JM

Johnson Matthey
Inspiring science, enhancing life

Informally speaking

A formaldehyde magazine from Johnson Matthey

- Sustainability: Perstorp aiming high with Project Air
- How Metadynea & JM tackled the pandemic
- Kastamonu using 100% recycled wood in Italy
- Customers make progress with **JM-LEVO**
- JM takes customer training online

AUTUMN 2021

Out of the woods?

Dear reader, when we first began working on this issue it felt almost as if the worst of the pandemic was behind us. As we are learning, things can change quickly from one month to the next as new variants of the Corona virus arise. No matter what, its impact on people across the globe has been undeniably severe.

As we continue to adjust to a new kind of normal there are also a few positives worth mentioning, not least of all regarding sustainability. Many have adopted a more sustainable way of living, working from home (less commuting), and taking holidays closer to home (less air travel), helping to raise awareness about climate change, reduce emissions and bring us clearer skies.

Our customers are also taking important steps in this direction. One is Turkish Kastamonu who is working towards large-scale production of particle boards made from 100% recycled wood (page 16). Another is the Perstorp Group, whose pioneering "Project Air" will use carbon capture to produce fossil-free methanol, something they hope will fundamentally change the chemical industry (page 12). Here at JM, we are doing our part in numerous ways. Read about our new sustainability strategy (page 3), collaboration for iUFC (page 7), and technology for producing green methanol (page 14).

Although the pandemic has challenged us all in several ways, with the help of digital platforms we have made advancements as well. Faced with travel bans and cancelled conferences, we hosted our first webinar in May. And in June we took customer training online for the first time (see page 6). Though we hope to restart our traditional live conferences in 2022, these digital forums will continue to be important.

And speaking of digital forums, we are glad to see the diverse ways that customers are now benefitting from the **JM-LEVO**™ Formaldehyde Portal (see page 8). We are especially pleased that it earned the IChemE Highly Commended global 2021 award in Process Automation & Digitalisation, thanks in part to early suggestions from customers like Metadynea Russia and Mitsubishi Chemical Methacrylates Singapore. So a big 'thank you' to all who contributed.

On the technical side, we also take an important look at how to work with hotspot temperatures in the formaldehyde reactor as well as what you need to do to get the most out of your spent catalyst, especially now after the price of molybdenum jumped during the summer.

Until next we meet, best wishes for a brighter 2022.

Lars Andersson and Ronnie Ljungbäck
Global Market Managers Formaldehyde

Content

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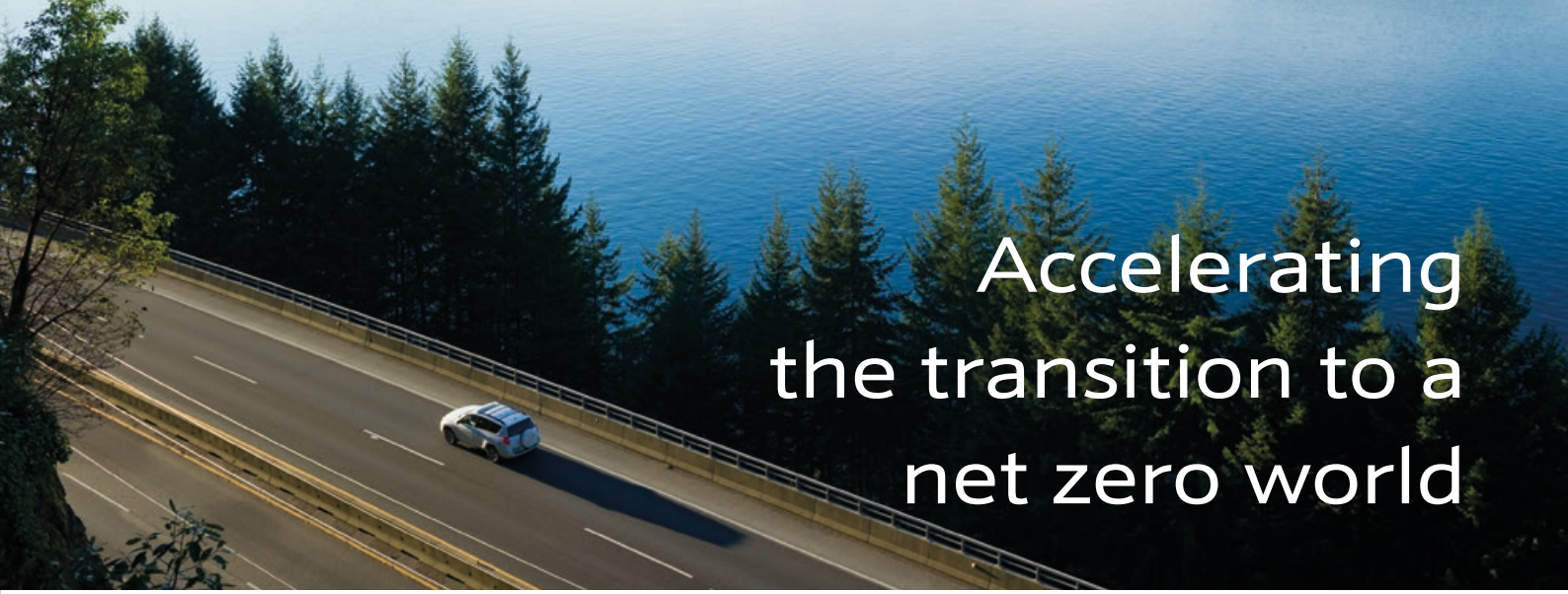


Accelerating the transition to a net zero world

JM has a 200-year history of using our deep understanding of, and innovations in, metals chemistry to solve big complex problems. With our strong DNA of science and innovation, we are enabling and accelerating the big transitions to decarbonise transport, energy and chemicals production.

JM's expertise in precious metals built a scientific base in areas such as catalysis and led the way in establishing the world's first circular economy in platinum group metals (PGMs). Today we are the world's largest recycler of these metals and are embedding circularity into how we think about all our technologies.

Decarbonising the production of chemicals

As has been the case with transport, much of the world's manufacturing industry has traditionally been based on fossil fuels. This goes way beyond the power needed to run chemical plants, but also the 'feedstocks' that make chemicals in the first place. Johnson Matthey's technologies are now decarbonising the way chemicals are produced through:

- Award-winning low carbon hydrogen technology, which reduces CO_2 emissions by over 95%
- Low carbon solutions produced at scale to enable the critical transitions needed for decarbonisation
- Greener, more sustainable technologies for the chemical, fuels and energy sectors
- Catalysis technology and process design to enable the pivot to greener feedstocks.

New sustainability strategy

We have a critical role in helping the world tread a more sustainable path. Right now, over 80% of our products contribute to four UN Sustainable Development Goals (SDGs). In June 2021 we announced a new sustainability strategy that will see over 95% of our product sales, and 95% of our R&D spend, aligned with these four priority SDGs by 2030. We will do this whilst also being net zero in our own operations by 2040.

BY

Nicole Watson
Marketing Communications Representative

On the front page:

Perstorp's site in Stenungsund, Sweden, the location for Project Air

Read more about this story on page 12

UPCOMING CONFERENCES

We are planning to pick up regional face-to-face conferences during 2022, preliminary Americas, Europe, China and in Turkey. We will reach out with invitations in due time.

Thank you for taking our customer satisfaction survey 2021

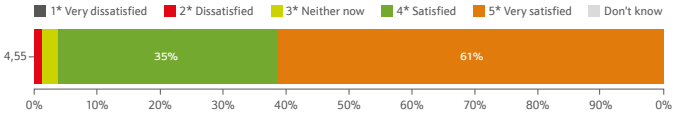
As many of our readers know, we conduct a customer satisfaction survey every second or third year to ensure that we capture input, feedback and trends on how we and our products are performing. This year it was time again, very much prompted by the Covid-19 situation. We are very grateful for your participation and want to say, "Thank You!" to all who took the time to respond. The information you provided will be valuable to us as we continue to try to improve our overall performance.

Always room for improvement

Compared to the previous survey, both our CSI and NPS scores improved and became our best results ever, which we are extremely happy about. Still, we know that we can always become better, and some areas identified for improvement were innovation, technical support and communication concerning complaints. This year's survey also included questions related to **JM-LEVO** Formaldehyde Portal as well as net zero solutions and sustainability. It was rewarding to see that there is a lot of interest in the Portal, and that we can expect to be involved in discussions as formaldehyde producers around the globe attempt to reduce their carbon footprint.

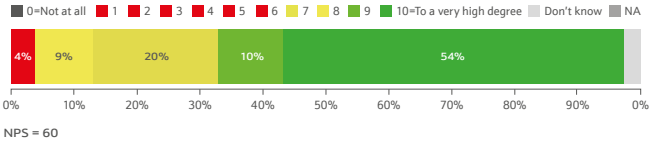
Customer Satisfaction Index (CSI)

Overall, how satisfied are you with Johnson Matthey as your supplier and partner?



Net promoter score (NPS)

To what degree would you recommend Johnson Matthey to a colleague?



NPS = 60

JM stands out at the IChemE Global Awards

We are delighted to have been selected as finalists, with eight of our projects qualifying in seven different categories, for the Institution of Chemical Engineers (IChemE) Global Awards 2021.

These awards are widely considered as the world's most prestigious chemical engineering awards, celebrating chemical, process and biochemical engineering excellence.

We are proud our **JM-LEVO** platform was selected as a finalist in the IChemE Global Awards 2021, for the Process Automation and Digitalisation Award, where we achieved a 'Highly Commended' result.

The awards showcased JM's work in innovative sustainable technologies and diversity and inclusion. To see all categories and projects that JM was a finalist in, please visit www.icheme.org

Formaldehyde legislation

Formaldehyde has been a controversial chemical for over a century and has been used in many different applications along the way due to its versatility. Some earlier applications, like as a preservative in foods for example, are clearly no longer recommended. Today formaldehyde is surrounded by heavy legislation to ensure that it is used safely and that risks to both workers and consumers are minimised.

Reclassification, limits and harmonisation

Five years have passed since the chemical was reclassified in the European Union as "presumed human carcinogen." This was not done due to observed human health issues, but because of experiments done on lab rats. The reclassification has resulted in a lot of relabelling of products containing formaldehyde. It has not placed formaldehyde on the list of "Substance of very high concern", nor has it reduced the use of formaldehyde.

One of the focuses of the legislation is providing safe working conditions at chemical plants that produce formaldehyde, or plants that use it as a raw material for producing other materials. The established occupational health limit concentration in air varies around the world and is typically between 0.3 ppm up to 1.0 ppm. The formaldehyde industry organisation in the European Union, Formacare, has set 0.3 ppm as a limit for its members. Continuous efforts are being made to harmonise the occupational health limits between different countries, and the feeling is that the industry will be able to meet these limits also in the future.

Meeting tomorrow's challenges

Another focus is on limits for formaldehyde in the air inside of homes. There is a strong, ongoing debate over acceptable limits ranging from 0.01 to 0.1 ppm. A decision here could have a dramatic impact on the wood panel industry. Newly developed low-emission board types meet the higher limit. The lower limit, however, is exceedingly difficult to meet even if all wood board were to be removed from the home environment. Outside city air has a higher concentration in many places.

And though many wood species do fall just below the lower limit, replacing all wood board with solid wood products is obviously not an option. Important to also keep in mind is that many natural items, from humans to coffee, and apples to trees, contain naturally occurring formaldehyde.

It is important that the legislation is based on reasonable data and that the set limits are met by the industry. Working with industry organisations like Formacare in Europe and the American Chemistry Council in the US is therefore important as we move forward into the future.

BY

Ola Erlandsson
Senior Process Specialist

Customer training goes digital

Developing our customers' understanding and knowledge of the Formaldehyde process has long been a cornerstone of our technical offering. Over the years we have done this through customer training linked to projects, publication of the Informally speaking magazine and at refresher training events held in Sweden, and at our conference sites, that have brought together customers from across the globe.

The pandemic, however, changed a lot of things, including how we interact with our customers when travel restrictions prevent us from doing things the way we traditionally did them. Nearly all our customer meetings are now via Microsoft Teams, and the use of video conferencing as standard has meant closer correspondence and regular conversations.

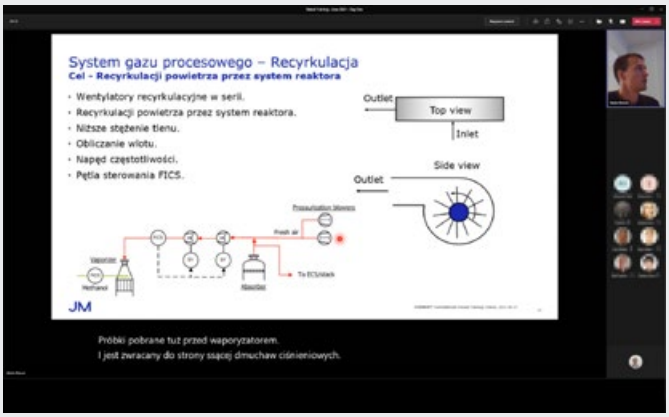
Training presents a new challenge

When one customer asked us to provide customised training for a group of their engineers and plant operators, we embraced the challenge by doing it digitally for the first time ever. Not only did we adapt the training for delivering virtually via Teams, but we also translated all the slides into the local language. Furthermore, we used the subtitles function to automatically transcribe what our presenters were saying in real time.

By using these tools, we were able to draw on the vast range of experience within our Technical Support and Process Engineering teams and provide tailored training based on the customer's specific requirements. The training ran in 3- or 4-hour blocks over 4 days in June 2021, including a range of topics from Control Philosophy to Troubleshooting & Incidents.

Interested?

If you feel that there is a need in your company, and you have an interest in training on site, a refresher training or a virtual training, please reach out to your Regional Sales Manager and/or Regional Technical Support Manager and we will be able to develop a scope which suits your needs.



▲ Marko Ristovic speaking and explaining details about the Formaldehyde Process Review with the slide content translated and his remarks transcribed in real time as subtitles

BY

Paul Walter
Regional Sales Manager

iUFC technology is characterised by the following:

- Based on well proven technologies – JM's **DAVY**™ methanol technology is widely used as well as **FORMOX**™ technology
- Simple to operate – No additional process operators needed
- Moderate CapEx
- Significant OpEx savings – UFC can be produced at close to zero cost in many cases
- Reliable UFC supply – Production on site – saves transportation and from raw materials and utilities already available on site
- Patented designs – Patents held by JM

JM and KBR begin new cooperation for iUFC technology

Since the summer of 2021 JM and KBR have entered an agreement concerning the marketing and sales of FORMOX integrated UFC Process (iUFC™). This innovative technology involves JM's methanol and UFC (Urea Formaldehyde Concentrate) technologies, where the methanol plant is integrated with KBR's proprietary ammonia process. As a world leading supplier of technology for ammonia and fertilizer production, KBR has a widespread network of contacts in the business. Together JM and KBR can offer the iUFC technology both as a revamp project at an existing plant or as part of new KBR installations where urea is one of the downstream products.

Enables low-cost production of UFC for higher grade urea

iUFC provides a cost-effective production of UFC at the ammonia or fertilizer production site. UFC is used in lesser amounts for production of urea, which acts as an anti-caking agent in the granulation process. Some companies use UFC for prilled urea production. The UFC used for urea production is small, generally in the range of 1% of the total output. The design of the iUFC production unit is customized according to the amounts required at each individual site.

For the integration, a small methanol production unit is added within the ammonia production plant where it uses CO/CO_2 sourced from the process gas stream in the ammonia plant to produce methanol. The savings in operating costs are significant when compared to purchasing UFC from a third party.

Sustainability benefits as well

The iUFC technology benefits the urea producer by providing reliable access to low-cost UFC at a moderate investment cost. From a sustainability perspective, the iUFC technology eliminates the need for transportation of UFC, which for many sites can be quite distant.

BY

Fredrik Rietz
Global Commercial Licensing Manager - Formaldehyde

Customers seeing benefits from **JM-LEVO** Formaldehyde as work begins on next version

Now that more and more customers are beginning to use the JM-LEVO Formaldehyde Portal regularly since its commercial launch last year, we are beginning to see how it is helping them in very concrete ways. In this update we would like to share with you a few of the observations and responses we have received so far, both through our survey and through regular dialogue.

Those of you who participated in our recent customer satisfaction survey know that it included new questions regarding the use of the Portal. The results of the survey not only provided us with a lot of positive feedback, but also confirmed that there is a strong interest among customers who have not yet tried it and would like us to demonstrate it for them.

Performance improvements and significant savings

Among those customers using the Portal regularly, roughly on a weekly basis, we have seen an improved performance with respect to methanol consumption of about 0.2% on average over the life of the catalyst charge. This represents a reduction of the specific methanol consumption by 1 kg per ton of formaldehyde 37% produced. With a MeOH price at 450 EUR/MT, this could amount to an average annual savings of approximately EUR 70 000 for a typical FS3 plant.

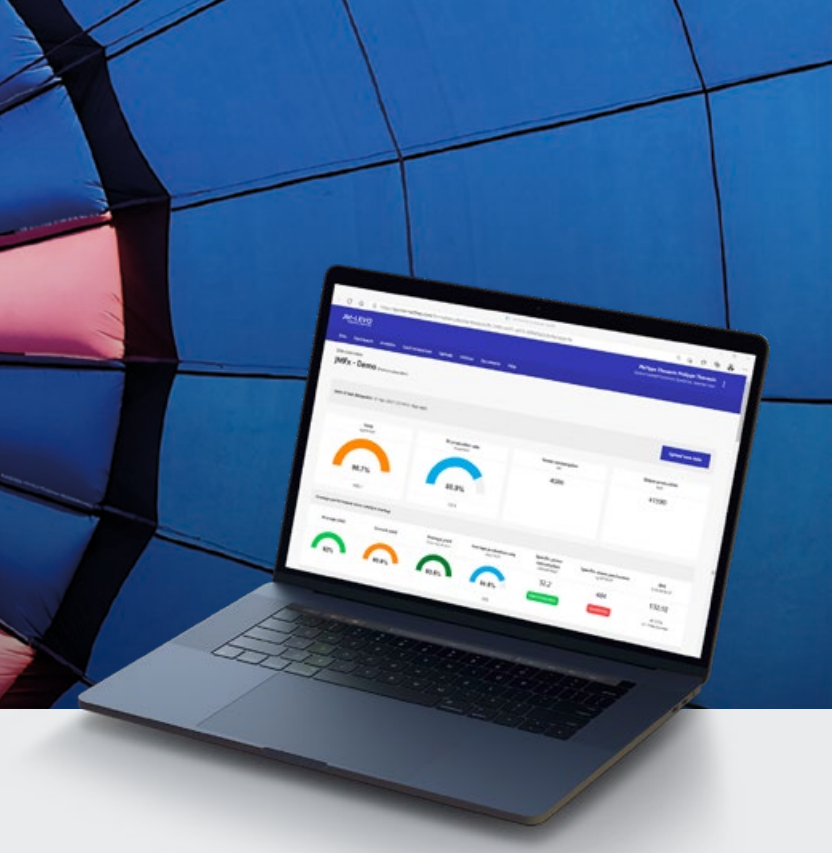
Educational purposes too

One interesting takeaway for me is that the **JM-LEVO** Formaldehyde Portal is helping in other ways than those we expected. For example, the optimisation tool is being used not only to maximize yield, but also as a way for process engineers to receive feedback on their intended adjustment of the operating parameters. And one customer told us how the load comparison feature helped them to onboard a new engineer by enhancing the engineer's understanding of the formaldehyde process and typical values for the various key parameters.

Up next?

Now after the recent launch of the **JM-LEVO** Methanol Portal, which focuses on the Methanol market, development is continuing so that we will be able to offer users of **JM-LEVO** Formaldehyde even more valuable features in the next version 2.0. One key area we are focusing on is direct data connection to replace manual upload of data (using the Excel spreadsheet). We are also working on improving tools to make the charts more interactive while increasing the customization of the load comparison feature. Other features previously mentioned include:

- Improved document library to replace the Customer Center that will be decommissioned at the end of 2021
- Development of a new machine learning model to be able to optimise operation with respect to the catalyst life
- Visuals for steam production and power consumption



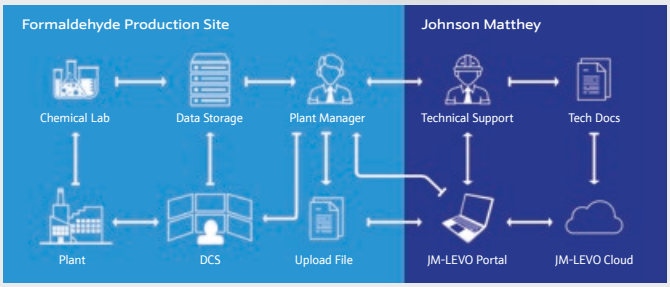


Figure 1: **JM-LEVO** Formaldehyde provides a new platform to efficiently share operating data (both with JM as well as internally) whilst having access to valuable functions, documentation and recommendations. This further enhances the collaboration with JM on plant operation, troubleshooting and other aspects of your formaldehyde production.

Is there something you would like to see?

We understand that the more you use the Portal the more ideas you might think of regarding what other features could be helpful to you to efficiently manage your formalin production. So please keep your ideas and feedback coming so that we can continue to deliver a valuable product.

For those of you who do not yet have access, please contact your JM representative for more details and a demonstration.

JM-LEVO WeChat

BY

Dr Philippe Thevenin
Global Technical Services Leader – Formaldehyde

We used to submit data on a monthly basis. Now we have a macro that fetches data and gives us an easy way to upload to the Portal on a daily basis. We are especially interested in monitoring yield, steam and power consumption to optimise performance of the catalyst over the long term. With the Portal we now have this analytic function that means we can get input from JM much sooner and make adjustments every few days if we want. We also really like the updates available in the Technical Documents section

June Lim,
Process Engineer, Mitsubishi Chemical Methacrylates Singapore (Premium **JM-LEVO** Formaldehyde user)

We have found the Portal very useful from the start. All production data and history can be easily viewed through a few graphs, and we can easily see when we need to make any adjustments. Besides being able to monitor the temperature of the HTF, I like being able to follow both current and average yield, as well as specific production. Now, the Portal is a part of our daily routine and has made our weekly review meetings much more efficient

Konstantin Oschepkov,
Production Manager,
Metadynea Russia

Follow us on LinkedIn for further updates or contact Philippe or your Regional Sales Manager or Technical Support Manager if you have any questions.

Metadynea Russia and JM build on close cooperation through historic 2020

When the pandemic suddenly struck in early 2020 a leading producer of synthetic resins in Russia, Metadynea, was as uncertain as everyone else about how long the situation would last. Once the borders were closed, Metadynea was concerned that JM might not be able to provide support at a high enough level.

"Covid-19 presented a great challenge for myself and my colleagues," recalls Vyacheslav Zhdanov, Deputy General Manager at Metadynea Russia, "and also for the relationship between our company and JM."

"It was indeed a bit distressing," agrees Vladislav Ksenofontov, Regional Sales Manager at JM's office in Moscow. "Everyone was trying to figure out how to proceed given the restrictions and all the uncertainty.

Metadynea Production Manager Konstantin Oschepkov, also remembers what it was like at the outset of 2020:

"We had been planning to reload the catalyst at our Orekhovo-Zuevo site in May, but then we had to shut everything down already in March due to Covid-19. Many customers backed out of agreed orders and we did not know if we would be able to sell the resins that were produced in advance."

Tried something new

Faced with these challenges, Konstantin and his team, with the support of Vladislav and Mike Brown at JM, then decided to try something new – lowering the oxygen content in the recirculation gas.

"That is a topic that became quite relevant during the pandemic," says Mike, Regional Technical Support Manager at JM, "and that we had just recently written about" (see article, Autumn 2019 issue). "Generally, customers lean towards high production over lifetime, but in this case the catalyst was nearing the end of its lifetime and we wanted to ensure continued safe operation. By lowering the oxygen level, Metadynea would be able to move further away from the risk zone for deflagration and operate at higher specific production for a longer period before reload."

Konstantin and his team were not only glad to be able to keep production going, but also happy about one unexpected result – higher yield. "Normally our specific production would be about 22 tons per kg of catalyst," says Konstantin. "But thanks to the help we got from JM, we were able to get 27 tons per kg, which helped us to meet customer demand."

"In the end," he says, "we were not left on our own as we had at first feared, but supported throughout by JM, which we are very happy about."

Improvements brought to, and by, JM-LEVO

Around the same time, Metadynea was an important collaboration partner in the testing and evaluation of the new **JM-LEVO** Formaldehyde Portal, eagerly trying it out and offering valuable suggestions for what might be improved. Both Konstantin and Vyacheslav are happy about how the Portal makes all technical information and performance data available in one place rather than fragmented in various places and computers. "It makes more sense and is very convenient for managing production," says Vyacheslav. "Also the speed of the response time when using the tools is a big step forward."

Mike Brown, who is now used to receiving data uploaded by Metadynea via the Portal every week says he and the Technical Support team can now give feedback much more quickly. "In this way we can help solve issues within a couple of days and, by doing so, reduce the length of time the plant would be running less efficiently. This has a positive effect on methanol and power consumption, as well as catalyst lifetime."

A history of trying new things together

"In 2015 we were experiencing a lack of formaldehyde," says Project Manager Vadim Galkin who began working at Metadynea when their first **FORMOX** plant was started up in 2008.

"The solution then was a revamp of our first unit from 2008 where we installed another fresh air compressor to increase capacity, which was a novel approach at that time. It was a way for us to start up a second unit and the results were very successful."

Vadim is currently overseeing a project involving Metadynea's third **FORMOX** plant which is now in the project phase and scheduled to be started up in 2023. "What is exciting about the new project," he says, "is that it will involve new automated sequences from JM that we are very much looking forward to."

Vladislav Ksenofontov is also pleased about what he has experienced since becoming a sales manager for JM's Formaldehyde business there in 2018: "For me it has been a pleasure to follow the development of Metadynea over recent years into one of our most innovative customers here in Russia. The staff's focus on safety, their keen interest in training and learning about new instruments, and their daily use of our **JM-LEVO** Portal all contribute to building a great production culture."

BY

Charles Hodgdon
Editor

Metadynea Russia at a glance

Metadynea Russia is a part of Metafrax Group, the largest private chemical company and methanol producer in Russia.

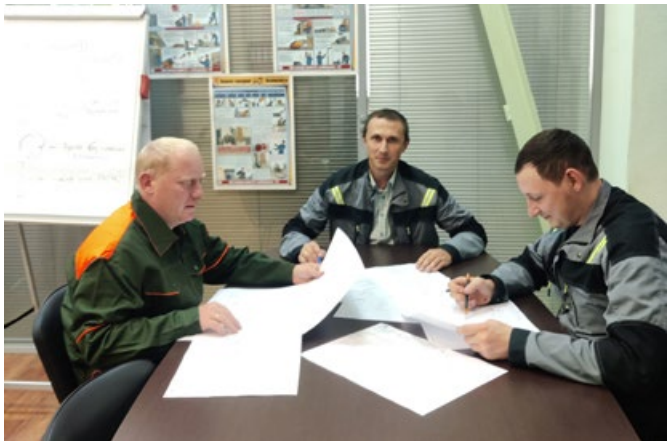
Headquarters: Moscow

Established: 2004

Employees: 350

Production facilities: 3 (Gubakha, Perm region, Orekhovo-Zuevo, Moscow region, Krems, Austria)

Main products: Resins used in the production of wood boards and mineral wool insulation; also solid phenol-formaldehyde resins and Bakelite powder widely used in mechanical engineering, automobile industry, tire production, and many other industries.



Head of Formaldehyde Production Igor Gromov (left), Deputy director of production site Konstantin Oschepkov (middle) and Chief technician Dmitry Slavkov during a weekly production meeting

Metadynea Project Manager Vadim Galkin (far left) and General Director Igor Spassky (next to him) during signing of contract for new FH-3 plant

Perstorp aiming high with Project Air

Imagine a day when it's possible to pull CO_2 right out of the air and inject it straight back into producing almost everything else we use. Science fiction? Not for the Perstorp Group.

Not only does the Swedish chemicals company Perstorp believe a scenario like this is feasible but see it as a necessity. And they are taking giant leaps towards making this, or something like it, a reality.

Perstorp co-created the **FORMOX** process more than 60 years ago and today the company remains an important customer to JM's Formaldehyde business. This autumn, we got a chance to speak with Håkan Kihlberg, who twenty years ago worked as the production manager in the catalyst and formaldehyde plant here in Sweden. Today he is Vice President Strategic Projects and Processes for the Perstorp Group, and his biggest priority now is a game-changing endeavor called Project Air.

JM: We understand the project is rather ground-breaking; can you tell us about it?

Håkan: Yes, it is something we are creating at our Stenungsund site together with Sweden and Uniper, and with a significant grant from the Swedish Energy Agency due to its importance for helping Sweden's to achieve its climate goals. In fact, it is the biggest thing Perstorp has ever done, which says quite a lot.

JM: That sounds ambitious.

Håkan: It is. The intention is to build a production unit capable of producing enough sustainable methanol to replace 200,000 tons of fossil methanol, and cut 500,000 tons of CO_2, annually. As such, it will be the first large-scale sustainable methanol plant of its kind. We're also setting up one of the biggest hydrogen electrolysis units ever built – the first to use purified wastewater and the largest one ever to be linked to chemical manufacturing.

JM: And it involves carbon capture?

Håkan: That is a big part of it, yes, and it also involves recovered waste streams, biogas and hydrogen based on renewable electricity and, as I said, purified wastewater. Regarding CO_2, Project Air will be the biggest carbon capture and utilisation unit ever to be installed.

JM: Why is Perstorp doing this now?

Håkan: For two reasons. First, Perstorp is fully committed to becoming climate neutral. Secondly, we are positioning ourselves as a supplier of renewable, fossil-free polyols, and methanol is by far the largest raw material used in this process.

JM: But Project Air is also part of a bigger picture, correct?

Håkan: Yes. Look, if we all keep doing business as usual, the world's industries will soon be having a tough time finding the carbon atoms they need. To keep digging up or pumping up more from fossil sources is simply not an option for the planet. So, part of our mission with Project Air is to take a leading role in helping to put a stop to that, if we can.

We see an opportunity to replace the fossil methanol that we normally have to buy every year, with a sustainable alternative that we can make ourselves and that benefits everyone. We believe that by doing so we will be able to provide industries with sustainable raw materials at a competitive price, which can then be used to manufacture more sustainable cars, furniture, paint, buildings and just about everything else society needs. This will have an enormous impact, but the impact will be so much more far-reaching if we can show the chemical industry what is possible when everyone puts their heads together.

JM: So it is a catalyst for change?

Håkan: Absolutely! The chemical industry, as well as others, needs to become climate neutral. And we believe that Project Air can be a beacon that can show others how to go about making such a sweeping, and necessary, change.

Project Air facts & figures

- World's largest carbon capture and utilisation unit
- Annual replacement of 200,000 tons fossil methanol in chemical products
- One of the world's largest hydrogen electrolysis units installed in the chemical industry
- Annual CO_2 reduction of 500,000 tons
- Planned startup: 2026

Read more at https://projectair.se

Håkan Kihlberg, Vice President Strategic Projects and Processes for the Perstorp Group

JM: That's a big task for one player.

Håkan: Exactly. No one can do this on their own. It takes a real collaborative effort and huge investments, which is why we are fortunate to have the energy companies Fortum and Uniper on the team. We are also pleased that the Swedish Energy Agency has seen the importance of it and provided us with nearly 30 million EUR to get started. And we are currently evaluating the best and most relevant additional funding. The EU Innovation fund is of course valid for us but there are other potential alternatives as well. We will be ready to decide within the next few months.

JM: Thanks Håkan, and good luck. We'll keep our fingers crossed and hope to do a follow up story – maybe when the unit goes on line a few years from now if all goes according to plan?

Håkan: Thanks. I'm looking forward to it.

BY

Charles Hodgdon
Editor

Green methanol for tomorrow's formaldehyde plants?

As the world moves away from fossil sources, new feedstocks will be necessary in the future for producing methanol. Instead of from conventional synthesis gas, methanol is likely to be synthesised from sustainable sources such as electrolysis-derived hydrogen and CO_2 in a process known as CO_2 hydrogenation.

Historically, the feed to methanol synthesis plants has been H_2, CO and CO_2, commonly known as synthesis gas. This synthesis gas is traditionally derived from fossil sources in processes such as the steam reforming of natural gas and gasification of coal. Now the world needs more sustainable solutions.

Green methanol via CO_2 hydrogenation

Moving forward, the electrical energy used to create hydrogen will come from renewables and the CO_2 from direct air capture or capture from a waste industrial source. The first plant based on CO_2 hydrogenation was commissioned in 2010 at CRI using JM reactor technology and catalyst. This so-called 'green methanol' will be an important feedstock for future formaldehyde plants as well.

Today JM is working on a pipeline of opportunities to enable our customers to turn renewable energy and CO_2 into sustainable fuels and chemicals as we continue to develop methanol technology and catalysts for this purpose. In 2022 we will deliver a methanol synthesis unit for the Haru Oni project in Chile, which will demonstrate production of eFuels from wind power and air.

If you would like to know more about JM's green methanol technology, please contact either Paul Cassidy at Paul.Cassidy@matthey.com or Zinovia Skoufa at Zinovia.Skoufa@matthey.com

BY

Paul Cassidy
Methanol Technology Manager

POM production in China looking up again?

The last time we wrote about Polyoxymethylene (POM) in Informally speaking was in the Spring/Summer 2011 issue. In that article we looked at its history and development, its strengths, the various ways it is produced, and the expected growth in production capacity, particularly in Asia.

Since then, the market has experienced its share of ups and downs, and has also been affected by the pandemic, so we thought it might be a good time to check in with some of our customers for an update. We spoke with a few earlier this autumn, and here is a summary of what we learned...

POM – an excellent engineering thermoplastic

- Discovered by the German chemist Hermann Staudinger who received the 1953 Nobel Prize in Chemistry for his discoveries in the field of macromolecular chemistry.
- POM is also known as acetal, polyacetal, and polyformaldehyde.
- Intrinsically opaque white because of its high crystalline composition but can be produced in a variety of colours.
- It is characterized by its high strength, hardness and rigidity to –40 °C, making it an excellent engineering thermoplastic for manufacturing precision parts requiring high stiffness, low friction, and excellent dimensional stability.
- Typical applications for injection-moulded POM include high-performance engineering components such as small gear wheels, eyeglass frames, ball bearings, ski bindings, fasteners, gun parts, knife handles, and lock systems.

POM development in China

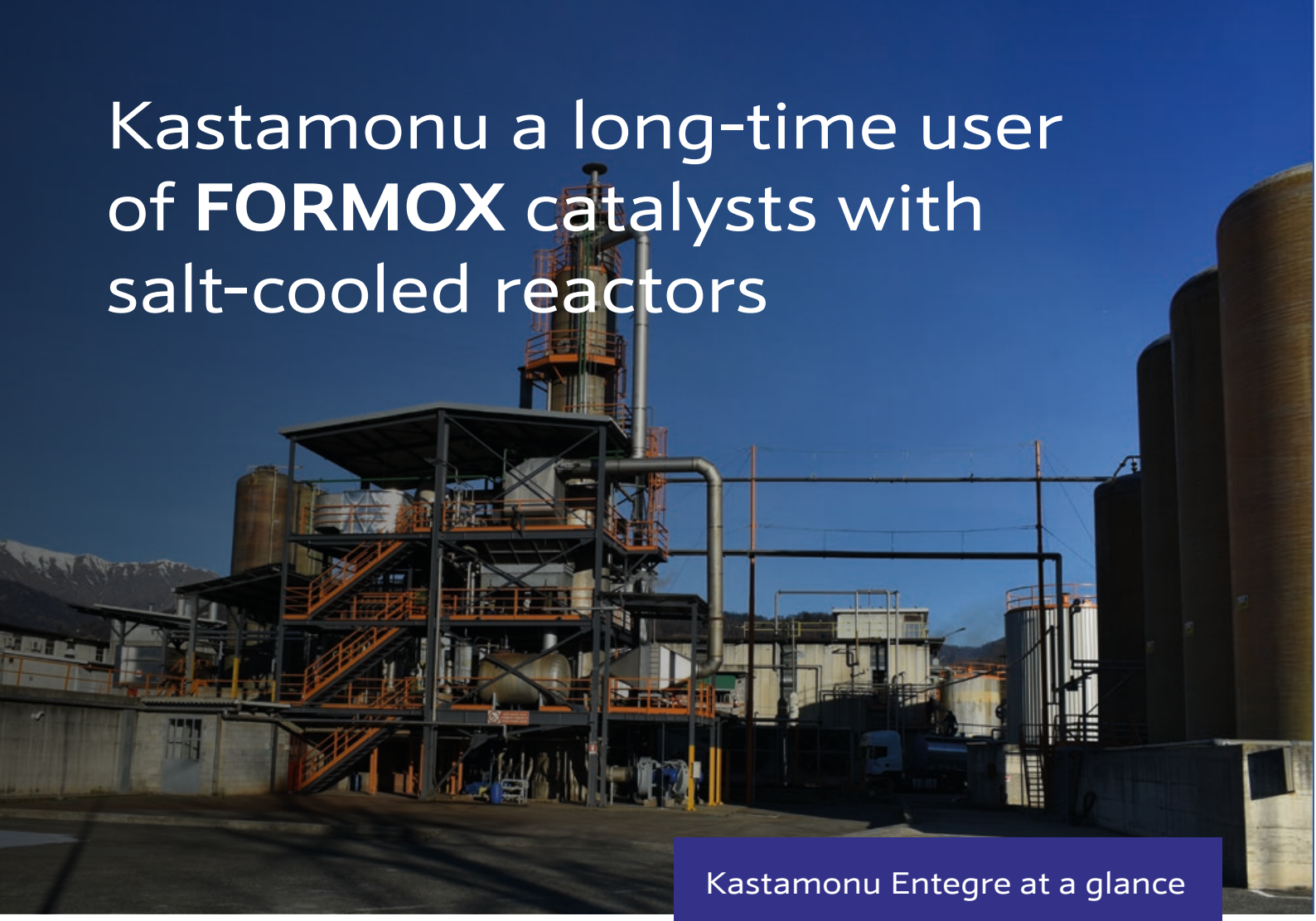
According to those we spoke with, the situation was quite bad before the second half of 2016. Almost all Chinese POM producers were experiencing losses. Many were in the low-rate operation, with some as low as 40%. Since then, the POM business has recovered and has a stable margin. In 2021, the margin is very good and there is even no product in stock. From 2018, several producers in China have announced expansion plans. The driving force behind this expansion wave is:

- The Chinese government placed the anti-dump policy against imported POM product from October 2017, which will last for 5 years. It gives more market share to local POM producers in China.
- Demand in China is presently around 800k MTPA with a switch from imports to exports during this period made possible mainly through increased utilization in domestic production plants and some addition of capacity.
- Demand growth for POM in China is now around 5.5% per year and according to data collected from various sources will continue to be so for the period 2021-25. Capacity growth is now approximately 4% per year and we now see many new projects announced and coming on stream.
- According to IHS Markit, more than 75% of all POM consumption both globally and in NE Asia is split between electrical/electronics, automotive and consumer articles/ appliances. The remainder is split between industrial applications, plumbing/irrigation and other. China is the largest auto market and leading the production of electronics and electrical parts, which creates the growth demand for those.
- The pandemic impacts the market and product accessibility. Products from local producers take bigger market share to replace imported POM. In the meantime, they are starting to export more products outside China.

BY

Lars Andersson
Global Market Manager
Formaldehyde - Plants

Kastamonu a long-time user of **FORMOX** catalysts with salt-cooled reactors



Kastamonu Entegre at a glance

Headquarters: Istanbul, Turkey

Established: 1969

Employees: More than 6,000

Production: In 6 countries

Main products: MDF and particle board, laminate flooring, worktop and door surface products, as well as value-added products for the furniture, decoration and construction sectors

Volume: Daily output equalling the living space of 4,500 houses – a total wood-based panel production capacity of 6 million m^3 / year

With **FORMOX** CAPs available for virtually all formaldehyde oxidation technologies, JM is used to working with customers operating other types of formaldehyde plants. One such customer is Kastamonu Entegre, Turkey's biggest wood-based panel producer.

Established in 1969 to serve Turkey's domestic market, Kastamonu has grown to become Europe's fourth largest producer of wood-based panels and currently operates production facilities in Romania, Bulgaria, Bosnia and Herzegovina, Russia and Italy.

"What makes Kastamonu's story especially interesting to me and others here at JM," says Philippe Thevenin, Global Technical Services Leader - Formaldehyde, "is that whilst their formaldehyde plants are not from us, they still prefer to use JM catalysts in those plants."

Long history with JM catalysts

Nurullah Binay, Kastamonu's Resin Plant Manager in Turkey, says that the company's history with JM dates back to the construction of their first formaldehyde plant in Gebze in 1996, when Formox (then part of Perstorp) was selected as preferred supplier for the catalyst. "Our cooperation has since grown through several new formaldehyde projects over the years," he says, "and at all of these facilities, JM has been one of our main catalyst suppliers."

In Turkey, Italy and other countries where Kastamonu operates, many existing formaldehyde plants differ from the standard **FORMOX** technology. These plants typically use molten salt instead of HTF oil as a cooling medium, have a shorter tube length and a lower methanol inlet, and are not pressurised. JM offers various catalyst solutions for these types of plants, including the recently introduced Lean Productivity System (LPS) catalyst and loading plan. See related article on page 15 in the Autumn 2019 issue of Informally Speaking.

Uniquely positioned to evaluate LPS

At the end of 2019, Kastamonu loaded one of its reactors with the new LPS catalyst. With several lines running at the same site well as in other places, the company is in a good position to compare the new LPS with different products in detail.

"Knowledge sharing is a big part of our company culture," says Nurullah, "and widening good practices to all of our sites is a top priority. Therefore, we were glad to be able to evaluate and compare the outputs from LPS after its discharge at the end of 2020. And I can say that the catalyst's performance is satisfying."

Actively working to develop sustainable solutions

"What makes Kastamonu's story especially interesting to me and others here at JM, is that whilst their formaldehyde plants are not from us, they still prefer to use JM catalysts in those plants"

In 2017, Kastamonu acquired Italy's Gruppo Trombini as part of what Nurullah says is a passion for "investment, innovation and production." This passion is also evident in their efforts to develop solutions for the circular economy. As a partner to the ECOBULK project, supported by the European Union's largest research and innovation programme under Horizon 2020, Kastamonu is working with special resin formulations aimed at facilitating the production of boards through a recycling process.

"Our vision is to begin large-scale production of particle boards produced from 100% recycled wood developed within the scope of the project," explains Nurullah. The boards are to be shared with the Moretti brand, a furniture manufacturer in Italy, one of the project partners, and the French Tree Research Institute (FCBA). In addition, furniture that is produced using these products will be exhibited in various countries across Europe as examples of what the project has made possible.

BY

Charles Hodgdon
Editor

"The Italian surprise"

When Turkey's Kastamonu Entegre bought Italy's third largest chipboard producer in 2017 it acquired a dormant formaldehyde plant that came with an unexpected surprise for the new owner, and a 'never-before-experienced' question for JM.

Following its acquisition of Gruppo Trombini, Kastamonu made an interesting discovery whilst preparing to modernise one of the facilities included in the deal. "That's when we learned from a former employee," says Nurullah Binay, Kastamonu's Resin Plant Manager, "that the formaldehyde plant inside the resin plant, which had been shut down years before, contained virtually unused catalyst from JM."

Apparently, the reactor had been reloaded just a week or two before Gruppo Trombini filed for bankruptcy back in 2013 without taking any measures to preserve the installed catalyst. "So there it was," says Nurullah, "a brand new, yet several years old, catalyst load. Would it still work? Was it safe?"

A first for JM

"This was a situation we'd never run into before," says Paul Walter, Regional Sales Manager at JM who remembers when Kastamonu contacted JM to get their opinion about attempting a restart of the reactor with the old, yet new catalyst. "But for us it was also a very interesting question from a technical perspective."

It was decided that samples of the catalyst were to be taken from across the reactor and sent to JM for analysis. "It looked okay," says Paul, "so we gave the thumbs up to go ahead and try it. But we also recommended having a spare load ready just in case."

Back in Italy, the decision was made to proceed. "Of course, we understood that it was probably not going to work as well as fresh catalyst," says Nurullah, "but after some discussion we decided to start with it and to keep plan B ready. That was back in September 2018, and the FA plant was running – surprisingly well in fact – with that same catalyst for as long as another two years."

Plant staff on the much anticipated start-up day of the formaldehyde plant after it stood idle for 6 years

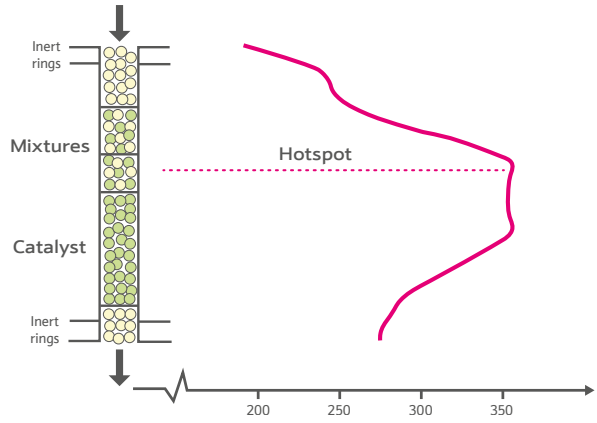
How to use Hotspot temperatures to maximise formaldehyde production

Hotspot temperatures, and particularly high hotspot temperatures, is a topic we often discuss with formaldehyde producers. The hotspot matrix provides a good tool for optimization of the performance in the formaldehyde plant, but high hotspot temperatures can also limit the capacity in the plant.

In typically seven of the tubes in the reactor in a **FORMOX** designed plant there are multitubes installed with 9 temperature measurement points (in each multitube). Reactor tubes that have multitubes are loaded with catalyst and ceramic rings to the same height as in the rest of the reactor tubes, which means they will typically contain slightly less catalyst due to the presence of the multitube.

There are three main reasons why JM uses multitubes as part of the design:

- During start-up of the plant, the temperature will help you to determine that the catalytic reaction has started.
- Hotspot temperatures and positions can be used as secondary indicators for process optimization together with the main indicators, which are yield and methanol in product. Other useful indicators for optimisation include Reactor delta (R_outlet_T – HTF_T), CO content in process gas, ECS delta temperature and reactor pressure drop.
- The thermocouples are connected to the alarm and trip system. The hotspot matrix trip system will detect patterns that indicate a change of reaction conditions in the tubes, which when exceeding certain pre-set values will then trip the methanol feed. High temperatures could result from low HTF level, overfeeding methanol, methanol distribution issues, coking on the shell side, fouling on the tube side, sub cooling of the HTF, etc.



		Multitube ID						
Inert	Pos.	1	2	3	4	5	6	7
Mix 1	1	277	279	276	280	278	276	277
Mix 2	2	305	299	301	310	303	307	315
	3	345	341	320	351	315	360	339
	4	339	334	339	340	347	342	320
Pure	5	329	322	326	321	325	328	332
	6	323	330	338	318	334	318	330
	7	333	312	309	325	307	329	346
	8	315	301	298	303	298	302	310
	9	286	284	283	287	281	286	290
Inert								

Figure 1. A typical temperature profile along a catalyst tube (top), and how the multitube temperatures are typically displayed in the DCS (bottom)

FAQ from formaldehyde producers:

The tubes in my reactor are designed for 350 °C. Is it safe to operate with hotspot temperatures above 350 °C? There is heat transfer fluid in the reactor on the shell side and process gas with catalyst on the tube side. The heat transfer coefficient on the shell side, with boiling oil, is much greater compared to the tube side which results in actual tube temperature closer to the heat transfer fluid's temperature (typically 270-300 °C). If you have sufficient level of the heat transfer fluid in the reactor you can operate the plant in a safe manner.

Optimising performance with multitubes

To follow the reaction position in the different catalyst layers the hotspot position provides useful information and can give information about the activity of the different layers of catalyst. It is important to ensure sufficient catalyst activity in the mixed layers during the beginning of the catalyst lifetime and the hotspot matrix can provide useful information about this. During normal operation the average hotspot temperature is normally around 60 °C above the HTF temperature with fresh catalyst and reaches up to around 150 °C above the HTF temperature closer to the end of the catalyst lifetime.

It is important to emphasize that the hotspot temperatures are a valuable piece of information, but these should be assessed in the context of other process indicators to obtain a complete picture of the catalyst performance when making process adjustments. Such indicators include primarily yield and methanol in product, but also CO concentration, reactor delta temperature (see above), ECS delta temperature, and so on.

When is a multitube representative? And when is it not?

As the catalyst ages the hotspots can be more difficult to interpret as they are less representative of the rest of the catalyst-filled reactor tubes. This is due to the presence of the multitube influencing the flow, reaction and ageing in these tubes. Also consider that the multitubes represent only 0.04 % of the tubes in a reactor having 17,400 tubes. Therefore, a high multitube temperature without any drastic drop in yield, significant change in reactor delta temperature or increase in CO content, is in many cases not representative for the other reactor tubes.

In the later stage of the catalyst run, hotspot temperatures are normally no longer representative. If you experience a high hotspot temperature at the end of the load you should determine if this is simply a local phenomenon in the multitube, or representative for all the tubes in the reactor. This is typically done by looking at all the performance indicators of the reactor described above, which when monitored from the start of the catalyst's load provides the best way to do this.

Example from modern **FORMOX** plant

You are operating a CAP 2.0 loading plan at 90 % capacity at SP 21. Your plan is to reload at SP 25, and you are experiencing a hotspot temperature of 510 °C in position 2 in one of the tubes. The rest of the tubes show maximum temperatures at 120 -140 °C above HTF temperatures. What should you do?

When experiencing high hotspot temperatures there are several things that should be checked:

- Firstly, how does the yield and methanol in product look like? If they are within normal expected values, then it seems to be a local phenomenon. But, what could be checked is if the reactor cooling is working properly, e.g. is the HTF level according to the recommended value? Other things to look at if it seems to not be a local phenomenon are:
- Is the methanol flow within the recommendations?
- Are there any variations in the gas flow? If there is too low relative gas velocity, it will cause a long residence time, and therefore may generate high hotspot temperatures.
- Is there something wrong with the methanol vaporization or distribution, e.g. a plugged spray nozzle. Poor distribution of the methanol flow will cause an uneven reaction in the reactor. This may result in some thermocouples showing higher temperatures than others, however maldistribution of methanol is not a common problem in a **FORMOX** plant.

If the items above have been checked the problem is often only related to the individual multitube. Ideally the plant data should be shared and reviewed by your Technical Support Service representative, and you can continue to operate at the given capacity.

What is the safe limit of a hotspot temperature?

To trip a **FORMOX** formaldehyde plant on high hotspot temperatures it is required that several positions indicate temperatures above 475 °C. If you have a logic where it is only needed to have one single high hotspot temperature to trip the plant, it is recommended to update the logic to our latest version. JM can provide support for such an update. Please contact your Technical Support representative for more information.

Potential risks with exceedingly high hot spot temperatures are discussed in more detail in Technical Info document 127 Hotspot temperatures. This document can be found in the **JM-LEVO** Formaldehyde Portal or contact your Technical Support Service representative to access the document.

Conclusion

The hotspot temperatures should be used as one piece of information when optimizing the plant performance, where the main parameters are the yield and methanol in product, together with other indicators in the formaldehyde plant. As the catalyst ages the temperatures in the multitubes become less representative compared to the other tubes in the reactor. Focus should always be more on the overall performance of the reactor than on individual high hotspot temperatures.

BY

Tomas Nelander,
Technical Services Leader - Formaldehyde

Only together can we get the most out of your spent catalyst!

It has been some years since we last wrote about spent catalyst (2013), and as the price of molybdenum increased greatly during 2021, now is a good time to revisit the topic. After all, it is in everyone's best interest to get the most out of this valuable raw material. And for you to gain the most compensation for your spent catalyst there are things you need to do to ensure safe and efficient handling during recovery.

We purchase spent **FORMOX** KH/iron-molybdenum catalyst as well as spent **FORMOX** PPt-47/PPd-47/emission control catalyst, and we separate off and clean your ceramic rings for a minimal fee. However, if different catalyst types are mixed together, other costly steps outside our facilities are needed, which reduces the recovery benefits considerably.

Tougher now, but still worth it

Since our last article, new legislation and regulations have made it tougher to transport spent catalyst. However, it still makes sense to recycle spent catalyst, to separate off and wash ceramic rings after usage, and to produce new catalyst from the recovered molybdenum.

No junk please

When returning spent catalyst, you must first make sure that it does not contain any HTF or paraformaldehyde, or any other waste or garbage. Believe it or not, over the years we have found everything from pens, screws, bolts, gloves and cigarettes mixed in with returned spent catalyst. All such waste must be disposed of locally at your site, and if any catalyst has been contaminated through a leakage of HTF oil, remove it from the shipment and do not send it to us.

How to ship

Spent catalyst should be shipped to us either in drums or in big bags. We prefer big bags, unused and fitted with a plastic liner inside, loaded onto pallets large enough to fit the entire bag. Most important is that you protect the catalyst from rain, hence the need for the internal liner/plastic bag. This is because catalyst that comes in contact with water will start to fuse together and can form large cake lumps, making it impossible for us to treat it in our process. This results in a loss of recovered molybdenum for us and lost compensation for you.

For big bags:

1. Fill catalyst in unused bags with an inner liner and a self-emptying spout
2. Place securely on properly dimensioned pallets
3. Keep weight under 1 ton per bag/pallet

For drums:

1. Ensure lids are tightly secured to avoid injury to staff
2. Mark them clearly as spent catalyst
3. Place securely on pallets

By taking these measures you contribute to smooth operations of our recycling unit, which helps maximise the output of molybdenum and the compensation you receive.

BY

Ronnie Ljungbäck, Global Market Manager Formaldehyde Catalysts

Drum with open lid

Containing rainwater

Containing all kinds of scrap

Contaminated with HTF oil

Several catalyst types all mixed together into one big mess

R&D lab continues to expand

In our previous issue of Informally speaking we wrote about the huge investment JM has been making to elevate process safety to even greater heights. In this issue we would like to give you a 'behind the scenes' look at how this investment is shaping our research and development in Perstorp.

Robert Häggblad

Robert Häggblad, Catalyst R&D Manager, oversees the R&D lab. In recent years he and his team have continued to expand its capabilities by adding several new analysis instruments as well as a mini plant for small scale catalyst production. The biggest news in 2021 was the construction of an entirely new pilot unit, Pilot 2, based on JM's refreshed Process Safety model.

Better data collection and ideal for testing green methanol

"Whilst all our pilots are very true to a real plant," says Robert, "the new Pilot 2 is even better than a full-scale plant when it comes to collecting temperature measurements and gas stream data. This helps us to build our understanding of how the catalyst performs at any position in the reactor."

Robert says that the new Pilot 2 also functions perfectly for performing pilot tests using methanol compositions or qualities containing various impurities or downstream compounds, as well as e.g. green methanol as feedstock. In addition to the new equipment, the team at the lab was expanded in 2021 when Laboratory Engineer Thomas Olsson joined from the Catalyst Manufacturing team.

"Thomas brings a lot of experience in catalyst manufacturing and analysis of catalyst material to the team," says Robert. "He also possesses excellent skills in programming and building databases, which is highly welcome as well."

Benefits for both development and customers

According to Robert, the combination of expanded lab capabilities and competencies is a big plus for both development and customers alike.

Peter Harrysson, Quality Control Engineer, in the heart of our quality control lab

> **With the new equipment we are now able to test new ideas and evaluate improvements to catalyst formulations much easier**

Laboratory Engineers Kim Wong (left) and Kevin Jönsson in front of our newly built Pilot 2 which went into operation in 2021

"With the new equipment we are now able to test new ideas and evaluate improvements to catalyst formulations much easier," says Robert. "We also use it to analyse numerous samples every year received from customers via Technical Support team, and to perform customer specific pilot tests."

BY

Charles Hodgdon
Editor

Anna hands the baton to Simon

After 24 years in the formaldehyde business, first with Perstorp and later with Formox and JM, Anna Wemby Björk is moving on to new challenges. Over the years Anna has had many roles and has been involved with process development and design, commissioning, and start-up of our **FORMOX** plants. In recent years she has been responsible for the Process Group in JM's formaldehyde business.

"It is with mixed feelings that I have decided to leave Johnson Matthey and the formaldehyde business to take on new challenges outside the company," says Anna, "but I am delighted to be handing over leadership for the process group to Simon Smrtnik who has been with the company for over 10 years. It has truly been a fantastic journey for me and the most rewarding part has been working with you, our customers, in trainings, meetings at your sites, and at our memorable formaldehyde conferences".

Simon takes the reigns

"Actually, it was Anna who hired me as a process engineer after I had just received my PhD from Lund University," says Simon. "Since then, I have had the opportunity to work in various roles including as a regional Technical Support Manager for Russia and the Middle East. Working close to the technology and development together with colleagues and customers is what I enjoy most. I find it very stimulating when a group jointly

"Actually, it was Anna who hired me as a process engineer after I had just received my PhD from Lund University,"

realises set objectives and can celebrate its achievements together. This is the atmosphere I want to bring forth in my new role as a Process Engineering Manager".

NEW FACES

Perstorp

Thomas Olsson
Laboratory Engineer, R&D

Tobias Iveby
Project Engineer
Engineering, Operations

Maria Olofsson
Learning and Development Advisor, HR

Michel Bellais
Associate Specialist, Process Engineering

Magnus Nilsson
Senior instrument & Automations Engineer, Engineering

Beijing

Kevin Sun
Electrical and Instrument Engineer

Shaoze Yang
Process Engineer

Marvin Su
Process Engineer

Projects & start-ups

New Projects

- An agreement with Foresa, Industrias Químicas Del Noroeste, SA has been signed for expansion of their plant to double the capacity to an FT2 plant. The plant is located in Caldas de Reis, Pontevedra, Spain.
- A client in Shanxi Province, China has signed an agreement for two FT3 plants.
- A client in Xinjiang, China has signed an agreement for one FT3 and one FE3 plant.
- An agreement for an FS3 plant to a client in Xinjiang, China has been signed.

Ongoing projects

- The project with a **FORMOX** FT3 plant in Sichuan Province, China is in the engineering phase.
- The project with a **FORMOX** FT3 plant in Fujian Province, China is in the engineering phase.
- The project with an FS3 plant to Eastern Europe is approaching shipping phase.

- The FS3 plant to a client in Europe is in the design phase.
- The project with Inner Mongolia Jiutai New Material Co., Ltd. in China is in the construction phase. The formaldehyde plant will have an annual capacity of 1,500,000 tonnes per annum and will be among the largest single site facilities for formaldehyde production in the world.
- The FT3 plant, built in Qinyang Yongrun Technology Development Co., Ltd, Qinyang city, Henan province, China, signed with China Chemical Sedin Ningbo Engineering Co., Ltd is approaching the commissioning phase.
- Works on an FS1 plant to a client in Southeast Asia is in the design phase.

Start-ups

- The project with a **FORMOX** FT3 plant in Henan Province, China was successfully started in July.
- The FT3 plant to Wanhua Chemicals Group Co. Ltd. in Yantai China, their third **FORMOX** plant on this site, went on stream in September.
- The FT3 plant to Wanhua Chemicals (Ningbo) Co. Ltd. in Ningbo China, their third **FORMOX** plant on this site, is proceeding well with scheduled start-up this winter.
- The project with an Emission Control System to a client in China is approaching commissioning.
- The project with two plants, FS3 & FT3, to Xuzhou Yuanfeng New Material Tech. Co., Ltd., China recently started up December 2021.

A formaldehyde magazine from Johnson Matthey

The newsletter Informally speaking aims to provide information about formaldehyde in an informal forum and is published twice annually by Johnson Matthey for its customers and contacts in the formaldehyde business.
The information included herein is part of our customer service and in no way entails or implies any undertakings, legal responsibilities or liabilities.

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Inspiring science, enhancing life

Our vision is for a world that's cleaner and healthier, today and for future generations. As a global leader in sustainable technologies, we use our cutting edge science to create solutions with our customers that make a real difference to the world around us.

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