase and thus open time.

However, the total drying time is visibly shorter. Besides the binder, slightly changed solvent compositions in the binders (all flash point > 60°C) and the proportionate use of a bio-solvent certainly play a role here. In the case of silk gloss coating systems based on alkyd resins, the rapid attainment of the desired gloss level plays an important role. Due to the high binder content and the film shrinkage caused by the oxidative drying of the alkyd resins over the corresponding total drying time, these basically show a rather pronounced reduction of gloss over a certain period of time. As can be seen in Figure 5, both coating systems show a very different development of the gloss level, despite the same proportions of matting agents.

The coating system based on the new alkyd resins is much easier to matt in comparison. In an adapted formulation, the proportion of matting agents can certainly be significantly reduced. This reduced use would also enable further advantages, for example in terms of flow properties.

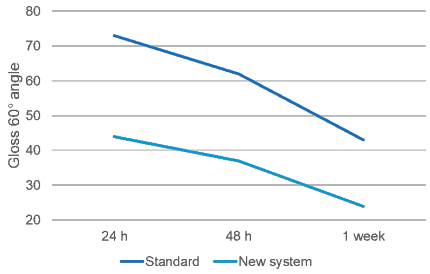

figure 5 – Formation of the gloss level over time

Outlook

We will be happy to provide you with additional information, such as guide formulations, upon request. Feel free to take a look at our improved products, check them out and give us your feedback. We are very pleased!

Together we can lead the way to more sustainable products. Our different departments in the area of research & development and application technology work on new and innovative raw materials every day. Please feel free to contact us about this as well.

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BRUNO BOCK THIOCHEMICALS

Thiocure in radiation-curing systems – The basics

Dr. Tom Beyersdorff
Bruno Bock Chemische Fabrik GmbH & Co. KG

$$\text{I-(H}_2\text{C-CHR)}_n\text{-CH}_2\text{-}\dot{\text{C}}\text{HR} + \text{HS-R} \rightarrow \text{I-(H}_2\text{C-CHR)}_n\text{-CH}_2\text{-CH}_2\text{R} + \dot{\text{S}}\text{R}$$

Figure 1 Schematic representation of the chain transfer in radical processes

Initiation:

$$\text{R-SH} + \text{PI} \rightarrow \text{R-S}^{\cdot} + \text{other products}$$
$$\text{R-S}^{\cdot} + \text{H}_2\text{C=CHR}' \rightarrow \text{RSH}_2\text{C-}\dot{\text{C}}\text{HR}'$$

Chain growth:

$$\text{a) RSH}_2\text{C-}\dot{\text{C}}\text{HR}' + \text{H}_2\text{C=CHR}' \rightarrow \text{RS-(H}_2\text{C-CHR}')\text{n-CH}_2\text{-}\dot{\text{C}}\text{HR}'$$
$$\text{b) RSH}_2\text{C-}\dot{\text{C}}\text{HR}' + \text{R-SH} \rightarrow \text{RSH}_2\text{C-CH}_2\text{R}' + \text{R-S}^{\cdot}$$

Figure 2 Schematic representation of polymerisation and chain transfer

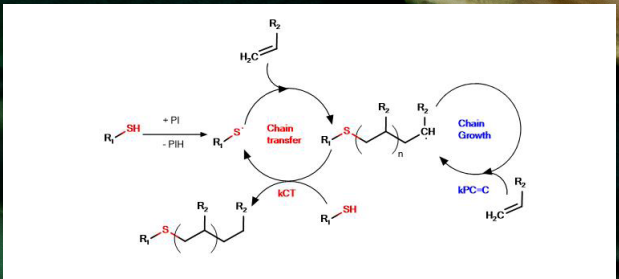

Figure 3: Schematic representation of the thiol-ene reaction

The radiation-initiated curing of unsaturated resins in the presence of polythiols, also referred to as a thiol-ene reaction, offers a few benefits compared to the curing of pure unsaturated resins. These benefits include, for example, a reduced sensitivity to oxygen ("oxygen inhibition") during curing, a lower volume shrinkage and the possibility of very thick layers, as well being able to cure heavily pigmented or highly filled systems. Furthermore, more homogeneous networks are developed, which are less brittle than pure acrylate networks.

In this issue of the Worlée customer journal, the basics of thiol-ene chemistry are presented again briefly. Subsequent issues will then examine the 1K stability of these systems and the benefits and mechanical properties of thio-lene systems.

Introduction to thiol-ene chemistry

The key to understanding thiol-ene chemistry is the concept of chain transfer in radical polymerisation, in which the reactivity of a growing polymer chain is transferred to another molecule, which in the case of thiol-ene chemistry is a sulphur atom (Figure 1).

If a formulation of (meth)acrylates and polythiols is irradiated in the presence of a photoinitiator, radical polymerisation is initiated, analogously to a pure acrylate system. The carbon radicals formed in the initiation step offer two reaction possibilities according to Figure 2. In one, the polymer chain can grow on the radical due to the addition of more monomer units (equation a) or a chain transfer can occur (equation b), whereby a thiyl radical is formed, which is able to initiate a new polymerisation.

Without the addition of polythiol, after initiation only the chain growth process a) occurs, which leads to the rapid formation of long polymer chains or networks, which already gel at low double bond conversion rates.

In the presence of polythiols, after the initiation both the chain growth process a) and the chain transfer b) occur. Due to the combination of these two processes, first smaller fragments are formed, which at a later time come together to form a fully developed network. As a result, the viscosity does not initially increase as much as in the case of a pure acrylate system, which means that the gel point is only reached at higher double bond conversion rates.

The fact that the reactions a) and b) run in parallel but with different rates has significant consequences for the quantity of polythiol used. As can be seen in Figure 3, the chain growth (right) proceeds with the rate constant of polymerisation kPC=C and the chain transfer (left) with the rate constant kCT.

In case of thiol-ene systems with acrylates, the chain growth process takes place considerably faster than the chain transfer. As a result, the monomer homopolymerises considerably faster than it reacts with the polythiol. To ensure in these formulations that all thiol groups are reacted off and integrated in the network, it is necessary to work with sub-stoichiometric quantities of polythiol. Approx. 30 mol% is recommended as the upper limit here. This aspect will be taken up again in one of the future issues of the Worlée customer journal, because the quantity of polythiol used has an influence on the mechanical properties of the cured thiol-ene system.

When using methacrylates in thiol-ene systems, the concentration of polythiol can also be up to 60 mol%, because in these cases chain transmission and chain growth occur at nearly the same rate and therefore the polythiol can react off completely even at higher concentrations.

In the case of ene monomers which do not homopolymerise, in which therefore no chain reaction occurs in the absence of a polythiol, it is possible to formulate with stoichiometric quantities of polythiol. These monomers include allyl or vinyl ethers, triallyl isocyanurate, SB resins or unsaturated polyesters, to name only a few possibilities.

The last case in particular shows that the thiol-ene reaction can be applied very universally to all unsaturated compounds and is not limited to (meth)acrylates.

Apart from all the benefits, the low storage stability of single-component thiol-ene formulations represents a significant disadvantage. The lower storage stability is due to the fact that, in addition to the radiation-induced curing, thermally initiated processes can also take place, which lead to an undesirable increase in viscosity during storage. This topic will be discussed in one of the next issues of the Worlée customer journal.

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Another platinum medal for Worlée-Chemie

We are delighted to have been awarded the platinum medal in the EcoVadis Sustainability Rating again this year, which recognises the achievements of our comprehensive sustainability management! With this, Worlée-Chemie once more finds itself in the top 1 % of companies rated by EcoVadis.

The EcoVadis methodology is based on international standards such as the UN Guiding Principles on Business and Human Rights, the ILO International Labour Organization conventions, ISO 26000, the UN Global Compact and the Global Reporting Initiative. The annual assessments cover seven management indicators, which include 21 sustainability criteria grouped into the areas of Environment, Labour and Human Rights, Ethics and Sustainable Procurement. Companies must provide evidence of internal regulations, measures, actions and key figures. The assessments are adapted to the size of the company, the section and the region.

The EcoVadis ratings are among the most reliable sustainability assessments in the world and are held in high regard in the chemical industry.

In 2021, Worlée-Chemie was able to improve on its overall score once again, taking it to 82 points. Its best ratings were achieved in the area of Environment with 90 points – where our scorecard highlights 38 particular strengths – and Labour and Human Rights with 80 points and 33 particular strengths.

Especially in view of the German Supply Chain Due Diligence Act, which came into force in summer 2021, and the proposed EU Due Diligence Act, it is becoming increasingly important to closely consider the risks and opportunities both within the company and throughout the entire value chain using independent ratings.

Customers and business partners are welcome to request access to our scorecard via the EcoVadis platform or contact our sustainability management team for more information.

The Interreg Deutschland-Danmark SARA project for the implementation of the 17 UN Sustainable Development Goals

In Worlée Journal 14/2021, we reported on the involvement of Worlée-Chemie in the Interreg Deutschland-Danmark SARA project.

SARA stands for Sustainable Development Goals (SDG), Adaptable Indicators and Methods, Regional Development and Active Implementation. The two-year study aims to establish a network to support small and medium-sized enterprises from the Southern Denmark and Schleswig-Holstein region to develop measures for the implementation of the SDGs and manage their businesses more sustainably.

After initial coronavirus-related delays, the project gathered full pace in the early summer and autumn of 2021.

We are in active exchange with companies and experts from the region in order to work together on the implementation of the SDGs.

In the German-Danish webinar 'Best Practices in Sustainability', for instance, we gave a keynote on the topic 'Field report on the implementation of the SDGs in operational practice'. At the Kieler Woche climate event, we also contributed with a report on challenges in sustainability management and our journey to becoming a climate-neutral company. This was followed by fascinating exchange between companies on the issue of how companies can prepare for the German Supply Chain Act, as well as lots of discussion with master's students from Flensburg University of Applied Sciences.

We are currently participating in a two-part workshop on the topic of 'Developing sustainability strategies', which also involves sustainability experts from Flensburg University of Applied Sciences.

The exchange with companies from other industries as well as with students and professors provides us with stimulating inspiration for the further implementation of the 17 UN Sustainable Development Goals in our company and corporate environment.

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#Einheitsbuddeln

‘Unity digging’: fifteen new trees for the climate

In 2019, the state of Schleswig-Holstein established the new tradition of Einheitsbuddeln (‘unity digging’) to mark German Unity Day on 3 October. The states of Brandenburg and Saxony-Anhalt continued the nationwide campaign in 2020 and 2021. This is the third year that enthusiastic colleagues from Worlée-Chemie in Lauenburg are joining in to make their contribution to climate and environmental protection. The idea originally came from the company’s suggestion scheme.

Ten strong Amelanchier trees and five crab apple trees were ordered from a nearby organic tree nursery and planted on the company’s own land along the banks of the Elbe-Lübeck Canal. What was once the ‘Worlée hedgerow’ is therefore slowly becoming the ‘Worlée woods’.

We are committed to planting native and ecologically beneficial trees. The plants also need to be robust and hardy with low care requirements.

To join the crab apple and Amelanchier trees already planted, this year, we decided to plant mainly Amelanchier.

Amelanchier blossom is pollinated by a variety of insects, especially honeybees, bumblebees and hover flies. It also attracts butterflies; the leaves in particular provide a valuable food source for many types of caterpillars. In addition, the Amelanchier is an important bird food plant and provides shelter and nesting opportunities for blackbirds, thrushes and jay, for example.

Last but not least, the Amelanchier bursts into rich blossom in spring, yields edible dark blue berries known as juneberries in late summer and exudes glorious leaf colours in autumn. In other words, short lunchtime walks to the nearby nature reserve will be a treat all year round!

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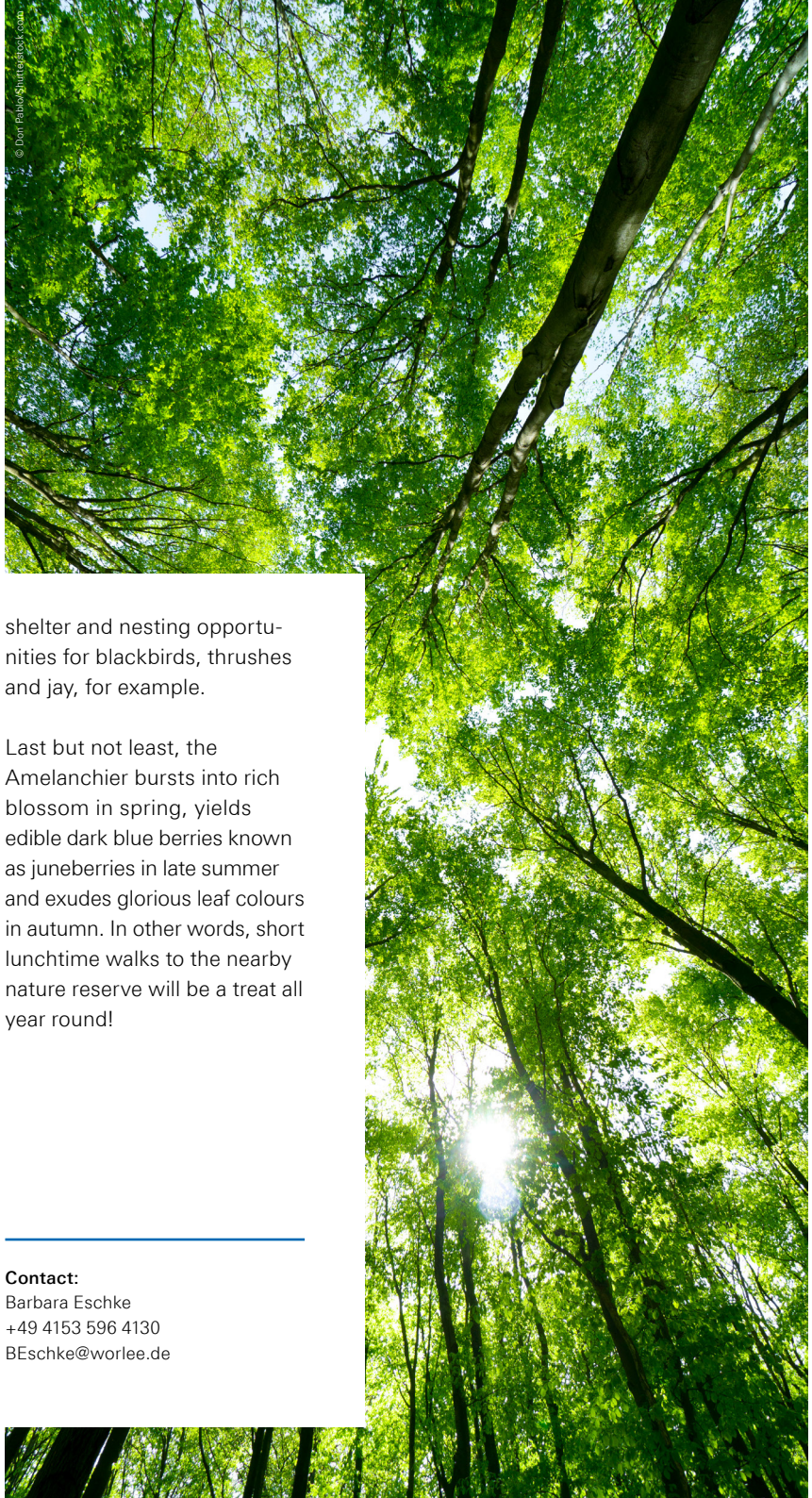


The Sustainability Report 2021 is published

The time has come – the third sustainability report from Worlée-Chemie is published and is covering mainly the years 2019 and 2020. With our reports, we want to paint a holistic picture of our corporate performance based on economic, ecological and social aspects. The report was created in accordance with the GRI Standards Option Kern.

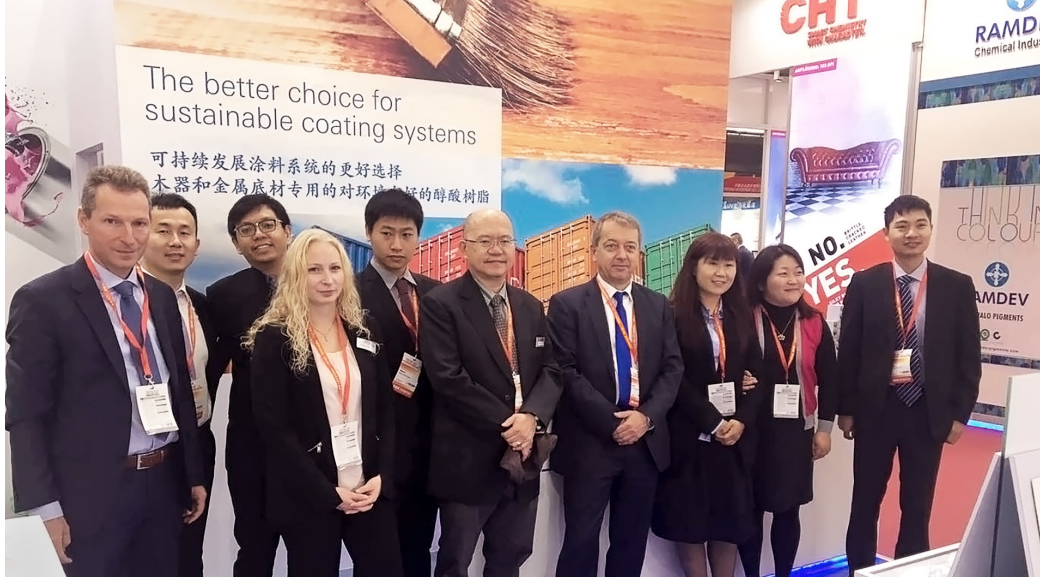
Openly and transparently, we provide insights into our work to date and our future goals. We would like to enter into a dialogue about them, thus making a contribution to a sustainable development in solitude with you.

You can download the Sustainability report on our website.

Greetings from Malaysia!

(Salam dari Malaysia)

In this issue we want to give you insights in our asian-pacific market. Our Sales Director Chee Kim Choy from Worlée Chemie Asia Pacific is answering some interesting questions for you.



China Coat Exhibition 2017 in Shanghai, Chee Kim Choy is 6 from left

1. How long have you been working for Worlée?
I came into Worlée, in June 2002, when Worlée started its Representative Office in Malaysia. At that time, Worlée was well known in the coating industry, for its additives in powder coating and liquid coating.

One of my first technical sales-promotion work was with thixotropic binders, for different application in coatings and other industries, which has been an interesting exploration and development, in China and Asian.

Worlée Chemie Asia Pacific office is based in Malaysia, where I am located, together with two (2) colleagues, Cecilia and Juen Lin. I travel for work with our local business partners, to visit customers in Vietnam, Thailand, Malaysia, Singapore, Indonesia and Philippines.

Worlée Chemie Asia Pacific also provide assistance and support all necessary commercial communication activities for Taiwan, China, S. Korea and Japan.

In years 2006 to 2017, I was travelling much in China to support and consolidate its business activities.

In year 2012, Worlée Chemie Asia Pacific Sdn. Bhd. was officially registered as a private limited company, in Malaysia.

2. Are there any special features for the Asia-Pacific market ?
Asia Pacific region presents an enormous challenge to the coating industry since this is a region where "one size" doesn't fit ALL. Depending on the segment, performance requirements by country differ significantly and also with regards to how the coating is actually applied.

Asia Pacific region is the home for approx. 60% of the total global population (approx. 4.6 billion). China and India account for more than half of this regions total population.

The region represents the single largest growth opportunity for the coatings industry. This trend is expected to continue. Asia Pacific region coating market is estimated to be valued at over $62 billion with an annual growth rate estimated at 12–15 percent.

Major coating producers in Asia Pacific are working on sustainable coatings (coatings that provide energy savings); functional or so called "smart-coatings," which will enhance dirt-resistance; more environment-friendly coatings such as, water-borne and bio-based renewable marerials, that offer reduced-VOC and formaldehyde-free.

The pandemic may have brought some changes in the consumer behaviour for DIY market and the Professional market. Anti-microbial coating and insulation coating are growing interest after the pandemic.

Major threats to the future growth are the rising cost and availability of raw-materials and transportation, making it even more challenging and ever-competitive.

The presence and investment-composition by global coating producers in the Asia Pacific coatings market are making it difficult for "new comers" to enter into the volume-based markets, eg. decorative and architectural-based coatings. As this region grow and become a more intergral part of the global coatings market, the small, country-centric coating companies in these volume-based markets, will most likely lose out. These small coating companies will consider to form alliances with the larger coating producers or maybe become an acquisition target while they still have value in their local markets.

However, local coating companies who create their niche

in selected specialty coatings will continue to thrive, due to their differentiation approach, for value-added applications.

3. What are your tasks in your position?
Engage with customers, for their daily problems, new problems and new projects, via customers visits, and social apps, eg. WhatsApp, WeChat, Line, Viber, Telegram, Zalo.

Guide, support and coach our business partner's sales team members, as a continuous education process of Worlée products.

Provide technical advise and support to customers and business partner's sales team members, in communication with Worlée Shanghai LAB and Worlée Germany Technical Leaders, for updated technical information.

Consistently update sales-kit presentation materials for business partner's sales team members, for their presentation to customers.

Continuous update and understanding of how present customers are using Worlée products and always exploring new USEs, USERs or other applications, for Worlée products. Share ideas, exchange views and discuss commercial and technical matters, with Worlée Shanghai team-members.

Assist and support all Worlée group business activities, based on advise from Worlée Germany.

Observe and report appropriate market intelligence information on market trends, competitor activities, change in customer's buying behaviours and related business activities.

4. What have you done so far or what training have you completed?
In 1988, I completed my Masters of Commerce, in Marketing, at University of Strathclyde, Glasgow-UK.

I started my career in Paint industry with Jotun Paints Malaysia (decorative, marine, powder, protective coatings), in July 1989. With Jotun Paints, I had my technical sales-training at Jotun A/S Sandefjord, Norway and multi-color tinting-machine training at Jotun Denmark.

I joined Syntech SpA, Italy (amino resins, modified-alkyds, oil-free polyesters, unsaturated polyesters, epoxy esters, hydroxyl acrylics, resins for powder) in Sept 1994 and had my technical training at, Novaresine-LAB (Verona). I assisted the start-up of a Representative Office for Asian market in Malaysia. Assist in the start-up of Syntech SpA, China. Syntech SpA was acquired by McWhorter Technologies and McWhorter Technologies was acquired by Eastman Chemicals, who also acquired Ernst Jager, Fabrik Chemischer Rohstoffe GmbH & Co, Syntech SpA, Lawter International USA, Chemicke Zavody Sokolov (Czech Republic), ABCO Industries USA. I was assigned as integration-team member, at Eastman Chemical, during these acquisitions.

In Sept, 1999, I assisted in the JV of Sirca Paints (Italia) Sdn Bhd with Sirca SpA, Italy (wood coatings) and had my technical training at Padova-LAB, Italy.

5. What has been your best experience at Worlée so far?
My best experience is the satisfaction of having great relationships with customers, business partners and fellow colleagues, who share the passion of working together to grow.

Customers who has trust, helped and spend time to use and develop present, new and creative applications, with Worlée present products and new products. Business partners and fellow colleagues, who has good market information, good customers relationship, trustworthy and dedicated commitment, to share ideas, exchange views, working together for the long-term.

The time and the experience shared together throughout the journey or process, to promote a new product, to coach a new sales person, travelling together for customers-visit, lab-training, product seminars, Coating Shows, etc.

These activities and time shared together and working together, to built and to grow as a team brings forth, the meaning of the experience and the efforts.

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