

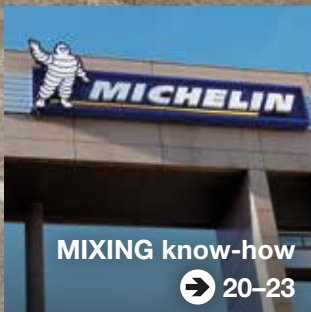


# MIXING TOGETHER

MAGAZINE OF THE HF MIXING GROUP



**MIXING markets**  
➔ 12-13



**MIXING know-how**  
➔ 20-23

**2016**



**MIXING career**  
➔ 36-39

## MIXING story

Smart Factory with networked value chain

➔ 06-11

### MIXING applications The new CONVEX™

Numerous advancements have made the standard machine for base compound mixing lines even better.

➔ 34-35

### MIXING events BANBURY® – 1916 to 2016

One hundred years ago, the invention of Fernley H. Banbury paved the way for internal mixing technology in the industrialised world.

➔ 60-61

# EFFICIENCY



Dr Andreas Limper and Mark Meulbroek.

Dear reader,

Even though it's hard to believe in view of the current geopolitical situation, the human race is actually constantly striving for improvement. Without this unique characteristic of our species, there would be no progress – and, in turn, no fire, no wheel, no plane and no Internet. Efficiency, the focus of this issue, is also an excellent example of our ongoing efforts to create a better world for us all. Although originally a necessity, parented by high prices for energy and resources, companies now optimise all segments of the value creation chain in the name of efficiency.

That the drive to make things more efficient is by no means always self-engendered, but sometimes comes from elsewhere, is clearly illustrated in our lead article. We asked prominent automobile manufacturers what efficiency means to them and how they implement it in their concerns and processes. New competitors and players from outside the industry are an instrumental driving force behind their efforts.

Even we do not bear sole responsibility for the efforts we make in our pursuit of efficiency. That this does not apply to our products – aggregates which are constantly renewed and revised by our engineers with the ultimate aim of creating an exceptionally efficient mixer portfolio – can be seen on page 16 and the following pages. Nevertheless, our efficiency and quality management programmes were hustled along to a great extent as the result of an audit request from Michelin, one of our customers (p. 25). Speaking of Michelin: the world's second-largest tyre manufacturer is following the recommendations of a man-

agement consulting firm and is changing its procurement policy with a view to increased ordering of turnkey products from their suppliers. Their business relationship with the HF MIXING GROUP has since been changed to adapt to the new situation. Readers can find out more about the background and the effects of this change in the article beginning on page 20.

As always, this issue also takes a look behind the scenes at the HF MIXING GROUP. This time around, we let our readers take a closer look at our employer branding strategy, which will be playing a significant role in preparing us for the onset of demographic change (p. 36). We would also like to show you what's so special about the HF Rubber Machinery facility in Topeka, Kansas, and give you the opportunity to get to know a few of our colleagues (p. 46/47). Thanks to them, and everyone else who contributes their expertise to the success of our company, we are ideally positioned for whatever the future may bring. Who knows: even the current geopolitical conflicts may ultimately bring about a change for the better. It would certainly be a wonderful thing for us all.

We hope you enjoy browsing through this issue.

Dr Andreas Limper

Mark Meulbroek

Managing Directors of the HF MIXING GROUP

# CONTENTS

<b>MIXING story</b> New technologies changing the automobile industry	➔ 04–11
<b>MIXING markets</b> Efficiency at Continental and in the rubber processing industry	➔ 12–15
<b>MIXING solution</b> The energetically ideal mixer line	➔ 16–19
<b>MIXING know-how</b> Michelin realigns its relationship with OEM suppliers	➔ 20–23
<b>MIXING responsibility</b> Certified more efficient	➔ 24–27
<b>MIXING continuous</b> Efficiency in plastics compounding	➔ 28–33
<b>MIXING applications</b> The new CONVEX™	➔ 34–35
<b>MIXING career</b> The HF employer brand	➔ 36–39
<b>MIXING innovations</b> Development of the most efficient mixing process	➔ 40–43
<b>MIXING locations</b> HF Rubber Machinery, Topeka, USA	➔ 44–45
<b>MIXING people</b> The people behind HF MIXING GROUP	➔ 46–47
<b>MIXING news</b>	➔ 48–53
<b>MIXING culture</b> Sponsoring as part of location safeguarding	➔ 54–55
<b>MIXING 'on tour'</b> Presenting competence the world over	➔ 56–59
<b>MIXING events</b>	➔ 60–65



# New technologies changing the automotive industry

Through alternative drive concepts and the digitalisation of the value chain, new players are stepping into the limelight.

An upside-down world. When the emissions scandal erupted in the media late last September, theoretically Apple Inc. could have simply bought up the premium German automakers. Volkswagen, BMW and Daimler in the hands of the world's most valuable brand? It's a scenario that is certainly no longer beyond the realm of possibility. Previously only a small minority of experts could imagine it. But now one thing is clear: the winds of digital change are blowing through the once impenetrable bastion of the automakers. A glance at the figures illustrates the power struggle: Apple, the manufacturer of computers, smartphones and entertainment electron-

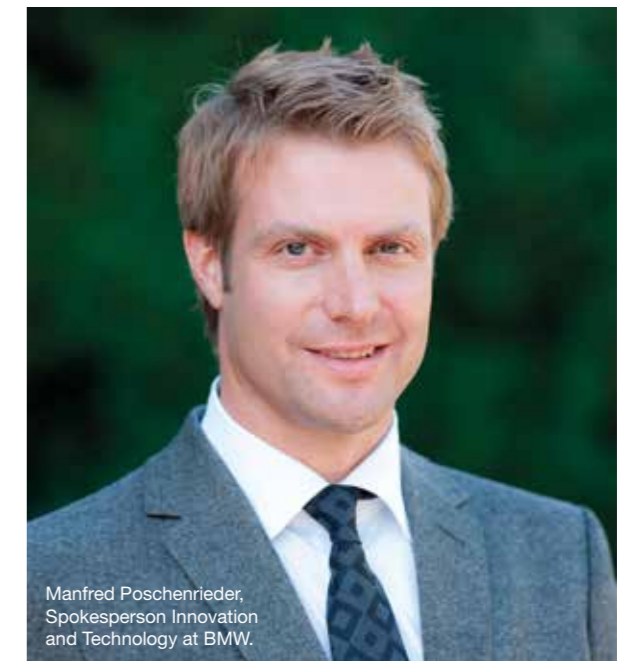
ics as well as various software products and applications, was valued at 582 billion euros on the stock exchange in the autumn of 2015. According to its own information, the company had cash reserves totalling nearly 180 billion euros. At the same point in time, Volkswagen was worth a little less than 58 billion euros on the stock exchange. BMW and Daimler – unaffected by the emissions mess as far as we know today – were listed at 48 billion euros (BMW) and 71 billion euros (Daimler). Incredible, but true: if it had wanted to buy up the pearls of German industry, Apple could have paid the necessary 177 billion euros in cash.

So much for theory. In practice, things look very different. The VW Law as well as the shares of the Porsche and Piëch families protect the Wolfsburg-based corporation. BMW is in the care of the Quandt and Klatten families, while Daimler's stock is widely dispersed. The only large shares are held by the Emirate of Kuwait and the Renault/Nissan Group. That's why the threat is coming from a completely different direction, because the American giant's possible entry into the mobility business is nonetheless real. Against the background of alternative drive concepts and the growing significance of the Internet and entertainment electronics on board vehicles as well as digital value creation chains, Apple's commitment would constitute a perfectly logical step. "Automotive progress today is determined above all by modern software." Sebastian Thrun, former professor of artificial intelligence at Stanford University (USA) and vice-president of Google, revealed this to Manager Magazin back in 2014. The company's entry into the mobility business is not official, however: in keeping with company tradition, Apple has made no official statement regarding any planned entry into the automobile business. Rumours of an "iCar" abound – bolstered by a whole series of telling clues. For quite some time now, for example, the Californians have been carrying out a massive expansion of their development department. According to the Wall Street Journal, Apple's automotive plans are being drawn up in a secret department dubbed "Project Titan" with a current staff of 600 employees. That number is reportedly projected to rise to as many as 1,800 employees. Production is predicted to begin in 2020. The long-term goal, according to the rumours, is to develop a self-driving car. According to those same rumours, an Apple iCar would initially be powered by conventional means.

## Efficient and eco-friendly drive technologies

Google is another Internet giant that is developing a self-driving car. Controlled by a computer, the prototypes have travelled some 1.6 million kilometres. Total number of accidents: 12. According to Google, none of them were their fault. In the race to achieve efficient mobility, however, a completely different player leads the field at the moment. At Tesla Motors, Inc. the South African-born Elon Musk is producing electrically powered serial-production sports cars. For its zero-emission vehicles with a range of more than 400 kilometres, Tesla was named the world's most innovative company by the American business magazine Forbes in 2015. All of Musk's business experience has been channelled into the project. The entrepreneur, investor and inventor was known to the general public as an Internet services provider, especially with the payment service PayPal, and the establishment of the solar power company SolarCity. Tesla's decisions, some of which met with consternation in the classic automotive industry, must also be con-

sidered against that background. With his roots in the new economy, Musk recently released his patents, in order to force the free development of electric vehicles. Utterly foolish, as far as the industry is concerned. For a long time, Musk was ridiculed for having done it, and few took him very seriously. The Model S, a four-door luxury saloon with up to 422 hp (310 kW), would not have made it off the production line without Daimler know-how to overcome some of the major difficulties. The Stuttgart-based automaker received a 9% share of Tesla (later reduced to 4%), and in exchange Professor Thomas Weber, member of Daimler's Board of Management responsible for R&D, sent former McKinsey consultant Jérôme Guillen and a handful of other employees to Tesla, in order to help them get the electric motor drive technology off to a successful start in serial production. Despite all the prophecies of doom, actions like these have enabled Musk to sail clear of the rocks in his path.



Manfred Poschenrieder, Spokesperson Innovation and Technology at BMW.

Meanwhile the assistance is no longer needed and Daimler has long since relinquished its holdings in Tesla. The visible result of Daimler's California commitment is an electrified B-Class, the electric drive components of which still originate from Tesla. For Daimler, however, their compact car is only an intermediate step along the path to establishing a more efficient and also eco-friendly drive technology. At the competitor BMW, the new eco-friendly era is likewise in high gear. "Individual mobility and its industrialisation are experiencing radical technological change", observes Manfred Poschenrieder, Spokesperson Innovation and Technology for the Bavarian automaker. BMW assumes that the automobile and its associated technologies will undergo more changes over the course of the next ten years than they did during the previous 50 years.

# Smart Factory with networked value chain

While automobile producers vie for the best drive solution of the future, the concerns are transforming from manufacturers into mobility service providers.

The future has already begun: along with battery-powered electric vehicles, hydrogen engines are vying to become the best drive solution of the future. While the transition phase is marked by hybrid cars, advanced digitalisation is transforming automakers into mobility service providers.

With the development of the urban mobility concept BMW i for sustainable and future-oriented mobility as well as the eDrive architecture and the new EfficientDynamics engine family, the Bavarian manufacturer feels perfectly equipped to meet the challenges of the future. Among all of the German manufacturers, BMW has positioned itself most clearly in terms of electrification, even having launched its own product line. The BMW i3 is currently the only pure electric vehicle. At its side is the i8 model. As a plug-in hybrid, the sports car combines an electric motor with an internal combustion engine. In parallel to this, for the drive of the future, Bayerische Motoren

Werke is placing its bets on a promising collaboration. "Together with our partner Toyota, we are well on our way to developing hydrogen fuel cell technology for implementation in series production by 2020", says Marcus Bollig, Head of EfficientDynamics at BMW, clearly indicating the line of approach.

Daimler AG is also charting a course similar to the one BMW has set. For more than 20 years now, the company has been investing in research into the fuel-cell-driven electric car. That commitment has yet to lead to a series production vehicle, however. Instead the Tesla holding cleared the way for two series production cars. Although the electric Smart is no longer marketed, the electric variant of the Mercedes B-Class is still available. Daimler also offers two natural gas vehicles, six electric hybrids and three plug-in hybrids.



In the race to achieve a breakthrough in new environmentally sound drive technologies, Porsche is another strong competitor. In keeping with the company motto "Where the future has a long tradition", Matthias Müller, current CEO of Volkswagen and former head of Porsche, considers high-tech racing as a development tool. "There really are enough examples of innovations which have made it from the racetrack to series production. The most recent one is the plug-in hybrid", says Müller, referring to the Zuffenhausen-based sports car manufacturer's commitment to the World Endurance Championship (WEC). In its second year, Porsche "cleaned up" with the 919 Hybrid, not only at the FIA World Endurance Championship, but also at the venerable 24 Hours of Le Mans. Müller adds: "The WEC, with its largely open hybrid regulations and long endurance race distances, is an ideal development field for future drives". Porsche is convinced about the bridge technology, which "might prove to be even more than that over the long term". In December 2015, Porsche also gave the green light for the series production of the Mission E. With 600 hp system horsepower, acceleration from 0 to 100 km/h in 3.5 seconds and a range of more than 500 kilometres, Porsche wants to challenge the electric

giant Tesla. Part of the development work is a rapid charging system based on an 800-volt charging unit. Plans call for charging 80% of the range in just 15 minutes.

## More technologies alongside one another in future

Ford is offering its customers an electric Focus and a hybrid Mondeo. Opel interprets the increased efficiency of its vehicles more in the here and now. The Rüsselsheim-based company has added efficient, small cars like the Adam and the Karl to its range. Opel does not market any electric vehicles. The production of the plug-in hybrid Ampera is being phased out. Instead, most models are offered with liquefied petroleum gas (LPG) engines. Volkswagen offers the widest range of models: with its e-up and e-Golf models, the Wolfsburg-based group has two battery-powered electric cars. Those electrics are flanked by three plug-in hybrids on the Golf and Passat platforms. With the Audi A3 e-tron, the sister company offers a plug-in hybrid model that is technically identical to the Golf GTE in most respects.



It still remains to be seen which drive concept will prevail. At BMW, strategists assume that along with classic internal-combustion-engine-powered vehicles, small- to medium-sized battery-powered electric vehicles and so-called plug-in hybrids will be needed in the medium term. The problem of how to achieve longer ranges for travel and long-distance driving could be solved by hydrogen-fuel-cell-powered electric vehicles. "But no near-term solution is expected", reports Manfred Poschenrieder, Spokesperson Innovation and Technology at BMW. The break-even point for hydrogen fuel cell-powered vehicles will be reached when the technology achieves ranges of 300 to 400 kilometres. Then the fuel cells will have a chance to become less expensive than battery-powered electric vehicles.

**Intelligent production processes and effective energy management**

Operating different drive technologies alongside one another is the sort of change in conditions that does not leave production processes unaffected. With their model series 3 and 8, for example, BMW has already turned completely away from the use of conventional materials for body construction. The chassis is made of aluminium (drive module), and the passenger compartment (life module) is made of carbon-fibre-reinforced plastic (CFRP). Together with optimised parts logistics, a new family of internal combustion engines is enabling efficient production conditions for manufacturing classically powered cars through the assembly of three-, four- and six-cylinder engines on a single production line.

All plug-in hybrid manufacturers are looking for the most efficient operating strategy in order to achieve the ideal combination of internal combustion engine and e-motor. Daimler adapts the energy management system in the new Mercedes S 500 plug-in hybrid not only to the charge level of the battery, but also to the traffic and the route. Drivers can also take control of the situation for themselves if they so wish. A haptic accelerator pedal gives the driver feedback about the shift point of the internal combustion engine and signals with a double tap when they should take their foot off the accelerator for recuperation. BMW is taking a similar approach. They share an overarching objective: to combine the two types of drives in the most efficient way possible and to minimise fuel consumption. That's why the BMW 3 eDrive favours electric operation in urban traffic and other low-speed areas, taking full advantage of the zero-emission drive. At higher speeds and during rapid acceleration, the internal combustion engine kicks in. A so-called 'boost function' makes it possible to superpose the torques delivered by the two drive systems. In

addition, an intelligent energy management system uses the stored energy to provide an electric power-assist while the internal combustion engine is running. Depending on the driving situation and the charge level of the high-voltage battery, this function takes some of the load off the internal combustion engine, thereby allowing it to operate in a more efficient load range.



**Change processes in the production area**

Alongside drive train electrification and autonomous driving, it is above all digitalisation that is driving change in the automotive industry today. Mercedes-Benz interprets this to mean the digitalisation of the entire value chain, from design and development to production, and finally to sales and service. Markus Schäfer, Member of the Divisional Board of Mercedes-Benz Cars, Production and



Supply Chain Management, puts it this way: “For us at Daimler, there is no question that the digital revolution will fundamentally change our industry. This applies to the methods by which we develop, plan and produce our vehicles. It applies to the way we make contact with our customers. And not least, it can be experienced through our products themselves.” The potential is huge. Intelligently networking man, machine and industrial processes improves competitiveness by increasing flexibility and reducing costs. At the Sindelfingen plant it is already today extremely rare for two identical examples of the S-Class to leave the production lines. Innovation cycles are also getting shorter and shorter. And the changes continue. All this culminates in the vision of Mercedes-Benz that automobile production will change from large-scale to “one-off” production. Then every car will be built entirely to individual customer requirements.

According to that vision, the working world of the future will be characterised by human-robot cooperation (HRC). Humans will maintain control, in order to combine the cognitive superiority of humans with the power, endurance and reliability of the robots in an optimal way. At the same time, this will lead to higher quality, increased productivity and new possibilities for ergonomic and age-conformant work. The path forward to the Smart Factory with a completely networked value chain seems clear. Products, machines and the entire environment will then be networked with each other. Elements of this strategy include the efficient use of resources such as energy, buildings or material stocks as a decisive competitive factor. Completely digital process chains here also enable continuous inventory control, because components can be identified anywhere and at any time. Production facilities can be controlled from anywhere. Today the automaker is already able to digitally simulate the production process from the press plant to final assembly, and to master the complexity of modern automobiles and their manufacture. In the assembly of Mercedes-Benz vehicles, some 4,000 individual processes are examined for technical feasibility long before series production commences.

### Suppliers must drive the digitalisation process

Change processes set in motion by the digital revolution concern not only production, but also the entire corporations. Automakers are becoming networked mobility services providers, and the employees also have to be on board. Michael Brecht, Chairman of the General Works Council of Daimler, says: “Technical changes are coming. To shape these properly, we need a new humanisation policy. The decisive factor is how to design



the relationship between autonomy and control in the man-machine interaction. Either: people will tell the machines what to do. Or: people will be told what to do by the machines. The key is to prepare people very well through qualification.” Such change processes do not leave supplier operations unaffected. Already today, automakers expect suppliers to join them along the course they have set. Take Audi, for example: when contacted, Sascha Höpfner, Spokesman Technology and Innovations at Audi, refers to the corporate procurement policy. It states that the goal of Audi AG is to select suppliers who meet the quality requirements of the company in all areas and who help to achieve the brand promise “Vorsprung durch Technik” (“Advancement through technology”). Since 2006, the procurement management of the entire Volkswagen Group has been based on the concept of sustainability in supplier relationships. Before submitting any quotation, suppliers must always declare active compliance with a so-called “Code of Conduct for

Business Partners” Volkswagen Group requirements regarding sustainability in its relationships with business partners. Sustainability requirements also become part of the supplier agreement. Moreover, the Group as a whole requires the implementation of an early warning system to identify and minimise risks along the entire value chain. For verification purposes, a monitoring process documents the development of suppliers.

The Ingolstadt-based company expects its suppliers to take a clear stand and maintain an unequivocal attitude. Like other manufacturers, Audi also requires its suppliers to use an environmental management system, to avoid damage to health and the environment due to production operations, to respect employees’ freedom of association, not to tolerate discrimination and to exclude child and forced labour, as well as to comply with national statutory requirements and minimum standards relating to working hours and remuneration. At the same time, Audi expects

its suppliers who act sustainably in this way to also require their own suppliers to comply with these same standards, thereby establishing uniform and consistent standards along the entire value chain. Since 2014, contracts include, in addition to the previously applicable environmental and social standards, a right to audit and a right to extraordinary termination in the event of violations. Closer attention is being paid to issues such as the fight against corruption, money laundering, import and export controls and unfair competition.

All manufacturers are continuing to develop relevant regulations. With the full digitalisation of the entire value chain, agreements concerning Corporate Social Responsibility will have to be supplemented by other comprehensive regulations.

# Efficient, resource-conserving processes and zero emissions

Interview with Dr Jörg Nohl, Vice President Engineering Tires in the Tire Division of Continental

## Dr Nohl, how much importance does Continental place on efficiency?

That's an easy question to answer: a great deal. Efficiency is actually inscribed very high on our list of company principles and is reflected in our products and processes. The topic is a multifaceted one, of course. Along with the optimisation of our production and business processes, it also involves reducing the consumption of energy, water, raw materials and operating supplies, the minimisation of environmental pollution, and the optimised use of resources.

Continental already established a group-wide environmental management system more than 20 years ago. All phases of value creation and the complete life cycle of Continental products are taken into account with respect to environmental considerations and with regard to clear

objectives. Our environmental responsibility extends from R&D and sales, to the raw materials, logistics and production methods used, all the way to the use and recycling of our products.

One of our primary goals, of course, is growth. And one important prerequisite for growth is that we provide proof of the technologically leading position of our products. In that context, we are very pleased that our products performed very well in the applicable summer and winter tyre tests once again this year. But there is only a limited supply of raw material resources, so we have to decouple growth from the resulting higher raw material consumption. For that reason, our development and production processes are aligned to the efficient use of resources in order to minimise waste.

## How does that work exactly?

Through research into new ingredients and the development of new raw materials, for example. That's how we developed a tyre that no longer uses rubber as its essential component, but Russian dandelion extract instead. It very closely approximates natural rubber. Unlike the rubber tree, however, this plant can be cultivated in large parts of the world. Moreover, it reaches maturity within a few months after it has been sown, so it can be harvested three times per year.

Continental also helps to reduce the CO<sub>2</sub> emissions from motor vehicles, of course. In that context, we are working on harder compounds for various components and tyre constructions, which make it possible to reduce the rolling resistance of the tyre. That applies both for UUHP (ultra-ultra-high-performance) tyres and for smaller tyres in the electromobility segment.

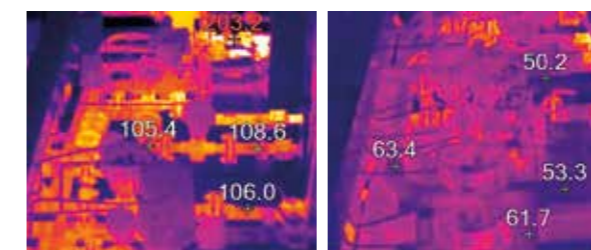
In general, the trend is towards lighter tyres which therefore also conserve less natural resources.

## What methods have you incorporated into your production operations for conserving resources?

For one thing, we are trying to reduce our waste even further. Where scrap cannot be avoided, we recondition the components and feed them back into the process. In the case of composite materials, such as rubberised steel cord, this is easier said than done. Continental developed the so-called "hurricane machine" for this purpose. It recycles the uncured steel cord scraps by separating the tyre compound from the steel cord. At the end of the process, there are two products: rubber granulate, which, after additional treatment, is added to new tyre compounds, and steel wool, which we return to the steel industry.

The retreading of truck tyres has already been standard practice for years now. Here we use the ground rubber as raw material. A recycling process is used to break down that vulcanised material, so that we can ultimately feed it back into the manufacturing process as raw material. In addition, at Continental we are working together with a number of different research institutions, universities and machinery manufacturers in order to develop appropriate recycling processes for all of the materials of a tyre. The goal is to be able to completely recycle the worn tyre.

We are also conserving resources through a group-wide energy campaign, which we have initiated in order to reduce energy consumption in the company and to optimise our in-house energy production. The campaign is also aimed at raising the employees' awareness of energy efficiency. When compressed air is escaping from a machine, for example, the employee who is controlling the machine must demand immediate assistance. We are also soliciting ideas for efficient energy production, the use of renewable energy sources and heat recovery. Moreover, we are achieving energy savings through the use of modular motor concepts, better insulation and the shutting off of energy consumers when plants are shut down.



Thermal measurement before and after an insulation of the piping package behind a curing press.

Our vision is zero emissions. We want to eliminate the production of scrap at Continental and generally to halt all further pollution of the air, the water and the environment.

## What expectations do you have of your machinery suppliers with regard to efficiency?

A machine is only efficient if it is highly reliable – in other words, if it malfunctions extremely rarely. We need machinery that does not malfunction, in order to reduce lead time and to provide a reliable production forecast. This is of crucial importance with regard to time to market in particular.

In order to keep downtimes to an absolute minimum, the machines must be equipped with self-diagnostic systems; we also need reliable documentation for preventive maintenance and simpler repair instructions. Nowadays nobody has time to read operating manuals that are hundreds of pages long. For that reason, machinery manufacturers should apply and further develop technologies such as augmented reality and make use of "wearables" such as data glasses for the repair and adjustment of equipment. This makes it possible to identify and eliminate problems faster.

In addition, we expect machines that can meet the demands of the increasingly complex production processes. Following a recipe change, they should be able to readjust their parameters autonomously and resume operation immediately. In the past we had to purchase instrumentation and link it to the machine. And after installation, we also need to be able to start the equipment up faster according to the "plug and run" principle. That means we want machines that run as soon as they are switched on. After all, when I buy a car I can just turn the key and drive away, without first having to install complicated software upgrades.

Of course we also want machinery that consumes as little energy as possible. Manufacturers are already making good progress there. Room for improvement remains, in my opinion, with regard to ergonomics. I mean more than just designing the machines so that the operator maintains a healthy posture at all times, or that the operator can execute all machine functions from a single station. To my way of thinking, ergonomics includes everything that improves the well-being of the employee, and therefore also environmental influences such as the noise level. And the handling of loads – when loading the machines with cassettes or materials, for example – must also be optimised. There is still plenty of room for improvement here.

Thank you for taking the time to speak with us, Dr Nohl.



Dr Jörg Nohl.

# Efficiency in the rubber processing industry

Efficiency is a top issue for nearly all manufacturers. They interpret it differently though.

Efficiency is a multifaceted topic. Duden, Germany's leading dictionary, equates the word with "effectiveness and profitability". According to Wikipedia, it is the "ability to avoid wasting materials, energy, efforts, money, and time in doing something or in producing a desired result" and BusinessDictionary.com defines it as "the comparison of what is actually produced or performed with what can be achieved with the same consumption of resources (money, time, labour, etc.)". HF Mixing Together asked some HF MIXING GROUP customers outside of Germany what efficiency means to them and how efficiently they make their processes and products. The result: nearly all manufacturers in the rubber processing industry have already considered the question – and most of them start-

ed doing so long before yesterday. But just as the definitions of "efficiency" vary from one dictionary to another, so do the companies' interpretations.

## Minimal waste of time and energy

NUVO, a leading South African rubber compounder, defines efficiency in production as the ability to manufacture high-quality mixtures with minimal waste of time and energy. "Our F305 BANBURY® mixer is equipped with the latest HF MIXING GROUP rotor technology, 4-wing NST, which ensures that the mixer delivers optimal performance", explains Dr Donal Ryan, head of engineer-

ing at NUVO. "In combination with our Rubber Process Analyzer (RPA Montech 3000), we conduct detailed analyses for all of our compounds, in order to use the best process regarding an optimisation of the parameters. That analysis always ensures the most energy-efficient process with optimal properties. In addition, the drive technology of the F305 reduces energy consumption by at least 10% as compared to earlier BANBURY® models, which likewise helps to decrease our carbon footprint, of course."

## Simplification of the processing

For NUVO, efficiency is also an important topic with regard to its products. The company aims to produce the best mixtures at all times. "Rather than merely fulfilling our customers' expectations, we always want to exceed them", says Ryan. "That's why product properties and efficiency are of crucial importance to us, and we work continuously to improve our mixtures, in order to optimise their properties for the intended purpose. In this way, we develop new formulations which minimise energy losses in applications such as conveyor belts. Moreover, we optimise the production efficiency of our customers' plants by simplifying processing conditions."

## Consistent employee development and economical machinery

Michelin extends the notion of efficiency even further. Europe's biggest tyre manufacturer considers efficiency in every aspect of the production process: from the suppliers to the raw materials, machinery and manufacturing steps, right through to personnel, everything has been streamlined for maximum efficiency. One of their main goals here is to improve the performance of employees and machinery, and another is to conserve resources. Michelin accomplishes this not only through the use of many lean management methods and continuous employee development in all areas. "For many years now, we have been using a corporation-wide idea management system", says Olivier Damon. "This is a powerful incentive system, through which we receive thousands of ideas every year, including very many for improving efficiency." With regard to the profitability of outsourced machinery, the Head of Worldwide Purchasing at Michelin sees increasing potential. "We expect efficient retooling times from our suppliers. Information about the overall operating costs of the products is similarly important to us. We're perfectly willing to accept higher purchase prices if the operating costs are lower in the long term, thereby making the machinery more efficient. The price differential must add value!"

## Positive interaction of many factors

Comet SRL, an Italian compounder that produces mixtures for all industrial applications, views the interaction of the right machinery, a sophisticated automation system and a highly trained workforce as the best means of guaranteeing efficient processes. Other key factors include regular maintenance and a state-of-the-art process monitoring system which continuously checks and stores all parameters and also displays them in a user-friendly format. Comet is convinced that efficiency also has a lot to do with continuing education and job satisfaction, clean and safe working conditions and well-established processes. "With regard to our products, efficiency begins right with the raw material suppliers", says Giancarlo Duina, Plant Manager at Comet. "We expect them to provide standardised materials which are stored in facilities ensuring the right conditions for their respective properties, i.e. the optimal temperature and appropriate relative humidity. Because we, too, must always provide mixtures of consistent quality to our customers. And at the end of the chain, suitable packaging also helps to optimise efficiency."

## Lean production system

TOVO GOMMA SRL also emphasises the role of raw material for efficient processes. Along with this, the manufacturer specialising in the production of rubber blends, sheets and cellular rubber focuses on highly standardised processes, low variability and the reduction of scrap. In order to make their production as efficient as possible, the company has already been using a lean production system for many years now. "In this overall system, the efficiency of the equipment – especially the mixer – plays a huge role, of course", explains Andrea Contri, Chief Engineer at TOVO GOMMA. "Important factors here include the shortening of mixing cycles, the regulation of temperature and an efficient process monitoring system. Short retooling times and downtimes also contribute to efficiency."

Robert Dodd, president of Airboss, one of the leading compounders in North America, sums up efficiency very succinctly: "Efficiency in production means maximum throughput in pounds per hour. Efficient products are the ones that promise the best value in the industry."



Dr Donal Ryan, head of engineering at NUVO.





## The energetically ideal mixer line

In order to cut the processing costs of its customers, HF MIXING GROUP is working on a high-efficiency mixer line. And that means every aggregate is on the test stand.

Increasing energy efficiency is a major topic, and not only for our customers. At HF MIXING GROUP, we too are continuously putting our production operations and our processes on the energy-efficiency test stand. Since early 2015, we have been operating an energy and environmental management system according to DIN 50001 and DIN 14001. As a machinery constructor in whose brand DNA the principle of sustainability is securely anchored, we naturally support the Blue Competence Initiative of VDMA, the Plastics and Rubber Machinery Association. We will also apply for the RAL "Efficient use of energy in manufacturing industries" quality mark as soon as it has been established. Unlike existing certifications, the RAL quality mark assesses not only the energy efficiency of the processes, but also that of the individual products.

But what we do above all else is that what we've always done: provide the best possible support to our customers for their projects. Specifically with regard to energy efficiency, this means that we are working in high gear to optimise all aggregates of a mixer line relative to their energy efficiency. We're working to build mixers that combine low energy consumption with high efficiency. And we didn't just start yesterday.

### Efficiency factor: drive system

Take the drive system, for example, where we have already accomplished a great deal. The drive of the mixer very strongly dominates the overall energy requirements of the mixing process, so its efficiency largely determines the energy savings potential of a mixing line. Not so long ago the direct current (DC) drive was the standard for mixer lines, but over the past decade we have equipped our mixers with modern alternating current (AC) drives. In combination with frequency converters, they deliver considerably more favourable efficiency curves for the specific requirements in the mixing room. This is because mixing demands very high outputs for only a short period of time, while requiring only low output from the motor during long phases of the process. In partial load operation, the AC motor works much more efficiently than its older brother. On average, it is reasonable to expect a 20% increase in efficiency when replacing direct current by alternating current. The effect of this on energy consumption is by no means negligible. In the tyre industry, a 320-litre DC-motor-driven interior mixer with a throughput of 3 t/h consumes 2.6 million kWh per year (assuming 6,000 h/yr operation), while the energy consumption of an interior mixer equipped with

an AC motor can, due its greater efficiency, be reduced by 650,000 kWh per year. Expressed in euros, the operating costs for the drive are reduced – at an electricity price of 14 cents/kWh and an average power input of 900 kW – by 90,000 euros!

In order to achieve further efficiency increases, we have studied modular drive systems. These work – depending on the size of the interior mixer – with four to six motors, which drive the mixer rotors via a special gearbox. Since the drives of interior mixers operate under partial load conditions during many mixing phases, they often work very far from their optimum rated power and therefore inefficiently. The additional motors counteract this problem: by switching them off and on as necessary, it can be ensured that the motors are operated in the optimal efficiency range. This serves to optimise the efficiency of the drive by another 5%. For the 320-litre mixer from the example previously mentioned, this improvement in efficiency would mean additional savings of about 16,000 euros per year.

### Savings potential: ram

Savings can also be achieved on elements other than the main drive, however. There is latent energy optimisation potential hidden in all other aggregates as well. Take the ram, for example. For about 15 years now, hydraulic ram pressure systems have been increasingly displacing the pneumatic systems widely used in the past. Not only are they quieter, but they also enable significantly faster ram motion while providing more precise and more reliable position control at the same time. In this way, they ensure constant process conditions – unlike the pneumatically driven ram, which can cause inconsistent mix quality due to pressure level variations.

When we compare the energy expenditures – and therefore the operating cost – of the two systems, the hydraulic ram is clearly superior. Operating an IM 320E mixer with a hydraulic ram results in up to 70% lower operating costs for the same number of hours – a considerable savings potential. A 320-litre interior mixer with a hydraulic ram requires half a million kWh per year less than an interior mixer equipped with a pneumatic ram. Expressed in euros, the operating costs for the ram are reduced – at an electricity price of 14 cents/kWh – by 70,000 euros.

The use of hydraulic feed systems offers many further advantages, however. With iRAM, the intelligent ram control system, process technicians and engineers have a power-



ful new process optimisation tool in their hands. Where the ram was once driven up and down pneumatically, iRAM permits displacement by predetermined distances.

This function and many other interesting ones can be used to exploit an extremely wide range of process engineering potentials. A broad range of practical experience shows that ram displacement control can be used to save cleaning steps and reduce ventilation steps. The result: mixing times reduced by up to 25%. Here, too, it is possible to save significant amounts of energy. Hydraulic feed systems and iRAM offer, beside the energy savings potentials described here, a large range of additional options. Not all rams are created equal.

### Influence of the tempering aggregates

When we turn our attention to the periphery of the interior mixer, we see that tempering equipment can also be designed for greater energy efficiency. Under the normal operating conditions of the mixing process, which is characterised by continuously changing requirements, the pumps of the tempering aggregates run only very rarely at their optimal operating point. This means that whenever the tempering system is operating, the pump is always running at full volumetric capacity without speed regulation and accordingly at full power, although only

part of that volumetric flow is needed. Without a need-dependent power adjustment, this results in unnecessarily high consumption of drive energy and therefore also higher operating costs.

Through the use of frequency-controlled pumps, the cooling can be adjusted to the process, thereby achieving additional energy savings. Tests on the system in the HF technical centre have shown that by controlling the speed control of the tempering units, the pump input power of the three TCU units – rotor / mixing chamber / ram – can be reduced by 50 to 75%. Expressed in energy costs, that amounts to about 8,000 euros per year.

Moreover, there is considerable savings potential in designing tempering aggregates with their specific purpose in mind. In order to do so, engineers must know not only the characteristic curve of the mixer component to be tempered (i.e. pressure loss as a function of flow rate) but also that of the tempering equipment (flow rate as a function of the back pressure to be overcome). The proper selection of pumps for each tempering circuit first requires a holistic analysis of those two relationships. Through individual examination of the mixer circuits, the size of a pump in a circuit can be reduced by up to 30% from the outset.

Thanks to intensive studies of tempering equipment with conventional temperature control systems, HF Automa-

tion has developed its own control hardware and software, which demonstrates significantly better energy consumption. Knowledge of the interaction of mixer components and the tempering equipment also played a decisive role here. Once the overall system response had been analysed, it was possible to develop stable control algorithms, unlike those of conventional tempering equipment which often oscillate around the operating point. The new HF TCU controllers also enable the direct control of the temperature of the mixing chambers and not just the water flow temperature. They are already being used in the latest generation of tempering equipment.

### Twin-screw extruder

In the downstream aggregates underneath the interior mixer, the installed drives are also scrutinised. These machines are also installed with substantial drive power ratings – up to 300 kW for a CONVEX™ 12, for example. Outdated drive concepts such as direct current or hydraulic drives are often still in use here – the efficiency of which usually still offers considerable optimisation potential.

Extensive comparison testing in the field has shown that the screw geometry of the twin-screw extruders has a significant impact on the operating characteristics. In general, the conicity of the screw diameter results in a substantially higher capacity in the inlet area versus the discharge area of the screw. For this reason, a large proportion of the mixture is transferred “in the loop” (or backflow) from the front to the back of the extruder area. With a favourable screw arrangement, that amount of backflow (which is unnecessary for the functioning of the machine) can be diminished considerably and the energy consumption of the screw drive can be reduced by up to 33%.

### Saving potential: dust seal

The area of the dust seals of an interior mixer offers attractive savings potentials, and not only with regard to energy efficiency. The load-dependent control of the compression forces of dust seals provides many additional benefits as well. With the recently developed “iXseal”, the HF MIXING GROUP offers an advanced concept aimed at achieving the following optimisation potentials:

- Reduction of lube oil consumption
- Minimisation of recycling costs
- Extension of dust seal service life
- Reduction of the load on the main drive

But how are these improvements achieved in the dust seal area? Extensive analyses at HF have shown that the rings of the dust seal need not be compressed against one another with full pressure in all process phases – as is the case today.

Moreover, this intelligent reduction of the hydraulic compression forces automatically enables a reduction of the lube oil supply between the seal rings. Shutting off the lube oil supply temporarily in this way can save significant quantities of oil.

A portion of the lube oil required for operation is not fed into the mixing chamber. The discharged oils must be collected and recycled. The associated costs often exceed the purchase price of the relevant oils several times over. So the reduction of the oils described here also minimises recycling expenses and makes the operation of mixers more environmentally sound.

“iXseal” reduces – as described above – the mean contact pressure between the rotating and fixed ring. This has a positive impact on the service life of the seal. Downtimes and maintenance frequency are reduced to a minimum.

In simplified form, the seals of an interior mixer are comparable to four disc brakes. If they are continuously subjected to high compression forces, that condition has an effect on the power consumption of the main drive. The intelligent reduction reduces the load on the seals, thereby also reducing the load on the drive of the rotors.

Our conclusion: a holistic view of the mixing process opens up opportunities for high savings potentials. Moreover, comprehensive automation of the complete mixer line system can eliminate further inefficiencies. Load spikes that occur when multiple lines are running load-intensive mixtures at the same time can be avoided in advance with an intelligent planning algorithm. Further potentials for energy savings become available to mixing room operators when the central automation system records and fully documents the energy consumed by each of the aggregates in the mixing room. This path will continue to be systematically followed by HF MIXING GROUP.



CONVEX™ twin-screw extruder.



# Michelin realigns its relationship with OEM suppliers

The world's second biggest tyre manufacturer is initiating a cultural revolution that is also benefiting HF MIXING GROUP. A visit to Clermont-Ferrand.

A company like Michelin needs no big introduction. For more than a century now, the products of the French group have been a part of life in the western world – and increasing in the rest of the world, as well: Michelin maps, travel guides and route planners have accompanied generations of travellers. The Guide Michelin is considered the gold standard for chefs, hotel operators and gourmets. Everyone knows the Michelin Man; in 2000, it was even named the best trademark of all time.

And of course their core business is tyre manufacturing. With 69 production sites in 18 countries, sales offices in more than 170 countries, 180 million tyres produced

each year, and an annual turnover of 19.2 billion euros (2014), Michelin is the world's second-biggest tyre manufacturer, just behind their Japanese competitor Bridgestone. Founder Edouard Michelin laid the cornerstone of the company's success in 1891 with the invention of the detachable pneumatic tyre, the predecessor of all of today's tyres. Innovation has remained a part of the company to this day. Many technological breakthroughs originate from Michelin: the removable steel wheel (1913), the first low-pressure tyre for passenger cars (1923), the tyre with an inner tube incorporated by vulcanisation (1930), the zigzag profile (1930), the first steel-belted tyre with steel cords to reinforce the tyre (1938), the first

tyre with a radial casing (1946), the TRX model, which united tyre and rim for the first time (1975) or the low rolling resistance "green" tyre (1992), just to mention the most important ones.

Along with its intensive research and development, Michelin is known for its advanced technology. Up until now, the company preferred to maintain direct control of this expertise: an army of in-house engineers developed and built the lion's share of the machinery and plants needed. Anything that was not developed in-house was specified in minute detail for the suppliers. This same culture also characterised the business relationship between Michelin and HF MIXING GROUP dating back to 1907.

## About-face in procurement

But now that is changing. Because Michelin is experiencing a minor cultural revolution: rising raw material costs and energy prices along with more expensive machines than the competition had recently resulted in increased stress on profit margins. A management consulting firm was called in to help. Besides the engineering area, they also took an especially close look at industrial procurement and made a number of recommendations for its optimisation. The consultants recommended to the Management, for example, to place greater trust in technologies from outside and to replace many of the in-house mechanical developments and production facilities by purchases. In that regard, greater emphasis should also be placed on the turnkey products of the manufacturers. In addition, the consultants suggested that Michelin's Purchasing department

should review the specification level, which was sometimes unnecessarily high.

Purchasing at Michelin wasted no time implementing the recommendations – at least with regard to their collaboration with HF MIXING GROUP. In February 2014, HF received the order to deliver two complete mixer lines for the new TIGAR tyre plant in Pirot, Serbia – a turnkey job including all necessary services such as construction supervision, scheduling, coordination of the trades on-site, etc. The only requirement that Michelin stipulated to HF in the technical specifications was the number of tyres of each type. HF then validated the corresponding mixing times for each type of tyre in extensive test runs at its own in-house technical centre. Subsequently, the engineering team developed the conceptual design for the complete TIGAR mixing room.

HF was well-prepared for the nearly 20-million-euro project – it had just completed its transformation from a pure machinery manufacturer to a system supplier. The hardware was delivered one full year after receipt of the order, and the installation was completed at the end of 2015. Acceptance was signed in early 2016.

Maurice Biegale, HF Sales Engineer for Michelin, took this occasion to travel to the company's headquarters in Clermont-Ferrand to meet with the responsible parties for a final review of the TIGAR project and also to take stock of the new form of collaboration. The mere fact that five Michelin managers were willing to do this together with him shows just how much Michelin cares about supplier relationship management.

**“With the TIGAR project, we were in uncharted waters. It was the first complete mixing room we've bought in the history of the company”,**

says Stéphane E., who is in charge of external solutions in the Corporate Development Department.

**“In the past, we always developed such lines ourselves and purchased the separate components – like the mixer bodies from HF – from our suppliers. In such projects, teams from several of our departments were involved, from Engineering to Purchasing to Automation and Maintenance.”**



“The advantages of the new approach are obvious: the responsibility is clearly assigned, for us the contact and coordination with multiple suppliers is eliminated entirely, and we save internal resources”,

explains his colleague Olivier D., Category manager at the Purchasing Department.

“Previously we knew HF MIXING GROUP as a supplier of high-quality technology. Now with this project you have also proven your ability to supply turnkey solutions and to manage big projects. Our experience with you in this context encourages us to purchase more turnkey solutions from you in the future. But the success of such a project depends not only on the supplier, but also on the type of mixes. That’s why we concentrated on the Tier 3 segment first.”

“The premium mixes are more demanding”,

agrees Stéphane E.

“Although we want to rely on turnkey solutions more often now, the production of ultra-high-performance tyres usually forces us to make a lot of modifications, so turnkey doesn’t make sense here.”

Pierre F. from the Engineering Department sees opportunities to improve the processes in the premium brand segment as well, however:

“In the future we have to work closer with the suppliers. Where OEM standard equipment suffices, there’s no reason for us to waste engineering resources. What we need to do here is find the right balance between internal design (make approach) or OEM solutions (buy approach). I think there are also some opportunities to develop solutions together – solutions that are not available on the market yet. Ones that are better and more profitable than the existing ones.”

“Of course, turnkey solutions also have to pay for themselves”,

points out Olivier D.

“At a global level, it would be uneconomical, for example, to purchase a mixer line for Indonesia with German manpower for installation and commissioning.”

But this situation could soon change as well, counters Maurice Biegale:

“We at HF already have a very good worldwide service network. And with the “Service 2020” project, we will significantly expand it even further in the coming years, so we can also organise such projects economically for our customers.”

Clement M., responsible for Methods and Processes at Michelin, explains:

“Along with turnkey solutions, there are many sources of added value for us. For example, good solutions for brownfield projects: existing plants whose processes have to be adapted to new products. Product cycles are getting shorter and shorter; requirements and specifications are changing faster and faster. We have to decide each time here whether to buy a solution from the market or develop one ourselves.”

“Where that’s concerned, surely we can also find ways to work together. After

all, now we know what HF MIXING GROUP can do”,

says Olivier D.

“Before the TIGAR project, we knew HF actually more as a supplier of good machine technology. Now we know that you can also develop solutions.”

Maurice Biegale and his colleagues at HF would be glad to see the cooperation grow: “We’re looking forward to many more successful years of collaborative partnership together with Michelin.” And they’re happy about something else, too: that the rapid implementation of Michelin’s new overall strategy has evidently already had a very positive impact on the company’s success: the results for the first six months of 2015 showed a 13.3% increase in net profit over the first half of the previous year!



Maurice Biegale (2nd from the right) spoke with five managers from Michelin about the new form of collaboration: Clement M., Mixing technical manager, Pierre F., Mixing engineering manager, Patrick P., Raw material mixing expert, Olivier D., Category manager Purchasing Department, Stéphane E., External solutions analysis (from left to right).



# Certified more efficient

A request for certification from Michelin helped make many proven processes in our company more sustainable and more transparent.

It came as no surprise when the French tyre manufacturer Michelin requested an audit. Manufacturers from many industries have been focusing intently on certification for quite some time now. This involves – in the broadest possible sense – efficiency, sustainability and the documentation of every imaginable procedure in the company. And that includes quality concerns. Against that complex background, the responsibility for the project was assigned to HF quality manager Dr Dieter Berkemeier, who holds a PhD in process engineering. The aim of the project was to use a sophisticated questionnaire to determine truthful answers to questions concerning, alongside a few general aspects, the four main topics of environment, work practices, fair business relationships and sustainable procurement. “Basically, as a company, we were not prepared for these kinds of questions”, admits Berkemeier openly.

To that end, Michelin had prepared everything perfectly and contracted out the assessment and support of the operative tasks to the service provider EcoVadis. The list of questions was available on the cloud, and an account for HF had already been set up. After an initial glance, it was clear that HF has already been complying with many of the requirements for several years now. Why? Because those procedures have proven effective. And because they are efficient, or serve to maintain or enhance quality. For the most part, however, this had not been documented. And this was precisely one of the core elements of the audit. There was no point whatsoever in searching for possible records. The situation was both simple and commonplace: information that has not been documented in the past cannot be found. Even the detailed knowledge of experienced, long-time employees revealed no hidden information.



## Assuming overall corporate responsibility

Meticulous preparation and thorough procedures were the order of the day. To understand what that really means, it is helpful to glance through the entire shelf of overstuffed ring binders in Berkemeier's office. They contain background information, standards and regulations, as well as explanations for hundreds of acronyms and abbreviations encountered in connection with the certification request. Working in highly exacting detail, the employees started from the basics to develop the required skills and knowledge. A positive effect is that audits like this one play a significant role in enabling companies like HF to assume overall corporate responsibility. Corporate Social Responsibility is the term used in professional circles. It encompasses trading on the market, ecological aspects, employee relations (workplace) and interaction with relevant stakeholders and interest groups. Transposed to the list of questions compiled by EcoVadis, those thematic elements are categorised under environment, work practices, fair business practices and sustainable procurement. Questionnaires like this one are used primarily by automotive groups and their suppliers to scrutinise service providers and companies comprising the value creation chain, in order to ensure consistent compliance in the four thematic areas. The required depth in terms of content goes well beyond quality assurance. The HF MIXING GROUP had to indicate whether it pursues an active policy relative to the work practices and human rights, for example, and whether it has implemented measures to prevent discrimination, child labour and forced labour. "Yes, we



Dr. Dieter Berkemeier – process technician and HF quality manager.

have. Of course!" states Berkemeier emphatically. Those measures are documented in, among other places, the Sustainability Report 2014 and in a Code of Conduct, which regulates the areas of ethics and integrity.

In the meantime, many other things have also been established for the record – and are now subject to continuous documentation. This applies in the areas of health management, for example, and the social commitment of HF. The volume of required information surprised even veteran

HF employees. And as a result it was soon clear that a crack team was needed to perform this complex task. Six employees took the job on: Larissa Reineck, Sabrina Jahn, Nadina Massuard, Stefan Gross, Dr Harald Keuter and Dieter Berkemeier. Together they brought the project to a successful conclusion. "According to comparative data from EcoVadis, our results place us in the top ranks among the other suppliers in all categories – and in the environmental area we actually lead the pack", states project leader Berkemeier.

## Energy management as a key component of competitiveness

All that effort has paid off. "The bottom line is, we've become a more effective company today", concludes Berkemeier positively. EcoVadis' seemingly unquenchable thirst for information often stretched the team to its limits. In the environmental category, for example, more detailed data about CO<sub>2</sub> emissions at the Freudenberg site were available – but not in the required form. The same was true regarding the consumption of fossil-fuel-based energies. We knew how much heating oil, electricity and gas we consume, of course. But as is so often the case, the devil was in the detail. No one knew exactly which users were consuming how much of that energy. That has changed. As a result of the Michelin audit, HF is now able to list energy consumption by user. Certification according to ISO 50001 documents the changes in the company. The energy management system records and evaluates the energy-related processes. That helps the company track down savings potentials, which then lead to concrete measures for reducing energy consumption. The new requirements are implemented so consistently now that even the consumption of individual radiators will be recorded in the future. In combination with the sustainable reinforcement of our employees' energy awareness, the energy management system has become a key component of our effort to improve our competitiveness. In parallel, HF has enhanced its corporate sustainability through the implementation of its environmental management system according to ISO 14001. It obliges the company to engage in active environmental protection, the conservation of resources and continuous improvement processes using the "plan – do – check – act" method.

In hindsight, those involved had not expected the audit requirements to affect so many areas of the company. Fire protection is a particularly impressive example: Thomas Wickler has been serving as the Fire Protection Officer at the Freudenberg site since 1 November 2014.

A lucky break for HF. As fire chief and captain of the volunteer fire brigade of Freudenberg's neighbouring municipality of Friesenhagen, Wickler is a seasoned expert who could fill this safety-related position from within the company. Not least against that background, EcoVadis' detailed questions produced another beneficial effect: intensive interaction with our own company – and above all with our own employees – drew attention to untapped resources. "Few employees at HF were aware that with Thomas Wickler we had a fire chief and fire brigade captain right in our own ranks. Now we're making full use of Thomas Wickler's expertise and making HF more efficient – and safer", sums up Berkemeier. Since then, the fire chief has been consistently improving the company's fire protection on behalf of HF. Along with fire protection safety instructions for all employees, Wickler has inspected all fire extinguishers and verified all escape routes. Training programmes for fire protection assistants and the installation of a fire alarm system across the entire site are in preparation. Both are scheduled for completion before the end of this year.

Things some might presume to be self-evident are also regulated. The Code of Conduct takes a clear position regarding fair business practices. Corruption, fraud, money laundering and other anticompetitive practices are unequivocally rejected. It requires employees to protect the privacy of individuals as well as the data of consumers and customers. Room for interpretation? None.

## Value creation chain with uniform standards

The cumulative experience with Corporate Social Responsibility (CSR) and especially the far-reaching effects of the Michelin certification continue to have an impact. Already during the 2015 financial year, the HF MIXING GROUP decided to encourage its suppliers to undertake CSR activities of their own. An informal query sent out to the 50 HF suppliers with the highest turnover is designed to determine which activities have already been implemented in the respective companies and where they have outperformed minimum statutory requirements. We are currently evaluating the responses submitted by the companies. For the current year, we intend to solicit similar information from an additional 200 suppliers. Our aim is to establish uniform standards along the entire value creation chain.





# EFFICIENCY – the key to compounder profitability

In order to withstand pricing and quality pressures, manufacturers of plastic compounds must design their processes as efficiently as possible.

Efficiency is a frequently used statement in any business and seems to be a generic goal of every business, production system, process or product. FARREL POMINI spoke to customers in each of its key geographic markets to better understand what efficiency really does mean to our customers, and how efficient solutions are used to

add and capture value in the global plastics compounding and masterbatch markets. FARREL POMINI's pursuit of efficiency in products, services and operations is focused on the goal of making its customers the most competitive and profitable companies in their segments.

## What is efficiency?

To understand what efficiency means to our customers we should start with a definition, then apply that definition to the field of plastics compounding, finally finding something we can understand and align with.

Efficiency is considered to be the ability to accomplish something with the least amount of time or effort.

Within a manufacturing context, efficiency is usually referred to as the ratio of work done or energy developed by a machine, engine, etc. relative to the energy supplied to it.

At FARREL POMINI, we feel the concept of efficiency is summarised well by Peter F. Drucker, management consultant, educator and author:

“Efficiency is doing better what is already being done.”

The plastics compounding industry is driven by efficiency. Efficiency is the driving force of FARREL POMINI.

## Why is efficiency important in the plastics compounding and masterbatch fields?

The plastics compounder or masterbatch manufacturer is in the business of conversion; meaning they buy materials in one form, convert that material using their business process and sell it in a different form. Usually raw materials are purchased from large powerful global suppliers almost on a fixed commodity pricing basis, and sold into a highly competitive global marketplace which is sensitive to price and delivery conditions. All producers face these common market conditions; accordingly the profit level achieved by each individual company is based on the cost of converting the raw materials into saleable product, or to phrase it differently, the efficiency of the conversion process.

“Our profit is decided by how efficiently we can run our business processes.”

In order to operate in highly competitive markets, it is impossible to account for inefficiencies within pricing models. Loss or waste are inefficiencies; minimising losses and waste is a key objective of the plastics compounder. Therefore, the pursuit of efficiency (or the elimination of inefficiency) is a key driver of successful plastics compounding businesses.

“We do not account for loss factors within our pricing models. Keeping those loss factors to a minimum is a key objective.”

## How can efficiency be seen, measured and improved in a plastics compounding business?

If efficiency is so important to the plastics compounding industry and if the elimination of inefficiencies is key to a successful conversion business, this topic is obviously a key management concern. Again, to quote Mr Drucker, “if you can't measure it, you can't manage it”.

How can efficiency be seen, measured and improved in a plastics compounding business? In most cases, the metrics are considered the costs of conversion and are relatively common to our customers.

### The key drivers of the cost of conversion were almost universally cited as:

- Energy consumption per kg of production
- Effective rate / production output / day of production
- Manpower cost per kg of production
- Plant running costs
- First pass yield

Outside of raw material, energy is usually the highest cost incurred in plastics compounding. Therefore it was not surprising that energy consumption (per kg) was considered a key metric for measuring efficiency. Usually measured during the conversion process as specific energy input, energy consumption is both necessary and expensive. A fixed amount of energy will be required to complete the conversion process in a perfectly efficient system, based on the process and equipment utilised; the difference between the perfectly efficient system and the actual system is the measure of efficiency.

Again, not surprisingly, production rate, utilisation or effective rate is considered a key measurement of efficiency. Production rate isn't just a factor of the size of machines used, but here is referred to in the form of utilisation or effective rate, namely the rate achieved vs the rate available. Equipment uptime, maintenance requirements, breakdowns and changeover times are all factors that affect the effective rate. Minimising downtime for any reason is an obvious goal and effective rate is the measure used. Plant running costs, or the costs incurred to keep the



plant running, are influenced by the cost of maintaining the plant and production assets. These costs will be affected by the time required to maintain production equipment and the cost of components or spares to keep the equipment running efficiently.

First-pass quality is critical and assumed in the pricing models of most converters – there is nothing more inefficient than having to repeat the process. Quality can be measured in terms of instance and consistency. Consistency of quality is a function of inputs, process/processor stability and human influence.

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**“We do not account for inefficiencies in our pricing models beyond typical loss factors.”**

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### The role of efficiency in a capital equipment decision

Efficiencies may differentiate the profitability of the converter but clearly the biggest cost effect on the converter is raw materials for the process. Significant attention is therefore rightly placed on the procurement of raw materials and day-to-day supply chain management efforts are the focus in this area. However, the transaction cycle or contract term for purchasing materials is normally relatively short. A deal which is not optimum for material supply will clearly have an effect on profitability in the short term, but another opportunity to correct will soon arrive. Significantly longer timescales and the effect on long-term profitability need to be considered when purchasing capital equipment. An ability to see beyond the purchase price and view return on investment and longer-term efficiencies is highly advantageous.

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**“I firmly believe that while raw material purchases determine the short-term profits, the long-term profitability is decided by the machines you operate.”**

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Production capacity and consistency are very much essential, so in terms of evaluating a capital equipment purchasing decision, most companies would not consider a purchase without metrics like ROI, which would capture efficiencies in primary cost areas. What other

factors would affect performance in the key efficiency areas and therefore ongoing profitability?

Although key factors such as lead time, machine reliability, ease of maintenance and spare parts availability remain important and critical for evaluation, there is also a consideration of less obvious aspects or intangibles that are becoming influential, including supplier engagement, participation in process improvements and longer-term development efforts. Capital equipment manufacturers have focused on what they do and selling what they have. To find efficiencies on a long-term basis there is a need to understand where customers are going, what they are working on for the future and where efficiencies can be identified. In short, capital equipment suppliers need to be engaged with their customers' goals and objectives.

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**“So many times OEMs want to tell you / sell you what they have and that may not be what you need. It is important to understand where your customers are going and what they are working on for the future.”**

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### How FARREL POMINI helps customers be more efficient

Reflecting on the customer feedback about efficiency in plastics compounding, it is possible to review how capital equipment can impact the efficiency of a plastics compounding operation and therefore how FARREL POMINI is helping customers become more efficient.

Energy consumption was one of the most influential efficiency factors and is an area where the FARREL POMINI Continuous Mixer excels. The unique design of the mixing element (rotors) enables the most efficient process for both dispersive and distributive mixing, thus allowing the Continuous Mixer to meet or exceed compound quality targets over a mixing length of around 6:1 L/D, which contrasts with a modern twin-screw extruder which uses lengths of 48–56 L/D. The result of both the efficient mixing solution and the drastically reduced length is a reduction in specific energy input and energy consumed by around 10–15% in comparison to a similar process using a twin-screw extruder.

### Effective rate, downtime and maintenance cost

With the additional processing variable of the orifice gate, the Continuous Mixer is inherently flexible. Most formulation or even compound changes are accommodated by adjusting variables within the control system rather than mechanical changes, making changeovers faster, eliminating downtime and maximising utilisation.

In addition, with larger clearances and no metal-to-metal contact within the mixing chamber, wear rates and therefore maintenance requirements are significantly reduced. When it finally is time to change the rotors, it is possible to complete this in a short one- to two-hour maintenance window, where only the mixing sections are replaced as an assembly. In addition, based on the construction of the mixing rotors, low-cost repairs are normally capable of returning the rotors to as new condition and eliminating the waste of scrapping worn component parts.

All FARREL POMINI machines are now installed with an EWAN remote network capability that allows our technicians to monitor the operation and performance of the machine to provide immediate real-time feedback to production problems or machine optimisation initiatives. Although process and technical support remains a key service as we support customers globally, the ability to complete simple or initial diagnostics 24/7 from anywhere in the world all but eliminates any risk of downtime on the machine.

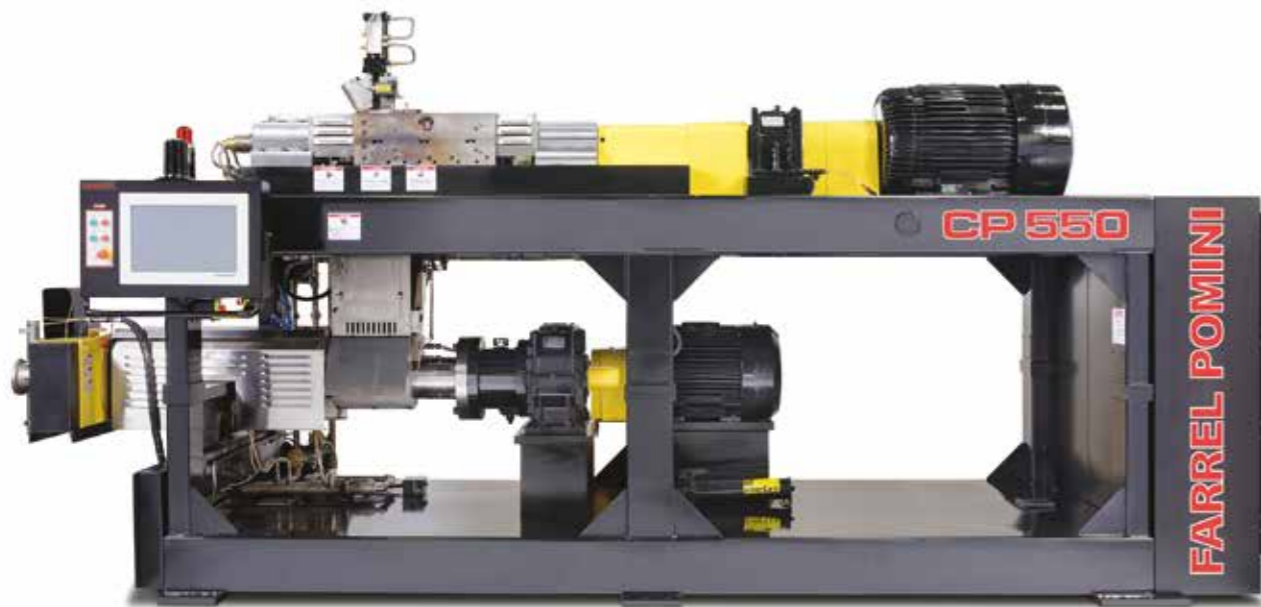
### The future of efficiency

Without question, increased globalisation, reduced barriers to trade and improved efficiencies will ensure that the competitive environment for suppliers of compounds and masterbatches will continue to intensify. Increased pressure for conservation will lead to higher costs for resources and penalties for consumption which will further fuel requirements for efficiencies on both macro and micro levels. Waste will increasingly become intolerable to successful businesses and value added will be determined both by ability to innovate and expertise at finding and optimising efficiencies. Supply chains will be populated by supply partners who find innovative ways to leverage efficiency independently and collectively to attain optimum levels.

For capital equipment suppliers, efficiency of production will be a minimum standard, producing highly efficient equipment as the minimum expectation and efficiency innovation a core competence. To participate in the most efficient and successful supply chains, FARREL POMINI will continue to drive efficiency through our business and look for ways to allow our efficiency to drive our customers' success.







# EFFICIENCY – a process not a destination

FARREL POMINI relies on many measures to increase the efficiency of its machines. This also increases the efficiency of the client companies.

## FARREL POMINI's efficiency is an ongoing process

FARREL POMINI needs to supply equipment which allows our customers to reach efficiency levels that surpass their competitors. However, it is also clear that in order to provide efficient products and services to our customers, FARREL POMINI must have a business which is capable of producing them efficiently, too.

## New facility and assembly improvements

In 2016, FARREL POMINI will move into a new, purpose-built facility in its home of Ansonia, Connecticut. USA. The

new facility will be a home to our employees and will allow us to make some key changes enabling improved efficiency in all of our business processes.

The main objective of the new facility is to put all employees on one site, on one level in close proximity to increase the interaction and communication within the company. This will lead to a more efficient model of interaction, collaboration and process improvement.

In addition, moving to a new facility has allowed the study and reworking of our machine assembly areas and processes, which can now be configured exactly in line with the requirements of building the Continuous Mixer and Compact Processor products. The assembly floor

has been designed to minimise movements and the lifting of machines, a major inefficiency in machine assembly. During the summer of 2015 a specialised consultant and an intern were engaged to model the optimum layout for the efficient building of our products using lean methodology. The designed assembly booth will be tested by assembly personnel in our current facility to evaluate efficiency before being incorporated into the new building layout.

## Efficiency through three-dimensional design

Driven by customers and competitors, manufacturers are pressured to develop products that are more sophisticated and complex and bring them to market in less time.

The use of state-of-the-art 3D modelling software helps FARREL POMINI decrease design time, predict assembly problems and analyse design integrity. The efficient use of 3D modelling software allows the company to develop virtual prototypes in order to identify issues before any capital investment is made in physical prototypes. 3D models are easier to visualise for non-technical people and allows for the efficient collaboration between inter-departmental personnel, customers and vendors. Modern 3D software can generate accurate 2D drawings automatically with the correct bill of materials, easy-to-read isometric views and exploded views on assembly drawings. The 3D models also help in computer-aided manufacturing, which further cuts down on lead times and improves accuracy and quality, thereby allowing FARREL POMINI to meet and even exceed customer expectations. In the last two years, FARREL POMINI has designed three new machines entirely in 3D with few or no part errors and assembly issues. These completely new machines were designed from the ground up and built in normal lead times and within budget, which would have been impossible without the use of efficient 3D modelling.

## Standardisation

In order to reduce lead times and maximise in-stock components to support existing customers, FARREL POMINI reviewed the design of the CP product range with a view to standardising the components on the machine without

affecting our abilities to deliver custom configurations to meet application requirements or customer preferences. Working with a key supply partner, drives, motors and machine frames have been standardised so that the machines can be installed anywhere in the world under any voltage conditions. This standardisation has allowed the development of standard frames, motors and drive systems for the range, reducing engineering time and lead times for machines. In addition, based on a joint stocking policy we are able to support customers' capital spare parts availability.

## Stocking policy

Following a thorough review of the spare parts requirements of the customer base, it was possible to identify spare parts purchased more accurately, then match stock levels with frequent requirements and leverage our supply chain to minimise lead times for even major items. FARREL POMINI now labels recommended spare parts with one of two classifications, "to be held by customer" and "always in stock", thus minimising duplicate inventories or, worse still supply gaps.

## Research & development process improvements

Efficiency in R&D is critical to driving the improvements that will add value to products and services and help drive efficiency in the customers' business. The speed of progress is ever increasing, and the ability to meet future requirements is essential. In order to improve the efficiency of R&D we have rotated the focus 180 degrees, or in our mind, a corrected focus. The R&D process is now driven based on customer feedback or problem identification and participation in joint R&D projects is becoming more common. Rather than develop something and then try to convince the market of its value with greater or lesser success, an approach of solving customers' problems is a far more efficient method for generating developments which add value to our customers.

# The new CONVEX™

Numerous advancements have made the standard machine for base compound mixing lines even better.



When it comes to energy consumption, personnel deployment, work safety and process reliability, the conical CONVEX™ twin-screw extruder is the undisputed efficiency champion among machines for discharging rubber mixtures from an interior mixer and feeding them to batch-off units. Its compact design with separate drives, the cooled screws, its robustness and a fully hydraulic cal-

ender make it a versatile and reliable machine which delivers impressive throughputs – with very good temperature control and excellent self-cleaning. The unique characteristics of the CONVEX™ are guaranteed to increase the quality and performance of mixer lines – which is why it's no wonder that it has been the standard in the tyre industry in Europe for many years now.

## Fit for more applications

The latest developments now also make it attractive for other players and markets within the technical rubber goods industry. This is because the developers at Pomini Rubber & Plastics have added some new functions to the CONVEX™ – functions which enable it to process sensitive raw materials and to make rapid and safe colour changes. The new Screw Inspection System, for example, makes it possible to open the extruder rapidly by means of an automatically driven mechanism, in order to exclude any possibility of contamination when changing over to very critical mixtures. Moreover, the system permits very rapid and easy inspection and maintenance of the extruder.

In addition, the engineers have developed a modular drive concept to satisfy various requirement levels. Now the customer can select from a number of different drives.

### The following variants are possible:

- **Four identical drives (motor + gearbox) for the two screws and the two rollers.**  
Advantage: simplified spare parts inventory.
- **Two identical drives each for screws and rollers, each with optimised power output for extruder and calender.**  
Advantage: less expensive and more energy-efficient.
- **Only one drive unit for the extruder and two for the calender.**  
Advantage: less expensive and simpler.
- **Only one drive unit each for extruder and calender.**  
Advantage: Lowest cost with full functionality – except for the possibility of driving the calender with friction between the roller pair.

And our Italian colleagues have also optimised the temperature distribution: the already highly efficient tempering of extruder housing and extruder screws has been enhanced with an optional screw flight cooling system. It guarantees a minimal temperature rise, even at maximum discharge capacity.

In addition, the so-called ASMA Cool Rollers use a combination of excellent surface tempering and special surface characteristics to minimise problems due to the adherence of sticky mixtures.

## Greater efficiency

Using sophisticated screw geometries and an optimised extruder design, the developers also managed to boost the performance of the CONVEX™ considerably. Now smaller models can be configured for higher efficiency, so that the discharge capacity is increased by up to 50% – with the major advantage for the customer that it is often possible to use smaller units, which are not only less expensive to purchase but also require less energy to operate.

Here is an example: the size of the extruder is selected according to the dimensions of the door top of the mixer installed above it, so the batch does not get wound up and hang there as it slides downward. In terms of that dimension alone, CONVEX™ 7 is adequately sized for a BM305N. But in terms of throughput, it is the right machine only for longer mixing times (and therefore lower throughputs), such as with masterbatches. If final mixes are produced with very short mixing times, however, the CONVEX™ 7 is not the right choice. Most customers install a CONVEX™ 12 in this case. With the new developments, the CONVEX™ 10 now becomes an attractive option for them. Its outside dimensions correspond to those of the CONVEX™ 7 while its rated throughput approaches that of the CONVEX™ 12 – and yet it is considerably less expensive than the latter.

Bottom line: with its new functions, the CONVEX™ is attractive not only for more applications. It is now less expensive and so even more attractive, without sacrificing any of its advantages.





# Sustainable corporate development

Against the background of demographic changes, HF MIXING GROUP has developed a so-called “employer branding strategy”

There is no doubt about it: against the background of demographic change, Germany's labour market is undergoing a dramatic transformation. Experts speak of an inversion of traditional conditions. The classic employer's market is mutating into an employee's market – with all of the associated consequences. Many companies are completely unprepared for this development. Everyone is amazed that so-called “goldfisch checks” (recruitment fairs where companies solicit prospective junior staff en masse) are spreading like wildfire across Germany and are well on their way to establishing an inversion of the classical relationship between employers and candidates. In these conferences, companies meet young potential junior staff – and have to woo the candidates and vie for their attention.

Today developments such as these primarily concern urban areas. However, they are clearly illustrating an ongoing trend: the days of surplus qualified professional staff are over. And they already have been for some time now. According to the Cologne Institute for Economic Research, some 54% of companies already had trouble finding suitable junior staff in 2010. This drastic development is affecting larger companies harder than smaller organisations with small and medium-sized business structures. The situation concerning qualified personnel is similar and likewise anything but satisfactory for the companies. In many cases, there simply are no specialists available.

## Demographically driven reductions in turnover are the norm

According to the small and medium-sized business barometer for 2015 published by the auditing firm Ernst & Young (EY), 52% of companies feel that the lack of specialists even threatens the development of their company. For 51% of the companies surveyed, reductions in turnover are the norm. EY estimates the losses due to lack of qualified specialists in Germany at 36.5 billion euros. “The lack of specialised staff is already having dramatic effects on German companies. In order to bring qualified employees on board, the small and medium-sized companies in Germany have to make more and more of an effort”, writes Peter Englisch, a partner with EY. His message to medium-sized businesses is unmistakably clear and very emphatic.

“The HF MIXING GROUP is of course not spared from the effects of the demographic change in Germany”, acknowledges Larissa Reineck, personnel officer at HF. Not so very long ago, young school-leavers searching for a qualified and future-proof training position were all it took to make job applications pile up on personnel department desks. That has completely changed now. “We have long since transitioned to actively soliciting potential junior staff”, says Larissa Reineck, indicating the

extent of the change with a view to years past. For proof that this is no temporary phenomenon with an expiration date, it is helpful to examine the demographics of Siegen as a typical example. In October 2008, in connection with a workshop entitled “Questions concerning the future in the face of demographic change”, Horst Fischer, the demography officer for the City of Siegen, estimated that the population of the city shrank by 6,000 residents from 1996 to 2008. At the same time, he predicted that the population would be 88,600 in 2024, compared to 109,200 in 1990 and 100,300 in 2014. According to his calculations, the decline in population in the age group of 20- to-24-year-olds will be particularly steep – 45%. If this trend follows the predicted course, then it is a scenario that threatens the existence of many companies.

## Secure prospects for the future

In view of these figures, the development of an employer branding strategy like the one adopted by HF MIXING GROUP in 2015 represents a logical and consistent measure for sustainably safeguarding the future. “The aim is to identify and accentuate what makes the HF MIXING GROUP attractive as an employer”, says the personnel officer as she specifies the direction HF's employer branding strategy is taking. It calls for the establishment of



key parameters derived from value-based leadership – parameters such as international character in combination with regional attachment. And it's true: along with good jobs with modern equipment, HF also offers its employees secure prospects for the future. "That explicitly includes above-average social benefits and an effective health management programme with an in-house fitness studio, physical therapy and many other offerings", assures the employee of the personnel department.

The effects of the employer branding strategy are directed both inward and outward in equal measure. A credible, unmistakable employer doesn't just have an effect on stakeholder groups, but also has the potential to limit employee turnover and can ensure the lasting loyalty of top performers. Furthermore, the positioning strategy encourages employees and managers to pursue the corporate objectives and reinforces their sense of identification with the company. With regard to the important task of recruiting, the well-defined profile of a potential employer attracts potential candidates like a magnet. The communication requirements for implementing the employer branding strategy compel HF to expend additional short-term effort. That expenditure will diminish again quite soon though, because it is reasonable to expect that the cost of so-called "recruitment activities" can be reduced somewhat after an intensive start-up phase.

### Regional activity for international successes

Regionally effective activities are good examples of supplementary measures that can help to establish a strong employer brand. The "Education Days" in Freudenberg (see inset) are a case in point: in this way, HF has created an opportunity to come into close contact with potential candidates early on. The concept provides a means of informing students – from Freudenberg, Niederndorf, Siegen and Betzdorf, for example – about HF MIXING GROUP and its training opportunities along with subsequent career opportunities. The goal of the action is to present the HF MIXING GROUP as an attractive employer – and to clearly formulate benefits and expectations. As a means of fostering a connection with the community, the sponsoring of the local football club pursues a similar objective. As of August 2015, the home of Fortuna Freudenberg now bears the name HF Arena. This local commitment forges a bond with more than 250 children and adolescents (see MIXING Culture) – and that makes it an ideal multiplier for communicating the attractiveness of the HF MIXING GROUP also at a level that can be experienced directly. HF has also raised a flag for its location with the Freudenberg Grand Prix. The HF MIXING GROUP supports the organisers of the local initiative "Wir für

Freudenberg" with their efforts to strengthen the location, and even sent its own racing team to the starting line. Under the banner "It's all in the mix", the team crafted an agile speedster aptly christened "6b on Wheels" (see MIXING News).

With its employer branding strategy, the HF MIXING GROUP is defining a strong brand identity. Passion forms the core of that brand and is flanked in turn by the values of reliability, ambition and sustainability.

### Two Education Days in Freudenberg

In mid-June 2015, at the first of two Education Days, some 40 students learned about the three commercial and six technical training positions at HF. As contact persons, there were "real" trainees there to answer the questions posed by the potential candidates. Afterwards employees led the teenagers from nearby schools on a tour of the whole company. They had good reason to pay attention, too: because at the end of the day each student could participate in an HF quiz, with ten cool Bluetooth speakers as prizes for the winners.

On the second day, HF opened its doors to visitors. Nearly 250 young people – some of them accompanied by their parents – came to HF to have a look for themselves. And no tour would be complete without a visit to the technical centre, of course. The guests were clearly surprised to find the company's own in-house fitness studio. The young visitors hadn't expected anything like that. After the Education Days were over, the HF team drew a positive assessment. Those responsible were pleased about the strong turnout and the positive feedback from the visitors, which could be measured by the numerous job applications received during the days that followed.



# Development of the most efficient mixing process

Raw material parameter changes as an example of developing an optimal mixing process.

Mixtures are subject to increasingly demanding quality requirements. This is also evidenced by the tyre label of the European Union and by the stricter requirements on tyre compounds which will come into force in 2020.

In response to this trend, raw materials suppliers are bringing new materials to the market, which often pose major challenges for the formulation and mixing process. This, in turn, makes both the design of formulations and the mixing processes themselves more complex. That's why, in order to optimise products, it will be useful to consider the entire process chain and to bring raw material suppliers, processors and customers together.

New materials can require a more precisely coordinated mixing process, for example. Just such a new, advanced filler has been brought to the market by a well-known carbon black supplier. It is an advanced grade of the highly active carbon black N134, as used, for example, in tread compounds for heavy goods vehicles, where the wear resistance of tyres – and thereby their mileage performance – become crucial factors. Highly active carbon blacks such as N134 are playing an ever increasingly important role here.

One of the key issues with highly active carbon blacks is their dispersibility. The physical arrangement of these carbon blacks in terms of surface and structure generally make them difficult to disperse. The small particles at the lower end of the particle size distribution are particularly problematic due to their high specific area, because they tend to agglomerate during mixing. The large particles at the upper end of the distribution are widely known to cause problems as well.

Figure 1 shows the frequency distribution of one such material.

When modified raw materials with an adjusted property profile come onto the market, they are often simply substituted and tested in existing formulations without modifying the mixing process. Under those conditions, the resulting compound might not or only partially benefit from the improved properties of the new and modified raw material. For this reason, it can be advisable to analyse the mixing process with regard to any necessary adjustment.

We know that the ideal property profile of a mixture can be generated with the right mixing process. Key process parameters include the order in which the ingredients of the formulation are added, and optimal process parameters in individual mixing phases such as filler incorporation in the form of suitable speeds, number of contact cycles, ram pressures and fill factors, just to name a few.

The following report describes a mixing process analysis of this kind. This study was designed to show which machine parameters have a significant effect on a model SBR formulation when a standard N134 is used and when a modified grade is substituted for it. Different kneader models were also used.

A three-stage process was selected, consisting of masterbatch, remilling and final mixing cycles. With the masterbatches produced in the "upside down" process, filler loading and speed were varied, because those parameters have a significant influence on mixing and dispersion quality for any given formulation. The mixtures were produced in five-litre laboratory mixers with tangential and intermeshing configurations. The ultimate objective was to produce the mixture with the best possible dispersion quality. This evolved into a test programme of some 450 mixtures in all.

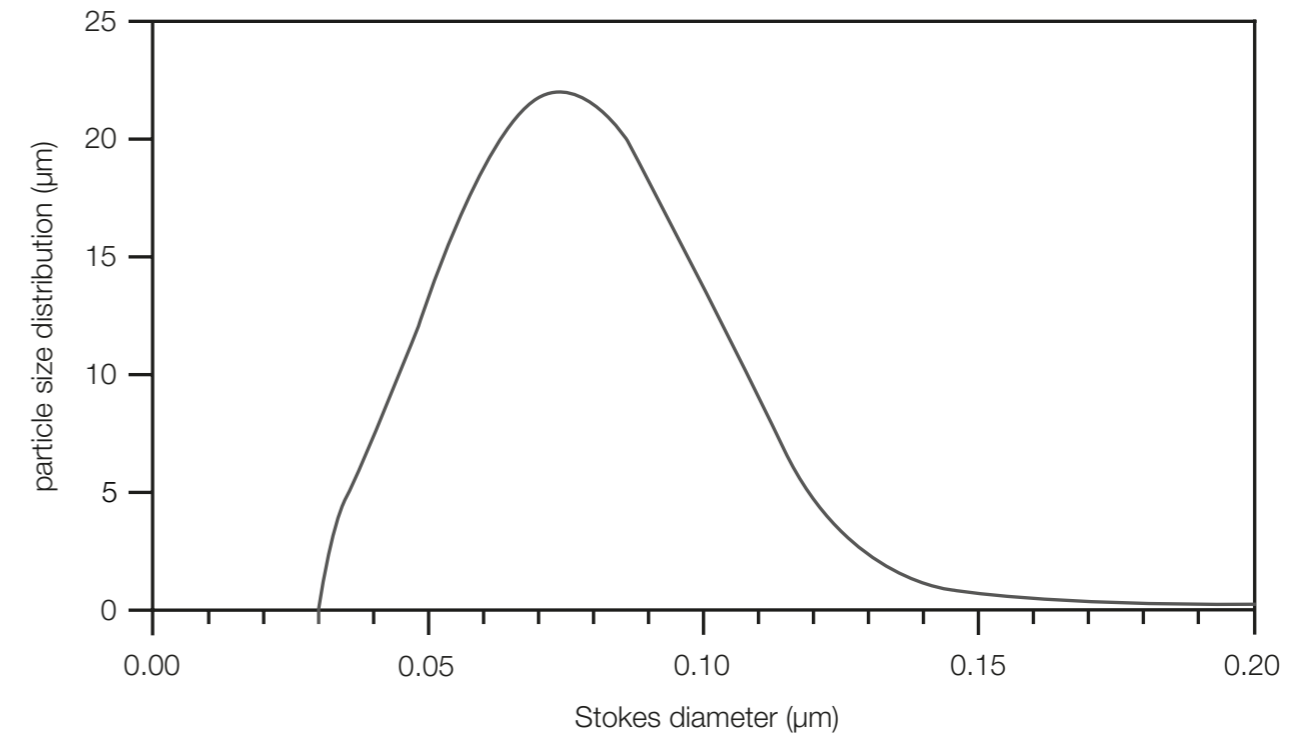


Fig. 1: Particle size distribution diagram for a highly active carbon black.

The tests produced a whole series of new findings and also unequivocally reconfirmed established principles. The overarching importance of the right filler loading, which has to be developed for any given formulation and for the type of rotor used in the kneader, was clearly demonstrated once again. For each type of rotor and for each speed selected, dispersion quality deteriorates sig-

nificantly as filler loading is varied away from the optimum level, as shown in Fig. 2 for the case of the standard N134.

The rotor speed itself likewise shows a significant influence on the mixing result, as might also be expected. Since the speed directly influences the level of shear and elongation deformation, which is so important for

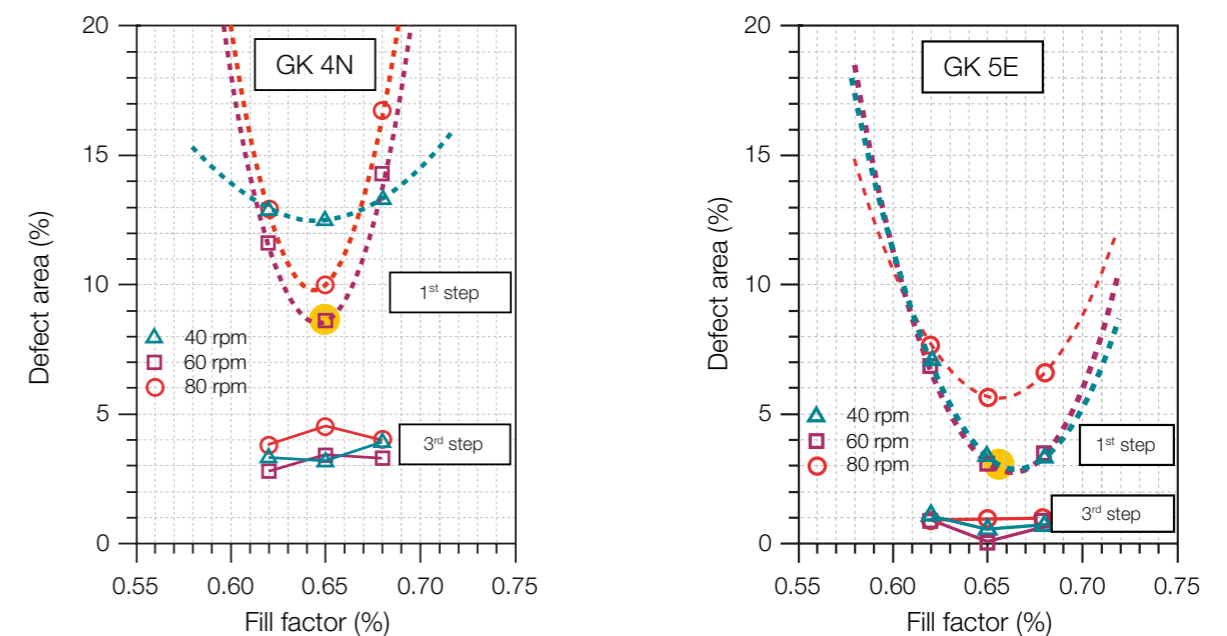


Fig. 2: Defect area (macro-dispersion) [Weh1995] as a function of fill factor and rotor speed after first and third mixing stage.

the dispersion of solids, an optimal speed of 60 rpm was determined for the standard N134. At slower speeds, the level of shear and elongation deformation no longer sufficed for good dispersion, whilst faster speeds raised the temperature of the mixture, which in turn had a negative effect on the stress level.

An astonishing effect was observed with the modified N134, because the lowest speed produced the best dispersion results. This effect is caused by the relatively soft carbon black beads of the modified material, which are much softer than the standard material due to the different production method used to make them. At high speeds and correspondingly effective forces, softer carbon black beads disintegrate more at the start of the mixing process. This, in turn, slows the speed with which the carbon black is incorporated into the polymer matrix, thereby resulting in poorer dispersion. In the kneader, the finer material leads to wall slipping, a finding which has also been proven in previous work [Keu2002]. This phenomenon is particularly evident in this case with the tests in the intermeshing mixer, as shown in Fig. 3. After feeding the material into the mixer (upside down), power peaks as the ram reaches its final position. In this stage, a multiphase system forms comprising fillers, the polymer and other components of the formulation, which leads to the aforementioned wall slipping effect. Subsequently the power increases until it peaks a second time, which is referred to as the “black incorporation time”

(BIT). If, as is the case with this modified carbon black, more fine material is present in this stage of the mixing process – fine material resulting from the disintegration of the softer carbon black beads – then wall slipping is increased, and in this case also as a function of speed. The higher the selected speed is set, the more these softer carbon black beads are destroyed in this mixing phase, thereby significantly delaying the BIT. A corresponding influence on the temperature rise is also observed. The mixing temperature of the carbon black with the softer beads increases more slowly than with the standard material. This can be attributed to the lower power input.

It is very interesting to analyse the properties of the mixtures and end products from the tests. The mixture properties were determined using the usual methods such as Mooney viscosity, RPA, mechanical tests, bound rubber and many more. In addition, both micro- and macro-dispersion measurements (TOPO) were used, in order to make more direct assessments of the dispersions produced. Abrasion tests with the LAT100 and directly from road traffic were included in the assessment [Schw-Keu2015].

The macro-dispersion with the surface topography method [Weh1997] already provides resolution down to an aggregate size of 2 µm, whereas the micro-dispersion measures smaller, non-dispersed particles. There is a new method for measuring the micro-dispersion which uses a confocal

microscope instead of a needle, thereby affording finer resolution. Performance in road traffic was measured with a heavy goods vehicle after 60,000 km (eight tyres of size 315/80 – 22.5) [Schw-Keu2015].

Initially the properties of the standard mixture showed no clear picture. Test methods such as Mooney, RPA, mechanical tests and bound rubber showed no clear relationships and did not correlate clearly to the measurements of the macro- and micro-dispersions or the abrasion tests. The results of the dispersion did match with the wear results, however. That means that, in this case, only the direct dispersion measurement is predictive of the wear behaviour of the HGV tread compounds. This result agrees with many of the findings of the European research project Mini Deru-com, in which 11 industrial and scientific partners investigated the influence of raw material properties on the mixing process and the properties of the end product. One of the key findings was that adjusted test methods for mixtures must be used in order to be able to draw conclusions about the properties of the end product [Keu2002], which this study re-confirms.

The study also showed that the intermeshing mixer after the masterbatch stage demonstrates better macro-dispersion performance than the tangential mixer, as can be seen in Fig. 2. This result can be attributed to the additional mixing effect between the rotors with the correspondingly high level of shear deformation and above all the high level of elongation deformation.

Moreover, it was found that despite the low bead hardness and the associated problematic incorporation behaviour, the modified N134 gave better dispersion results. This actually also manifested itself in the wear resistance. The effect was apparent in both the tangential kneader and the intermeshing kneader, whereby it was more pronounced in the intermeshing kneader. The abrasion tests with the LAT100 showed an improvement of up to 6% in the tangential kneader and up to 13% in the intermeshing kneader.

After 60,000 km driven on the road, this carbon black showed 9% better abrasion performance, which is considered to be a significant improvement in abrasion characteristics.

Based on the results of the investigations, it is reasonable to conclude that an optimisation of the mixing process for the purposes of achieving better properties of mixtures and end products can always be worthwhile, because the process parameters significantly affect those properties. This is particularly advisable when using new raw materials, the properties of which may differ from the original ones. The example given here clearly demonstrates once again the importance of specifically adapted test methods for the development of optimal process parameters which in turn produce good quality mixtures, thereby ensuring the best possible end product properties.

In sum: it's all in the mix – in this case, the interdisciplinary collaboration of specialists!

**[Weh1998] A. Wehmeier:**

Entwicklung eines Verfahrens zur Charakterisierung der Füllstoffdispersion in Gummimischungen mittels einer Oberflächentopographie (Development of a process for the characterisation of filler dispersion in rubber blends using surface topography); graduate thesis, Münster Technisches College, Steinfurth Department, 1998.

**[Lim-Keu2002] A. Limper, H. Keuter:**

Quality assurance in the rubber mixing room, Institut für Kunststoffverarbeitung, Universität Paderborn, 2002.

**[Schw-Keu2015] B. Schwaiger, H. Keuter, F. Diehl, A. Limper, A. Quast, H. Steiner:**

Reinforcing Filler for Truck Tyres & Impact of Mixing Technology on Dispersion of Carbon Blacks with High Specific Surface Area; DKT presentation, Nuremberg 2015.

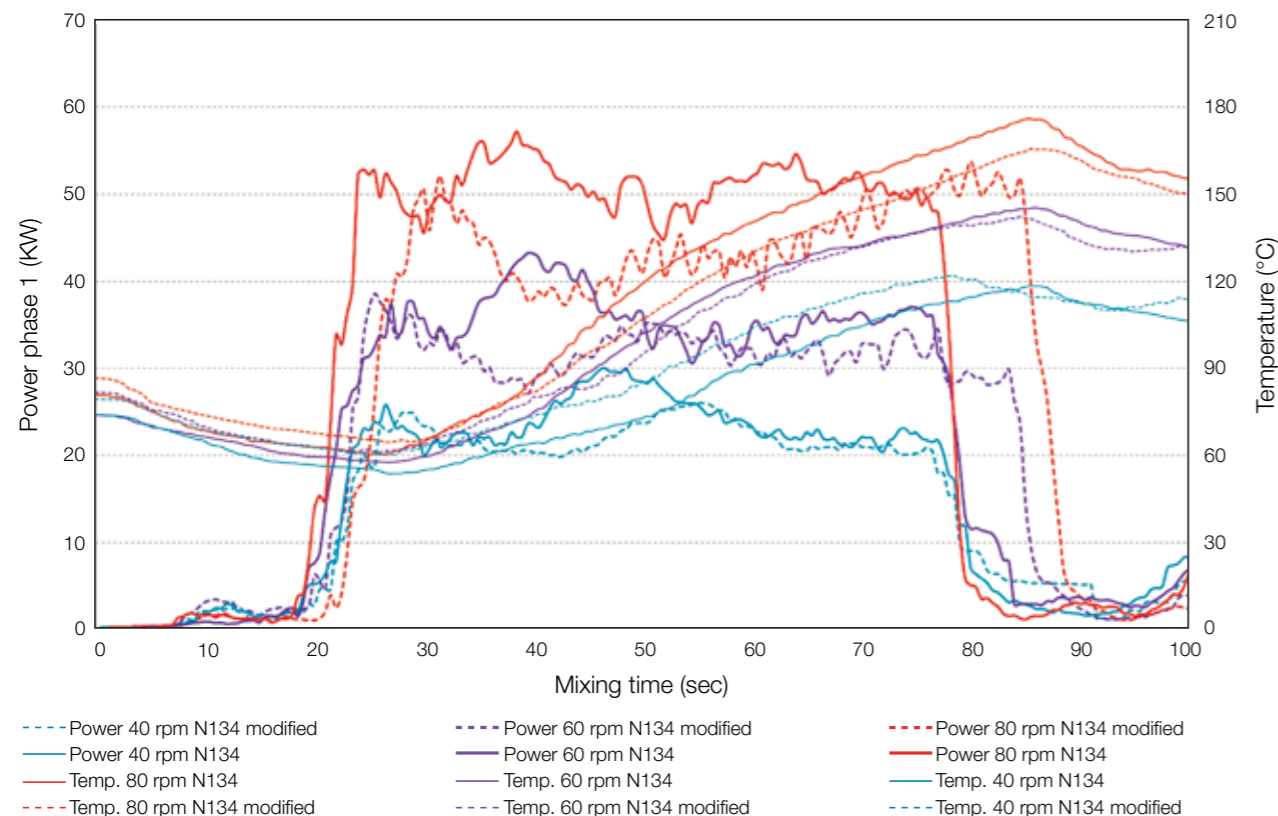


Fig. 3: Power and temperature curves as a function of rotor speed in the tests of N134 and modified N134

Carbon black type	Mixer	Fill factor (%)	Rotor speed (rpm)	Assessment
N134	GK4N	65	60	100
N134	GK5E	65	60	102
N134 mod	GK4N	65	40	106
N134 mod	GK5E	65	40	113

Table 1: Results of abrasion tests on LAT100 (Grosch) [Schw-Keu2015]



# Rubber equipment from the “Land of Oz”

How the colleagues at HF Rubber Machinery live and work.

HF Rubber Machinery, Inc. is located in the heart of Tornado Alley in the centre of the United States. Although the last major tornado that hit Topeka was in 1966, the threat is very real every spring through the summer months.

Topeka is a city located in East Central Kansas with a population of 128,000 people. It is the state capital of Kansas with the Kansas River running through the centre

of the town. In addition to being known for the Wizard of Oz, Kansas has also been referred to as the “Heartland of the US”, “The Bread Basket of the World” and the “Wheat State”. It is located in an agricultural area. Many of the local businesses and much of the local economy is tied directly to the fertile, irrigated, river bottom ground that produces corn, soybeans, wheat and milo. Because of the abundant production of grains, the area also produces large amounts of beef and pork.

Topeka is located about one hour from Kansas City, which is the largest city in Kansas and the home of the world champion baseball team Kansas City Royals and the American football team Kansas City Chiefs. Many of the employees of HF Rubber enjoy a weekend in Kansas City in the summer, taking in a Royals game and enjoying the big city atmosphere that Kansas City provides. Topeka is also located between two major sports colleges: Kansas State University (Wildcats) in Manhattan, Kansas, and Kansas University (Jayhawks) in Lawrence. The rivalry of these schools is ongoing during the football and basketball seasons. Hunting, fishing, camping and many other outdoor activities are very popular year round in the Topeka area.

With the majority of rubber production being located in the eastern and southeastern parts of the United States, many people wonder how a machinery manufacturing company the size of HF Rubber ended up in Kansas. As with most business starts, it has a unique history. Although it does not have the hundreds of years of production like our European counterparts, it has been in business for 55 years. Leonard Smith was the original founder and started the company in 1960 under the name of Midwest Machine Works. Leonard was an employee at the local Goodyear Truck/Bus/Off-Road tyre plant and saw a business opportunity to rebuild tyre moulds for the plant. He took this idea and started the company. It began in a 2,400-square-foot building that housed both manufacturing and office space. As Leonard’s contacts grew through the years of working with Goodyear in Topeka and Akron, so did his contacts with other tyre producers. In the early 1970s, Leonard was able to acquire the mixer rebuild business for all the Firestone Tire Co. plants and this was the beginning of manufacturing rubber mixers in Topeka.

As his business grew, additional manufacturing space was added and a two-storey office building separate from the manufacturing was constructed. Through the years of growth, Midwest Machine Works not only furnished new and rebuilt mixers but also developed other equipment for the rubber industry.

A machine that is still used today in limited quantities are bead-wrapping machines. These machines were very innovative at the time and many tyre plants used them for manually wrapping tyre beads with string or mesh. The Adams T-Mix was also redesigned during this time by reducing the overall length of the equipment and freeing up valuable floor space in manufacturing plants. Larger single-screw dump extruders were also manufactured. These ranged from the smaller 6" screws to the larger 20" x 24" extruders.

As Midwest Machine Works grew and established a high reputation in the rubber equipment industry, it caught the attention of Werner & Pfleiderer (W&P) located in Freudenberg, Germany. Werner & Pfleiderer was a well-known rubber equipment manufacturer in Europe and wanted to expand their business into the North American market. It began its search to purchase an established manufacturing company in North America and found Midwest Machine Works in Topeka.

In 1989 Werner & Pfleiderer purchased a portion of Midwest Machine Works with the option to have full control by 1994. The name was eventually changed to Midwest Werner & Pfleiderer and the company began marketing the “GK” style of tangential and intermesh mixers in North America. Through the years, the German parent company changed names, which resulted in name changes in the US as well. Krupp Rubber Machinery and ThyssenKrupp Rubber Machinery were among the name changes. With the change of owners – the parent ThyssenKrupp elastomertechnik was acquired by the Possehl Group in 2005 – the current name of HF Rubber Machinery, Inc. (HFRM) was established.

After the Possehl Group acquired the company FARREL in 2009 all the US-based rubber mixing business in terms of equipment rebuild, spare parts supply and service was transferred to Topeka. This additional business required more manufacturing area and after the addition of a new assembly/warehouse in 2014, HFRM currently occupies 100,000 square feet manufacturing and 20,000 square feet office space. In the machine shop HFRM manufactures high-quality machine parts with state-of-the-art CNC machines and the latest welding technology. With a total of 101 employees HFRM today services customers in the tyre industry as well as companies in the field of technical rubber goods.

**The strength of HFRM lies in:**

- Rebuilding all mixer types and sizes back to original specifications
- Supplying mixer spare parts out of a strong stocking programme
- Installing and maintaining rubber mixing equipment including upstream and downstream equipment

As part of the HF MIXING GROUP, HFRM continues to grow and introduce new and innovative products into the rubber market.

# The people behind the HF MIXING GROUP

Our performance and our innovative spirit are rooted in the individual abilities of our employees. Allow us to present a few of them to you here.

## Chengwei Fan – Mechanical engineer in China

➔ HF Machinery (China) Co., Ltd., Qingdao, China



Located in the city of Qingdao (pop. 3.5 million), HF's Chinese subsidiary has a German history: the port city on the Yellow Sea was a German colony from 1898 to 1919. To this day, traditional Chinese values are fused with the remnants of colonial influence. Chengwei Fan has also internalised that affinity for Western culture – without sacrificing his own roots. Born in Anhui Province, the mechanical engineer is responsible for the team of mechanics at HF Machinery (China). Meanwhile, under the leadership of HF managers Shimin Wang and Xiaolin Ma, Fan has also assumed a central role in the area of procurement for hybrid projects.

The engineer's working style is marked by his straightforward, conscientious attitude and his strong sense of team spirit. Fan has a broad range of interests. Alongside his fascination with machines, the engineer has a deep passion for all aspects of marketing. This is the source of his clear sense that best-in-class machinery

also always demands the highest quality marketing performance, in order to establish and maintain an excellent position on the market. At HF MIXING GROUP, Chengwei Fan is experiencing that in a particularly impressive fashion. "It is a great honour and a good experience to participate in the growth and development of HF Qingdao in China", says Chengwei Fan with unabashed pride. "The process by means of which HF, Farrel and Pomini is merging the top three players of the industry to become HF MIXING GROUP is resulting in a new worldwide market leader in the area of mixing technology." Fan is convinced of this. And he's working hard every day to make it happen. Chengwei Fan is honest and humble. And also willing "to work under pressure". Passion? Fan equates that with "striving for success". And to be successful is one of his personal goals. Out of this experience, he is acquiring the courage to try out new things and the self-confidence to explore unknown territory and take calculated risks.

## Olaf Christian – Service employee in France

➔ HF France S.a.r.l., Houilles, France

Passion for detail – for Olaf Christian, that is one of the keys to the company's success. Originally from Oldendorf near the town of Stade in northern Germany, he has been maintaining an installed base of some 170 interior mixers for more than 15 years now and is responsible for customer service throughout France. His job is to inspect the machines, assess their condition, and identify any wear, in order to minimise downtime due to unscheduled shut-downs. His detailed first-hand knowledge also makes Christian the perfect candidate to manage the spare parts business. In addition, he implements complete projects in the area of general overhauls and takes charge of install-

ation planning and system upgrades. The complexity of the work is a source of satisfaction for Christian: "Keeping customers satisfied brings new challenges every day. I really enjoy the direct contact with the customers and the communication and interaction with the different HF teams in France."

In his day-to-day work, Christian spends a lot of time travelling. The service expert places an especially high value on family as a result. Early on, Christian developed a particular affinity for France and its *savoir-vivre*. His work in the field of rubber mixing technology for the companies Werner and Pfeleiderer brought him to France in 1992. Today Christian lives in St. Cloud – west of Paris not far from Versailles – together with his wife, a Frenchwoman, who works in the banking industry as the head of a controlling department. Their 21-year-old son is studying graphic design in the French capital.



Christian takes a very positive view of HF MIXING GROUP's prospects for the future, not least because the fusion of the different companies provides the opportunity to offer expanded services in France and to combine the best technologies and ideas. But Christian finds that the new dimensions of the organisation also impose new demands. In order to get to know the colleagues from the different locations better, he believes that it would be useful to plan even more customer visits together. That would promote internal and external communication.

## Ahmad Supian – General Manager South-East Asia

➔ HF MIXING GROUP Services S.E.A. Sdn Bhd, Kuala Lumpur, Malaysia

The since October 2014 newly married Ahmad Supian is as general manager responsible for HF MIXING GROUP's South-East Asia region. From the Malaysian capital of Kuala Lumpur (pop. 1.6 million), Supian organises all services in that area. In order to provide rapid response times and good service, Supian has a service employee based in the Indonesian capital of Jakarta. Some 9.5 million people live in the political, cultural and economic centre of Indonesia – and about 30 million in the metropolitan area of Jakarta. There is another service technician based in Thailand who is also supported from the main office in Kuala Lumpur. The General Manager knows that it's no accident that the HF office has been established in the Malaysian capital. The transportation network is excellent. That favours the logistics of the HF MIXING GROUP: rapid access to the key customers in Malaysia, Indonesia and Thailand is guaranteed – an important competitive advantage for Ahmad Supian.



The General Manager also has a positive opinion regarding the creation of HF MIXING GROUP. Each and every product offers its own very special qualities and strengths, which have to be combined in the future. That will make it possible to realise synergy effects, which will provide the HF MIXING GROUP with good prospects for further technological progress. If you ask Supian, this will result in additional growth. He's absolutely convinced about that. And to make sure it happens, the General Manager applies his core attributes of passion and tenacity in the pursuit of his objectives. Moreover, he is also widely admired for his skills as a listener and a negotiator. He knows, of course, that the path forward is never a straight line. But obstacles are there to be overcome. Supian's credo: he who works hard also achieves his goals.



# MIXING News

Read about the worldwide developments and news of HF MIXING GROUP.

## Outstanding: Pirelli Supplier Award 2015

➔ Bicocca, Italy

High praise: on 16 April 2015, HF MIXING GROUP was honoured with the Pirelli Supplier Award 2015 in the category "Equipment". The prestigious award was presented by Marco Tronchetti, Chairman and CEO of Pirelli, at the corporate headquarters in Bicocca, north of Milan. Every year, the tyre manufacturer applies an extremely broad range of criteria when it recognises its best suppliers. The recipients of the awards come from different areas and their extensive expertise contributes to Pirelli's success,

as Tronchetti explained during the gala award ceremony. Pirelli currently collaborates with 12,000 different suppliers. In his address, the CEO emphasised the strong innovative force and high quality of the companies that received the awards. "The nine award winners stand for absolute top performance", stated Tronchetti, adding: "It is our sincere wish that we continue this positive and solid collaboration."



Festive ambiance: The Pirelli Awards were presented during a small ceremony in Milan.



Marco Tronchetti Provera, CEO, Mark Meulbroek, member of the board of management, HF MIXING GROUP, Otto Huth, division manager, twin screw discharge extruders, HF MIXING GROUP.



Coveted trophy: HF MIXING GROUP was awarded the Pirelli Supplier Award 2015.

## Clear commitment to sustainable and responsible corporate management

➔ Freudenberg, Germany

The HF MIXING GROUP is characterised by a high degree of broad-based technical and process engineering expertise gained over the course of 150 years and a corporate philosophy that reflects long-term vision and sustainability, as well as a conscious emphasis on close collaboration with customers and business partners. The result of this proactive approach is shared and continuous success. The central building block of the corporate value system is sustainability. It expresses the future-oriented action of the Group. A logical extension and continuation of the activities in the area of sustainability is the signing of the United Nations Global Compact in early May 2015.

The HF MIXING GROUP is currently integrating the ten principles of the Global Compact into its everyday activities. At the same time, the company is actively working to persuade its business partners to align their business activities likewise to the ten universally accepted principles from the areas of human rights, labour standards, environmental protection and the fight against corruption.

### Ten principles of the UN Global Compact

1. Businesses should support and respect the protection of internationally proclaimed human rights.
2. Businesses should make sure that they are not complicit in human rights abuses.
3. Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining.
4. Businesses should advocate the elimination of all forms of forced and compulsory labour.
5. Businesses should advocate the effective abolition of child labour.
6. Businesses should advocate the elimination of discrimination in respect of employment and occupation.
7. Businesses should support a precautionary approach to environmental challenges.
8. Businesses should undertake initiatives to promote greater environmental responsibility.
9. Businesses should encourage the development and diffusion of environmentally friendly technologies.
10. Businesses should work against corruption in all its forms, including extortion and bribery.

[www.unglobalcompact.org](http://www.unglobalcompact.org) | [www.globalcompact.de](http://www.globalcompact.de)

## Employees donate to help disabled Nico

➔ Freudenberg, Germany

The generous action was motivated by HF's partner in occupational health and safety: when the "Gesellschaft für Rehabilitation, Prävention und Pflege mbH" (Rehabilitation, Prevention and Care Centre) at Oberberg Hospital brought their campaign to the attention of the HF employees, their willingness to participate was great. The centre proposed to provide treatment to a disabled boy named Nico in exchange for donations on his behalf. The employees at the Freudenberg site soon decided to donate a larger amount from the "Joy and Sorrow Fund". Out of solidarity, all employees pay into that fund by contributing the amount to the right of the decimal point on their payroll statements. General Management of the company was so impressed by the commitment demonstrated by the employees that it immediately doubled the amount that they had agreed to donate, in order to support Nico as well.

The collection of donations was initiated by the "Ursula Barth Stiftung" and "Helfende Hände Oberberg" for the purpose of providing financial support to help Nico's family purchase a new, wheelchair-compatible van. Some 10,000 euros were needed to make it easier for the family to transport Nico's wheelchair.

Fifteen-year-old Nico suffers from muscular dystrophy. This disease is caused by a genetic defect which slowly converts muscles into fatty tissue. The progress of the disease cannot be stopped, and there is no chance of improvement.

## Participation in Legnano Night Run 2015

➔ Legnano, Italy

A huge crowd gathered on the Piazza San Magno: in the pleasant early autumn temperatures, some 3,000 athletes met on 11 September 2015 for the traditional Legnano Night Run, not far from the northern Italian metropolis of Milan. Legnano's proximity to the HF site in Rescaldina enticed 18 employees of Pomini Rubber & Plastics to enter the competition. The idea of running the 7.5-kilometre route through the centre of Legnano originated with Business Unit Manager Otto Huth.

Following an impressive battle cry and the crowd's unison countdown, the starting gun fired at 9.30 p.m. As Fabio de Angeli, the winner of the men's competition, crossed the finish line, the clock showed a very good

time of 24:08 minutes. The first participant of the Pomini team to finish was Maurizio Franchi with a time of 29:09 minutes. Ultimately, the results were only of minor importance, however. What really mattered most was the shared experience of participating in the Legnano Night Run. Afterwards, the HF runners used the occasion to throw a spontaneous party on the Piazza San Magno, thereby promoting friendly relations among one another also outside of work.

**Certification in the areas of environment, energy and quality**

➔ Freudenberg, Germany



After an intensive period of organising and implementing an environmental and energy management system, the Freudenberg location has received the relevant certificate from TÜV Nord (see pages 24–27). With the implementation of the environmental and energy management system, the company is taking responsibility, thereby making a decisive contribution to the preservation of natural resources for future generations. HF NaJUS is pleased to have obtained a certification as well. In October 2015, the Slovakian location was certified by ACERT in the area of quality management EN ISO 9001:2008.

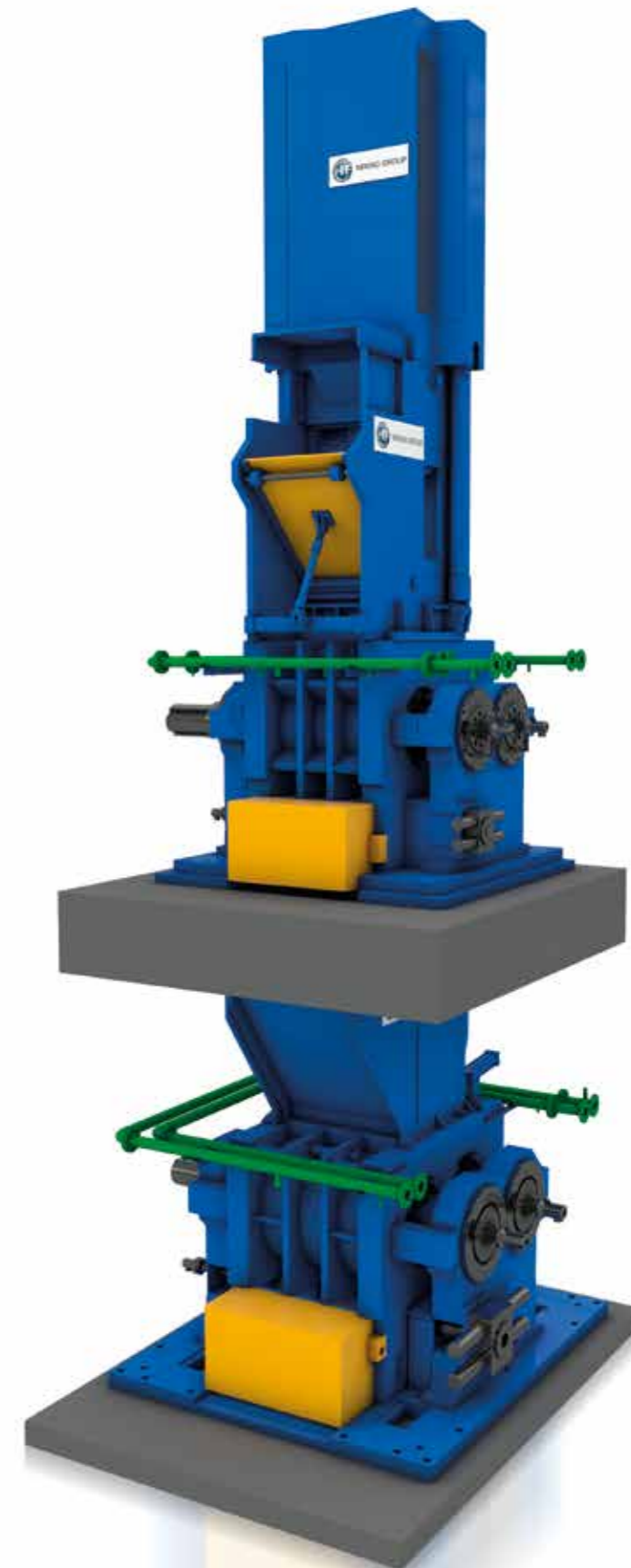
**Investment in equipment for quality testing**

➔ Freudenberg, Germany

This much is certain: HF MIXING GROUP makes products you can trust. In order to continue to fulfil that promise also in the future, the company has invested in state-of-the-art measurement technology for quality control at the Freudenberg site. Thanks to a second FARO Edge measurement arm, employees are now able to carry out quality-relevant measurements more precisely and effectively than ever before. In the opinion of the HF experts, this high-tech device is the most advanced measurement system of its kind currently available on the market. One main advantage of the FARO measurement arm is its portability. That makes it possible to inspect components right on the machine or in other areas of manufacturing. The system can also be used to carry out complex measurements and analyses of drawing dimensions and their associated shape and positioning tolerances with high precision. Three-dimensional inspections and CAD comparisons help make it possible to meet the high quality standards of HF MIXING GROUP products.



The FARO Edge measurement arm.



TANDEM MIXER

## EZD is counting on HF MIXING GROUP with the supply of the universal kneader UMIK

→ Selb, Germany

The European Centre for Dispersion Technologies (Europäisches Zentrum für Dispersionstechnologien – EZD) in Selb, an institution of the Würzburg Kunststoffzentrum SKZ founded in 2014, is Harburg-Freudenberger Maschinenbau GmbH's first customer to purchase the new UMIK line.

EZD decided to opt for the machine as they were confident with the rock-solid structure, in line with that of Werner & Pfleiderer, which is based on over a century's worth of experience in the construction of universal mixers as well as on the know-how of the manufacturer in the field of batch mixing, which is of great value for the ADVISE® CS control system used for the UMIK machines. Other rotor geometries than the sigma blade will also be available for this type of machine in the future.

The ADVISE® CS control offers a variety of possibilities for laboratory mixers that are otherwise only known from larger, production-sized machines. Thanks to the graphical user interface and the sophisticated arrangement of the displays and data entry screens, the user is able to quickly get to grips with the operation of the machine. Information screens can also be accessed quickly and intuitively, thanks to the 19" touch screen.

In addition to the "standard operating mode", which mainly comprises the control of the mixer drive (On/Off/Speed), individual mixing steps can be defined and linked to a mixing cycle with ADVISE® CS. For each step, the most important parameters such as mixing time, blade speed and if necessary the control of a temperature control unit or vacuum pump are specified. So any recipes developed on laboratory mixers can be transferred to production-sized machines without much effort at all.

Besides the automatic numbering of steps, the function of each mixing step is also displayed. In addition to

the mixing time, process parameters such as the temperature of the compound can be selected as a condition for handoff to the next process step. This may be a manual intervention, for example the addition of another component of the mixture. Up to 20 mixing steps can be combined into a cycle and stored.

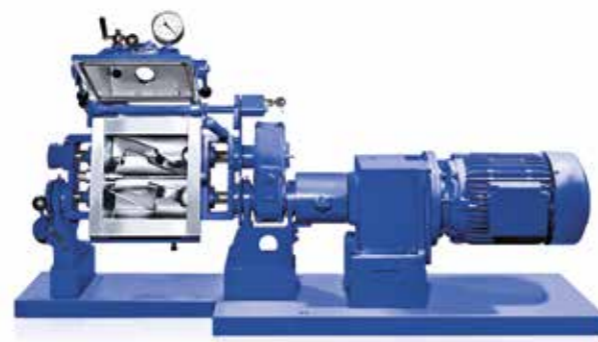
During operation of the machine, key process parameters (such as rotor speed, power consumption of the drive, temperature of the compound, temperature of the temperature medium) are displayed numerically and graphically. All recorded process parameters are stored in the controller itself or on a network and are available for evaluation or for comparison with other mixing cycles in Excel format. For adaption to the process, the data acquisition can be configured individually.

The head of the EZD, Dr.-Ing. Felipe Wolff-Fabris, is convinced that this combination of robust, proven technology with the possibilities of modern control will be a valuable aid at the work of his institution.

The UMIK series includes laboratory mixers with useful volumes from 0.25 to 8 litres and production mixers up to a useful volume of 4,300 litres. The machines are used in the manufacture of various products of medium to high viscosity, for example silicones, glues and adhesives, paints, pigments and ceramics, as well as chewing gum and chocolate. Depending on the application the machines are equipped with removable or tiltable trays, with bottom discharge valves or discharge screws. The machine control systems are modular in design and range from the simple basic control of ADVISE® CS described above through to complete process control systems that include quality monitoring incorporating all components involved in the process, such as material weighing and supply, as well as the further processing of the final compound.



Dr.-Ing. Felipe Wolff-Fabris of EZD in Selb is delighted with the new member of the team.



Tiltable production mixer

## Daredevil teams in their flying machines

→ Freudenberg, Germany

Hectic activity in the pit lane of the Freudenberg Grand Prix: on 10 October 2015, 17 teams competed in the Freudenberg Grand Prix to determine the best soapbox pilot.



Premiere in Freudenberg: in ideal weather conditions, several hundred spectators gathered to support 17 daredevil teams at the 1st Freudenberg Soapbox Grand Prix. The illustrious field of drivers was a tumult of students from the local secondary school, a number of different company teams, and historic car fans. The soapbox derby was open to Freudenberg's companies, restaurants, schools and associations. Only homemade vehicles were authorised to compete. To ensure an equal chance of winning, all participants received a kit containing the basic construction materials. The teams then had ten days to build their race cars according to simple rules.

Lacking a genuine race track, the organisers did not hesitate to lay out the course in the town. Along steep terrain, the 200-metre route led full speed ahead toward the Freudenberg spa gardens. In order to control the tempo of the race, the stewards stipulated a mandatory pit stop in the regulations. The winners were the team from the Freudenberg gymnastics club with the imposing name "4 wins". A team of 6th-graders from the local comprehensive school represented the HF MIXING GROUP. With the help of HF employees from production, the students assembled a lightning-fast speedster in just four days. With a good dose of creativity and a whole lot of hard work, they built a race car decorated with flames, which made it easy to recognise even from a distance. The race car was assembled in the HF production hall. Initial test runs were made on the factory grounds. "6b on Wheels" made a particularly impressive entrance during the team presentations before the race. With a stage choreography developed all on their own and an entertainingly detailed introduction, the students won the enthusiastic applause of the audience with their story of how their "Fire Speedster" was created.



## Freudenberg

Fresh air natural setting and a long history: Freudenberg – with a population of some 18,000 people, the town is part of the Siegen-Wittgenstein municipality in the German Federal State of North Rhine-Westphalia. Spread across an area of nearly 55 square kilometres, Freudenberg is divided into 17 neighbourhoods. The oldest part of the town was first mentioned in the historical records as far back as the 11th century. Today the "Alte Flecken" – Freudenberg's historic town centre – tells the story of the town. With easy access to the A45 motorway, local companies such as the HF MIXING GROUP take advantage of the rapid connections to the business centres of Cologne and Frankfurt and the metropolitan region of the Ruhr.

## The "We're for Freudenberg" initiative

Sustainably marking and ensuring the future of the Freudenberg site – those are the main goals of the "We're for Freudenberg" initiative. The commitment and combined efforts of regional companies in this influential initiative aim to bolster the attractiveness of the town and its environs and to anchor that positive image in people's minds more firmly than ever before. This applies above all to the young people living in and near Freudenberg. Through intensive and close collaboration with schools and clubs, the companies participating in the initiative actively address young people in order to call their attention to career prospects in the area early on. That's why schools and clubs could also participate in the 2015 soapbox derby through sponsorship by Freudenberg-based companies. Members of the initiative "We're for Freudenberg" include, along with the HF MIXING GROUP, the electrical and electronics wholesaler Hagemeyer, the special machinery manufacturer Albrecht Bäumer, the construction firm Otto Quast, and Welke Consulting Group.





## Network for success

The sponsoring of the local football club is part of a long-term strategy to safeguard the company location.

HF MIXING GROUP sponsors the athletic club SV Fortuna Freudenberg-Büschergrund e.V. The partnership with one of the biggest football clubs in the Siegerland region of Germany started on 30 August 2015. One clear sign of the increasing collaboration between the globally active company and the regional football powerhouse is that the stadium in Freudenberg has been renamed. Now known as "HF Arena", the facility in the Wending river valley's Büschergrund district serves not only as a training pitch for more than 250 youngsters, but also hosts home matches for both junior teams and seniors. The new arena's official dedication ceremony was held before the district league match against SG Hickengrund. Numerous sports fans, club members and em-

ployees made their way to Büschergrund Wendingtal's HF Arena and participated in the small opening ceremony.

### Win-win situation for Freudenberg

HF MIXING GROUP's commitment to SV Fortuna Freudenberg-Büschergrund is much more than an investment in the local sports scene or a sign of solidarity with the Freudenberg community. The sponsorship is part of a broad-based employer branding strategy through which the company actively engages in the social sphere of potential junior employees, in order to raise their awareness of the professional opportunities at HF MIXING GROUP.

And in this way, both partners benefit from the close networking. "A football club has long since become more than a mere side line", explains the club president Karsten Klappert, speaking of the necessity of viable support from a serious partner. "Without a committed partner like HF MIXING GROUP, it is hardly possible to provide appropriate conditions for youngsters and adults anymore." This cooperation with the footballers from Büschergrund is a real win-win situation that benefits both partners. The intensive contact with the young athletes raises public awareness of HF MIXING GROUP. HF believes that the training and promotion of young people is particularly important in order for us to achieve our objectives sustainably. Solid practical training, the opportunity to work abroad, and a "dual education" programme are just a few of the components of the offer.

### "Big Star of Sports" in bronze

Against the background of the demographic shift, networking common interests closely together is to the benefit of all involved. With that in mind, it's no wonder

that HF and Fortuna are so confident about the "many professional, athletic and private opportunities". As a company firmly rooted in the region, this creates the ability to demonstrate opportunities and prospects in an ongoing process. Moreover, both partners share a great love for football: whilst the club has been chasing the leather ball since 1907, teams from HF MIXING GROUP's international locations have been competing in a company-wide football tournament every year.

And HF MIXING GROUP is not the only organisation that believes in SV Fortuna Freudenberg-Büschergrund. That became apparent a few days after the HF Arena's dedication ceremony. The club was awarded the "Big Star of Sports" bronze medal for the project "Football can do more...". The 750-euro cash award honours the close interaction between the club with schools, health education and social care. As an initiative of the German Olympic Sports Confederation as well as the Volksbanken and Raiffeisenbanken credit unions, the "Big Star of Sports" has been awarded annually since 2004.

# Presenting competence the world over

Worldwide trade fair presence is a key component of HF MIXING GROUP's sales and marketing activity. We presented our capabilities in 2015/2016 at the following industry gatherings.

## Tire Technology Expo 2015

➔ 10–12 February 2015, Cologne, Germany

At the world's leading trade fair for tyre design and tyre manufacturing, the HF MIXING GROUP presented itself as every year together with its colleagues from Hamburg as the HF Group. The 144-square-metre stand featured "Mixing Solutions", "Extrusion Technology", "Tire Building Machines" and "Curing Presses" alongside four thematic areas. The highlight of the show was the AD-VICE® system exhibit.

After 15 years, the Tire Technology Expo has decided to turn its back on Cologne and pitch its tents in Hanover in the future. For that reason, the "HF meet & greet" traditionally held at the Bauwerk Köln event facility was also a farewell party. The overarching theme of the customer evening emphasised international spirit. In keeping with that theme, culinary highlights from different countries were arranged in four stations for the group of more than 100 visitors to savour: German & local, Pacific/Asian, American, and French/Italian. It was all rounded out by a dessert from the British Isles. One of the high points of the evening was the performance by the Cologne-based light show artist "Lemmi". For more than ten years now, he has been mesmerising his audiences with a fascinating light show – so-called "laser juggling". The musical programme was provided by a talented trio comprising a female DJ, a vocalist and a saxophonist.

## NPE 2015

➔ 23–27 March 2015, Orlando, Florida (USA)

At NPE 2015, FARREL POMINI provided proof of its capabilities. At the world's biggest trade fair for plastics and

plastics technology, the company's presentation emphasised innovation. A CP1000 was on display – the medium-sized processor of the CP Series IITM. The CP1000 has all new characteristics and is suitable for use in both new machines and retrofits. The patented Self-Aligning Seal (SAS) offers faster assembly, improved dust seal performance and longer service life versus a standard seal. The Synergy Control System – a comprehensive automation and control system – seamlessly integrates upstream and downstream equipment with an extremely wide variety of suppliers, while increasing efficiency and equipment reliability at the same time. In so doing, the Synergy Control System makes data available in real time, which can also be modified during the process, in order to improve productivity and product quality. The new design of the vent assembly improves ventilation performance, thereby minimising losses. This increases product quality and reduces waste.

CPXL rotors using the latest technology were also presented at the NPE. FARREL POMINI extended the rotor technology for the processors of the continuous mixers. This evolution makes it possible to support existing LCM customers and to make the LCM-based rotor technology available to all FARREL POMINI customers. The CPXL Compact Processor has an increasing mixing section from 6:1 L/D to a nominal 10:1 L/D and two-stage LCM technology rotors.

The NPE 2015 attracted 2,029 exhibitors and a total of 65,810 visitors – an increase of 19% over the previous exhibition in 2012. The visitors represented more than 23,000 companies from all over the world. Nearly 44% of the exhibitors and 26% of the visitors came from outside of the USA.



The HF MIXING GROUP stand at Tire Technology Expo 2015.

## Plast 2015

➔ 5–9 May 2015, Milan, Italy

Eight employees from POMINI, FARREL POMINI and Farrel UK represented the HF MIXING GROUP at Plast 2015 in the northern Italian metropolis of Milan. With accustomed competence, the sales, automation and engineering experts answered the questions posed by the many visitors to the stand. Among the industry's European trade fairs, Plast is second only to K in Düsseldorf. In terms of content, HF MIXING GROUP's participation here focused primarily on convincing the market of the improved quality of the compounds despite shorter mixing times. Videos informed visitors about the CP Series IITM and provided a comprehensive overview of the HF MIXING GROUP's capabilities.

## Chinaplas 2015

➔ 20–23 May 2015, Guangzhou, China

In its first appearance at Chinaplas, FARREL POMINI presented its equipment to the public. There was keen interest in the CP550 with its recently developed Self-Aligning Seal, which provides the customers with concrete benefits such as faster assembly, improved dust seal performance, and longer service life versus a standard seal. Even at a distance, the contemporary styling of FARREL POMINI's trade fair stand highlighted the company's modern, attractive flair. Videos about the company and its products underscored the capabilities and know-how in moving imagery. One product video offered impressive proof of the CP550's performance characteristics. In the wake of the trade fair, the feedback was correspondingly positive: the CP550 attracted the visitors' attention. Those responsible reported prom-

## A review of 2015

### Arabplast

➔ 10–13 January  
Dubai, United Arab Emirates

### 8th India Rubber Expo and Tyre Show 2015

➔ 15–17 January  
Pragati Maidan, New Delhi, India

### Interplastica

➔ 27–30 January  
Moscow, Russia

### PlastIndia

➔ 5–10 February  
Gandhinagar, Gujarat, India

### Tire Technology Expo

➔ 10–12 February  
Cologne, Germany

### NPE

➔ 23–27 March  
Orlando, USA

### PLAST 2015

➔ 5–9 May  
Milan, Italy

### DIK/DKG Seminar

(Production of rubber blends)

➔ 6–7 May  
Freudenberg, Germany

### AMI Conference

➔ 12–13 May  
Denver, USA

### Chinaplas 2015

➔ 20–23 May  
Guangzhou, China

### ACHEMA

➔ 15–19 June  
Frankfurt, Germany

### IOM<sup>®</sup> 22nd National Rubber Conference

➔ 19–20 June,  
Drakensberg, South Africa

### DKT + IRC (German and International Rubber Conference)

➔ 29 June – 2 July  
Nuremberg, Germany

### 6. WPC & NFC Conference

➔ 16–17 December,  
Cologne, Germany

ising meetings and keen interest in the products. In addition, visitors from the USA and the UK obtained extensive information about ongoing laboratory testing.

Chinaplas is the plastics and rubber industry's biggest event in Asia. This 29th edition hosted 3,282 exhibitors from 40 countries. Some 128,000 visitors made their way to the exhibition grounds in Guangzhou. The annual international plastics and rubber trade fair alternates between Guangzhou (pop. 12 million) and Shanghai (pop. 15 million).

### ACHEMA 2015

➔ 15–19 June 2015, Frankfurt am Main, Germany

A genuine premiere for ACHEMA: for the first time, the HF MIXING GROUP was represented with the universal mixing and kneading machine UMIX at the leading international trade fair for the process industry. The main attraction, crowd-pleaser and eye-catcher on the stand was the UMIX-L 1.0 T laboratory machine. This striking exhibition unit served as the impetus for many meetings and helped the stand personnel generate new contacts and gain new potential buyers for the machines. The continuous stream of visitors and the strong interest in HF products made it clear that ACHEMA was a complete success and that public attention is now focused on the HF MIXING GROUP as a manufacturer of sigma kneaders.

More than 166,000 visitors came to learn about the offerings on display by 3,813 exhibitors. Interestingly, nearly 54% of the exhibitors came from abroad. Germany edged out China as the country with the largest number of exhibitors. As measured by exhibition space, however, Italy bested the competition.



### DKT 2015/IRC2015

➔ 29 June–2 July 2015, Nuremberg, Germany

As a major manufacturer of mixers and mixing room systems, the HF MIXING GROUP was represented with its own stand again this year at the German Rubber Conference 2015 (DKT). Many highly respected presentations given by HF MIXING GROUP experts contributed significantly to the success of the International Rubber Conference 2015 (IRC), which was held at the same time as its German counterpart.



As a global gathering for all of the key players in the rubber and elastomers industry, the DKT once again drew networking partners from more than 30 countries to the Franconian metropolis of Nuremberg. More than 270 exhibitors and over 3,000 technical experts and managers from around the world took the opportunity to get an extensive overview of the entire industry.

Held in parallel, the International Rubber Conference (IRC) also resonated with the professional public. More than 1,000 interested parties had registered to attend some 120 presentations. Remarks delivered by Dr Andreas Limper, Managing Director of HF MIXING GROUP, and Maik Rinker, head of HF's "Systems & Automation" business unit, met with keen interest. They offered deep insights into the world of mixing room technology and explained key aspects of the processing technology. Dr Harald Keuter, head of the "Intermeshing Mixers" business unit at HF MIXING GROUP, contributed on the third day of the IRC with a presentation about developing the optimal mixing process based on the example of the aggregate size distribution of carbon black. On the last day of the conference, Maira Magnani, research engineer at Ford Motor Company, reported about compounding natural-fibre-reinforced thermoplastics using an interior mixer. At the same time, the engineer presented important experimental results concerning material composition and process parameters. The research project was carried out by the HF MIXING GROUP together with Ford.



### Exhibitions 2016

#### Interplastica

➔ 26–29 January, Moscow, Russia

#### Tire Technology Expo

➔ 16–18 February, Hanover, Germany

#### Rubbercon 2016

➔ 1–3 March 2016, Chennai, India

#### GRTE (Global Rubber, Latex and Tire Expo) 2016

➔ 9–11 March 2016, Bangkok, Thailand

#### Plastimagen

➔ 8–11 March, Mexico City, Mexico

#### Chinaplas

➔ 25–28 April, Shanghai, China

#### IMS (International Mixing Seminar)

➔ 26–27 April, Topeka, Kansas, USA

#### Mixing Seminar of DIK

➔ 11–13 May, Freudenberg, Germany

#### Argenplas

➔ 13–16 June, Buenos Aires, Argentina

#### ITEC

➔ 13–15 September, Akron, USA

#### K Exhibition

➔ 19–26 October, Düsseldorf, Germany

#### 100th Anniversary BANBURY®

➔ 26–27 October, Manchester, UK

#### PLAST EURASIA

➔ 7–10 December, Istanbul, Turkey

# BANBURY® – 1916 to 2016

One hundred years ago, the invention of Fernley H. Banbury paved the way for internal mixing technology in the industrialised world.

In 1916, Fernley H. Banbury, an English engineer, revived Hancock's idea of internal mixing. During a period of employment with Werner and Pfeleiderer of Saginaw, Michigan, which led to an interest in and an understanding of machinery, Banbury recognised the need for an effective mixing machine for rubbers.

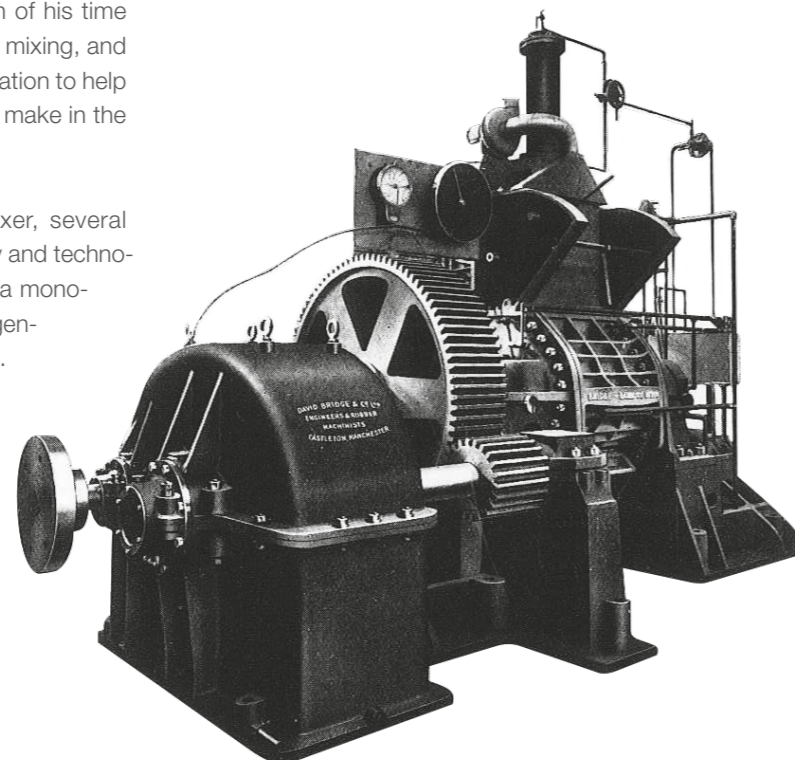
Werner and Pfeleiderer (which later became Harburg Freudenberger) had already at this time started the development of a mixing machine. Banbury (by this time having definite ideas on the subject) set himself the task of improving one of the original Werner and Pfeleiderer machines sited at the American Metal Cap Co., Brooklyn, mostly in his own time, and in the cheapest and quickest way possible. He changed the rotor geometry, and added a wooden floating weight that acted on the rubber in the mixing cavity. Banbury was prompted to file a patent in his own name, which was granted.

Soon after, Banbury joined the Farrel-Birmingham Company, Connecticut, where he installed the world's first Banbury enclosed rubber mixer in a testing room at the plant. It was here that Banbury spent much of his time during the next few years, learning the art of mixing, and at the same time extracting first-hand information to help him with the many improvements he was to make in the period ahead.

Since the birth of the original internal mixer, several changes have taken place both commercially and technologically. No longer do Banbury mixers hold a monopoly (even though the use of the word as a generic term might convince a listener otherwise).

The first workable internal mixer used by Goodyear Tire and Rubber Co., Akron, Ohio, paved the way for the widespread use of internal mixers throughout the industrial world. Improvements and refinements are continually being made; these include dust seal design, automation, rotor geometries with advanced cooling, hydraulic hoppers with intelligent control, new ram profiles, mixer drives, discharge door designs and considerable material loading improvements. HF MIXING GROUP is at the forefront in leading such developments.

All thanks to Banbury,  
the "MASTER MIXER"



The conference will span two days and will include various presentations from HF MIXING GROUP employees and external guest speakers, highlighting current developments from within the rubber industry and other relevant topics.

**Date:** 26–27 October 2016  
**Location:** Museum of Science & Industry (MOSI), Manchester, UK

If you are interested please do not hesitate to contact us!  
Contact: Steffi Allatt (sallatt@farrel.com)



## Mixing seminar

Fifty-nine participants from around the world learned theoretical and practical skills for the production of rubber mixes at a mixing seminar.

Once again the Deutsche Kautschuk Gesellschaft e.V. (German Rubber Society) and the Deutsches Institut für Kautschuktechnologie e.V. (German Institute for Rubber Technology) organised the workshop “Mixing of Rubber Compounds” together with Harburg-Freudenberger Maschinenbau GmbH in Freudenberg.

Taking place for the seventeenth time from 6–8 May 2015, a total of 59 participants from 13 countries and three continents had the opportunity to test their theoretical and practical knowledge on the rubber mixing process.

The technical knowledge imparted could be practically implemented right away during a series of mixing trials carried out in the Technical Center of Harburg-Freudenberger Maschinenbau GmbH.

Three German and three international groups had to face a range of challenges in a mixed competition consisting of three trials on two different laboratory mixers

(tangential mixer GK 4N and intermeshing mixer GK 5E). The aim was to produce a high-quality EPDM (German group) or SBR/BR (international group) compound as quickly as possible.

Employees of the Technical Center were on hand to ensure that the trials went smoothly and they supported the teams in creating the recipes and carrying out the trials. Also present were employees of MonTech to provide results of the analysis for evaluating the quality of the individual test samples.

With the theoretical knowledge learned, the participants were ready to improve their next attempt on mixing with the help of the analysis results and data measured on the mixer.

At the end of the seminar the winning teams received a very special prize: a bag full of gummi bears ...

## Team building knows no borders

Under the banner “Sports, games and fun”, HF MIXING GROUP employees from Germany, England and Italy joined their colleagues from HF NaJUS in Slovakia for their annual get-together. Legendary highlight: the football tournament where colleagues become opponents.



A great tradition at HF MIXING GROUP: from 3–5 July 2015, employees from all over Europe met in Dubnica nad Váhom, Slovakia. The colleagues at HF NaJUS were the hosts of the 2015 summer festival. They proudly showed their guests from Germany, England and Italy not only the local tourist attractions, but also their own production facilities. The full programme included an excursion to Trenčín Castle and an outdoor dinner on the cannon bastion. The cornerstone, however – and the event eagerly awaited by all of the guests – was without a doubt the traditional football tournament where the company locations competed for the coveted title of HF Football Champion 2015. In hard-fought but consistently fair matches, the hosts ultimately prevailed over the tough competition from the other locations. As a result, the team from HF NaJUS brought the coveted trophy home to Slovakia for the first time. The English team from Farrel Ltd. took second place ahead of the players from Freudenberg, Germany.

### “Third half” featured tempting culinary delights

The hosts organised a big summer festival for the “third half”, the entertainment after the game. The employees from the various international locations gathered around all sorts of culinary delights and enjoyed themselves at their leisure, engaging in activities such as tug-of-war, “board racing” and throwing games. The richly varied visit concluded with an exuberant party. The employees danced, laughed and enjoyed themselves late into the evening.

With pleasant memories and a hint of sadness, the guests set out for home on the following morning. The continuation of the summer festival has already been decided – not least because the team from HF NaJUS wants to defend its title as “HF Football Champion” in 2016.



# HF NaJUS opens new production hall

With a new production hall, HF commits itself to the site in Slovakia.

Major investment in the future: over the course of last year, the Slovakian HF spin-off, HF NaJUS, successfully took up operations in a prestigious new production hall at the Dubnicanad. Váhom site. After the building permit was obtained in December 2014, the 604-square-metre welding facility with five stations was already up and running by January 2015. Work in the newly constructed assembly area (3,517 square metres) started in April 2015. In single-shift operation, the new facilities enable work volumes of approximately 188 to 200 hours per week in the welding shop and between 600 and 900 hours per week in the assembly operation. That means the production hall provides adequate space for 40 to 60 jobs.

The Slovakian site produces, among other things, the CONVEX™ series and extrusion units, as well as MILLMIX sheeting and mixing mills.



# IMPRINT

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HF MIXING GROUP  
Harburg-Freudenberger Maschinenbau GmbH  
Asdorfer Strasse 60  
57258 Freudenberg | Germany

Phone: +49 2734 491-0  
Fax: +49 2734 491-150  
mixing@hf-group.com  
www.hf-mixinggroup.com

A member of the Possehl Group  
www.possehl.com

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## **Responsible for content at HF MIXING GROUP**

Dr Harald Keuter, Melanie Jahn

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Please contact Melanie Jahn from Freudenberg, Germany, at [mixing@hf-group.com](mailto:mixing@hf-group.com).

Many thanks for your interest!

[www.hf-mixinggroup.com](http://www.hf-mixinggroup.com)

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