

JM

Johnson Matthey
Inspiring science, enhancing life

Informally speaking

A formaldehyde magazine from Johnson Matthey



FORMOX technology turns 60!

Massive MEG complex takes shape

New Lean Productivity System catalyst

Formaldehyde Asia returns to Kota Kinabalu

Into the future with automation and digitalisation

AUTUMN 2019

60 years young and stronger than ever

Dear reader, we have so much to tell you about since the last issue of Informally Speaking was distributed! To begin with, we are celebrating the fact that in August of 1959, the first **FORMOX™** plant was started up here in Perstorp. Among the first to help us celebrate were the nearly 50 participants at our conference in Kota Kinabalu in April, marking a joyful return to the site of our first ever Formaldehyde Asia 23 years ago (see page 6).

Looking back over these 60 years it is so rewarding to see what huge leaps we have made in terms of increases in productivity, ease of operation and safety improvements. As the graph on pages 8-9 shows, these developments have contributed to making **FORMOX** the world leading formaldehyde technology that it is today. And in order to continue on that path we have several development projects underway not only to further improve on safety and productivity, but also to optimise investment and operating costs, and to make the **FORMOX** technology even more sustainable.

On the global arena, the environment is high up on most governments' agendas, and as an effect of this we are seeing a major industrial change taking place in China. There, the need for new formaldehyde capacity is emerging as existing, less efficient, smaller scale

production units are being replaced whilst at the same time production sites are being moved to Chemical Industrial Parks. When nearly 200 delegates from the industry gathered in Linyi this August, we were there to help show how this can be done (see page 16). There is also a need in various places to upgrade formaldehyde and resin plants with regards to formaldehyde emissions, where **FORMOX** technology is one important piece of the puzzle.

We are also happy to see that the groundbreaking new MEG (mono ethylene glycol) technology that we wrote about in the latest issue is now taking shape in Inner Mongolia, where the world's first syngas and methanol to MEG plant is being built (p 4). The outlook for this new downstream product shows great potential for the next decade, as does the versatility of formaldehyde as a basic building block.

"Technology" is clearly the theme of this issue as we not only consider how far we've come, but more importantly take a look at what lies ahead. Digitalisation and automation are two great examples of this – see the articles on pages 12-14. Both of these projects represent pieces of a bigger picture where customers will be able to receive even better and quicker recommendations for improving operations and optimising performance.

Finally, by the time you read this, our first high pressure **FORMOX** 2.0 plant will have just been started up and we look forward to bringing you more news about the performance of our latest technology in our next issue. In the meantime, be sure to read about our exciting new Lean Productivity System catalyst specially developed for plants belonging to the "low productivity designed reactor" segment (see page 15).

As always, we look forward to seeing you at our upcoming conferences and in between, in the personal encounters between members of our team and yours that have always been, and will continue to be, the highlights of our continuing story.



**Lars Andersson and
Ronnie Ljungbäck**

Global Market Managers
Formaldehyde

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Taking action for sustainable development

The world is faced with an unprecedented set of challenges.

As the global population rises, communities must overcome issues such as air pollution, climate change, scarcity of natural resources and ever increasing demands for clean energy, water, food and access to healthcare.

At Johnson Matthey (JM) we strive to make the world cleaner and healthier, delivering sustained growth and value creation for stakeholders by applying leading-edge science to solve customers' complex problems. We work with customers and partners across markets from pharmaceutical and medical to automotive, industrial and chemical production. With operations in over 30 countries and around 14,800 people employed worldwide, some of the ways we are responding to today's challenges are by:

- Taking action for sustainable development.
- Shaping a new era for clean energy.
- Achieving more from less.
- Providing clean air for all.
- Helping people live longer and healthier lives.

To find out more about how we are doing this we encourage you to view the Johnson Matthey 2019 Annual Report outlining our strategy, achievements, financial and non-financial performance, as well as where we are investing in our world class science and technology.

You can view the detailed report at www.matthey.com/investors/report-archive/annual-report-2019

BY



Nicole Watson
Marketing Communications
Representative

On the front page:

JM sponsored the 'Formaldehyde Safety to CIPs' conference in Linyi, China.

Read more about this story on page 16.



UPCOMING CONFERENCES

Formaldehyde Forum China 2019

December 18-20 in Zhuhai, China

Registration open

Formaldehyde Americas 2020 March 16-19, 2020 in Houston, USA

Registration open

Formaldehyde Turkey 2020 Date TBD, 2020 in Istanbul, Turkey

Please check our web page.

World's first syngas and methanol to MEG plant now under construction



Interview with Atul Shah, Licensing Development Director at JM

In Inner Mongolia, China, the Jiutai Group has begun construction of an enormous complex for producing mono-ethylene glycol (MEG) in a ground-breaking new way. And the technology, developed by JM and Eastman Chemical, was recognised by The Institution of Chemical Engineers as a highly commended industry project at this year's IChemE Global Awards.

In the previous issue of *Informally speaking* we wrote about the first contract to be signed for licencing this new technology, the result of a decade-long collaboration between Johnson Matthey and Eastman Chemical. We asked Atul Shah, who has been working on the commercialisation of the technology since 2011, to explain a bit more about it and its significance.

Hello Atul. Why is this plant, and this new technology, a big deal?

First of all, it's a huge plant capable of producing one million tonnes of MEG per year. It is also the first plant to use the new technology. Up until now, producers of MEG have had to rely primarily on ethylene as a feedstock. The new technology doesn't require any ethylene, so markets that currently need to import ethylene or MEG now have options.

Such as China?

Exactly. China is a good example. China consumes a significant share of the world's MEG capacity for the production of polyester fiber, fabrics, packaging and much more, but has limited ethylene. However, China does have a lot of coal, which, thanks to the new technology, can be used to produce MEG at a lower cost than with the conventional, ethylene-based technology.

Is coal the only alternative?

No. The technology uses synthesis gas which can be made from a variety of feedstocks including natural gas, biomass and even municipal waste. This makes it interesting also for markets like Russia and Middle East, where natural gas is readily available at a low cost. Indonesia and India, which have significant amounts of biomass, are other examples of markets that could benefit for similar reasons.

Can you describe how it feels for you and the team at JM and Eastman to see the first full-scale plant finally being built?

It is of course very satisfying. A lot of dedicated people at both our companies have been instrumental in making this happen.

About Mr. Atul Shah

Atul Shah is Licensing Development Director at JM. He is a Fellow of the Institution of Chemical Engineers and has led the commercial negotiations for over 20 technology licensing contracts, including the first syngas to MEG complex comprising methanol, formaldehyde and MEG technologies.



Jiutai MEG plant at a glance

Location: Togtoh Industrial Park, Inner Mongolia

Type: Syngas and methanol to MEG

MEG lines/capacity: 2 x 500 ktpa

Online: 2022

Mono ethylene glycol

Main uses: Polyesters for packaging and fiber applications

Market: approx. 30 million tpa, 4-5% growth per year

New JM/Eastman technology: Converts synthesis gas (from coal, natural gas, biomass, bio-waste) and methanol into MEG and small amounts of co-product diethylene glycol

Other JM technologies developed using mini-plants

Oxo alcohols – produced from olefins and syngas and used for the production of plasticisers, paints, solvents and detergents

Butanediol – produced from maleic anhydride or succinic acid and used for the production of engineering plastics and solvents

And being recognised at this year's IChemE awards was naturally very rewarding as well. As far as the R&D process goes, I think one of the things we are particularly happy about is the role that our mini-plants have played.

Like a pilot plant?

No, mini-plants are much smaller. Basically, we design, build and operate a very small-scale version of a MEG plant, small enough to fit inside a small conference room. It includes all the key recycles and uses the actual catalysts, and operates at the same conditions (e.g. temperature and pressure) as the commercial plant. This enables us to collect valuable data that we use to develop simulation models and to predict performance for the commercial plant.

How reliable are the results you get from the mini-plant?

Very reliable. Mini-plants are more heavily instrumented than a commercial plant, so we are able to collect a lot of data and valuable experience that we use for designing the commercial plant. We've used the same approach when developing our other licensed technologies such as Oxo alcohols and Butanediol where we've had a 100% success rate in meeting performance guarantees. Plus, customers can come and see the mini-plants for themselves, which has proven very helpful.

Why is this of interest to our customers in the formaldehyde business?

MEG, is a key building block in the production of polyesters for fiber and packaging applications. Fiber produced from MEG is very versatile, much easier to dye and a lot cheaper than cotton which requires a lot of land and water. As a result, the MEG market is experiencing high growth, about 4-5% per year globally, and even higher in Asia particularly in China and India where the standard of living is rising. And because formaldehyde is a key part of the new process, formaldehyde producers who may be looking to diversify their product portfolios now have an opportunity to take advantage of this growth.

For further details or information about licencing the new MEG technology please contact Atul Shah at atul.shah-davy@matthey.com.



Figure 1: 3D depiction of the world's largest coal to MEG complex at Togtoh Industrial Park in Inner Mongolia, including world's largest single site **FORMOX** formaldehyde plant



Figure 2: The massive complex now under construction

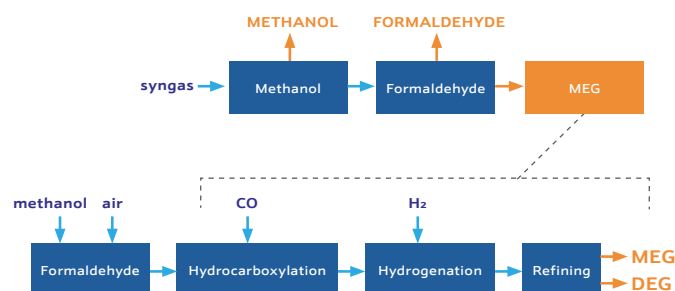


Figure 3: The new technology developed by JM and Eastman

BY



Charles Hodgdon
Editor

Formaldehyde Asia 2019

Kota Kinabalu, Malaysia
8th – 11th April

'The best Formaldehyde Asia ever!' That's how some of the 60+ participants at this year's conference in Malaysia described it, and we tend to agree.

Every third year our formaldehyde conference touches down somewhere in the Asia-Pacific region. This year we returned to the same idyllic spot where our very first Formaldehyde Asia took place 23 years ago, Kota Kinabalu on the island of Borneo.

Following an arrival reception at the beautiful Shangri-La Tanjung Aru Hotel on Monday evening, Eddy Lee, Regional Sales Manager for APAC welcomed everyone on Tuesday morning and announced that the conference also kicks off this year's celebration of JM's 60th anniversary

of our **FORMOX** technology. He then turned the stage over to Mr. Daniel Kang, Head of Commercial Sales for APAC, who officially opened the conference with an introduction and update on Johnson Matthey.

Various speakers followed with updates on the formaldehyde and methanol markets, catalysts, plants, upgrades and more. Lars Andersson, Global Market Manager Formaldehyde Plants, and Dr. Philippe Thevenin, Global Catalyst Solutions Specialist, talked about **FORMOX 2.0**, our latest technology designed for higher pressure and capacity. The presentation was ranked among one of the conference's most valuable according to a survey of the participants.



Reunion: Claes Lundström (left), Leong Oi Kok (centre) of Norsechem (Sabah) Sdn Bhd, and Eddy Lee (right) were also present at the first Formaldehyde Asia in Kota Kinabalu, 1996.



"The participants were from different countries and different types of production, and everyone had a lot of fun with it. Even people who on any other day are competitors became great teammates for a while. There were many smiles."

On Wednesday, focus shifted to Technical support led by Global Technical Support Manager Tomas Nelandar. Participants were invited to take part in a number of practical sessions which included the opportunity to visit with several vendors showcasing specialised services and products. These ranged from tower scan diagnostics and explosion proof blowers, to a catalyst loading machine, HTF oil and various tools used by our Regional Technical Support Managers in their work to support our customers.

Later, one of the true highlights of the conference took place when everyone participated in a team-building excursion that brought about lots of laughter and unforgettable moments.

"It was the first time we have done this type of activity," says Eddy Lee.

"The participants were from different countries and different types of production, and everyone had a lot of fun with it. Even people who on any other day are competitors became great teammates for a while. There were many smiles."

The third and final day of the conference was dedicated to training and focused on various ways to achieve improvements, including a close look at catalysts in operation. This included a workshop on plant and catalyst optimisation as well as the opportunity for participants to share their own issues and experiences, all of which was especially appreciated.

"It is always rewarding every time someone shares from their own experiences," says Eddy Lee. "There was a lot of discussion about specific problems in their plants, about expansion, and of course about diversification – there is a lot of interest in finding out about what else formaldehyde can be used for."

"For me," says Eddy, "the best thing about the conference was to see how much everyone got out of it and enjoyed themselves – and told me how much they look forward to coming back for the next one."



BY



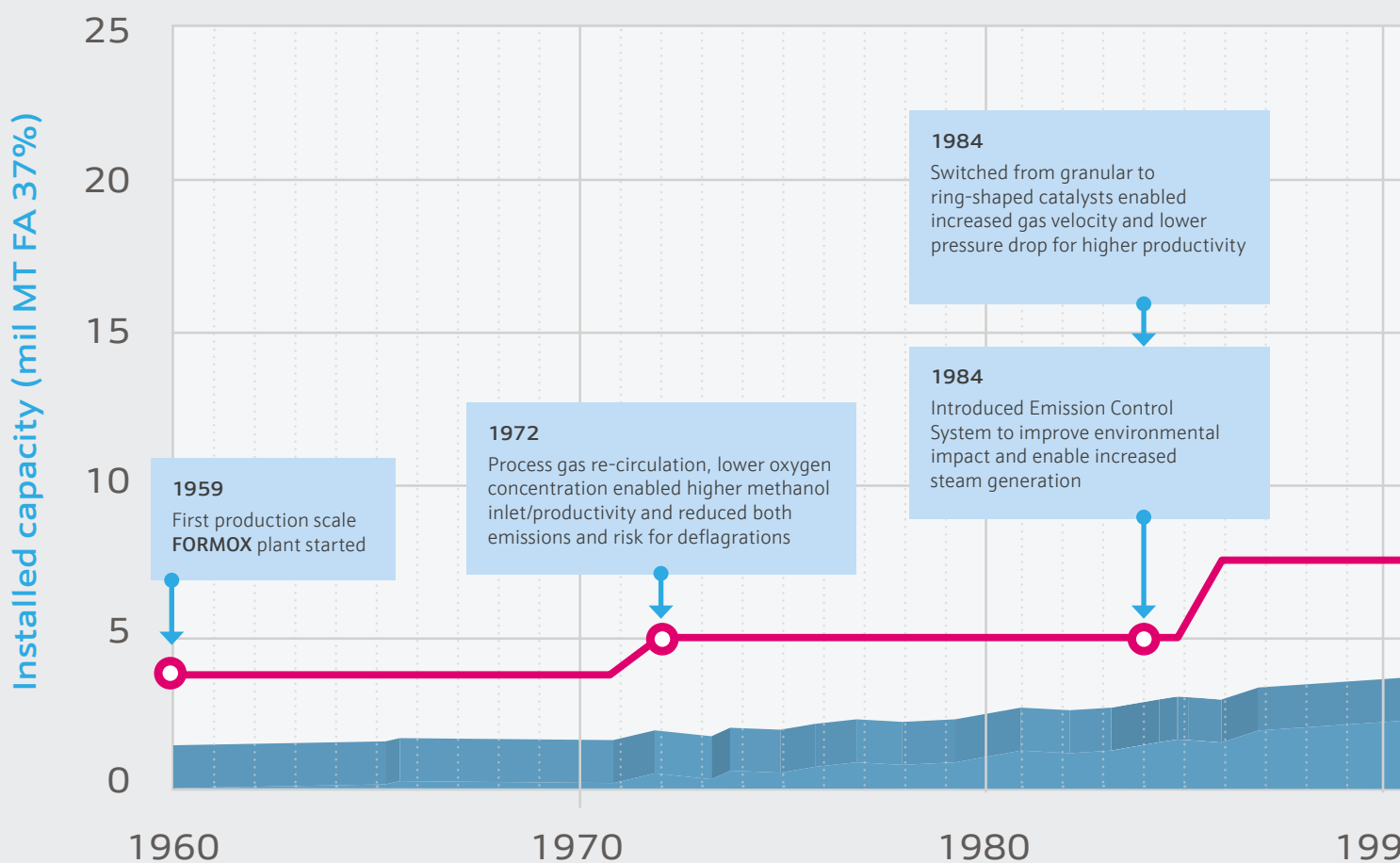
Charles Hodgdon
Editor

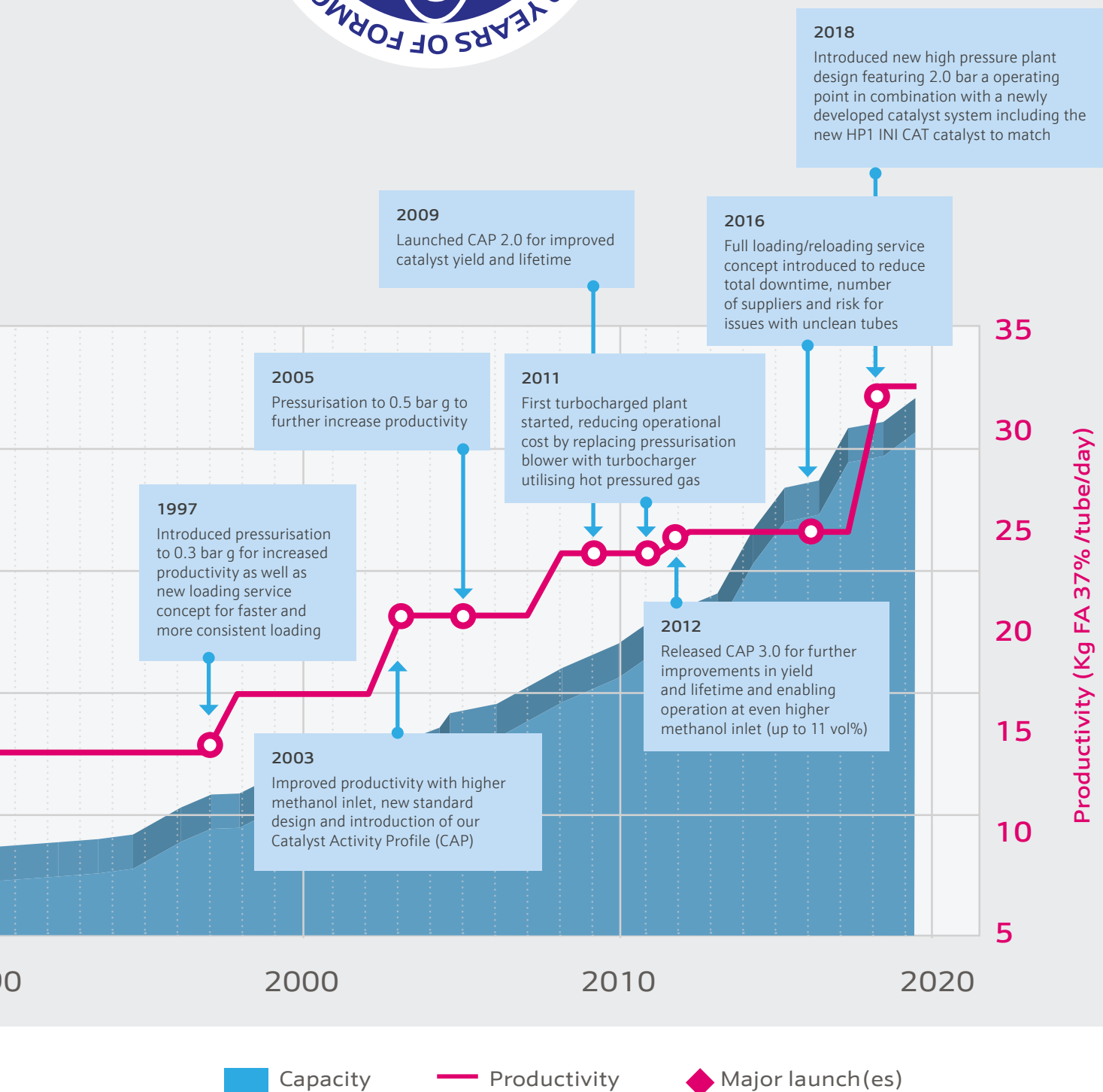
FORMOX turns 60!

Six decades and nearly 200 plants later

On August 6, 1959, the first commercial formaldehyde plant based on a new technology known as FORMOX was inaugurated and started up in Perstorp, Sweden. Since then, it's been an exhilarating ride on the road to becoming the world leading Formaldehyde technology that it is today. Now, 191 plants/277 reactors later, most of which are still in operation, **FORMOX** has accounted for a global installed capacity amounting to 25,800,000 metric tons of 37% formaldehyde accumulated over time! So, how did we get here?

The answer is equal parts imagination, ingenuity, dedication, hard work and exploration into a world of applications and rewarding encounters with people, both co-workers and customers alike, who have made something out of it. Below and to the right we've highlighted some of the key technological developments and how they correlate to the accelerated growth of **FORMOX** technology as well as to the significant increases in productivity per reactor tube. On the next two pages you'll find a few highlights from our past, present and future.





Where one era ends, another always begins

THE LATEST CHAPTER

New possibilities with Johnson Matthey

Just six short years ago, we became a part of Johnson Matthey, a global science and chemicals company with a 200-year history of its own. In the Spring/Summer 2013 edition of *Informally Speaking* we described how gaining access to JM's worldwide network of specialists in catalysis and process technology would help us "to do what we are here for, namely to support you by providing state-of-the-art plants and catalysts for the manufacture of formaldehyde."



Since then, not only has the formaldehyde business continued to grow at an impressive rate, but we have also developed and launched our exciting new **FORMOX 2.0** technology and catalyst. On top of that, we are now delivering the world's largest single site **FORMOX** formaldehyde plant as part of JM's ground-breaking technology for the production of MEG. On the other end of the size spectrum we have our iUFC products for integrated UFC production – our smallest plants. And we are also diving into the world of digitalisation and automation. These advancements to plants and catalysts are examples of how becoming part of JM has enabled us to bring even more value to formaldehyde customers.

Celebrating in Båstad

On October 17th of this year, employees of JM Sweden gathered together in the small coastal village of Båstad, Sweden's tennis capital, to celebrate our 60th anniversary. We all shared a very nice day together, and one of the highlights of the event was when 'Mr. Formox' himself, Max Henning, spoke about the history of formaldehyde production in Perstorp and how the **FORMOX** technology was born and spread around the globe. Focusing on the 'early **FORMOX** era', Max delighted us with a captivating mix of interesting facts and humorous anecdotes from his early days. He also mentioned the long and close collaboration with Bob Crichton, whom some of you may recall once travelled the globe together with Max and played a key role in the rapid development of the business during the 1990s. It was spellbinding, and made everyone in the room feel proud to be part of this fantastic company.



Max, now 81 years of age, devoted most of his working life to the formaldehyde business. Not only did he work as an engineer in the first **FORMOX** plant in Perstorp and take part in the building and starting up of several licensees' plants, but he also sold 98 plant licenses globally – a true living legend!

Thank you, Max!

THE NEXT CHAPTER

A look at 2020 and beyond

If our first sixty years have proven anything, it is that innovation is in our DNA and that customers and their needs are close to our heart. And as we turn the page to begin a new decade, and the next chapter in our history, we do so with loads of enthusiasm and a "to do" list that includes exciting opportunities such as offering higher degrees of automation and safety with the help of a new generation of instruments. The development of new catalyst systems is a given, and of course we foresee new service concepts as well as increased levels of service. Digitalisation platforms along with even higher productivity and even lower specific CAPEX are all on the list as well.

Another reason why we feel so excited about what lies ahead is the addition of several young engineers who have joined our ranks in recent years and who bring their own brand of enthusiasm to the table. One of these is 26-year old Victor Åberg, who, having worked for three summers in the catalyst factory here in Perstorp whilst studying Environmental Engineering at nearby Lund University, returned after completing his studies to apply for a position here.

Victor, what made you want to come back here to start your career as an engineer?

"When I saw there was an opening for a Process engineer position in the Licensing department I jumped at the chance. Partly because it would allow me to stay here in Southern Sweden. But mostly because it would mean being able to work with 'the whole package'."

Does it feel to you like you are part of 'new generation of engineers', so to say?

"I think so. Lukas Olsson has been here about three years, me a year, and there a few others who are even newer. We're a 'formable' bunch and keen about carrying on the work. The great thing is that we are learning so much from those engineers who've been around and who really know the industry and the technology. So, yes, it feels a bit like a passing of the torch from one generation to the next."

What was your impression from the 60th celebration in Båstad?

"The history is really fascinating. Listening to Max tell about the start of the business and how they pioneered the sales of plants hand-in-hand with developing the technology, not to mention how they went about actually digging up customers way back then, was all very interesting."

Finally, how do you feel about the future of FORMOX technology?

"You can really feel that pioneering spirit here and I especially find the unique way that turbo technology has been implemented to be very interesting. Looking forward I'm really excited about HP and FORMOX 2.0. It's going to be really interesting to follow what happens and to see if these developments will revolutionise the business, which they have the potential to do. And of course technology connected with automation will also be really interesting to follow in the future."



Above: Victor Åberg shown here taking part in 'Confined space entry' training

DID YOU KNOW?


- Our first customer conference was held in Perstorp in 1991
- As of today we have sold 191 FORMOX plants, comprising 277 reactors
- The first issue of Informally Speaking was published in 1995



BY



Charles Hodgdon
Editor



Speaking of the future, let's talk 'Automation'

For 60 years, starting, stopping and running a FORMOX plant has always been a 'hands-on' operation. So when a large customer said, "We would like a more automated plant – can you do it?", it represented a clear break from tradition, although it has been brought up as a request at times over the years. In fact, one of our customers decided to implement a certain degree of automation on their own. But now, since our first project for a partially automated plant is currently underway, we thought it might be helpful to give some insight into what automation entails.

WHY AUTOMATE?

The customer's perspective

"We've spoken with several customers and found that there are as many reasons for why they might want some degree of automation," says Fredrik Rietz, Global Commercial Licensing Manager Formaldehyde Plants. "For one customer it might be related to staff issues. Like a lack of understanding about safety among the operators. For another it's about their operators not getting enough training because their plant runs so reliably."

"But our first automation solution is being developed for a

completely different reason," says Fredrik. "In this case, the customer wants to automate the start-up process to get the plant up and running more quickly after an interruption. Once normal operation is restored, the operators will then resume control of the production process just as usual."

IS IT SAFE?

The R&D perspective

"We have always been very focused on the risks that exist for both people and plants," says Ola Erlandsson, Senior Process Specialist, "and we've always emphasised the important role that people play in making sure a plant is operated in a safe way. So with our first automation project, just as with any new development, we had to look closely at it from every angle, especially safety."

Ola says that on the one hand, removing people from a potentially hazardous environment reduces risks to humans. "But on the other," he adds, "people inside the plant easily notice things such as leaks, unusual noises or vibrations. So an automation solution has to include built-in safety measures to steer away from any direction that could possibly harm the plant."

WHAT ABOUT PERFORMANCE?

The process specialist's perspective

In his new role as Associate Specialist Formaldehyde Process, Simon Smrtnik has looked at the effect of automation on the process and what it means when designing a solution. "One consideration is the greater investment in instrumentation that automation requires. And with a greater dependency on instruments, the question of availability also comes up. For example, what if an instrument stops working and a replacement is not readily available? Is built-in redundancy then necessary to secure production?"

"Owners want their plants to run as optimally as possible = low direct variable costs, whilst maintaining as even quality as possible. Yield, power consumption, catalyst lifetime, etc. are all things that I look at. And even with only a partially automated solution such as the one we're working on now, it is possible to achieve improvements simply by ensuring that stopping and restarting the process is done in the same optimised way every time. Similarly, our Performance Package offers customers another means for optimising their production. And if we combine this with the potential that digitalisation offers, the future of plants with enhanced performance looks bright."

HOW IS IT BUILT?

The engineer's perspective

Following the initial analyses into the possibilities, risks and effects of automation, the engineering team of Ronny Lindström and Lorentz Rensfelt were tasked with coming up with the actual solution.

"Our role in the project is to make the changes in the design, select the necessary hardware, do various analyses and develop the software to make sure everything will run as expected," says Ronny. "It calls for more instruments, valves and control systems – about twice the normal amount," he says. "That's because instead of people, the equipment will have to determine whether or not the conditions are right for starting up and proceeding. Is there liquid in the pipes? Full access to feedstocks? Enough power everywhere?, etc."

"It's very exciting to be part of this development and to see where we might be headed with it," says Lorentz, who's responsible for making sure that all the new instruments get the power they need. "Who knows what the future holds... automation solutions for controlling capacity? Or for improving product quality? These could be right around the corner."

For further details or information about automation solutions or our Performance Package, please contact your local formaldehyde representative.

BY



Charles Hodgdon
Editor



FACTS

JM automation project

JM's **FORMOX** technology can provide an automatic start-up and shutdown sequence where the DCS controls each step in the sequence with a minimum of operator interaction. The first plant with this system is scheduled to go on stream in late 2020.



Formaldehyde digitalisation just around the corner

Interview with Tomas Nelander, Global Technical Support Manager

A high profile digitalisation project aimed at bringing big benefits to customers operating a variety of chemical processes, is under development at Johnson Matthey. And the good news for our readers is that customers within the formaldehyde business will be the first to get access to these new tools.

Tomas Nelander is product owner for the digitalisation project at Johnson Matthey Formox and is excited about the new possibilities it will open up for producers of formaldehyde:

"The aim is to help JM's customers optimise the operation of their plants with the help of a unique digital solution," says Tomas. "And that the **FORMOX** business was chosen as the first to implement it feels pretty special."

Through the new digital platform, formaldehyde producers will have access to new capabilities to help them to run their plants more efficiently. Using a device (computer/laptop/tablet/smartphone) to connect, they will be able to log in to a web portal where they will find an optimisation tool of their plants along with a wealth of related information and documentation.

Significant advantages ahead

"One key advantage with the new portal," explains Tomas, "is that customers will be

able to receive valuable recommendations in just a matter of seconds. Currently we have to sift through the data we receive from a customer and enter it into a database. It can then be analysed by our engineers and recommendations developed for each specific plant. This whole process means there is some time before the customer receives the advice."

Thanks to the portal, customers will be able to easily enter the relevant data directly into the system and receive recommendations almost straight away. In the future, the plant's control system will be able to automatically upload the data so that the customer won't need to do anything manually.

A further advantage is that the customer will get a much better indication of the optimal time to reload the reactor. This activity is dependent on many factors, such as yield losses, pressure drop, etc. "Thanks to these new capabilities, the optimal time to reload a reactor will be clearly presented on a graph, making the customer's planning easier and their processes more efficient."

Unique in the world of formalin

"Unlike our competitors," says Tomas, "we are able to apply our knowledge and experience from both plants and catalysts. No one has collected data over as long a time as we have, which is a huge



Figure 1: Prototype of the customer's plant overview as seen in the web portal (Disclaimer: Layout and data may appear differently when launched)

benefit to our customers. By combining machine learning with our experience, the model will become better and better as more data is uploaded to the system."

In terms of release date, Tomas says that a pilot project involving a customer is currently underway and that the plan is to roll it out to the majority of JM's **FORMOX** customers during 2020.

BY



Charles Hodgdon
Editor

Introducing our new Lean Productivity System catalyst

Johnson Matthey (JM) provides efficient, flexible and high productivity formaldehyde plants as well as high performance catalysts. In order to get the most out of any formaldehyde plant, a suitable Catalyst Activity Profile (CAP) or catalyst loading plan is required. All the CAPs are tailor-made to match your exact requirements in terms of performance, flexibility and, of course, productivity.

The new **FORMOX** Lean Productivity System (LPS) catalyst focuses on a segment of formaldehyde plants where, by design, the productivity and operating conditions significantly differ from that of the standard **FORMOX** technology. The main difference is the design productivity and in most cases the cooling medium, where molten salt is used instead of the heat transfer oil. Moreover, such plants have generally shorter tubes (< 1100 mm), run at atmospheric conditions and operate at lower methanol inlet (typically 7.0 to 8.5 vol %).

Maximised catalyst utilisation

The development of the product addressed these differences while maintaining high performance and flexibility, two parameters which are of the utmost importance for formaldehyde producers. As a result, LPS maximises the utilisation of the catalyst in each load, i.e. minimises the total amount of catalyst required and at the same time reduces the pressure drop over the reactor and also slows its development. All whilst achieving the highest possible yield and lifetime.

Although the new LPS may appear very similar to our standard KH products (see Figure 1), it differs quite appreciably. As highlighted in the charts below, the new **FORMOX** LPS catalyst offers a more suitable and optimised CAP product for plants operating in this regime. A huge benefit from the lower and slower pressure drop development (Figure 2) is the ability to maintain the original capacity substantially longer. The operation of the LPS allows maintaining the maximum process gas flow for a longer period, which allows operation at the maximum methanol throughput (Figure 3) for a larger part of the catalyst life.

Increased plant productivity

The reduction in plant output due to increasing pressure drop over the reactor is thus significantly postponed, maintaining the productivity and available product out of the plant over a longer period of time. This, of course, is a great benefit.

Regarding the quality of the formalin produced, there is no difference between a traditional KH-type or our new LPS when it comes to the concentration of residual methanol or level of formic acid.



Figure 1: High performance **FORMOX** formaldehyde catalysts – product families by size

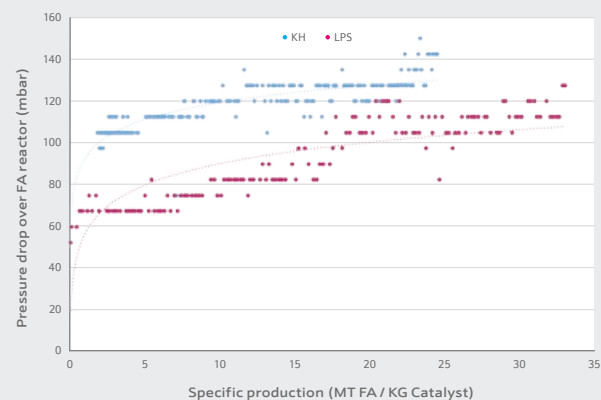


Figure 2: Pressure drop development as function of the catalyst life (SP)

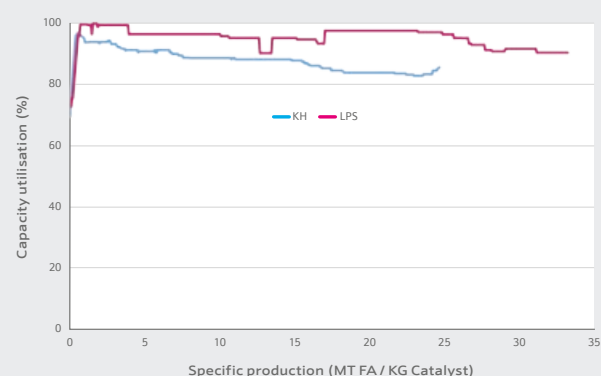


Figure 3: Utilisation of the plant maximum capacity

For higher productivity plants – higher inlet, higher system pressure - we recommend the use of our other CAPs, based on the traditional high-performance KH-catalysts.

The LPS has been optimised to perform at its best between 6 and 8 vol% in methanol inlet. For these specific low productivity designed reactors, the LPS can therefore provide a more efficient production of formalin with significantly improved utilisation of the plant capacity, extended catalyst life as well as reduced energy cost.

BY



Philippe Thevenin
Global Catalyst Solutions
Specialist



Safer and more sustainable formaldehyde production in China with JM and its FORMOX technology

At the end of August nearly 200 delegates attended the 'Formaldehyde safety to Chemical Industrial Parks' conference in Linyi, China.

The conference was co-hosted by the China National Forest Products Industry Association (CNFPIA) and the China International Chemical Consulting Corporation (CICCC), and sponsored by JM Formox Beijing.

The venue, Linyi, was a strategic choice as Shandong and the bordering province of Jiangsu represent the centre of the board and resins industry in China, with a formaldehyde output of 8 million tonnes per year.

With the Chinese government advocating the safe and sustainable development of formaldehyde, the China Forest Association addressed producers about the benefits of moving resins/formaldehyde production to approved chemical industrial parks (CIPs). They also talked about how they can help to accelerate the process.

In the future, process technology that prioritises energy conservation along

with environmental protection and safety, will obtain more support in terms of policies. This, in effect, presents new market opportunities for JM and its FORMOX technology.

The conference gave us a unique opportunity to introduce our formaldehyde technology and inline production of UF-concentrate (intermediate for resins production) to a large audience made up of resins and board manufacturers. Most of these are currently using outdated technology and facing a relocation to an approved CIP.

Over the short to medium-term, this creates a unique opportunity for accelerated growth in the Chinese Formaldehyde market. Due to our strong technology position, JM is well positioned to secure a large part of this growth.

CNFPIA encouraged discussion with CIPs on how to move resins/formaldehyde

production to approved CIPs and how CNFPIA can accelerate this process

The conference was opened with a keynote address by Mr Shi Feng, Secretary General of CNFPIA. He emphasised the importance for the board industry to develop resins and to welcome upstream and downstream vendors to the conference, including formaldehyde.

Mr Shi Feng expressed the increasingly strict environmental regulation and pointed to recent accidents in the chemical industry as a warning to the wood industry, requiring higher environment and safety standards for wood-based panel enterprises where formaldehyde is an important feed.

Promoting advanced formaldehyde technology is therefore important for optimisation and integration of small enterprises moving into industrial parks. This will lead the adhesive industry to a new level and become a milestone.

Sino-US trade war has no significant impact on the board industry according to CNFPIA

Mrs Qian Xiaoyu, Vice Secretary General of CNFPIA, presented and discussed the impact of trade war and shared opinions on the development of the wood industry from the aspects of the industry situation and industrial development direction.

New opportunities for high-concentration FA and UFC, and for professional resins producers

Mr Zhang Zhongtao, Vice Secretary General of CNFPIA, gave a presentation on New opportunities and challenges for the integration of the resins industry. Wood-based panel enterprises may need to alter how they think about development, which requires enterprises to improve quality and to increase the level of automation.

Production of UF and PF adhesive increased by 7.4% and 4.9% in 2018 – both record highs

Mr Zhang Jianhui, Ph.D., Secretary General of Adhesive and Coating Committees, held a presentation on adhesive development and application in the wood industry. FA-based adhesive has had an average growth of 12.6% in the past ten years. New GB standards have a stricter limit for FA release, which in turn requires a higher standard for resin makers and will thus promote development.

UF-Concentrate used for producing resins introduced by JM's **FORMOX** technology

Bolin Qu, JM Sales Manager **FORMOX** license plants, talked about the use of UFC producing resins for the board industry. UFC is easier and safer to handle, store and ship compared to formaldehyde because it is stable under ambient temperatures also at high concentrations. The **FORMOX** process can be extended to produce UFC as an intermediate for modern board resins, making UFC readily available as a raw material.

BY



Lars-Olle Andersson
Formaldehyde Expansion
Project Lead



Managing Director, Efficient Natural Resources China, Terry Qian, held a presentation on JM's leading position as a provider of **FORMOX** formaldehyde technology and its long-term collaboration with the board and resins industry globally.



Mr Shi Feng, Secretary General of CNFPIA, studying material from JM at the conference.



Jianguang Zhang, JM Commercial Manager **FORMOX** license plants, gave a presentation on JM's **FORMOX** technologies and benefits. Seen here with a map showing JM's leading position in China with more than 35 plants sold.

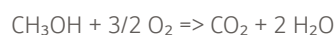


The conference team from JM Beijing including Management JM China and support from Shanghai office and JM Sweden.

Lower oxygen, higher safety

Control of the oxygen is very important for avoiding deflagrations, and the closer the methanol/oxygen mix is to stoichiometric conditions, the greater the risk for deflagration.

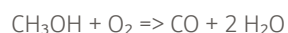
Methanol in air will burn to carbon dioxide and water.



The stoichiometric methanol inlet concentration is 12.4 vol% in air with 21 vol% oxygen. This mix will give the largest deflagration and is also easy to ignite, thus only a low ignition energy is required. Liquid methanol will give off vapors with stoichiometric concentration in room temperature. This makes it very important to make sure that no liquid methanol is in the plant before start-up. The best way to do this is to drain the system below the vaporizer after shutdown and before start-up.

Lowering the oxygen

The stoichiometric methanol concentration will only be 6.9 vol% when the plant is operated at the normally recommended 11 vol% oxygen. The methanol concentration during normal operation (~10 vol%) will then be above the stoichiometric, and a deflagration will then burn part of the methanol to carbon monoxide.



The lower oxygen concentration in combination with the methanol over stoichiometric concentration makes igniting the gas mixture more difficult. The JM oxygen control trip limits are based on a maximum ignition energy of 5 mJ, please see Figure 1.

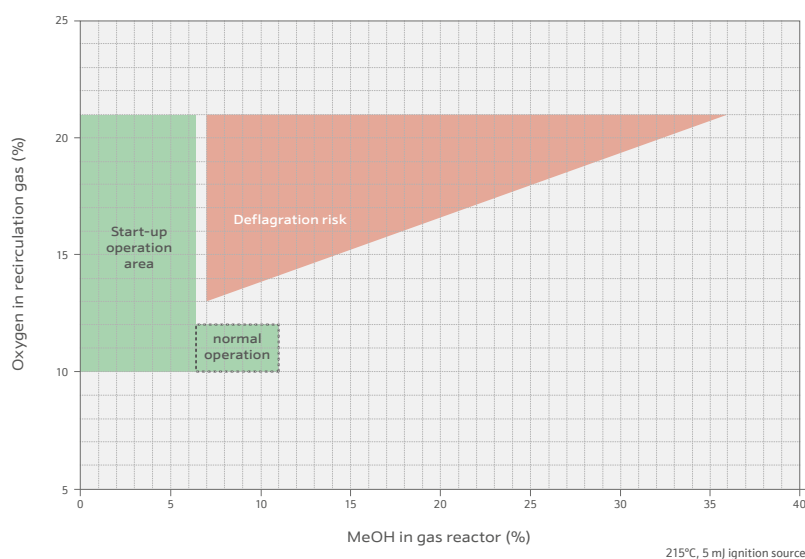


Figure 1: The JM FORMOX oxygen control trip limits are based on a maximum ignition energy of 5 mJ

Running the plant with less oxygen and more methanol generally provides greater margin for avoiding deflagrations. Our present recommendations for the catalyst say that the oxygen concentration should be at least 0.5 % units above the methanol inlet.

Example: 9.5 vol% methanol inlet => minimum oxygen of 10.0 vol%

Monitoring oxygen and performance is important

Too low oxygen concentration, however, will cause chemical reduction of the molybdenum in the catalyst and a shorter lifetime. This shows itself as black/dark spent catalyst during the reloading. For this reason, it is very important to ensure well-functioning oxygen analyzers and to keep track of the catalyst performance if the plant is run with less than the recommended methanol inlet + 0.5 vol%

oxygen. Furthermore, a lower oxygen concentration will, in general, decrease the dilution of the gas to the Emission Control System (ECS) and thus increase the ECS delta temperature, which may influence the production rate.

Conclusion

Reduction of the oxygen is the best way to give more margin for avoiding deflagrations, but a too low oxygen concentration will negatively impact catalyst lifetime and increase ECS delta temperature, possibly impacting the productivity of the plant.

BY



Ola Erlandsson
Senior Process Specialist

Keeping pressurised plants safe

Over the past 60 years, no **FORMOX** plant equipped with rupture discs has ever sustained damage due to a deflagration, and we're pretty pleased about that.

A deflagration is the rapid combustion of a hydrocarbon vapor in air, which increases the temperature and causes the gas to expand. The heat ignites the boundary layer between the expanding burning gas and the unburned gas bulk. The expanding gas increases the pressure if contained in a vessel. If the vessel is not equipped with any relief devices, the final pressure will rise to about 15 bar.

Proven protection

All **FORMOX** formaldehyde plants from JM have been equipped with rupture discs in order to limit the maximum pressure developed inside vessels to 4.5-5.0 bar g. This gives a critical flow through the open rupture discs and determines the practical sizes of the disc areas. The critical flow makes it impossible to use the common NFPA sizing standard directly. The NFPA formula does not take into account critical flow for sizing. Instead, the rupture disc sizing formula used by JM in the **FORMOX** design is from Chemie Ingenieur Technik, and has been proven effective in all deflagrations occurring over the last 60 years, with no damage caused to a pressure vessel protected by rupture discs during that time.

$$F = \frac{100 \cdot V_L^{1/3} \cdot V^{2/3} \cdot \left(\frac{dp}{dt} \right)_{\max}}{k \cdot \left(\frac{2}{k+1} \right)^{\frac{1}{k-1}} \cdot \sqrt{\frac{k}{k+1}} \cdot \frac{2 \cdot R \cdot T}{M} \cdot \alpha \cdot P}$$

Figure 1: Rupture disc sizing formula from Chemie Ingenieur Technik used by JM since the 1960s

New research and what it means for your plant

The formula in use has a small pressure dependent caused by the adiabatic compression temperature (T). New research driven by the use of methanol as an automotive fuel has shown that the dp/dt term is also pressure dependent. This needs to be taken into account when designing pressurised plants and will result in slightly larger rupture discs. A general check of the old pressurised plant designs has shown that the margins built into the systems are sufficient to cover the higher dp/dt values. There is no need to change anything in an existing plant in order to keep it safe. All plants also have an additional safety margin from the early rupture disc opening (burst pressure ~2 bar g) that is not taken into account in the sizing calculation.

Safety in the blast zone

The gases (CO₂, CO, H₂O and N₂) from a deflagration are directed from the open rupture disc through the outlet pipes to a safe location. The blast zone around the outlet pipe opening is 45° from the pipe wall up to a horizontal distance of 1500 mm (see Figure 2). The height of the zone is more than 20 m. The safe distances are estimated from film sequences from actual deflagrations. It is important that the blast zone is kept free from any equipment that could deflect the blast towards platforms, walkways, etc. Normally, no debris should be released from the opening of a petal type rupture disc, but with older, non-petal rupture disc types there is a risk of the disc coming loose, which we want to make customers aware of.

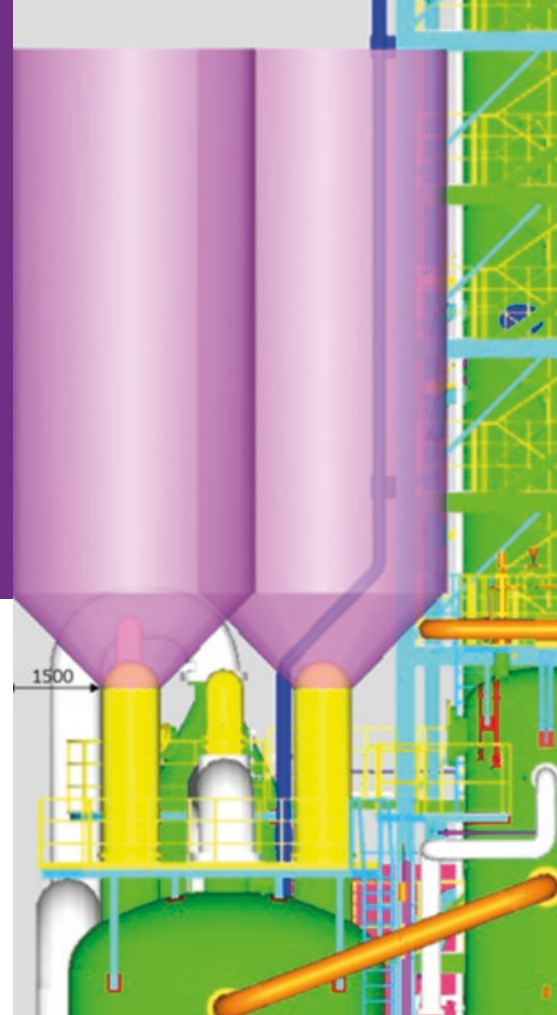


Figure 2: The blast zone around the outlet pipe opening is 45° from the pipe wall up to a horizontal distance of 1500 mm, and extends more than 20 m vertically

Conclusion

- Old plants have sufficient inherent design margins to handle the updated dp/dt values.
- New plants will have slightly larger discs to keep the design margin.
- There is generally no need to change the rupture discs due to the updated input to the sizing calculation.

BY



Ola Erlandsson
Senior Process Specialist

Mo update

From a price perspective, the molybdenum market has remained very stable since March 2018, with a price of around 12 USD/lb, so maybe a bit boring from any investor's point of view. Hence, my prediction from the previous edition seemed, until this summer, to be on track, although we have not yet seen the price increase from 12 to 13-14 USD/lb as I had anticipated back in late 2018. On the contrary, the price began to drop this October and, at the time of writing this update, a low-point of around 8.3 USD/lb has been observed. So why has this happened?

Following the price development during 2019, and reviewing the opinions of various analysts to get a grasp on how the molybdenum market looks going forward, the outlook for 2020 seems to be more uncertain. As anticipated, more capacity did indeed come on stream this year due to expected continuous strong demand.

What was not expected, however, was a decrease in Mo consumption during the first half of the year and that, despite lower output in China due to some mines being forced to shut down or to reduce capacity because of environmental pressure, the Mo price, except for a smaller drop in July, still remained stable until late September. Since then a larger fall has been noticed, down to 8.3 USD/lb.

During the year, GDP growth in China has slowed down to 6% in the 3rd quarter, which could be associated with both the trade war and a more (temporary) negative outlook globally. But whether this is a sign of a more global slowdown or just a small dip on the curve (due to destocking?), is a bit difficult and early to tell. If there are no fundamental changes in the global market, and this was just a temporary disturbance, I would expect the price to rebound to around 10-12 USD/lb within the next few months and continue

to increase as indicated in previous communication to around 12-14 USD/lb during 2020-2021. But if this is a bigger dip in the global economy, then we may be looking at lower prices for some time still during 2020.

This is my present view, and as usual we always do our best to keep net prices as stable as possible no matter what fluctuations are occurring on the market. And of course, you also play an important role in keeping catalyst prices stable by returning spent catalyst in good condition and according to our specifications to our catalyst recycling facility!

BY



Ronnie Ljungbäck
Global Market Manager
Formaldehyde Catalysts

Are you in need of more capacity?

Formaldehyde and UFC producers around the world constantly meet new challenges. Change in demand, changed legislation and new technology introduced to the market are a few examples, and it is not always easy to address them all. It is important that our customers stay competitive for the lifetime of their plants and make use of the developments and improvements introduced by JM regarding both plant and catalyst technology. This is why upgrades are an important part of what the JM technology is offering – they are an excellent way for our customers to stay competitive.

The main reason to consider a plant upgrade is, by far, capacity increase. In recent years JM has conducted upgrades that, through a combination of options, have increased capacity by as much as 75 to 80% over the original design. Very

often in such projects, a feasibility study is done before the upgrade, and customers also take the opportunity to make energy efficiency improvements or to replace old equipment to prolong the lifespan of their plants.

Planning and execution are key

As plant output is important for downstream production or external sales, a critical factor for all upgrades is the length of downtime needed to implement the upgraded parts. This places high demands on good planning of the installation and commissioning phases, as well as on selecting an experienced and reliable partner for executing the project. Our experience in project execution concerning both new and upgraded plants is essential for making your projects successful.



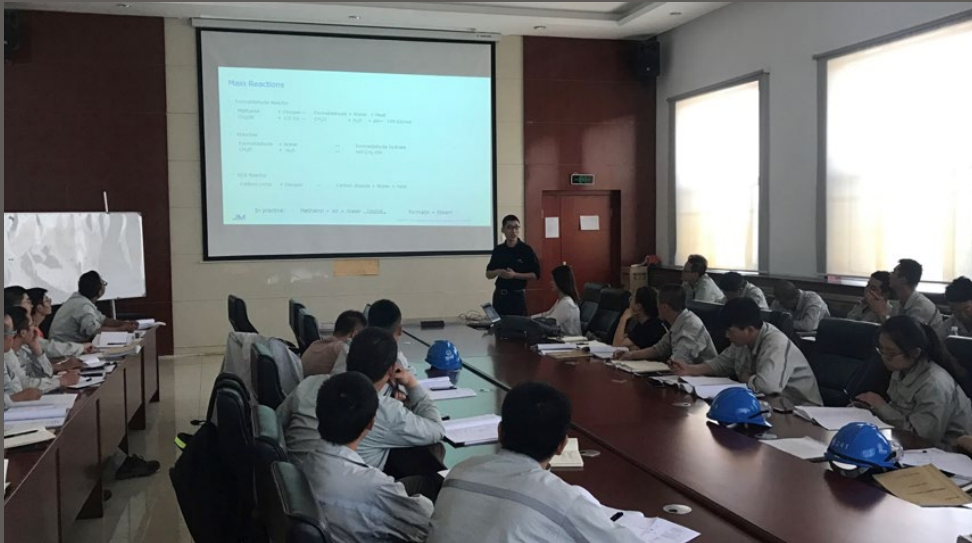
Don't hesitate to contact your JM representative in order to discuss your requirements – we can help you with the solution.

BY



Claes Lundström
Senior Consultant –
Plant & Revamp Sales

Training



JM conducted an onsite training in August of 2018 at the Xinjiang Xinye site i Wujiagu City, Xinjiang province, China. About 35 engineers and operators from the customer participated in the exercise held by 4 members of the Chinese JM team.



JM conducted an onsite training for Foresa at their plant in Caldas de Reis this past June; two different teams attended



Friends from Yanchang Petro in China visited Perstorp in August for project training



A refresher training took place in Helsingborg and Perstorp in late September and was attended by customers not only from Europe but also from Africa, Middle East and South America



Ashish Bhave

From APAC to Bahrain

I completed a M.Sc. (Organic Chemistry) in 1998 and Ph.D. (Chemistry) in 2016 from University of Pune, India.

I have more than 20 years of experience in the chemical industry and joined JM in 2003 on a PGM plant in Taloja, India. Since then I have worked in a variety of roles - quality, process support, technical services, sales within various JM businesses such as Life Science Technologies (LST), PGM refining (Smopex) and Chemical catalysts. In my most recent assignment as Regional Technical Manager I was looking after Chemicals customers in the APAC region (excluding China).

I will be moving to Bahrain for this new role as Regional Sales Manager – Chemicals, Middle East.

"I love travelling, meeting new people, exploring new cultures and cuisines. I feel great satisfaction in providing solutions to customer problems. I sincerely feel that at JM we are well poised to do so".

Joining the formaldehyde business gives me an opportunity to widen my knowledge base. I am looking forward to adding value to the business based on my previous experience.

New faces

Perstop



Debopriya Das
Process Engineer



Jim Svensson
Project Manager Operations

Beijing



Zhankui Bu
Project Manager



Ratly Li
Instrumentation Engineer



Mei Zhu
Catalyst Sales



Lipeng Zou
Site Engineer

Projects and start-ups

New Projects

- A customer in China has signed an agreement for two plants, FS3 & FT3.
- **Wanhua Chemicals Group Co. Ltd.**, in Yantai China, has signed up for a new FT3 plant. This will be their third **FORMOX** plant on this site.
- A customer in China has signed up for an FS3 plant.
- An agreement for an FT3 plant to a customer in China has been signed.
- The FT3 plant to **Wanhua Chemicals (Ningbo) Co. Ltd.** in Ningbo China, their third **FORMOX** plant on this site, is proceeding well.
- The project with INNER MONGOLIA JIUTAI NEW MATERIAL CO., LTD. China, is in the design phase. The formaldehyde plant will be the world's largest single site JM **FORMOX** formaldehyde plant.
- The project for a new **FORMOX** 2.0 plant in Europe is in the construction phase with start-up scheduled for this year.
- An FT3 plant for a customer in China is in the construction phase with start-up scheduled for next year.
- Works on an FS1 plant to a customer in Southeast Asia is in the design phase.
- The FT3 plant for a customer in China is approaching start-up this year.

Ongoing projects

- Works on the project for a capacity upgrade of an existing formaldehyde production plant in Eastern Europe is in progress with start-up scheduled for this year.
- The FT3 plant to a customer in China is proceeding well with shipping ongoing.
- The new project for an FS3 plant to a customer in China is in the shipping phase.
- The revamp of a pressurisation unit for a customer in Asia is proceeding well with start-up expected this year.
- A capacity upgrade and revamp project for a customer in South America is in the shipping phase.
- An FE2 plant for a customer in Southern Europe is approaching commissioning.

Start-ups

- The FT3 plant to **Wanhua Chemicals Group Co. Ltd.**, in Yantai China, their second **FORMOX** plant on this site, went on stream in December of last year.



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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Watch: Chief Executive Robert MacLeod explores how we're tackling some of the world's most complex challenges
matthey.com/meeting-global-challenges