JM

Johnson Matthey
Inspiring science, enhancing life

Informally speaking

A formaldehyde magazine from Johnson Matthey

- Conferences are back - we meet again!
- Wanhua's energy conservation and innovation
- Turbocharger and energy efficiency in focus
- Meet China's largest BDO manufacturer
- Catalyst analysis performed by R&D lab

AUTUMN/WINTER 2022

A year to remember

2022 was truly a year to remember for many reasons, both good and bad. On the positive side, we were able to restart our Formaldehyde conferences. And as you can tell by the cover photo and the reports from both Helsingborg and Houston, it felt great to finally meet face to face again! We also had a common Safety Day across all of JM for the first time ever, which was an inspiring and important event.

It was a fantastic year in terms of both sold projects and catalysts (see Projects & start-ups) as well, and the future is looking good from a formaldehyde growth perspective, particularly in China. As a result, we were excited to announce a decision to increase our formaldehyde catalyst capacity in Sweden. We are also happy to have received input from two of our expanding customers in China, Wanhua and Markor, who share some insights about their companies and perspectives on the future.

On the negative side, 2022 brought a tragic war to Ukraine impacting so many people and leading to a difficult energy situation, particularly in Europe. This has put a lot of pressure on all of us to use less energy, and forced some industries to slow or shut down, or even move production. The war has disrupted the supply of important materials, spurred inflation, and pushed central banks in many countries to increase interest rates, risking a downward spiral if we have less money to spend overall. COVID also continued to have a dampening effect on the economy in 2022.

Due to the situation with the high energy prices and overall cost focus, we have included a few articles on the subject in this edition. Whether you need more capacity or are just wanting to optimise your operation, you will find useful information illustrating ways to make best use of energy in your present or new plant. You will also find tips to consider on absorber packing to help minimise costs. An update on our **JM-LEVO**™ Formaldehyde Portal is about both optimising and simplifying your production.

Finally, we look forward to being in contact with you, hopefully at one of our conferences or in the personal meetings between our teams, and we hope for a more peaceful 2023 for all of us.

Lars Andersson and Ronnie Ljungbäck
Global Market Managers Formaldehyde

Content

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Accelerating global transition to net zero

For over 200 years Johnson Matthey has focused on turning the magic of precious metals into technologies that address some of the biggest societal, economic and environmental challenges that exist today. As we enter a period of great change within the energy, automotive and chemical industries, this work has never been more critical.

Our expertise in process technology and catalysts is required to produce a wide range of sustainable fuels from CCS-enabled (blue) hydrogen and electrolytic (green) hydrogen to sustainable aviation fuels as well as green methanol and ammonia. For our chemical industry customers who are developing the building blocks that go into everyday essential household products, we're supporting a move to greener factories and production processes. We're also developing technologies using sustainable materials to make products such as sustainable paints and plastics and decarbonised fertilisers.

CEO Liam Condon says, "I have no doubt that Johnson Matthey can and will be a catalyst for the changes the world needs most as we transition to net zero. Since joining as CEO in March 2022 I've been really impressed by how deeply passionate everybody is to meet this challenge head on. I've been equally impressed with how important JM is for our customers who are literally dependent on us delivering for them to meet their business and sustainability commitments as well."

> "We have a bright and green future, and the world is depending on us to deliver for this and for future generations."
>
> Liam Condon, CEO

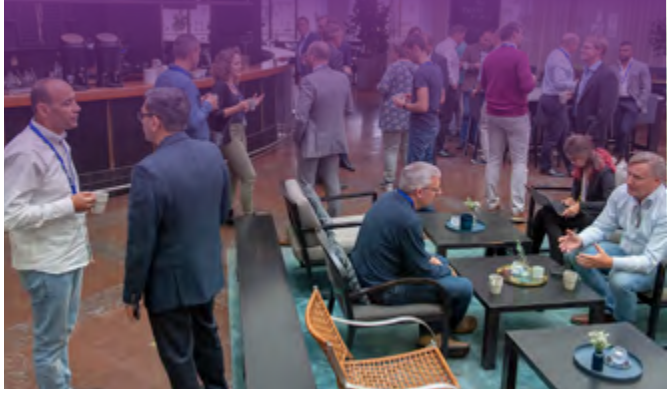
BY

Nicole Watson
Marketing Communications Representative

On the front page:

Formaldehyde Europe, September 2022

Read more about this event on page 6-7



Conferences coming up...

Formaldehyde Asia
Bali, Indonesia,
March 13-16th 2023

We are planning formaldehyde conferences in both Turkey and China during 2023, details to be confirmed.

All JM employees took five together during JM's first ever Global Safety Day

On September 7, 2022, JM held its first ever Global Safety Day – one day where all JM employees everywhere took time out together to talk about safety

Making sure we can all go home safely each and every day and also protect the communities in which we live and work is of paramount importance at JM. To emphasise that this is something that we all do together, on September 7th, 2022, JM held its first ever Global Safety Day – one day where everyone across the globe took part in workshops and open discussions dedicated entirely to safety for the benefit of everyone.

JM's everyday approach to safety is called TAKE 5 (Stop, Think, Assess, Control, Complete). The idea of having everyone take part on one and the same day, no matter where one works, was reflected in the theme of the event, 'TAKE 5 Together'. This was to highlight the importance of making time every day to keep everyone safe from harm and to engage in conversation and talk about safety.

In Perstorp, all employees gathered at Persgården, a nearby conference center, for two highly engaging sessions inaugurated by Finance Director, David Heginbottom. There we shared and celebrated our EHS achievements, discussed and emphasised the importance of having positive and constructive safety conversations, factors that influence behaviors both negatively and positively in the workplace, and the appropriate process to receive feedback and appreciate the commitment and care of others. The two sessions ended with employees signing a pledge as a sign of our commitment to keeping safety at the core of everything we do.

In addition to the global programme, the R&D department in Perstorp hosted two open house sessions on the same day to highlight the safety initiatives and upgrades in their facilities, such as the updated gas alarm and a shutdown system on incoming gases to the pilot hall.

BY

Khaled Younes
EHS Advisor

JM announces major expansion at Perstorp

In December 2022 Johnson Matthey announced a major investment in its formaldehyde catalyst manufacturing facilities in Perstorp, Sweden. When complete, capacity will be increased by approximately 50%. The expansion, which is expected to be operational by March of 2024, was one of the strategic investment milestones outlined by JM in May 2022.

"By expanding our Perstorp site," says Alberto Giovanzana, Managing Director for Catalyst Technologies at Johnson Matthey, "we will be best placed to meet the global demand for this versatile chemical, and ensure the team at Perstorp can continue to deliver for its customers around the world."

The increase in demand for formaldehyde has partly been driven by the chemicals market in China where new legislation has been introduced to phase out the use of single-use plastic by 2025.

"It is great to finally be able to make this announcement, since we want to ensure that our customers and the market understands our ambition to grow with the market and maintain our position as market leader," says Ronnie Ljungbäck, Global Market Manager Formaldehyde – Catalysts.

50%
capacity increase by 2024

Scan the QR code to read the full press release

Formaldehyde Europe 2022

12 - 15th September 2022, Helsingborg, Sweden

After a few years of interruption due to the pandemic we were excited to finally be able to resume our business conferences. The first was in September where we welcomed many new and familiar faces to Helsingborg, beginning with a joyful reception at the Marina Plaza Hotel.

Day 1

On Tuesday morning the conference was opened by Ronnie Ljungbäck and Lars Andersson, and Tomas Nelander, Technical Services Leader, shared safety experience regarding correct HTF level to avoid reactor tube damages.

Alberto Giovanzana then greeted all of us 'welcome' to this 11th occasion of Formaldehyde Europe and delivered an update on Johnson Matthey business and sustainability efforts. Alberto commented on how the community of formaldehyde producers is strong and characterised by long relations. He also brought up how gratifying it was to have a mix of newcomers and participants with long experience attending.

We moved on to **FORMOX**™ technology's success story since 1959 as explained by Fredrik Rietz, Global Licensing Manager. So far, 213 plants (319 reactors) have been delivered with an installed capacity of 30 million tonnes (as 37%) per year by 2025.

Ronnie continued with reviewing our catalyst portfolio and ongoing developments including higher yield, longer lifetime, and faster reloading. Tomas explained the scope of our technical services and announced the good news that another occasion of the long-awaited Refresher Training is planned to go ahead in 2023.

Philippe Thevenin, Global Technical Services Leader – Formaldehyde, elaborated on the latest developments and experiences from the **JM-LEVO** Formaldehyde Portal. In a live demonstration of the Portal, Philippe showed how easy it is to share process data and get quick advice on optimal operating conditions according to a desired output. This, he said, eliminates a lot of trial and error for customers, especially when making changes in production capacity to meet new business demands.

News on the **FORMOX** 2.0 high pressure plants and catalysts concept, was presented by Simon Smrtnik and Robert Häggblad. Market updates and regulatory news were presented by Lars Andersson and invited speakers Paul Girard, Cefic / Formacare, and Simon Maddren, MMSA.

Important safety aspects including deflagration risks were reviewed by Ola Erlandsson, Senior Process Specialist.

Before ending the day in order to enjoy a nice dinner together at the nearby SeaU, a poll was taken regarding priorities for future development of the formaldehyde process. Not surprisingly, emissions, formic acid content, and formaldehyde yield ended up at the top of the list.

Day 2

On Wednesday morning we boarded the bus to Site Perstorp for tours and demonstrations in our R&D laboratory as well as Perstorp Specialty Chemicals' formaldehyde plants. Both visits provided a nice break from the "classroom" sessions and were highly appreciated by everyone.

Back in Helsingborg, Sebastiaan van Haandel, JM's Business Development Manager Low Carbon Solutions, illustrated how the greatest contribution to the carbon footprint is made by the feed methanol. He then held a highly appreciated decarbonisation workshop ending with a survey which revealed that while delegates feel some pressure from customers to decarbonise FA products, many of their customers are unwilling to pay premium prices for it. When asked what kind of support they expect from JM on their decarbonisation journey, most delegates answered, "Low carbon methanol technology," something that JM can deliver today.

Tomas Nelander presented his summary of experiences entitled "Seven operational problems", which ended up being the highest ranked presentation in a survey of the participants. Tomas then ended the second day of the conference with an overview of hotspot aspects.

The evening was spent with a lot of socialising and fun while playing a few games of bowling.

Day 3

The last day of the conference contained technical presentations on optimisation of plant performance, instrument errors, and theoretical and practical aspects of absorber operation.

We were happy to finally meet and greet everyone in person again and to receive positive feedback from participants both during and after the conference about the technical content and networking opportunities that the event provided:

"It was nice to see you all in person," wrote one participant. Another wrote, "I thought the conference was excellent and I found the topics very interesting and informative. Thank you to you and your team for all the efforts."

After closing, the JM team turned to putting the final touches on the Formaldehyde Americas conference in Houston, drawing on our experiences from Helsingborg.

BY

Paul Walter
Regional Sales manager

Formaldehyde Americas 2022

10 - 13th October 2022, Houston, Texas USA

An unforgettable sight greeted us when we were finally able to meet at the Formaldehyde Americas conference in Houston in October. As a bright orange glow appeared on the Gulf of Mexico, we were all wondering what we were actually witnessing. But after a few moments of uncertainty, it became clear when an incredible full moon rose up out of the sea.

I don't think anyone who stood at the Hilton NASA hotel that evening will ever forget it. And I hope the same can be said of the conference itself. For me, it was by far the best conference I have been a part of, although different.

For sure, the effects of the pandemic were still being felt, which explained in part why fewer than normal participants were registered to attend, so it was a difference compared to before. But in the end, this actually turned out to be quite a good thing. The discussions and interaction between customers that took place over those few days, with everyone sharing on an equal basis, felt extra special.

It was a perfect blend of customers from North and South America, as well as a couple from Europe. We also had a delegation from one producer that is not yet a customer.

When I asked one of their delegates for his thoughts on the conference, he said he was impressed by the amount of sharing of technical information which was on a whole other level than what he has experienced at conferences organised by other suppliers. This response added to my feeling of satisfaction regarding the conference and finally being able to host it.

From the presentations given, one that really stood out for me was by Julianne Ogden of the American Chemistry Council: "Formaldehyde: Regulatory Activity and Potential Implications". This I believe was a real eye-opener for everyone as Julianne broke down just how many people are employed in the FA industry and how much revenue the industry generates.

Formaldehyde Americas day by day

Much of the program was the same as the Formaldehyde Europe conference a month earlier (see previous article). What follows below is a shorter summary:

Day 1

Atul Shah kicked off the conference on Tuesday morning with a welcome address and introduction. After Tomas Nelander shared important safety experience, JM's Head of Commercial Sales – Americas, Lisa Wadlington, updated customers on Johnson Matthey business and sustainability efforts.

Claes Lundström, Senior Consultant - Plant & Revamp Sales, Ronnie Ljungbäck and Tomas Nelander talked about **FORMOX** plants, catalysts and technical support respectively. After a coffee break, Philippe Thevenin once again demonstrated the **JM-LEVO** Formaldehyde Portal, followed by updates on **FORMOX** 2.0 high pressure plants and catalysts, and market updates including the Methanol market by invited speaker Mark Berggren, MMSA. Decarbonisation and the future development of Formaldehyde technology were also discussed before ending the day with a visit to Top Golf where we enjoyed hitting a few golf balls together and a nice dinner.

Day 2

Caio Amorim, Senior Technical Service Engineer for the Americas, opened the second day of the conference which focused a lot on safety and operational challenges. This included presentations by delegates from Foremark, Oxiquim, Foresa and DuPont. The afternoon sessions included a look at various tools, energy-saving turbo technology, Tracerco services, as well as a break to visit a number of vendor stations. And the eye-opening presentation by Julianne Ogden from ACC on the importance of formaldehyde.

Day 3

Just as in Helsingborg, the final day of the conference contained technical presentations on optimisation of plant performance, instrument errors, and theoretical and practical aspects of absorber operation, where Ola Erlandsson was the main speaker. The final presentation on absorption seemed to be a very much appreciated one, based on the survey feedback provided from all customer participants.

All in all, I think the customers who attended got a lot from the conference and took home with them a sense of how important safety is so as not to add to the bad reputation that the formaldehyde industry struggles with. Also how important sharing our experiences with each other is in this regard.

BY

Atul Shah
Business Manager

JM-LEVO Formaldehyde simplifies data sharing with ADI

One of the biggest advantages of using the JM-LEVO Formaldehyde Portal is the ability to receive advice on how to achieve improvements in areas such as yield, catalyst life and energy efficiency much quicker than was possible before. And the key to all of this is the ability to share your plant data easily and regularly with us through a secure connection.

The newest release features ADI, short for Automatic Data Ingestion (see Figure 1). This is a solution that replaces the earlier process of uploading data manually through spreadsheets as shown in Figure 2. ADI can be set up in a couple of different ways depending on your existing, or soon to be installed, setup. But no matter which way you prefer, ADI is easy to integrate into your existing systems and is a one-way data stream for best security. It enables data to automatically be fed as often and as regularly as you would like, with virtually no effort on your part.

Experiences from recent conferences

As part of the two conferences held in Helsingborg and Houston last year, I did a live demonstration of just how the data sharing possibilities work and make it possible for us to evaluate the data and get back to the customer with our recommendations already after a day, instead of after a week. The discussions we had during the conferences were much appreciated as customers shared several things that they were having trouble with themselves and that they felt could be solved more quickly with **JM-LEVO**. As many could see through the demonstration, the way that they used to go about optimising production can now be achieved without the time-consuming trial-and-error method that they may sometimes have been using up until now.

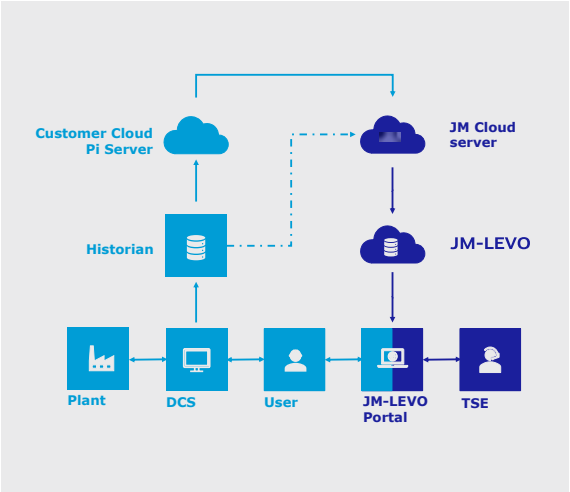


Figure 1: ADI Process flow where data is transferred automatically from the customer's environment (server or cloud services) to JM

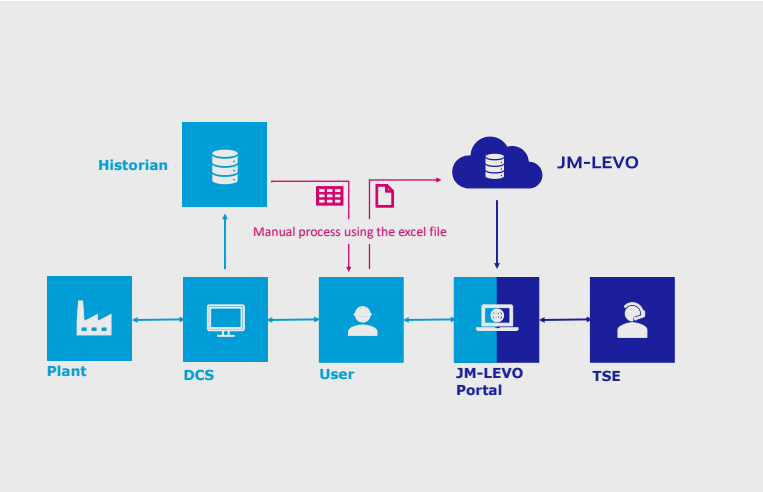
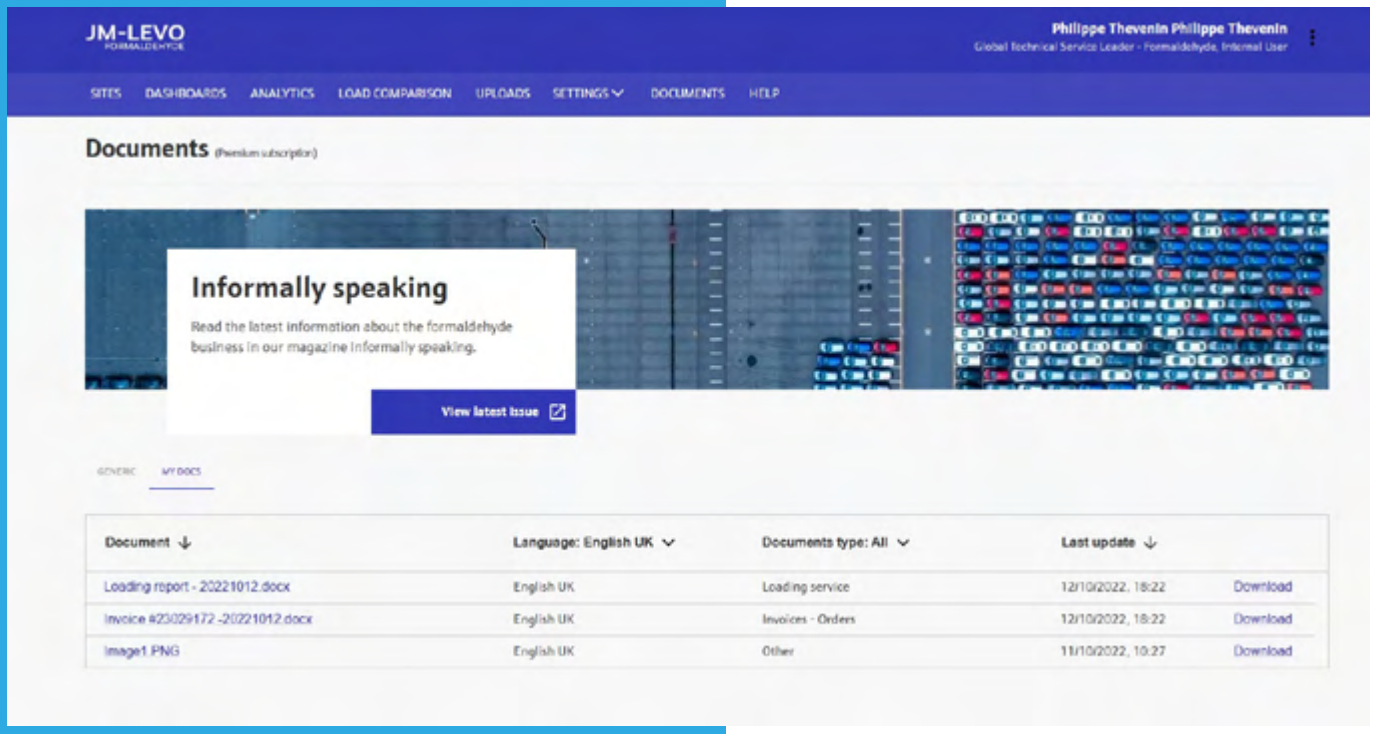
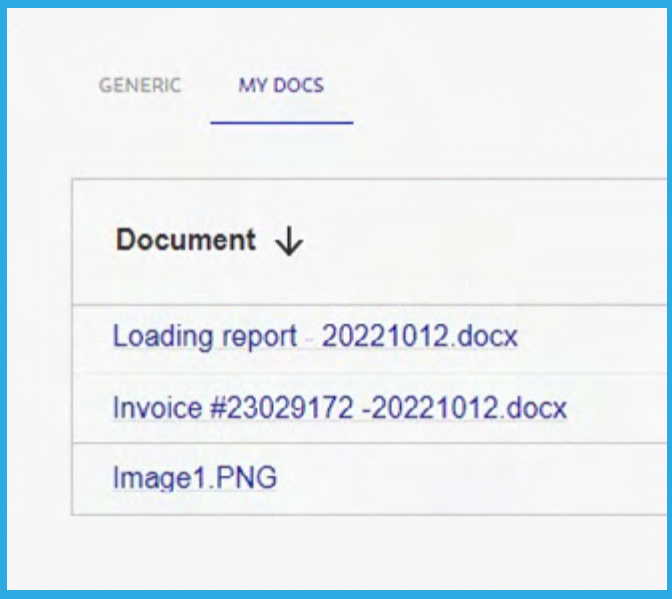


Figure 2: Present solution based on the manual upload of a spreadsheet.



New space for customer documents

In September of 2022 we launched a new space on the Documents page called My Docs – see screenshot. Whereas our regular Technical Information documents are stored under the Generic tab, many of your own (customer-specific) documents such as analytical reports catalyst samples, invoices, orders, documentation related to the loading service, plant details such as drawings, etc. can now be stored under My Docs, an improvement over the decommissioned Customer Center. Please reach out to your JM representative and let us know which documents you would like to have stored on the Portal.



Easy to get onboard before FPC shuts down

In other **JM-LEVO** news we are happy to have welcomed our first customer in China to begin using the Portal. In addition, JM has also successfully launched the **JM-LEVO** Methanol Portal, which many of you may also be interested in learning about. As a reminder, our old FPC system, for manually generating charts from process data, is being decommissioned, meaning that from April 1, 2023, **JM-LEVO** Formaldehyde Portal will be the only way that you will be able to share data with us. However, we have made the onboarding process very easy. It requires virtually no work at your end and normally you can start uploading data into the Portal only a few weeks after signing our Terms of Use.

BY

Dr Philippe Thevenin
Global Technical Services Leader – Formaldehyde

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

Multiple ways to save energy for new plants, upgrades and existing plants

As always, optimal usage of energy is important to consider for obtaining good plant economy. But as energy prices have increased significantly over the past year, especially electrical power, it may be more important now than ever before. Plant economy is of course influenced by installed hardware as a first thing, but also how the plant is being operated regarding DVC (Direct Variable Cost). In this article we look at different ways to save energy, with the main focus on the large consuming units of electricity and energy in a formaldehyde plant. Other minor energy consuming items include compressed air, heat tracing, lighting, etc., but are not the focus for this article. We start off with the palette of options for new plants.

Turbocharger

Taking advantage of inherent energy with a turbocharger (TC)

Unlike a Roots blower that uses electrical power, a turbocharger uses inherent energy in the system – enthalpy of the process gas from the Emission Control System – to drive the compressor. This implies electrical power savings, but on the other hand a loss of steam production as the energy is used to drive the TC instead. Overall, however, the relative net savings are higher as the cost of electrical power is higher than the value of the steam.

Parameter	FS3:2 TC	FS3:1 TC	unit
Reduced power consumption with TC compared to 0.5 bar g & 10 vol.% inlet*	42	19	kWh/MT37FA
Production	557	418	MTPD 37FA
Savings per MT37FA (%)	221	100	- / MT37FA
Additional maintenance cost (%)	-1.8	-2.6	- / MT37FA
Lost steam value (%)	-40	-24	- / MT37FA
Relative Net Savings with TC (%)	179	73	- / MT37FA

Table 1: Relative net savings with TC as compared to a Roots blower for pressurisation, FS3:1 (FORMOX 1.0 standard design) base case as per above*, and FS3:2 (FORMOX 2.0 High Pressure [HP] design) at 1.0 bar g. Price of electrical power 0.12 EUR/kWh; Value of steam: 15 EUR/ton, or ~0.03 EUR/kWh

This calculation shows how significant electrical savings are achieved by using the TC for pressurisation when considering both the value of the steam and the maintenance costs for the TC and Roots blower. For example, for an FS3 plant running at full capacity, replacing an electrically driven Roots blower with a TC reduces electrical power consumption by 19 kWh/MT37FA. The value of the power in this case is normalised (base case, 100%) and used as a reference, and shows a net relative savings of 73%. If the plant is pressurised further to 1.0 bar g system pressure using our latest HP plant technology, the electrical power with a TC instead of a Roots blower is reduced by 42 kWh/MT37FA and the relative net savings are 179% compared to the base case! Though heavily dependent on the price of electrical power, this calculation clearly shows the significant cost of pressurisation.

Steam utilization

Making better use of steam

Generally speaking, a good use of steam is for heating purposes. But depending on the location and configuration of your site, a turbine solution may offer advantages.

Alternative with steam-driven fans

A set up involving a turbine to drive recirculation fans is an interesting solution for utilising the steam inside the plant area. In this case, an electrical motor is replaced with a turbine. The set up can vary a lot depending on local conditions. For example, some of the steam can be extracted from the turbine to produce low-pressure steam for heating purposes, especially in the resin industry (see Figure 1). JM is willing to look at such an investment together with a customer for new formaldehyde capacity. As the solution may be very different depending on company specific conditions, it is difficult to estimate the total savings. But available steam from the formaldehyde production is enough to run the recirculation process gas flow.

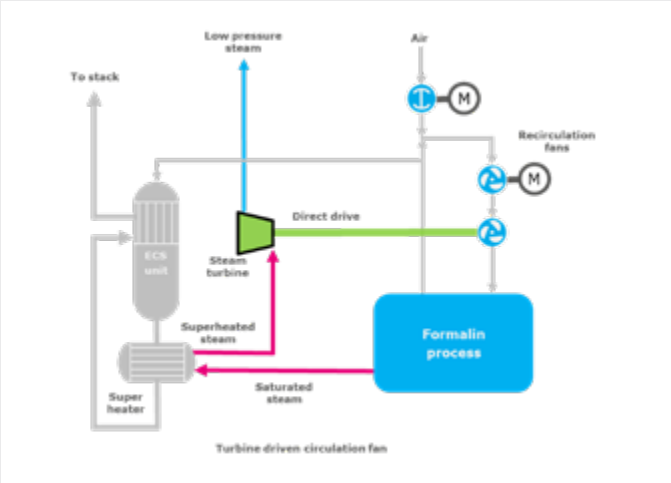


Figure 1: Solution with steam turbine and extraction of low-pressure steam

Alternative with electrical power generation

Using a generator to produce electricity is another alternative that reduces overall power consumption at the site. Typically, JM is not involved in the installation of the generator itself, but we have fitted formaldehyde plants to generate superheated steam for increasing efficiency in the turbine.

In concert with a TC for even greater savings

Both of the above alternatives can be combined with turbocharger technology. This can result in normal operation in which electrical power is used only for the pumps in the absorber system. In the case of installing a generator, the formaldehyde plant can even become a net producer of electricity.

Upgrades

The above-mentioned options could also be an opportunity for existing plants, although the payback time may be difficult. However, upgrades may be worth considering (or reconsidering) based on the high price of energy and possibilities to get access to local subsidies now becoming available for energy investments. To find out more about how we can help you to implement any of these energy saving solutions please contact Fredrik Rietz or Claes Lundström.

Optimising operation

Plant economy is of course influenced by installed hardware as the first thing. But how the plant is operated with regard to DVC also has a major impact. Optimal operation can be achieved through various adjustments to some of the key parameters. To calculate actual savings, it is important to have the specific costs updated for your specific site conditions when estimating your DVC. Here, both the JM Performance Package and the **JM-LEVO** Formaldehyde Portal can be highly valuable for helping you to set the optimal control conditions for achieving high yield at minimum specific power consumption.

It is important to remember that there is an offset between optimal yield and power usage. For example, a good yield is obtained for lower inlet operation, but this means higher usage of specific blower power (kWh/MT37FA). See the article by Mike Brown in the Spring/Summer 2020 edition of Informally speaking (page 10) where he discusses the influence that the methanol inlet, process gas velocity and system pressure have on yield and power economy.

Even when using a turbocharger, which gives good power economy to begin with, further optimisation is possible – see article on page 15 of the Winter/Spring 2021 edition of Informally speaking.

Absorber circulation pumps

Another parameter influencing power consumption is how the absorber circulation pumps are operated. First, check that you have the correct circulation flows over the absorber packed sections for good absorber performance, but also for good power economy. If the pump is not correctly adjusted for the intended circulation flow, there is a risk that the pump is operating at too high a flow, resulting in higher usage of electrical power. A higher flow will also have other negative implications such as deteriorated absorption properties and increased risk of flooding.

Please contact your Technical Service representative for more advice on optimising operation with a focus on power consumption.

BY

Simon Smrtnik
Engineering Manager

Fredrik Rietz
Global Commercial Licensing Manager - Formaldehyde

Innovation, energy conservation and 'lower-carbon' go hand-in-hand at Wanhua

Over the past few years Wanhua Chemical has steadily climbed in the Top 50 global chemical companies as ranked by Chemical and Engineering News (C&EN), from no. 43 in 2018 to no. 29 in 2021. In the most recent rankings for 2022, Wanhua made a big jump to no. 17 after nearly doubling its revenue in 2021. And while doing so, the company also continues to keep a focus on innovation, energy conservation and emissions reduction.

"Wanhua Chemical has always adhered to the implementation of high-quality investment strategies to lay a solid foundation for sustainable development," says Mr. Zhang Yang, Operation Engineer Wanhua Ningbo. "We have many investment projects planned for the next few years."

In the future, Wanhua Chemical will join hands with upstream, downstream and technology to explore product cycle routes, continue the high-quality growth of the entire industrial chain under the stimulation of diverse industry demands, and continue to develop towards greener, lower-carbon, and sustainable ecological changes.

"In the long-term enterprise development process, Wanhua Chemical is focused on serving human development and thinking about how to deal with the four major problems of human society: climate change, water shortage, plastic pollution, and population growth," says Zhang Yang. "That is what we mean with our motto, 'Advancing chemistry Transforming lives'."

> **"Wanhua is taking action in accordance with the idea that clear waters and green mountains are as good as mountains of gold and silver"**
>
> **Zhang Yang, Operation Engineer**
> **Wanhua Ningbo**

Promoting energy conservation and emission reduction

Through the coupling of various innovative technologies, the waste heat from production in industrial parks is recycled, realising a superb combination of energy-saving technology for chemical equipment and low-grade thermal energy technology for civil use. Meanwhile, innovative process and disposal technologies are developed at multiple levels in hydrogen chloride recycling, solid waste treatment and comprehensive utilisation, and wastewater treatment to promote energy conservation and emission reduction.

"Wanhua is taking action in accordance with the idea that clear waters and green mountains are as good as mountains of gold and silver," says Zhang Yang. "We are realising the goal of carbon peak and carbon neutrality, and aim to build a 'zero carbon' industrial park."

"One way we are doing this is by optimising our energy structure to strengthen our carbon footprint management from the source," continues Zhang Yang. "By 2030, it is expected that green electricity will account for more than 50%, so as to maximise economic, ecological and social benefits."

History with JM, turbochargers and automation

Wanhua Chemical's first formaldehyde plant was put into operation in 2002, which was also the first cooperation between Wanhua and JM (then Perstorp Formox). With the continuous development of Wanhua Chemical, Ningbo Wanhua, Yantai Wanhua, Fujian Wanhua, Sichuan Wanhua, Penglai Wanhua and other production sites have been successively established. There are formaldehyde production units at each site – three at Ningbo, three at Yantai, one at Fujian and one at Sichuan.

"Together these production units have a designed capacity of nearly 2 million metric tons"

"Together these production units have a designed capacity of nearly 2 million metric tons," says Zhang Yang. "And among these, three are equipped with advanced turbocharger technology."

In addition to the turbocharger projects, Wanhua has also found automation to bring several advantages.

"At present, the reactor temperature controlling for the catalyst whole life has been optimised from manual adjustment to APC, meaning 'Advanced Process Control'," says Zhang Yang. "APC is an advanced way to find the best reactor operating conditions via testing and using the limitation operation conditions. We have found that this can decrease the consumption of methanol, prolong the Specific Production of the catalyst, improve the automation level and operation stability, and finally reduce the Direct Variable Cost of formaldehyde."

BY

Mei Zhu
Sales Representative

with co-authors
Hans Han, Senior Technical Service Engineer
Wilson Wang, Project Head

Startup of Wanhua Meishan with Mr. Wang Yongtao (second from left) next to Carlos Du from JM (center), and teams from other Wanhua sites

A center of innovation

Wanhua Chemical is home to seven national laboratories with the China National Accreditation Service (CNAS), as well as five national-level innovation platforms:

- National Engineering Research Centre for Advanced Polymers
- National Technology Innovation Base for New Chemical Materials
- National Polyurethane Engineering Technology Research Centre
- National Enterprise Technology Centre
- Postdoctoral Workstation

Startup of Wanhua Ningbo with Mr. Zhang Yang (second from left in the front row), and teams from other Wanhua sites and JM

What is BDO and what is it used for... and how much?

1,4-Butanediol, more commonly called BDO, is another very interesting product that can be made from formaldehyde.

Chemically it is a primary alcohol, and it has several different production routes, most of them via petrochemicals.


Walter Reppe

We bring it up in Informally speaking since the major manufacturing route globally, the Reppe process, accounts for well over 65% of all BDO and uses formaldehyde as one of the raw materials. The other important raw material is acetylene. The name originates from the inventor of several interrelated reactions involving the acetylene gas in a safer high-pressure environment, Walter Reppe. He started his work with acetylene in the late 1920s and one of the type reactions is the addition reaction with an aldehyde, in our case formaldehyde.

$$CaO + 3C \rightarrow CaC_2 + CO$$
$$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$$

To give you more background, acetylene is normally produced from calcium oxide and carbon (coke) via calcium carbide. So this is old chemistry, but still feasible where coal is readily available. Acetylene can also be produced from natural gas, but globally only about 6% of total production is, even though this is the dominating source in Europe and the US.

In 2006 Bob Crichton wrote an article in Informally speaking titled "Reppe rides again". In it, Bob outlined the changes over time how the energy sector and chemical industries used different sources for raw materials to get the necessary hydrocarbons. In general, the coal-based methods had gradually been replaced by other methods using crude oil and other lighter hydrocarbons instead. Then suddenly, 17 years ago, there was a renaissance for Reppe-chemistry and BDO production in China, and several new projects were launched. This was not anticipated then; Reppe chemistry was considered a dying breed. Today, again a bit surprising, we see another wave of BDO plants based on Reppe technology being built and planned. Primarily in China but also in other places where acetylene is still available. But we will come back to that and other production routes for BDO later in this article.

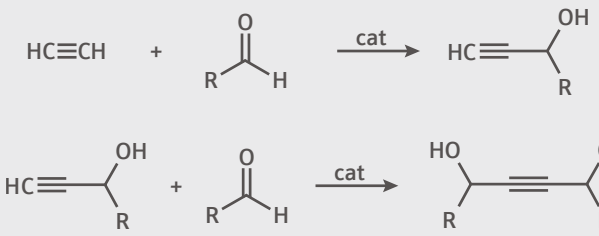
What is it used for?

There are many different industrial applications for BDO, the biggest being tetrahydrofuran (THF). THF is used in performance polymers and in making poly tetramethylene ether glycol (PTMEG) used to make polyurethane fibers like spandex (think modern training clothes), but also as an industrial solvent. The second largest is polybutylene terephthalate (PBT) resins, which are used in engineering plastics. One example is insulators in electrical and electronics applications. The third largest application is gamma-butyrolactone (GBL), used in products like paint strippers, nail polish removers, stain removers and circuit board cleaners. It is also a common intermediate in the manufacture of pyrrolidones and pharmaceuticals.

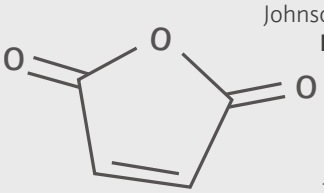
These three major applications stand for about 85% of the global BDO consumption, but other interesting applications are increasing fast and are partly the reason for the high growth now seen in China. The reason is synthetic biodegradable plastics. Government ambitions in especially China to transition to circular economies and minimise waste pave the way for great opportunities for these types of products. Biodegradable plastic blends are manufactured using BDO. Examples are polybutylene adipate terephthalate (PBAT), polybutylene succinate (PBS) and polybutylene succinate adipate (PBSA). You can read and get more details about degradable plastic materials in the Winter/Spring 2021 issue of Informally speaking.

How is it made?

We have already mentioned and described the Reppe method which still is the dominating production route. If all planned and announced new capacity in China is implemented this situation probably will be strengthened. As can be seen in the general ethynylation reaction here, acetylene and aldehyde are reacted catalytically at around 200 bar and 300°C. More aldehyde is added in a second step. All in all it requires about 2 tonnes 37% formaldehyde to produce 1 tonne BDO.



As a result of raw material availability, new projects have emerged using other materials than acetylene. Integrated n-butane–butanediol processes have been developed by several producers.



Johnson Matthey has developed the **DAVY**™ butanediol process which, in a single reaction train, can produce varying ratios of BDO, THF and GBL. The process uses butane or benzene as the feedstock to first make maleic anhydride (MA), and then involves three major steps. Esterifying the MA feedstock to dialkyl maleate, hydrogenating the ester, and then product refining.

There are other processes using n-butane as the starting material, like those developed by DuPont and Lurgi. Both utilise different catalytic routes involving MA as an intermediate.

Another production method uses propylene oxide as the raw material. This process was developed and patented by Kuraray and is used by Lyondell. Propylene oxide is isomerised to form allyl alcohol, which is then hydroformylated. The last step is hydrogenation to form BDO.

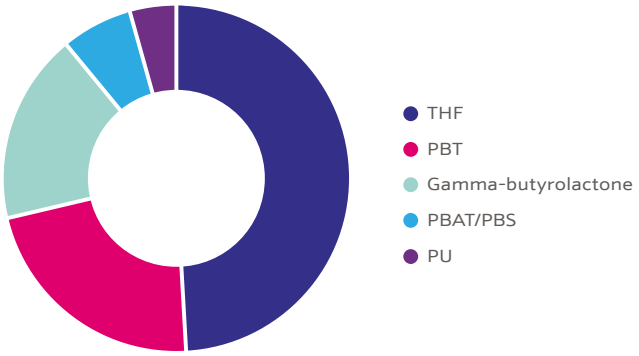
Mitsubishi operates a plant for producing BDO where butadiene and acetic acid are reacted with oxygen at high pressure to get diacetate. In the following step this is hydrogenated and hydrolysed to get BDO.

New methods using renewable sources

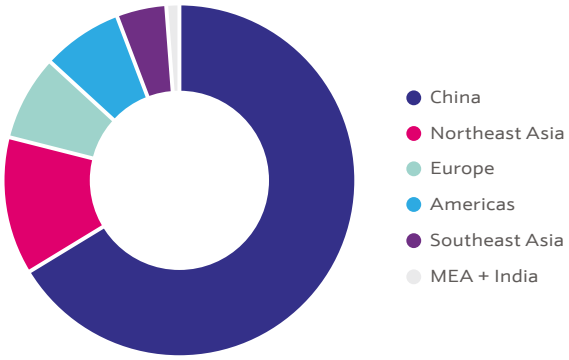
In addition to the traditional production routes based on petrochemicals, research and innovation over the last decade or so has resulted in commercial methods based on renewable sources. There are several reasons and drivers for this, the more important ones being to reduce the use of fossil raw materials and the environmental and overall carbon footprint. So far, the main challenges have been material availability (competes with food) and higher production costs (small scale). Two of the more well-known routes are briefly described here.

In the first, biosuccinic acid is obtained by fermenting e.g. sugars or biomass material. The aqueous succinic acid stream is then separated, purified, and catalytically hydrogenated to produce BDO, GBL and THF. A second process, developed by Genomatica, uses a genetically modified bacteria to convert sugar into BDO through fermentation, with high yields.

BDO application areas 2022



BDO consumption 2022



The market outlooks

The global BDO capacity 2022 is around 4 million tonnes. The biggest market is by far Northeast Asia, including China, which is about 80% of the total. Europe and the Americas are about the same size, each corresponding to 7-8% of the total. As mentioned earlier, THF is the largest application, followed by PBT and GBL.

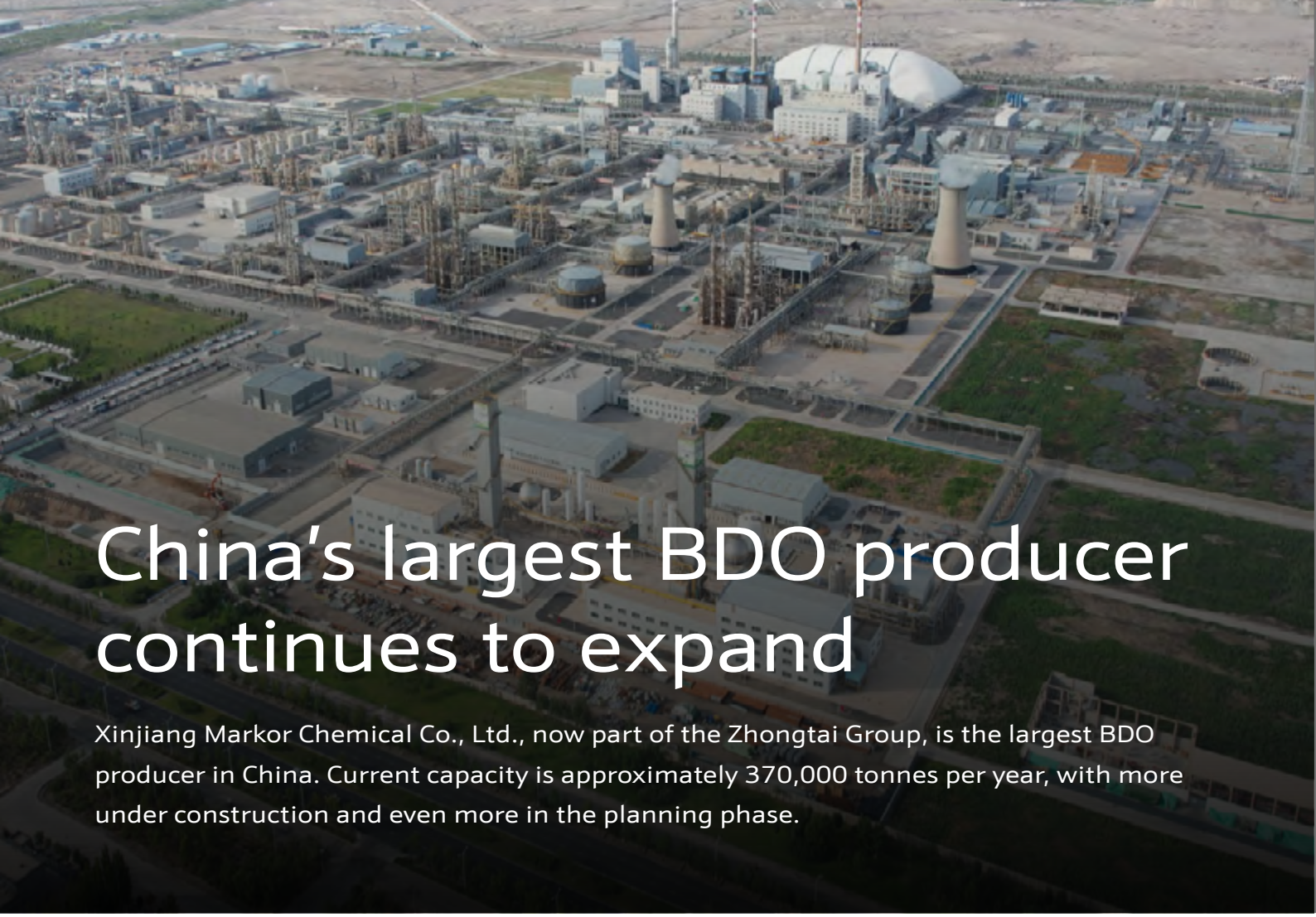
In the coming 5 years, world consumption of BDO is expected to increase about 9% annually driven mainly by China and the expansion of PBAT/PBS production there, as well as by GBL production. During this period, BDO demand in China is expected to grow 10-15% annually to support the huge capacity developments for the biodegradable plastics PBAT and PBS. The Chinese government is enforcing a "plastic ban" on nonbiodegradable plastic products which drives this industry. Also, the growing market for Li-ion batteries will increase demand for pyrrolidone (and GBL) production.

The other larger markets in Europe and the US are expected to grow at more moderate rates, 1-2%.

As you can see, it is indeed an interesting development for BDO now, and JM is thrilled to be actively involved by providing technology both for BDO through our **DAVY** process and formaldehyde through the **FORMOX** process. In Projects and startups on pages 24-25 you will notice that there is a lot going on, and BDO is a major reason for this.

BY

Lars Andersson
Global Market Manager
Formaldehyde - Plants



China's largest BDO producer continues to expand

Xinjiang Markor Chemical Co., Ltd., now part of the Zhongtai Group, is the largest BDO producer in China. Current capacity is approximately 370,000 tonnes per year, with more under construction and even more in the planning phase.

BDO is the company's leading product and an important basic raw material as an organic chemical and as a fine chemical.

According to the Chinese BDO association, Markor Chemical is an important BDO supplier in the domestic market, offering a substitute for imported product, and has become the industry standard in product quality and service quality. Production takes place at the Markor Chemical Industrial Park located in the Korla Economic and Technological Development Zone in the city of Korla, which lies in the Tarim Basin area of Xinjiang.

Markor's BDO expansion over the years

2008 Markor I (70,000 tpa)
2013 Markor II (100,000 tpa)
2015 Markor Meiou (100,000 tpa)
2022 Markor IV (100,000 tpa)

Under construction: Markor V (100,000 tpa) In planning phase: (2 x 300,000 tpa)

"Based on the geographical advantages in the Tarim region, which is rich in oil and gas," says Mr. Xu Pengfei, Vice General Manger for the company, "Markor Chemical attaches great importance to the clean transformation of these resources and on making positive contributions to the in-site intensive processing of the region's excellent natural gas resources."

"The Tarim base will be built into a first-class new material industry base," Mr. Pengfei continues. "In alignment with the Zhongtai Group's industrial layout of 'Refining, Chemical and Textile', the focus is on extending the upstream supply chain and downstream industrial chain of BDO and PTA, using existing resources to build a number of olefins, aromatics, BDO and downstream new materials projects."

Long cooperation with JM

Asked about the company's history with JM, Mr. Zhang Bin, Production Manager at Markor says:

"Markor I, Markor II and Markor Meiou all use Johnson Matthey **FORMOX** license and catalyst. The operating parameters of each unit are within the normal specification range. The catalyst life and capacity are stable. JM has given great support on new projects and existing units, especially for technical and after-sales service."

"In addition, I still remember the Formaldehyde Conference in China where I met many industry experts, and in the process of technical exchanges, I had a deeper understanding of formaldehyde process, catalysts, loading plan, automation, etc. I learned some advanced experiences of domestic enterprises in equipment management and quality control. At present, domestic enterprises have begun to use CAP 3.0 loading plan,

The Tarim Basin

The Tarim Basin is an endorheic basin in Northwest China occupying an area of about 888,000 km^2 and one of the largest basins in Northwest China. Its northern boundary is the Tian Shan mountain range and its southern boundary is the Kunlun Mountains on the edge of the Tibetan Plateau. The Taklamakan Desert dominates much of the basin. Source: Wikipedia

Markor and JM at the 2017 Formaldehyde China conference in Chengdu; Mr. Zhang Bin is at the far right

which not only increases the production capacity of the plant, but also lengthens the catalyst replacement period."

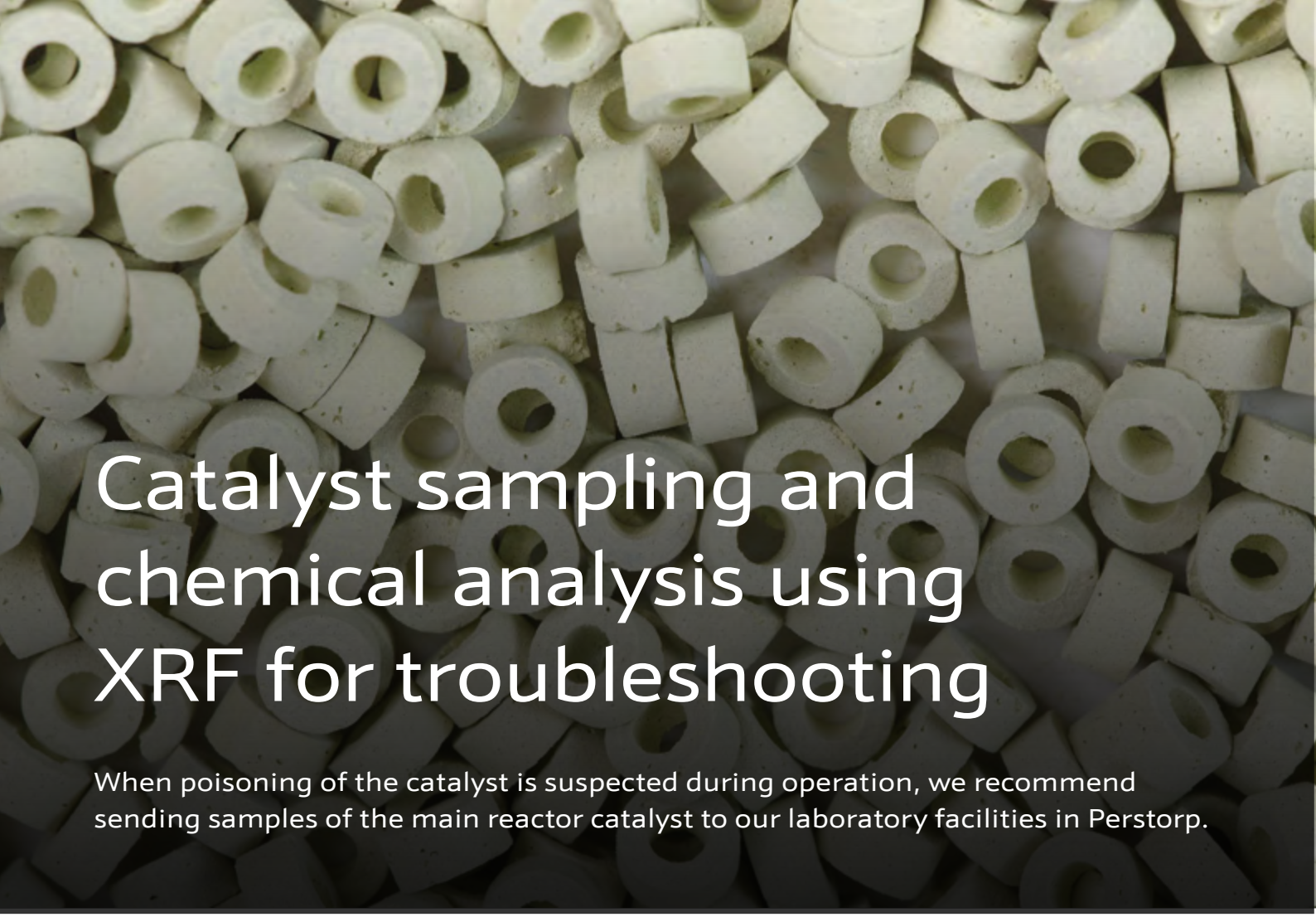
"We hope that JM can provide some capacity, plant consumption and FA yield comments and suggestions at the end life of catalyst operation, and hope to see the development trend of the industry and the development of new license/catalyst of FA."

BY

Mei Zhu
Sales Representative

with co-authors
Hans Han, Senior Technical Service Engineer
Wilson Wang, Project Head

Reactor pressure test during catalyst loading in January 2021



Catalyst sampling and chemical analysis using XRF for troubleshooting

When poisoning of the catalyst is suspected during operation, we recommend sending samples of the main reactor catalyst to our laboratory facilities in Perstorp.

In order for the lab to be able to make a thorough analysis, there are some important aspects to consider when sampling the catalyst.

To avoid crushing the iron molybdenum catalyst when taking the sample, special precautions should be taken. A common method involves using a small vacuum cleaner with marked levels on the suction pipe, and dedicated bags for each level. To reduce the amount of catalyst crushing, it is recommended that a nylon stocking be used at the collection point inside the vacuum.

A minimum of four tubes is recommended for sampling:

- Near the reactor edge
- Near the reactor center
- Near an HTF inlet
- Near an HTF outlet

However, more locations may be needed depending on the problem.

The amount of catalyst material in the top fractions (B and C) of one tube is usually not enough for the analysis technique we use to detect contaminants. Thus, it is recommended to sample from two or more additional tubes next to the selected tube and combine the fractions. This is particularly relevant towards the end of the catalyst's life. About 10 grams (100 catalyst rings) of catalyst is required for a composition analysis, but as the top fractions typically contain ceramic rings and a lot of crushed catalyst, much more material needs to be collected to make up the 10 grams.

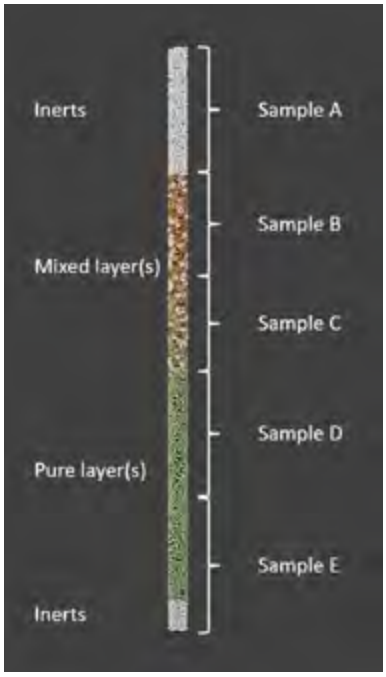


Figure 1. Sampling for CAP 1 and CAP 2.0

For other loading plans, e.g. CAP 3.0, special instructions will be provided for sampling.

Packaging, labeling, and shipping

Proper packaging and labeling of the samples are important to ensure correct and safe handling of the used catalyst. It is recommended to use transparent plastic bags for packaging the catalyst, and each bag should be clearly marked with the information found on the label (Figure 2). JM can provide bags and labels for sampling.

An analysis request form should also be included in the box with the samples along with a Safety Data Sheet for the used catalyst material. Johnson Matthey will provide the analysis request form prior to sampling and can provide examples of Safety Data Sheets for used catalyst.

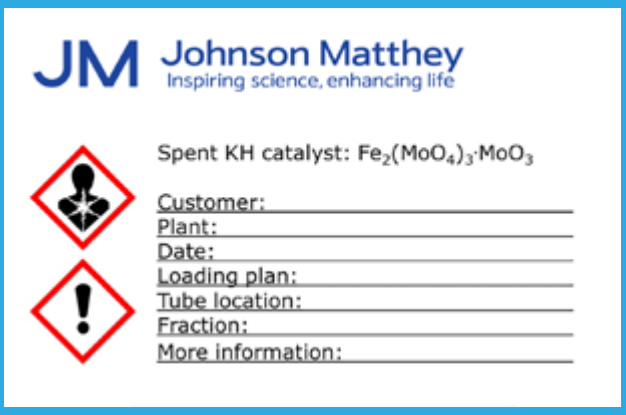


Figure 2. Information needed on each sample of catalyst

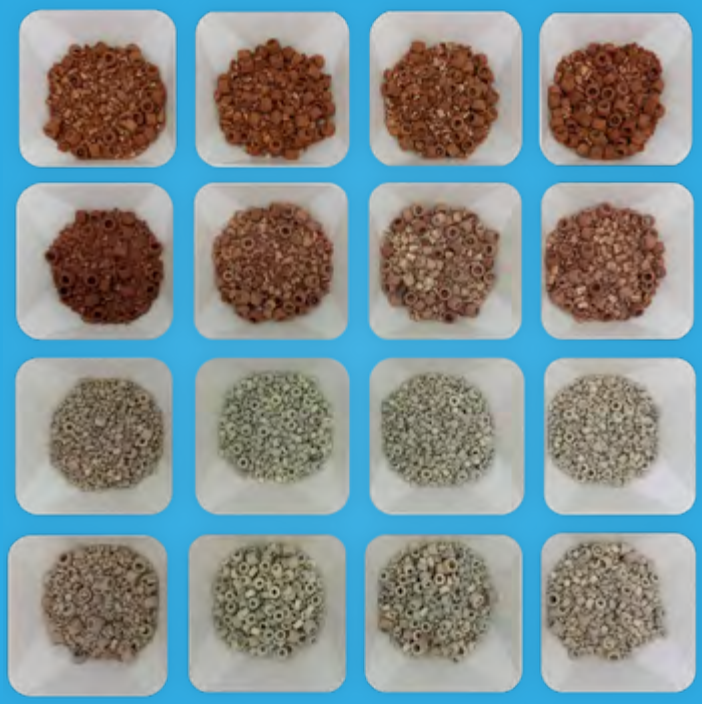


Figure 3. Example of visual inspection

Visual inspection

Visual inspection is the first thing we do when the catalyst samples arrive in the lab. This gives an indication of the catalyst's ageing, and guides selection of catalyst for further analysis.

The catalysts are unpacked and arranged according to the various locations and fractions as shown in Figure 3. If the samples from all the locations appear similar, this is an indication that the reaction conditions inside the reactor have been uniform.

The color of the catalyst in the different fractions along the tube will be different. The catalyst in the mixed layers (B and C) will typically be red due to ageing and loss of molybdenum. The catalyst in the pure layers (D and E) will shift more towards yellow – green. Sometimes, the pure layer catalyst may also turn black, which is an indication of reduced catalyst. Talk to your JM representative to determine whether there is something to optimise in your process.

The visual inspection can reveal a lot, but it cannot detect poisoning of the catalyst. For that, we will need to turn to elemental analysis.

XRF analysis

X-ray fluorescence, XRF, is the method we have chosen for analysing the chemical composition of the catalyst. The advantage of XRF is that it can be used to detect both the major elements (Molybdenum and Iron) and the minor elements, such as Sodium, from the same sample. The downside is that a relatively large amount of catalyst is needed for analysis, so please be sure to collect enough material!

Sample preparation begins with retrieving catalyst rings from the provided samples. The uppermost catalyst fraction is expected to contain the highest concentration of eventual poisons, and therefore we typically focus our efforts there. In a case like that shown in Figure 3 where visual inspection does not reveal any major differences between locations, we could combine all the B fractions into one sample.

Once we have retrieved enough catalyst, it is pressed into a flat pellet, which is analysed using X-rays. Each element has its unique fluorescence pattern, and the concentrations are calculated from the strengths of the fluorescence peaks. Finally, the results are compared to fresh catalyst to reveal the presence of any poisons on the catalyst.

Additional analysis

Visual inspection and XRF are the standard techniques used for analysing spent catalyst, and, in most cases, will provide the answers required. However, in some cases further analysis may be needed, at which point we would review all the available data together with Technical Services to decide on the best way to continue. If needed, analysts at JM's two technical centers in the UK are always happy to assist with special analysis.

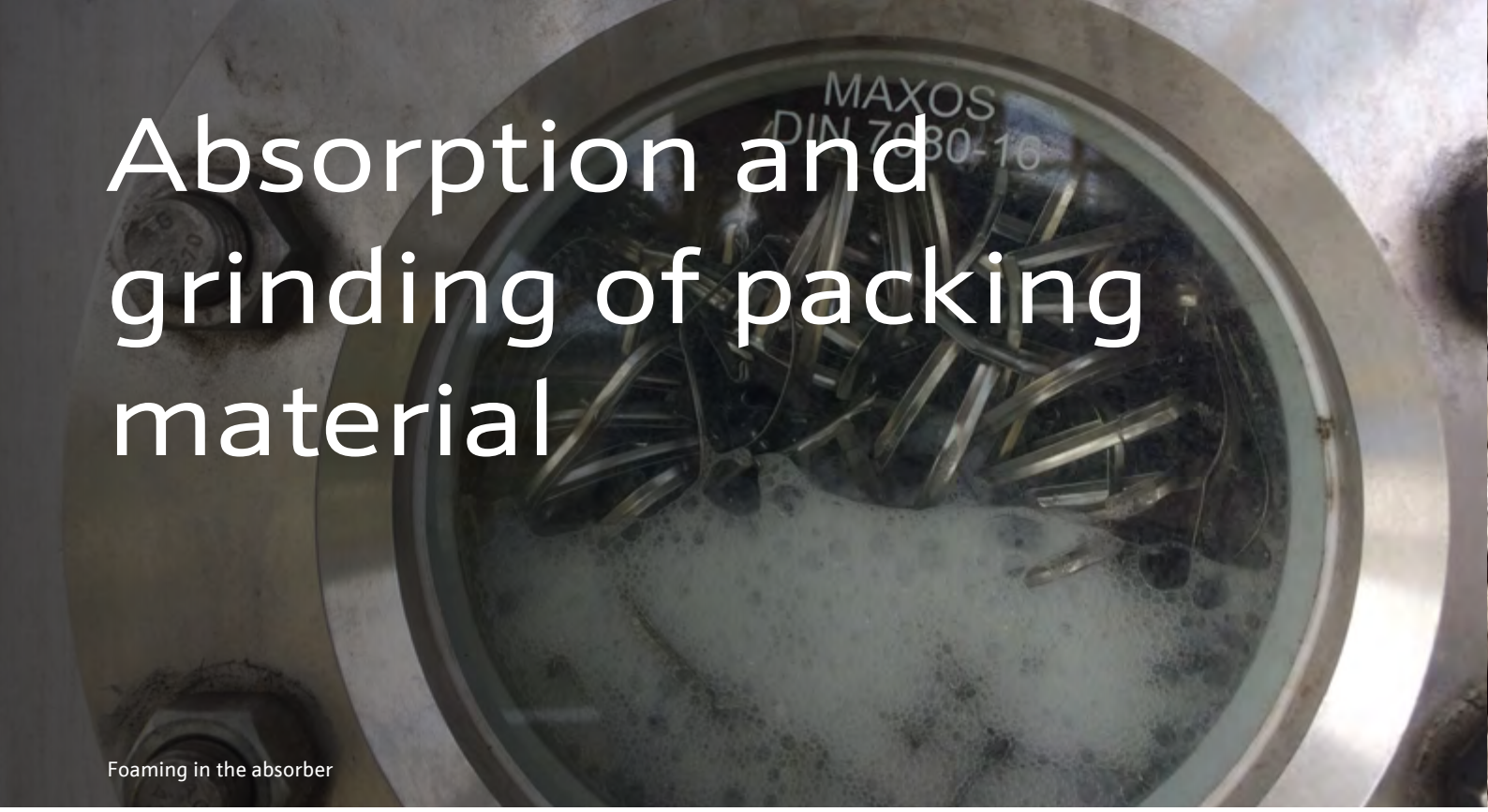
For further information please read the TI document 147 Sampling of main reactor catalyst in the **JM-LEVO** Formaldehyde Portal, or contact your JM representative.

BY

Tomas Nelander
Global Technical Services Leader - Formaldehyde

Kaisa Kisko
Senior Scientist

Absorption and grinding of packing material



Foaming in the absorber

In the previous issue of Informally speaking Michel Bellais wrote about the importance of pH control in the absorption process.

In this article, I want to focus on the packed sections and some of the problems to be on the lookout for.

The packed sections are an important part of the absorber internals. They perform several different functions to support the absorption:

- Gas / liquid mixing
- Water condensation
- Gas / liquid separation
- Formaldehyde absorption
- Water evaporation (PS1)
- Gas cooling

Typical problems that can occur in the packing are:

- Foaming
- Fluidisation of packing
- Liquid entrainment
- Restrictions / blockage

Grinding

Grinding of the packing material can typically start with foaming that may be caused by high methanol or caustic content in the liquid. The foaming is normally first seen in the packed section distributor. The foaming could cause the packing to fluidise and packing material might flow up into the distributor. The fluidisation could also cause grinding of the packing material and the breaking off of smaller metal parts.

These small, broken metal parts will then fall through the packed section and accumulate at the bottom. The broken packing will restrict the packing's open area and increase the gas velocity, which will then cause new foaming. This foaming in the lower part of the packing and in the collector will continue also after the original foaming problem in the distributor has been solved. A decreased liquid flow over the packed section could reduce the foaming, but the final solution will always be to replace the broken packing.

Collected damaged packing material

Conclusion

If foaming is found in the lower part of the packed section but not in the distributor, there may be a problem with ground packing. This can be investigated by:

- Inspecting the packing support plate and the collector for broken metal
- Inspecting the packed section pump suction for metal parts
- Inspecting the distributor for packing material that might indicate fluidisation

BY

Ola Erlandsson
Senior Process Specialist

Emissions on everyone's mind

When we gathered in Helsingborg this past September for our first Formaldehyde conference since the pandemic broke out, not only were we glad to be meeting in person again. We were also glad to discover that a lot of participants had questions regarding emissions. In fact, in survey questions about future development, emissions topped the list in two categories, Safety and Sustainability.

The fact is emissions from oxide formaldehyde plants have been cleaned by a catalytic reactor since more than 40 years. Nevertheless, the general trend toward trying to reduce all emissions further is already affecting, and will continue to affect, formaldehyde production.

At the moment, the European Union is probably the leader in implementing new stricter limits. EU legislation is typically focusing on VOCs (volatile organic compounds), with a special focus on formaldehyde. Carbon monoxide can also in some cases be included.

In the previous issue of Informally speaking I listed the main sources of emissions within a formaldehyde plant, along with several suggestions for what can be done about them (see page 6 in the Spring/Summer 2022 issue). Based on the discussions that took place during Formaldehyde Europe, I would like to repeat a few key ways to increase the performance of an existing catalytic reactor. Note, these recommendations are particularly valid for **FORMOX** designed plants, but should be generally valid:

- Operate at higher temperature by closing the bypass over the preheater and increasing the temperature before the catalytic bed. The maximum temperature is limited by the design temperature after the bed, typically 550°C.
- Eliminate all kinds of slip through the catalytic bed. This is done by inspecting the catalytic bed to make sure that it is even and that the support net is without any holes. Any catalyst found below the bed is a clear indication of a hole.
- Add more catalyst if the pressure drop allows it. There is room to add catalyst as long as the oxygen valve is not 100 % open and the catalyst not get in contact with the ECS reactor structure. The expected pressure drop can be estimated by JM.
- Replace the catalyst more often. Normally the catalyst will last for 4-5 years but in some cases, there can be pollutants that will shorten the lifetime.
- Operate the plant with a low methanol inlet concentration during part load. This will reduce the effects of slip and also make it possible to increase the temperature before the bed.

Problems with the catalytic reactor could be detected by doing stack gas measurements, traversing the exit pipe cross section with a CO meter, or by doing temperature measurements across the bed below the support net.

Finally, just a reminder that JM has a lot of experience in this field and would be happy to help. Just contact your Technical Service representative to find out how.

BY

Ola Erlandsson
Senior Process Specialist

Record high sales in China while Europe struggles with war

When writing this we have just left 2022 behind and can look back on a year that has been heavily affected by the war in Ukraine. The impact on those directly involved and on the civilians in Ukraine are on our minds. It's horrifying. Its effects on trade overall, both through sanctions and indirectly through the increases in energy prices and inflation that the war has triggered, are also hitting the formaldehyde industry. The main impact is in Europe, but other regions around the world are feeling it as well. Less so in the U.S. where energy prices have not been driven up in the same way as in Europe. In general, our formaldehyde plant licensing business is seeing longer delivery times and higher prices from our suppliers.

In China, on the other hand, the licensing of formaldehyde technology is booming. As you can see on the opposite page, the number of licenses and the amount of capacity sold there has been record high. This is largely due to calls in 2022 for a lot of new BDO and PBAT capacity, which in turn is the result of political steering towards biodegradable plastics, something we have written about before (see Winter/Spring 2021 issue page 12). We have also seen several investment projects for POM moving forward this year.

What to expect for 2023 is difficult to say. The situation for individual companies is very different depending on location and industry. Some hesitation regarding new projects is to be expected, but since it takes time to get new capacity in place, investments made at the right time can help your company to be well prepared for when the market picks up again. And of course, decarbonisation will play an increasingly important role when considering new capacity, with the pressure on to find alternative sources for methanol. Keep in mind that JM has the capability to supply low carbon methanol technology as outlined earlier.

BY

Fredrik Rietz
Global Commercial Licensing Manager Formaldehyde Plants

From left to right: Four plants started up in China and Southeast Asia in 2022; Qinyang Yongrun, Yuanfeng, Wanhua Fujian and Wanhua Sichuan. Large image from Qinyang Yongrun.

New Projects

Agreements have been signed with customers in:

- Qingtongxia, China for two FT3 plants
- Nantong City, Jiangsu province, China for one FT3 plant
- Chuzhou City, Anhui Province, China for one FT3 plant
- Egypt for an FS2 UFC plant with **SMD** as the end user
- Wujiaqu City, Xinjiang, China for two FT3 plants
- Jingzhou City, Hubei Province, China for two FT3 plants
- Changji, China for one FT3 plant
- Korla, China for one FT3 plant
- Nanchong, China for two FT3 plants

Ongoing projects

- The project with a customer in Xinjiang, China, for three FT3 plants is in the design phase.
- The project with three FT3 plants for a customer in Wuhai, Inner Mongolia, China, is in the design phase.
- The project with one FS3 and one FT3 plant for a customer in Nantong, Jiangsu Province, China is in the design phase.
- The project with an FS1 High Pressure plant for a customer in United Kingdom is in the design phase.
- The project with two FT3 plants for a customer in Dalian, Liaoning, China is in the construction phase.
- The project with an FT3 plant to a customer in Hebi, China, is proceeding well with scheduled commissioning this summer.
- The project with a customer in Wuhai, China, for three FT3 plants is in the design phase with scheduled start-up in late 2023.
- The project with **Foresa, Industrias Químicas Del Noroeste, SA** to double the capacity of their plant in Caldas de Reis, Pontevedra, Spain to an FT2 plant is in the construction phase.
- The project with two FT3 plants for a customer in Shanxi Province, China is in the construction phase.
- The project with one FT3 plant and one FE3 plant for a customer in Xinjiang, is in the construction phase.
- The project with an FS3 plant to a customer in Xinjiang, China is in the installation phase with planned start-up this spring.
- The FS3 plant for a customer 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.

Start-ups

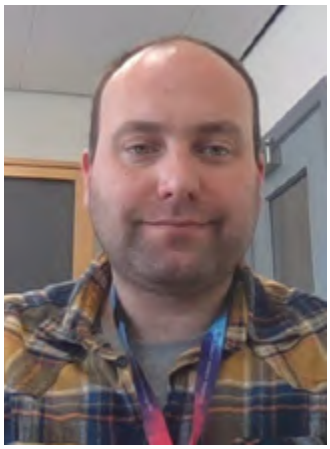
- The project with an FT3 plant in Fujian Province, China, was successfully started in November 2022.
- The FT3 plant for **Qinyang Yongrun Technology Development Co., Ltd,** in Qinyang city, Henan province, China, signed with China Chemical Sedin Ningbo Engineering Co., Ltd went on stream in October.
- An FS1 plant for a customer in Southeast Asia went on stream in September.
- The project with an FT3 plant in Sichuan Province, China went on stream in August.

Training

JM conducted onsite training in August of 2022 for Qinyang Yongrun at Qinyang City, Henan province, China in connection with the startup of their new FT3 plant

New colleagues

Meet Will



New Regional Technical Service Engineer for Europe

Will Breeze is a Chemist with a BSc in Chemistry from the University of Hull and a MSc in Polymer engineering from the University of Manchester.

"I joined JM Royston as a process development chemist for Clean Air in 2016. After a brief time in Battery Materials, I Joined the Formaldehyde business in 2022. I currently focus on Europe and some Indian Customers. I am an avid reader and hiker. Enjoying long walks in our national parks, and along England's north-eastern coast, which is my adopted home. Sometimes I take nature pictures along the way. Feel free to email me with good book recommendations."

Meet Miller

New Commercial team member for China

Miller Yang is a Chemical Engineer who began his career with Sinopec in 2006.

"I graduated from Dalian University of Technology (DLUT) in 2006, and my major is Chemical Engineering (industrial catalysis). I have 16 years' experience in the chemical industry, starting my career with Sinopec in 2006 working in R&D. I joined JM in October 2022, and I am glad and excited to work in the role of Plant Sales Manager in China. In my free time, I enjoy walking, listening to music, playing table tennis and cooking for my family."

New faces

Perstorp

Agnes Ly
Legal Counsel

Carina Gustafsson
Project Administrator

Khaled Younes
EHS Advisor

Lina Cronström Sjöberg
Supply Chain Coordinator

Marion Kugler
Sales Representative

Oscar Enander
Process Engineer

Sofie Persson
Legal Counsel

Beijing

Caleb Chen
Project Engineer

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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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JM Johnson Matthey
Inspiring science, enhancing life

JM

Catalysing the net zero transition for our customers

Our vision is for a world that is cleaner, healthier today and for future generations

Using science and technology expertise developed over decades, Johnson Matthey's catalyst technologies help our customers efficiently convert natural resources into the fuels and chemicals that create products essential to modern life. Our catalysts, additives, absorbents and process technologies minimise the use of energy, materials and the amount of greenhouse gases produced.

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