

A formaldehyde magazine from Formox

# INFORMALLY SPEAKING

spring/summer 2013



Johnson Matthey  
Formox

- Formox. Now part of Johnson Matthey
- The impact of contaminants in the methanol

Formaldehyde China 2013



Formaldehyde  
seminars 2013

page 4-9

# Welcome to the “new” Formox!

Much has happened since the previous issue of Informally Speaking. Most notably for Formox, the Perstorp group decided in March to divest the Formox business to Johnson Matthey Plc, a UK-based, international specialty chemicals company with a focus on precious metals, catalysis and process technology. This marked the start of an exciting journey for Formox and its employees.

Being part of Johnson Matthey gives us access to a worldwide network of specialists in catalysis and process technology. These specialists will be able to support us in our efforts 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. I truly believe that the acquisition of Formox by Johnson Matthey is good for Formox, for its employees, and most importantly, for its customers. Going forward, you will notice that some things are changing – a new logo, new business cards, an altered graphical profile, etc. But the key things remain the same: Formox will continue to operate independently, your contacts are still here, and our business model is unchanged. In other words, it is business as usual!

The business climate has been somewhat gloomy also in 2013. Yesterday, concerns were about Southern Europe. Now the focus is on India. At the same time we see a Chinese economy that is steadily moving along, albeit at slower pace than before 2009. Europe seems to be through the worst of its perils, although it still has a long uphill climb. It is also comforting to note the improvements in North America. This time, the light is coming from the West. In the Formox business we also see China as the main driver for new plant sales, with budding activities in the US and in Eastern Europe.

In 2013 we have held a record number of customer seminars: Hua Hin, Thailand in March; São Paulo, Brazil in April; and Beijing, China in May; all mentioned in this issue. All of these seminars have been successful, with high attendance and many new business leads. We are currently planning for the next seminar, which will be held in Las Vegas, Nevada, USA during the spring of 2014. Look for your personal invitation to be arriving shortly.

I also encourage you to read more about process safety in the page 15 article by Anna Wemby Björk, head of our Process Group. Remember that safety is, and will always be, our top priority!

Together with Johnson Matthey, we expect to bring you further improvements of our plants as well as our catalysts, something I hope to be able to tell you about in future issues of Informally Speaking. For now, please enjoy the issue you are currently holding in your hand.



Mårten Olausson  
General Manager  
Formox AB

## CONTENT

### Special features

Formox. Now part of Johnson Matthey	3
Formaldehyde Asia 2013	4-7
Formaldehyde São Paulo 2013	8
Formaldehyde China 2013	9
Thank you Bob!	16
Three decades of friendships	16

### Training & Project news

Training	19
New projects & start-ups	20

### Market updates

Mo update	11
Methanol Supply and Demand	12

### Downstream

Fertilizer, an unexpected use for UFC	10
New technology for polyether diesel fuel creates enormous potential for formaldehyde in China	10

### Formaldehyde in society

Formaldehyde reclassified	13
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### Technical support

The impact of contaminants in the methanol	13-14
Make your non-routine work safe	15
How to use the hotspot temperatures in the reactor	17

### Other news

ECS catalyst development – past, present and future	18
How to make the most money from your spent	19
Personnel changes	20

## Formaldehyde Americas 2014

Next year's formaldehyde conference will be held in Las Vegas on March 10-13. The conference program is still not fully defined but will follow the route our customers has come to appreciate with a welcome evening before three days of conference including technical news and industry related topics, technical discussions and training. Invitations and program will be sent out later this year.

## Do you need to be trained? – Let us know!

If there is enough interest we intend to arrange a refresher training in Perstorp, Sweden in October or November. The contents will be of general character and the training is open for all our customers operating a Formox plant and Formox catalyst.

Contact your Formox representative to discuss what areas of training you are interested in or if you just would like to hear more about what we can offer.



# Formox. Now part of Johnson Matthey.



On 28 March 2013, Johnson Matthey acquired Formox. Through press releases, letters and the conversations we have had since then we have informed you about this important milestone in the history of Formox. Now we would like to take this opportunity to tell you a bit more about the background of our new owner, and how this will affect both you and us.

## Who is Johnson Matthey?

Johnson Matthey was founded in 1817 as a gold assayer in London. Today it is a global specialty chemicals company with operations in over 30 countries and around 11,000 employees. The company is a leader in sustainable technologies and while not a household name, many of its products enhance the quality of life for millions through

their beneficial impact on the environment, human health and wellbeing. Johnson Matthey operates in a wide range of market sectors, supplying many different products and services with a focus on clean air, clean energy and low carbon technologies. In addition, given the company's history, they are experts in the application and recycling of precious metals.

Johnson Matthey is headquartered in the UK and is quoted on the London Stock Market and in the FTSE 100 index with a current valuation of over £ 5 billion. It has continued to perform well and is making good progress towards achieving its key long-term strategic objectives. The company is well positioned in its key markets, with good potential for future growth, and it

holds leading positions in its major areas of activity. In recent years there has been substantial expansion in Asia, Eastern Europe and other geographic regions, driven by the successful introduction of new products, technologies and markets, and by acquisitions like Formox.

## Why did Johnson Matthey buy Formox?

The acquisition of Formox is an important step in Johnson Matthey's strategy to grow new business areas that build on its skills in advanced catalysis and technologies. The complementary expertise of the combined companies offers exciting business growth potential.

The company has a strong technology base in hydrogenation catalysts for the chemicals industry and now, with Formox, it has presence in the large and growing market of oxidation catalysis. Furthermore, Johnson Matthey is active in plant design and licensing, and the addition of Formox provides exciting opportunities to integrate and expand the technology offering into a broader range of chemical processes.

## What is going to happen now?

Currently we are in the process of integrating Formox with the Johnson Matthey organization and systems. Dedicated teams are working hard to make this transition as smooth as possible. As we have said before, this is all taking place in the background, which for you means that everything is business as usual. Your contact people remain the same, and the valued Formox brand will stay, too.

We at Formox are pleased to have entered this new chapter in our history, and we are confident that our new ownership will bring benefits to you. So don't be surprised if you should see more of Johnson Matthey, its technologies and its people in the future. We will keep you informed!

BY



Mårten Olausson  
General Manager  
Formox AB

# Formaldehyde Asia 2013

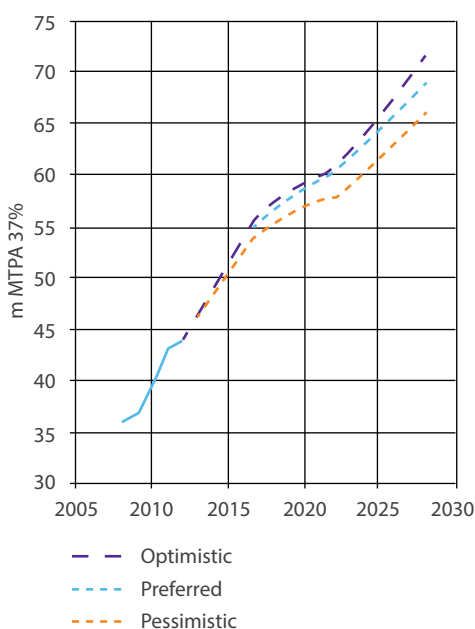
This was the 7th seminar under the Formaldehyde Asia banner and the third to be held in Thailand. After Phuket in 1998 and Bangkok in 2007 it was turn for Hua Hin. The Hua Hin area was once favored by the Thai Royal Family and one of the first beach resorts in Thailand - not that the delegates had much time to relax on the beach!

This particular seminar is always well attended; according to Informally Speaking, even the very first event, Kota Kinabalu, Sabah in 1996 had 60 participants; this seminar proved to be no exception with 83 participants from around 20 countries – setting a new seminar record.

Networking, providing a forum for Formox clients to exchange experiences, is a key component of these events and this started early with an informal reception on the evening before the conference proper; an ideal opportunity to meet old friends and make some new ones. Despite a late night (at least for some) the full complement was in attendance the next morning to be officially welcomed by Eddy Lee, who went on to introduce Mårten Olausson in his first conference as General Manager of Formox. Mårten confessed that he had not known quite what to expect when he first came to Formox. But what he found was a highly motivated team fully focused on the customer. He went on to review how Formox had got to where it was today, the market leader in formaldehyde technology. He noted that though much had changed over the years, not least the people, the essential spirit had been preserved. But as he concluded:

Local culture was not neglected, during dinner on the first night there were displays of Thai dancing and a demonstration of Thai boxing. And if that was not enough on the last afternoon there was an opportunity to take in some of the Royal connections in the area with a visit to Khao Wang, a hill top royal palace built in 1860 by Rama IV (of King and I fame). There was even caving on the agenda as we were taken to a nearby underground shrine that had been frequented by the royal family in the past. Even the site monkeys were respectful!

“Even if it is important to understand and learn from your history, it is also important to understand what is around the corner” — thereby providing a pertinent introduction to Bob Crichton’s market projections.



Bob likened his presentation to the new Volkswagen Golf – looks the same as the last one but is actually all-new! He explained that over the last few months he had taken a long hard look at the underlying facts and figures and incorporated new data. But though the numbers were slightly different, the general conclusions were much the same: little or no change in the rate of growth up to 2020. Thereafter, a slight easing as growth slowed in the emerging economies. Nevertheless Bob remained reasonably optimistic; the projection for 2020 was 57 to 59 m MTPA, growing to 69 to 75 m MTPA by 2030 (see graph). The greater spread for 2030 was down to some of the uncertainties Bob touched upon in his presentation. The only certainty, as Bob put it, was that he would be long retired by the time it became necessary to defend the numbers!

After the delegates were suitably refreshed with coffee, the conversation turned to methanol and a talk by Mark Berggren of MMSA. He reviewed 2012 and presented an overview of how he saw methanol going forward to 2017; he concluded with a look at the year ahead. Demand increased by 10.6 % in 2012 compared with 2011 but most of this (87%) was in China and though traditional derivatives such as formaldehyde showed growth, most of the demand was either in energy/fuel outlets or MTO (methanol to olefins) projects. On the supply side 2012 proved to be just below the record increase seen in 2011 but going forward the situation was much more fluid. Indeed Mark went so far as to say that it could become difficult to source the methanol required to sustain the envisaged growth. Though there was still some capacity overhang, plant availability would need to be much higher than in the recent past if demand was to be met. To compound the problem some new projects were in doubt, despite improved margins.

Mark’s presentation concluded the market block; it was now time for EHS – Environment, Health and Safety. This was introduced by Ola Erlandsson who also made the first contribution, “Formaldehyde in Society”. Ola’s basic point was that it was not enough to say that arguments against formaldehyde were based on bad science. We had to recognize that the general public had real concerns and the formaldehyde industry had some way to go to meet those concerns. However, he concluded that the future still looked bright; as he saw it formaldehyde would continue to be a major building block though it would be more regulated. But we, as an industry, would need to improve products and the production processes; he assured us that Formox would play its part.

One of the industries already experiencing increased regulation was the wood indu-

stry, which as Bob had explained in his presentation, consumed, in the form of binders and overlays, approaching half of all the formaldehyde produced in the world. Explaining how to produce wood based panels with low formaldehyde emissions was the job of Nikos Pargianas from NTL Chemical Consulting. Though UF resins had many advantages, there could be issues such as emissions, poor moisture resistance and degradation. Nikos explained some of the mechanisms governing resin performance before going on to show how boards could be manufactured to meet the many and diverse standards applied across the world. As he pointed out Australia, USA and Europe (I assumed Europe need not be mentioned twice) not only had different targets but different ways of measuring board emission. He displayed a list of resin types, activators, scavengers, hardeners and cross linkers available from NTL (and used by clients world-wide) before concluding with some performance data for MDF produced using different combinations of NTL products.

Fredrik Rietz then informed us about “carbon footprints” – a term we have all heard but maybe not fully understood. As Fredrik explained, it was a way to reflect the impact of a product on the environment – at least in terms of carbon dioxide emissions. He showed how to calculate formaldehyde’s carbon footprint and how it was influenced by raw material and energy inputs. The key was materials and energy efficiency; the lower the energy consumption and the higher the yield, the smaller the footprint.

After lunch it was time for Ola Erlandsson to return to the fray. His first topic was a review of a recent incident, one with an interesting “twist”. As at the Helsingborg seminar, the topic was deflagrations. As in Helsingborg, the basic cause was the same – foreign material. This time it was wood left in the reactor; this had caught fire and caused the deflagration. The twist in this story was that there was apparently a second deflagration when the plant was restarted. The keyword was “apparently”; what was found to have happened was that insufficient torque had been applied to the bolts, the disc simply came loose and tripped the plant. Ola’s second topic concerned the catalyst – was the dust hazardous? Clearly it was, as indicated by the MSDS; but as Ola demonstrated, provided suitable precautions

were taken during loading and unloading, operators were exposed to be very low dust levels – well below those mandated.

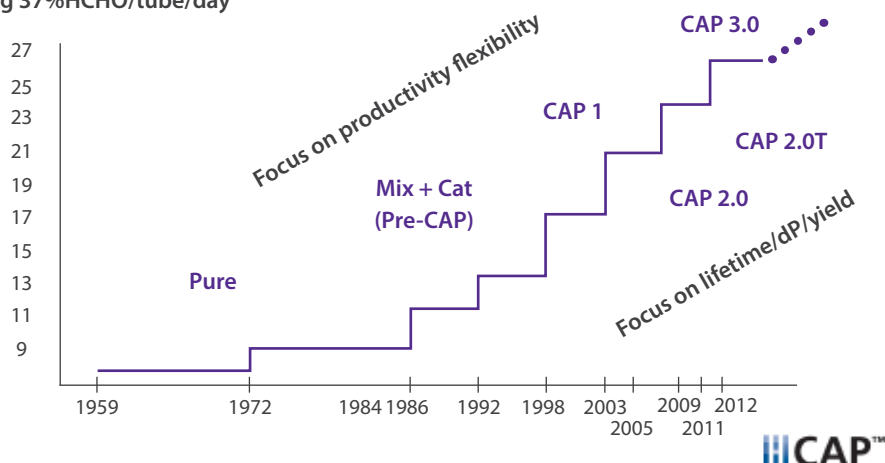
And then it was time to review recent technical developments, a topic introduced by Lars-Olle Andersson. Ronnie Ljungbäck started the ball rolling by presenting a comprehensive history of how and why the CAP concept had developed. The initial driver had been higher productivity through the use of higher methanol inlets. But ever-higher inlet concentrations meant more severe operating conditions for the catalyst, leading to degradation. CAP was the answer and as this concept developed, Formox was able to climb ever higher up the productivity

able to withstand these severe conditions. Johan was able to say that this had been achieved with a new development – the KH-CAP 3.0 INI CAT. Incorporated into CAP 3.0 load plans it was possible, under certain conditions, to achieve 10% extra production. It was also possible to use CAP 3.0 in another way – to give a longer lifetime. In concluding Johan commented, “the limits had still not been established”. Indeed CAP 4.0 was already at the planning stage; one target was to increase the operating pressure still further.

And higher pressure operation at no extra cost was now possible using the turbo-charger described by Andreas Magnusson.

## Formox loading plan development

Kg 37% $\text{HCHO}$ /tube/day



ladder – improving yield, catalyst life and backpressure development at each step. Today there was a whole family of CAPs and each could be customized to meet specific needs – no matter the type of (oxide) plant. Though, as Ronnie pointed out, the most economic CAP for a given set of circumstances could only be determined by a thorough analysis. Uprating plants in this way could, however, lead to other issues, notably a high ECS exit temperature. But, as Ronnie was able to demonstrate, there was now also a catalyst-based solution to this problem.

It was then Johan Holmberg’s turn to tell the next chapter in the CAP story – CAP 3.0. The aim had been to take productivity up to the next level (11% inlet). This time the team concentrated on the top catalyst layer, where the potential for degradation was highest; their aim was to develop a catalyst

Usually the specific power consumption (kWh/ MT) increased as the system pressure rose above 0.3 barg. With the turbocharger this did not happen, the extra power is recovered and the power consumption is the same. Andreas, in conjunction with Nico Schmäling of MAN Diesel and Turbo, described the development process through to successful operation. And now Andreas was able to say that it worked and worked well; the operators could easily start and stop the plant and make all the normal adjustments. At the end of the day it had proved to be very little different from a conventional plant but, as Andreas commented, “it took Formox nearly seven years and thousands of engineering hours, not to mention extensive site testing – to get to this point”.

Needless to say the turbocharger attracted a lot of interest among the delegates, no wonder as it offered a substantial power reduction of some 19 kW/MT 37%. But Andreas did not stop there, he went on to discuss other energy efficiency schemes, such as using steam turbines to drive the recirculation fans, either directly or indirectly using a turbocharger. And steam turbines could be used in conjunction with the turbocharger; some schemes even exported power! But, as Andreas noted, these options depend on the value of the steam/power at the particular site. If steam is of little or no value and/or power costs are high, all the turbine schemes had a very short payback.

Lars-Olle Andersson, in introducing his presentation on technical service, noted that the Formox family had always been service orientated, something that Lars-Olle appreciated more than most having been part of the catalyst service team in the late 1980s. The challenge, as he saw it, was to retain responsiveness and personal contact in today's world - a very much larger Formox customer base (and ever growing product portfolio). As he said, it was pointless having good technical solutions to client problems

if they could not be communicated. This was why Formox were putting more effort into the technical support function; it was now fully integrated into other functions and could draw on support from the entire organization.

Lars-Olle then concluded the proceedings by summarizing the entire day. Day 2, introduced by Lars Andersson, was more plant orientated and directed at tools available to improve plant performance.

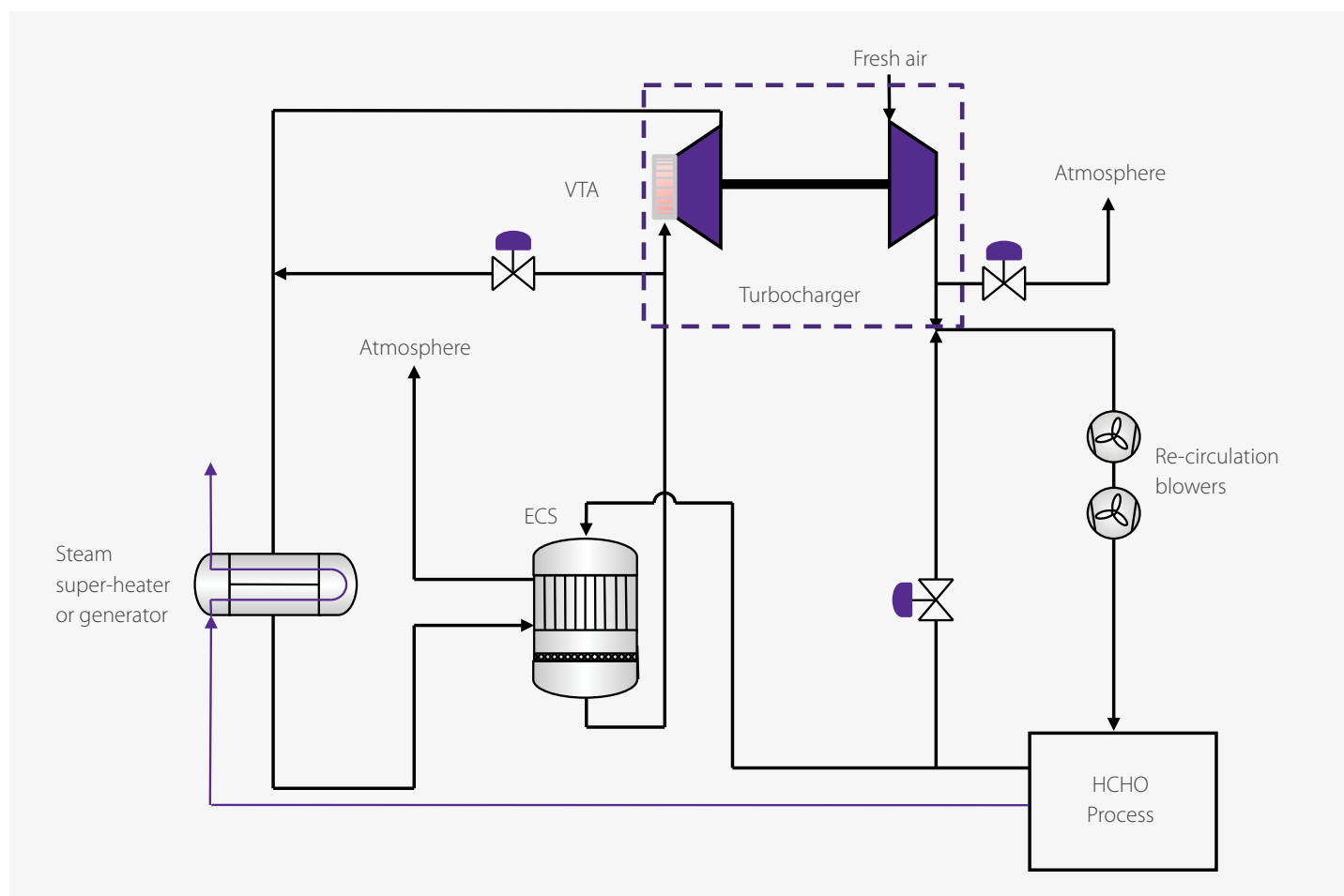
The title of Johan Holmberg's presentation was "Optimal Performance: A Result



of Information". But you would not have guessed that from his title slide where the

letters had been manipulated to disguise the words. This illustrated Johan's point, that incorrect information could lead you to the wrong conclusion. There was no room for guesswork in the plant environment, data had to be CCC – complete, clear and correct! From experience he said that failure to optimize could result in a yield 0.5 to 1% points below the optimum. Wrong decisions could also lead to premature catalyst aging and a yield as much as 2% points lower. Johan showed some of the ways that plant operators could ensure their data were CCC but it was left to a later presentation "Formox Performance Package", by Tomas Nelander to show how all this information could be collated within the DCS and used to provide real-time trending of performance parameters, even costs if required.

Sandwiched in between these two presentations was one by Lars Andersson titled "The Flexible Approach to Better Plant Performance". And in recent years this topic had assumed greater importance. Plant operation was no longer simply a matter of operating as hard as possible for as long as possible; these days operating conditions had to be changed frequently to match mar-









ket and downstream demands. The object of this work had been to show how to keep costs low in such circumstances. This was illustrated graphically for different cases. In brief, to decrease rate in an optimal manner, first keep inlet as high as possible, then reduce pressurization pressure, then the re-circulation rate and finally reduce methanol inlet – particularly if low DVC is prioritized.

rely features at seminars. Even rarer is the opportunity to hear about it from a client's perspective. So the presentation by Sergei Afanasyev, who talked about experiences at JSC Togliattiazot, was a unique opportunity. The company had been producing UFC since 1997 and had noted some interesting differences between the early product and that produced now on the large Formox

Wemby Björk's presentation; as Anna said, "there is no point in optimizing the plant if it is not able to run because of some maintenance issues". Anna categorized the different types of maintenance (see diagram) and emphasized that maintenance never ends; it is essential for safe as well as successful operation.

To conclude the technical sessions Ola Erlandsson tried something new, at least for this particular seminar, a workshop, inviting contributions from the audience on plant design and any other topics they cared to raise. This proved to be a lively discussion but all too soon it was time to close the seminar, which brought Mårten back to the podium to thank all the participants for their contribution and the organizers for putting together what he described, in true "Olympic" style as the "best games ever".


Parameter	Action	MeOH conversion	Reactor temp./pos.
Methanol inlet			
HTF temp.			

If long catalyst lifetime was prioritized, this method should be performed in reverse order: first reduce the inlet, then the pressurization pressure and finally the re-circulation flow.

Though Formox has been building UFC plants for many years, this topic ra-

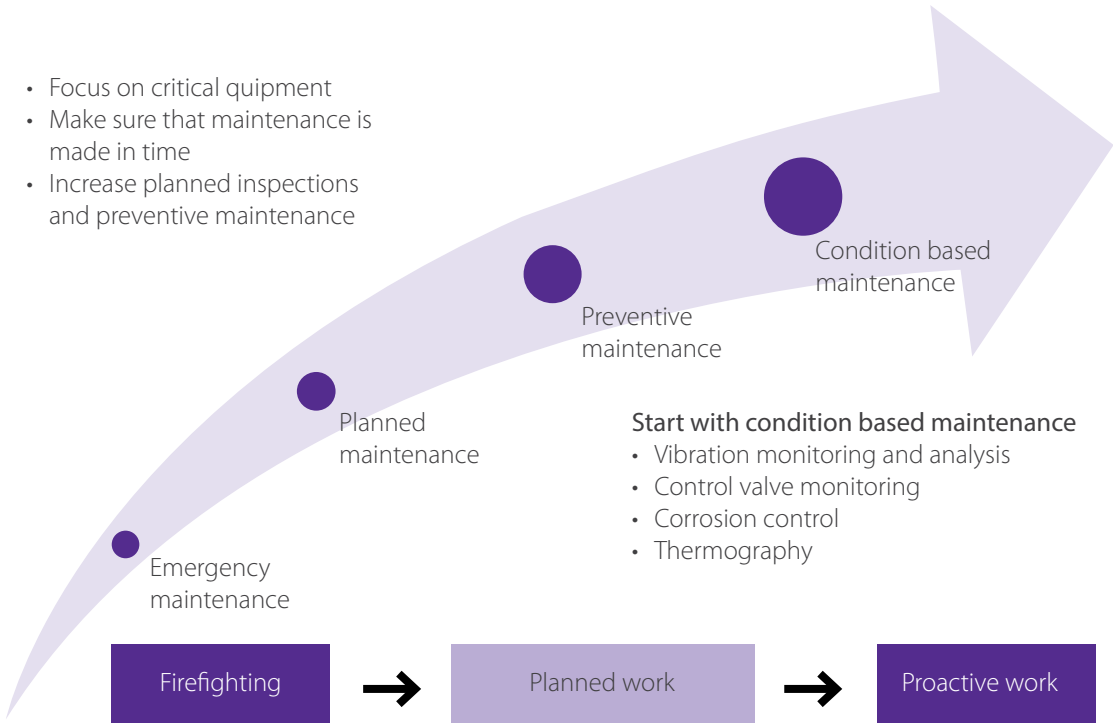
units. Sergei explained some of the composition issues, notably the formation of urones and triazinones. He also drew attention to the effect of storage on UFC quality. As with formaldehyde, storage temperature was important if the material was to remain within specification, particularly with respect to pH. "Keeping it running" was the topic of Anna

BY



Bob Crichton  
Formaldehyde Specialist  
R.S. Crichton & Associates

# Maintenance – action needed to improve





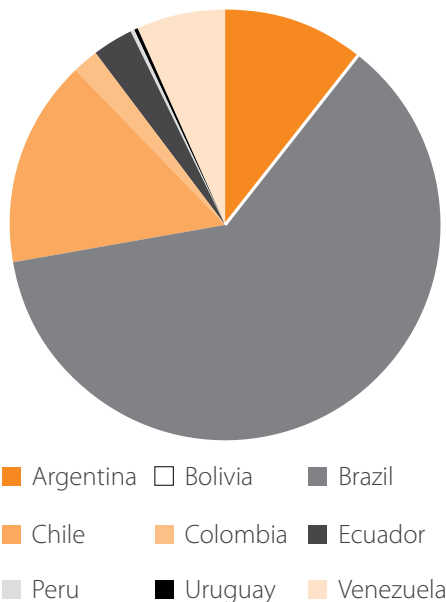
# Formaldehyde São Paulo 2013

Formox hosted a two-day formaldehyde conference in Brazil in April 2013. It marked the first time for our South America team to arrange this kind of event, which was dedicated for our customers and prospects in South America.

While we have considered this type of customer activity for many years, when the formaldehyde market reached almost 1.5 mMTPY in 2012 it was the right time to go ahead and do it!

## South America & formaldehyde facts

The formaldehyde market in South America is dominated by the wood sector and there are several big resin and panel producers competing for the existing market. While the market growth in the region is not exceptional, it is rather stable at 3-5 % per year. In general, raw material availability is good with room for growth and additional new formaldehyde capacity is expected for the near future.



Brazil is the biggest country on the continent and also has the biggest formaldehyde capacity; it felt like a natural choice for the conference. Many of the large producers have their facilities in the areas near São Paulo. The venue chosen was the Jequitimar Hotel in the town of Guarujá. Guarujá is situated only about 115 km south from Guarulhos, the international airport in São Paulo.



The participants represented the following companies; Akzo Nobel (Interquimex), Alto Parana, Arauco, Copenor, Duratex, Elekeiroz, GPC Quimica and Oxiquim. Formox was represented by Anna, Fredrik, Johan, Lars-Olle and Lars.

## News and more on day one

The conference was a condensed version of the Formaldehyde Asia event; most of the topics presented in Hua Hin were also covered at the São Paulo conference. The conference focused on presenting and discussing the Formox product portfolio as well as the benefits we can offer with our unique plant, catalyst and technical support package. Of course, the Turbocharger and the CAP 3.0 concepts came into the limelight. But areas like formaldehyde and methanol market updates, formaldehyde in society and formaldehyde plant related safety issues from real life were also covered.

## Day two all about training

The second day was entirely dedicated to the training program and technical discussions. We knew many of the customers wanted us to do the training and we were provided with a "full-to-the-brim" classroom. In addition to the more or less "mandatory" topic about catalyst and optimizing plant and catalyst operation we also had lengthy and important sessions about absorber operations, including UFC, as well as maintenance of the formaldehyde plant. The maintenance discussions were about matters related to "what to do" and "how to do it" as well as strategies for planning maintenance.



## Excellent participation and feedback

We got a lot of direct feedback during the conference from participants. And we are proud that their verdict of our first conference was overwhelmingly positive! They especially appreciated to hear about Formox news, like the Turbocharger and CAP 3.0. They also said the training was really useful and the possibility for networking was excellent! We had 26 participants from eight different companies and four countries. All of which we think is a very good result for this first ever Formox conference in South America.

BY



Lars Andersson  
Technical Sales Support  
Manager  
Formox AB



# Formaldehyde **China 2013**, Beijing May 15th to May 16th



The host, Mr. Eric Li, opened the seminar by introducing the 17 Formox representatives from Beijing, Singapore and Sweden that were in attendance.

This past May Formox hosted a formaldehyde seminar at the Vision Hotel in North West Beijing. The event marked the conclusion of the Formox seminar seasons for 2013 as well as the first seminar held by Formox in China. So everyone within the organization shared equal amounts of both excitement and nervousness. How many participants would attend? Would the seminar topics be well received? Would traditional Chinese entertainment be appreciated? Our nervousness turned out to be groundless: 35 customers from 15 different companies attended the two-day seminar and training. Judging by the rating they gave in the evaluations, we could also see that the customers appreciated the event and activities. As Formox GM Mårten Olausson said during his closing: "Formox will aim to return to China every second year to host similar events".

The event and seminar was divided over two days. The first day covered Formox news and developments, market updates and Environment Health and Safety. Day

two was dedicated to in-depth technical discussions and training.

Following Eric's introduction Formox GM Mårten Olausson then presented Formox in 2013. One of the highlights was that Formox is now a part of Johnson Matthey and not a Perstorp company anymore. He emphatically pointed out that, for our customers, the different ownership will have little to limited impact on daily business. Other presentations from Formox speakers covered 20 different topics, these were basically the same topics covered at the Thailand seminar in Hua Hin (see separate article). In Beijing, all presentations were translated and interpreted simultaneously so that everyone would be able to follow along easily.

Two external speakers joined us. Mr. James Xie from MMSA gave an update on the methanol market. Mr. Wang Qing Yang from Coreteam presented a new, exciting application for formaldehyde, where it is used as an intermediate when producing diesel from coal (see separate article).

We were also very pleased to partake in numerous quality discussions and receive so many good questions during the second day workshop. We try to plan for even more Q&A session time at our next Formox venue as this was highly appreciated and desired by all in attendance.

At a Formox seminar, it is important every participant is able to have ample opportunities to discuss specific topics with our specialists, meet other formaldehyde producers as well as to have some fun, too. The night before the start of the seminar, all participants were invited to a welcome drink; the second night Formox hosted a welcome dinner at the hotel.

After the event, all customers were taken out to dinner at a popular Beijing restaurant. During the dinner there, we were treated with traditional Chinese entertainment, several competitions between the tables (with an some happy winners) and delicate singing!



Unlike Hua Hin, there were no chance to enjoy an ocean swim. But our impression is that our first event in Beijing was well received. Thanks to all our customers that attended and made the seminar a memorable event. We welcome you back to China in 2015!

BY



Andreas Magnusson  
Global Product  
Manager - Plants  
Formox AB

# Fertilizer, an unexpected use for UFC

Plants need nitrogen to grow. Nitrogen gets added to our fields as fertilizer. Before 1915, all fertilizer was produced from organic origins, such as guano, manure and other sources. Then the Haber-Bosch process made it possible to make ammonia from nitrogen gas and methane. Ammonia could then be reacted with carbon dioxide to form urea. This spawned the era of the commercial fertilizer that is now used by farmers all over the world. It is thanks to this invention that food production has been able to keep up with the increasing population on Earth.

When we speak of UFC (Urea Formaldehyde Concentrate) we are mainly referring to resin production for board manufacturing. However, there is also a small but important usage for urea fertilizer production. Urea is made from natural gas and nitrogen from the air. The urea product is then made into granules in a granulator for distribution to the market. Alternatively, a prill tower can also be used to produce prills. A small amount of UFC (<1%) is mixed with the urea prior to granulation to improve the crush strength of the final granules. Crush strength

is very important both during the production of the fertilizer and for transportation and handling during spreading onto fields by farmers. The reaction between the UFC and the urea prevents breaking of the granules and dust formation; it also enables the production of larger diameter particles that are easier to use in the farming.

Urea has the highest nitrogen content of all fertilizers, making it well suited for transportation. The high nitrogen content can be a problem if it is released too quickly into the ground. That is because it can then damage crops as well as be washed into rivers and lakes before being absorbed by plants. The added UFC can be optimized to control the nitrogen release from the granule to minimize the effect on the environment and to maximize the growth of the plant. UFC will be broken down to ammonia and carbon dioxide in the same way as the urea by bacteria in the ground.

It is important that UFC is clear in order to prevent coloring of the white urea product. The buffer value of UFC is of less importance

compared to resin production. A UFC plant can be integrated with one for urea production if they are built on the same site. Formox has experience using liquid streams directly from the urea plant for UFC production instead of the usual dissolving of solid urea prills. Formox has also improved the UFC process to eliminate excess condensate from the plant. This is a great advantage in a fertilizer plant where there is no need for any condensate.

UFC is more than just board resin. They also ensure fertilizers with the highest nitrogen content keep plants growing.

BY



Ola Erlandsson  
Manager Technology  
Formox AB

## New technology for polyether diesel fuel creates enormous potential for formaldehyde in China.

A very interesting presentation of how to synthesize methanol into clean diesel oil was covered at the Formox formaldehyde conference in Beijing this past April. It was held by Mr. Wang, General Manager of Coreteam Engineering & Technology CO., Ltd, based in Beijing and representing this new technology. The route to synthesizing methanol into clean diesel oil is very interesting as China faces a growing dependency on importing crude oil at the same time as that country has large amounts of natural mineral coal resources. According to Mr. Wang, coal accounts for 94,3% and natural gas for 5,7% of China's petrochemical energy reserves. China is ranked second after USA in terms of total consumption of transportation

fuel and expects to grow fast as the route to synthesizing clean diesel fuel from coal. This could only help China to reduce its dependency on imported crude oil while utilizing its enormous resources of domestic coal. China would also reduce carbon monoxide emissions as well as improve fuel economy, compared to gasoline.

The product is called DMM3-8 (polymethoxy dimethyl ether) and the adding proportion could be up to 20% in petrochemicals diesel oil. Of special interest to Formox is how to accomplish the route of synthesizing DMM3-8. The process includes synthesis gas from coal to methanol as well as introducing formaldehyde over a catalytically

process synthesizing DMM3-8. According to Mr. Wang, the process has an excellent utilization rate and the potential for this product could be about 18 million MTPA, when adding 15% to China's current annual diesel demand. A first semi-pilot plant of 10,000 MTPA will be on stream this year, according to Mr. Wang, and the first full scale production of 200,000 MTPA of DMM3-8 could be on stream in just a few years. Mr. Wang's presentation led to many discussions at the Formox conference as there is a lot of interest to develop new downstream products in China. Formox has initiated a cooperation with Coreteam and will be following the application development with great interest.

BY



Lars-Olle Andersson  
Business Manager  
Formox AB



# Mo update

This update has been made somewhat later than usual, due to the delay of publishing this year's spring edition. As a result, the coverage has been extended to August. That does of course not change that the price of molybdenum (Mo) has been very much stable since the previous edition of informally speaking. At the end of last year, Mo pricing hovered just above 11 USD/lb and in January peaked at 12. Since then the price has slowly but gradually decreased, having reached a four-year low in July of USD 9.15/lb and in mid-August just above that. As reported in the previous edition, various analysts expected Mo price to stay within a 12-17 USD /lb level for an extensive period of time. However, it seems that projection might be changing, also supported by the present drop in pricing. There is a span between 9 to 15 USD/lb mentioned in various forecasts from different experts. According to the latest available information, these are the pricing levels that seem to be likely over the next two years.

Looking beyond 2015, it becomes more difficult to provide accurate Mo pricing estimates. In general, the price forecast is gloomy and

points downwards, but can be heavily influenced by decisions in China – please note that China is both the largest user and producer of Mo in the world. The reason being that unless demand would drastically change, it is believed that the present level of about 12 USD/lb will be a baseline level, since this is the cost estimated as acceptable for molybdenum mining in only molybdenum mined mines in China.

Prior to 2015, a number of copper mines will come on-stream outside of China. Since Mo is a by-product in these mines, there will be a surplus. Already now, there are signals on a movement from export to import of Mo into China. So it seems like we have a time of further lower Mo pricing ahead of us – depending on how the only molybdenum mined mines in China will be handling the situation. One possible scenario could be that Chinese companies would buy copper mines outside China in order to be able to control the availability and hence the price of Mo – but this is only a speculation.

Of course, sudden increases in demand due to market changes (incentives to buy

new cars or infrastructure projects such as in the previous crisis in 2008-2009), new legislation or import-export restrictions could drastically change Mo pricing levels. A new usage for molybdenum could also lead to a change in demand.

You can rely on Formox to maintain reasonably stable net prices regardless of possible market changes due to new usage scenarios or other impacts on the global flow of molybdenum. This is due, in part, thanks to your efforts to return spent catalyst as well as our efficient catalyst recycling system!

BY



Ronnie Ljungbäck  
Global Market Manager -  
Catalysts  
Formox AB



# METHANOL NOTES™

Tuesday, April 16, 2013

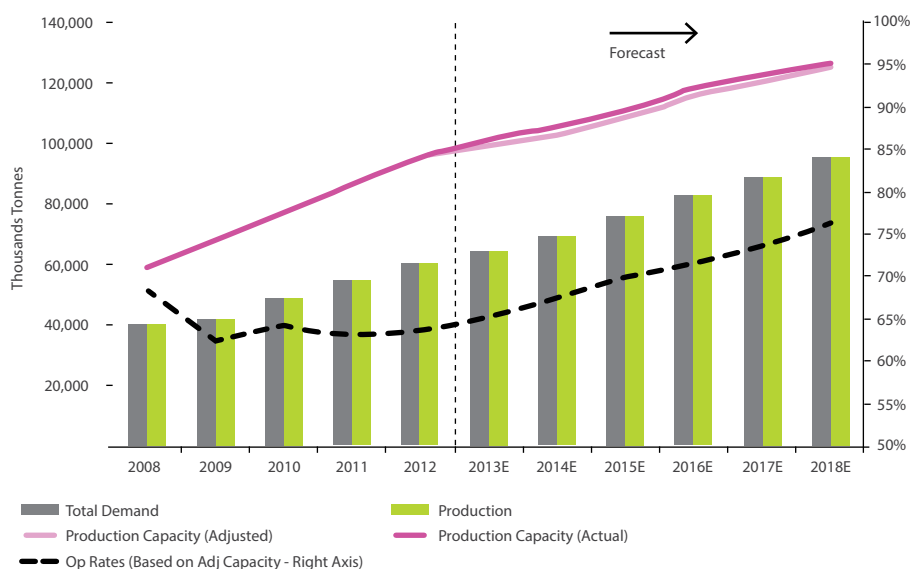
As another calendar year gets well underway, methanol demand continues to grow, despite worries about the ability of economies, particularly in Europe and in Asia, to maintain momentum. While worries are rational, due to the advantaged cost of the simple alcohol, demand will continue to grow in admirable fashion despite these possible economic constraints.

These findings are supported by findings from the major annual major review of global supply and demand balances for MMSA's upcoming 2013 Methanol and Derivatives Analysis. Updates to global methanol, acetic acid, formaldehyde, MMA, mixed methylamines, and DME supply and demand balances, along with price forecasts for methanol globally, and acetic acid in Asia, are now complete through 2030. Balances and price outlooks for the study period (2008 – 2018E) are now available to clients utilizing their login credentials. Of course, those interested in the longer term views can approach MMSA.

Some of the major changes to these updates are 1) an upward revision to methanol demand in MTO in China, as the viability of the too-many announced projects there becomes clearer 2) increased US supply of methanol from the restarts, relocations, and greenfield investments leveraged by lower natural gas feedstock perceptions in that country 3) and an India increasingly reliant (pardon the pun) on imported acetic acid, with associated ramifications for future investment and trade flows 4) on the pricing side, margins are expected to stay strong to increasing, which will be crucial as effective operating rates will remain high in the forecast. As in 2008, "western" prices have shot ahead of those in Asia, especially as Iranian product remains only available to China and India. For a variety of reasons, the spread between regions is expected to lessen in the future, although price volatility is expected to remain low given expectations for crude and refined product pricing.

Of course, this is a small sampling of the study findings. For those who are clients, please enjoy. For others, please contact MMSA to obtain a copy.

## Methanol Supply and Demand - World 2Q13 Update



## Global Methanol Pricing



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# Formaldehyde reclassified

There is an ongoing global debate focused on how to safely handle formaldehyde. With its REACH legislation (Registration, Evaluation, Authorisation and restriction of CHemicals), the European Union has taken one of the leadership role. At present, registration standards for formaldehyde is already complete and evaluation is ongoing. The next question is whether evaluation will result in a demand for authorisation and/or restrictions of chemicals related to producing, importing or selling formaldehyde or formaldehyde products in the European Union.

The REACH legislation process is handled by ECHA (European CHemicals Agency). Part of the evaluation is done by RAC (Risk Assessment Committee). This committee has released a recommendation to reclassify formaldehyde as "Muta. 2, suspected

of causing genetic effects" and "Carc.1B, presumed to have carcinogenic potential". Experience has shown that ECHA will not go against RAC recommendations and that the final reclassifications will probably affect the REACH evaluation.

Companies interacting with the European Union will have to get used to stricter legislation when REACH is fully implemented for formaldehyde. Formaldehyde will then have to be handled as if it could cause cancer, even if this theory has not been proven. It is of critical importance that different companies meet all requirements. The future of the industry depends on demonstrating that formaldehyde can indeed be handled safely throughout its entire life cycle. In all probability, REACH legislation will also affect other markets in the long run.

See more.

ECHA's formaldehyde announcement: [http://echa.europa.eu/view-article/-/journal\\_content/title/rac-adopts-seventeen-scientific-opinions](http://echa.europa.eu/view-article/-/journal_content/title/rac-adopts-seventeen-scientific-opinions)

Formacare's press release:

[http://www.formacare.org/uploads/ModuleXtender/NewsPressRelease/19/12\\_12\\_07\\_-\\_Press\\_Release\\_-\\_Formacare\\_on\\_RAC\\_opinion.pdf](http://www.formacare.org/uploads/ModuleXtender/NewsPressRelease/19/12_12_07_-_Press_Release_-_Formacare_on_RAC_opinion.pdf)

BY



Ola Erlandsson  
Manager Technology  
Formox AB

## The impact of contaminants in the methanol

How contaminants end up in methanol is obviously an intriguing question. Regardless of the answer, their presence can potentially impact the formaldehyde production.

The importance of the methanol quality was discussed in an article titled "Methanol quality" in the 2009 spring/summer issue of Informally speaking. In the article, Formox recommend using high quality methanol. However, it also clearly highlighted possibilities to use other methanol qualities, such as crude methanol, recovered methanol and lower quality of methanol. Our recommendation was to, if applicable, evaluate the non-standard type of methanol in order to determine if the methanol could be used.

The focus of this article is the limitations and impacts of using different methanol qualities. The impacts can be split up into those for:

- Environmental Health and Safety questions
- Plant related questions
- Reactions related questions

This also means we can distinguish between organic and inorganic contaminants. The presence of most organic compounds is mainly an EHS issue. In general, it is almost only when recovered or crude methanol is used that other impacts are significant. However, higher concentrations are many times feasible from an operational stand-point, which is the main reason that recovered methanol and crude methanol can be used. Typically, higher concentrations of contaminants can result in foaming

in the absorber, impact on the reactivity or product quality as well as affect the ECS. Obviously, this is taken into consideration when designing the loading plan and evaluating the possibility to use methanol. The impact of the different organic contaminants can be different. For example, water will compete with methanol for the active sites; hence water blocks the sites responsible for the conversion of methanol to formaldehyde. Many other organic contaminants will impact the temperature profiles if the conversion of those components are endotherm, meaning that heat is consumed and not generated. Certain organic contaminants might have a significant impact also

continues on next page»

at low and intermediate concentrations. This is especially true for basic compounds such as ammonia and pyridine, which will have a negative impact at elevated concentrations as they will block the active surface.

Inorganic contaminants is a different story. Even very low concentrations will have a significant impact, as methanol is a major flow into the plant. The focus of the methanol specifications is mainly on organic contamination in combination with a few inorganic elements, such as sulphur, chloride and iron and to a lesser extent on potential catalyst poisons. The only real specification would be non-volatile matter which is stated to be below 10 ppm, however even lower concentrations of the most ions will have a significant negative impact on the performance and lifetime of the catalyst. Metal-based catalysts are generally more susceptible to poisoning than metal-oxide catalysts. This is mainly due to the simple fact that metal-based catalysts have less active material. However, the impact on metal-oxide catalyst can still be significant as the contaminants generally are accumulated on the active surfaces.

The impact depends on which catalyst is used, the type of contaminant as well as whether both the activity and the selectivity have been impacted. Poisoning may be a direct effect of blocking. It might also be a secondary effect due to its influence on the electronic configuration of the active site or due to some other change in the active site. For example, if the poison were to act on sites responsible for the active site's oxygen supply, this would impact the active site. These effects might be reversible or irreversible, depending on the catalyst, poison and the mechanism. Moreover, poisoning may be selective (some sites are more susceptible to being poisoned than others, which might make it a promoter blocking non-selective sites and increasing the yield). Or non-selective, meaning that all sites have the same probability of being poisoned. Thus there is a thin line between a promoter and a poison. In general, many poisons have a positive impact at low concentrations, while the impact is negative at higher concentrations, compare with vitamins. As the level of contamination increases, the impact on the activity normally also increases. This is because the number of active sites is proportional to the number of non-poisoned

sites. However, poisons may be effective at very low levels when the poisoning is selective and the poisons adsorb on the most active sites first. This means that the decrease in activity will also be significant at lower levels of contamination. Further, it means that low levels can also have an impact. So it is difficult to estimate what can be considered as only having limited impact on the yield and lifetime as well as what will be considered as a troublesome impact.

**"The impact depends on which catalyst is used, the type of contaminant as well as whether both the activity and the selectivity have been impacted."**

The impact evidenced depends on operating conditions. In general, the impact of the poisons are more severe when the catalyst is operated at high productivity. The influence of poisons of much higher contamination might be insignificant compared to much lower contamination when operated at a high pressure or high methanol concentration.

For example, 1000-1500 ppm of sodium correspond to a monolayer if a reasonably high dispersion is assumed. This means that the entire surface is covered and the activity will be close to zero. However, the impact begins to become pronounced at much lower levels; generally concentrations in the range 200-400 ppm in the catalyst at the point of termination will start to have a significant negative impact. Lower concentrations will also have an impact, however, to a much lesser extent and can be considered as part of the normal ageing. The most common poisons are Na, Mg, Ca and K which will poison the catalyst irreversibly, basic elements such as ammonia, which with its lone pair of electrons will reversible block the active sites.

The challenge is to convert the amount of poisons found on the catalyst into concentrations in the methanol. The contaminants found in the methanol will reach the reactor. However, there might be a build up before the tubes, thus hindering all contaminants to reach the catalyst. The earlier "Methanol

quality" article indicated high levels to be possible. It did not fully cover that those high levels are only possible assuming contaminants precipitate before the reactor. Besides precipitation prior to the reactor, there are also gradients along the bed; generally the poisons will be much higher in the upper part of the bed. Assuming a normal level of precipitation prior to the reactor tube and gradients along the reactor into consideration, 0.1 ppm of sodium in the methanol, for example, will completely deactivate the catalyst in the top of the tube and the concentrations in the catalyst can reach 1000-2000 ppm, depending on time of operation of the catalyst. Which can be considerably shorter as a result of the poisoning. Hence the level of contaminants that will irreversibly poison the catalyst must be kept on a ppb level if they are suspected to pass the vaporizer and reactor dome without precipitating.

When the contaminants reach the reactor the effects of poisoning are usually rather severe. The yield might be significantly lower and problems with high methanol in the product are usually apparent. Furthermore, lower activity generally has to be compensated for by an increased HTF temperature. In addition high reactor outlet temperatures usually tend to be a problem. Based on operational performance, impacts can include a considerably shorter lifetime or severe problems, especially if there is only a narrow window for reloading. In addition, if high levels are evidenced and precipitation occurs, other impacts include potential scaling in the vaporizer and piping; this can result in pressure drop and constitute a fire hazard, depending on the contaminants.

The conclusion is that many different qualities of methanol can be used. However, methanol type should be considered in the design of the loading plan and it should also be verified that there are no inorganic contaminants present. Finally, prior to considering using any off-spec methanol, turn to Formox for assistance in the evaluation process.

BY



Johan Holmberg  
Catalyst Application Specialist  
Formox AB



# Make your non-routine work safe!

A well-maintained, regularly inspected Formox formaldehyde and UFC plant is a safe workplace equipped with a trip system to protect people and the environment as well as to prevent damage to the plant itself. But the trip system only protects the plant when it is in normal operations. For non-routine operations, such as maintenance, protection provided by the trip system has to be replaced with procedures and routines to maintain safety.

For continuous processes, the probability of a hazardous condition occurring is proportionately greater during operational start-up/shutdown as well as maintenance intervals. Around 70% of all major accidents occur during non-routine operations, even though plants only typically remain in that operational condition 5% of the year or less.

We want to increase safety awareness during non-routine operations and share insights about how to handle situations that can occur. Maintenance can either be for planned routine interventions, scheduled shutdowns or unscheduled repairs.

At the minimum, we recommend plants establish routines for communicating work to be done on site and, preferably, also establish rules for operating and enforcing a work permit system.

A work permit system should comprise, but not be limited to, the following:

- A risk assessment of the specific task
- By-passing safety systems procedure
- Lockout/Tagout procedure
- Hot-work permit
- Confined space entry permit
- Checklist of mandatory safety equipment

Non-routine jobs not described in standard operating procedures must be reviewed for job hazards. Appropriate precautions must be taken for those involved.

Shutdowns need to be addressed because hazardous process chemicals are still present in storage tanks, vessels and pipelines

even when the production process is not running and some of the equipment may have been emptied or cleaned. The organization carrying out maintenance during a shutdown is typically much different from that working during normal plant operations and, for the most part, tasks to be performed by the plant's own personnel during shutdowns are different to those for normal routine production.

A management procedure should be put in place to make sure that operators and foremen are fully aware of how to make the plant – or a part of it – safe prior to maintenance work and how to constantly maintain this level of safety throughout shutdowns and start-ups.

Routine maintenance work in a formaldehyde plant involves reloading of catalyst and absorber cleaning. Therefore, we strongly recommend you to incorporate this kind of routine maintenance into the plant's standard operating procedures.

Entering confined space is a major hazard when performing maintenance. The atmosphere in a confined space may be extremely hazardous because of the lack of natural air movement. The risks to serious accidents occurring are reduced by having a vessel/confined space entry permit procedure in place.

To evaluate that a space is safe to enter, we recommended using a checklist with items to control, such as: identifying the hazards and assess the risks, evaluate the ventilation, check and evaluate gas measurements, evaluate the need for isolation etc.

Some of the safety precautions that are in place during normal operation will have to be removed during non-routine operations and maintenance. One example is catalyst reloading with a loading machine that is not Ex-classified. The conditions in the plant must then be changed so that the Ex-classification can be temporarily removed. Formox recommends the following workflow procedure for this task:

1. Reduce the HTF temperature below the



A portable gas detector with correct sensors can be used both to detect combustible gases and ensure enough oxygen.

flashpoint of 112°C in all parts of the system

2. Depressurize the methanol pipe system
3. Check the atmosphere inside and outside the reactor with a portable gas meter

The loading machine can then be used safely when the actions have been documented and a permit has been issued. The entry permit will ensure that the working environment is acceptable for the loading to commence, which among other things means that ventilation over the reactor is in place (if not an open reactor) to ensure enough oxygen and that the temperature inside the reactor (if kept) is acceptable.

These are some of the ways to make your non-routine work safe and increase awareness of the need for safety during non-routine operations.

BY



Anna Wemby Björk  
Process Group Manager  
Formox AB

# Three decades of friendship



During a recent interview, Bob Crichton recounted his long history with Formox, which we in turn would like to share with the readers of informally speaking.

## How far back does your history with Formox actually go?

My first visit to Perstorp was in 1979, but it wasn't until a few years later that I started my own consulting firm and began working with Formox technology more closely, then via Adaibra in Barcelona. It was through Adaibra's first project in the 'English speaking' world, Kronospan in Wales, that I came into contact with Max Henning for the first time.

## Max spoke very fondly of your travels together when he retired in 2002. What recollections do you have from that period?

Max and I were 'partners in crime' for 20 years, so there are so many memories, especially after 1992 when Formox began to develop the detailed engineering in house. The idea was to engineer and sell a limited range of standard plants, and the process design was also revised to make it more competitive.

Up until then Formox had mostly been selling the right to use the technology. Selling a complete plant required a lot more, including new marketing material and new proposal

documentation. But it was not long before Max and I were back on the road selling our new product. And it did not take long. We sold the first plant in August 1992.

## What happened after that?

Business boomed! Max and I sold another plant later that year, three more in 1993, four in '94, and in 1995 we sold seven! New markets were developed and the business continued to grow – almost faster than the business structure could be developed! But gradually over time the pieces were put in place. Each general manager and many other people too numerous to mention contributed to developing the professional group we see today – the world leader in formaldehyde technology.

## And what happens next?

Now, 34 years on from that first contact with Formox, the ownership of the business is changing and Formox is entering yet another phase in the development of the Formox story. It seems an appropriate time to bow out and move on. Doubtless I will remain in contact with my many friends in Formox and around the world, and Max and I will continue to share reminiscences of our globetrotting days.

Bob can be contacted at [r.crichton@ntlworld.com](mailto:r.crichton@ntlworld.com)

## Thank you Bob!

In business, just as in life, many people come and go. Some become associated with a company for a short while, others long enough to earn a special place in the annals of a company's storied success. Bob Crichton is undeniably of the latter category.

After more than 30 years of close collaboration with Formox, the man who once traveled the globe together with the legendary Max Henning, is now moving on as

the company enters a new era. Long time colleagues, and many customers too, know how instrumental Bob has been in the development of our business over the years. It is for his contributions, efforts and friendship that we will always hold him in the highest esteem. So here's to you, Bob! Please know that you have our heartfelt thanks and best wishes as you embark on your new endeavors.

**Mårten Olausson, General Manager**

# How to use the hotspot temperatures in the reactor

If your plant is equipped with thermocouples (TCs) or multitubes for measuring the reaction temperatures in the catalyst layer(s), it is a very good tool for monitoring what is going on inside the reactor tubes. Whether fixed or moveable, these devices will provide valuable information about temperatures in the tubes where you have the measuring points. The locations of the actual measuring points is very important information for both you and us. This is why we always need to determine these locations – preferably in the loading plan design phase when discussing the new load with you, but at the latest until the start-up of a catalyst load – in order to be able to judge how the hotspot profile should look like in the particular reactor. This is especially important if you have multiple reactors – and if those (reaction temperatures) would be different, since operators or managers monitoring the different reactors might think that the conditions should be the same in all reactors.

There are differences in lengths and diameters of the thermocouple and multitubes. Furthermore, the distribution of the thermocouple can vary – from even distribution of the thermocouples along the tube to more densely present in the pure layer. This is all relevant information for us, especially if we want to compare with other loads. If the diameters are different, for instance, there will be differences in temperatures and pattern shown. In some cases, we have found this out a lot later than we would have liked to since it was not seen as relevant information from the beginning. But it really is!

In general if a multitube has a larger diameter, the highest temperatures measured will be higher compared to a smaller diameter multitube. This normally leads to an indication of a lower temperature than expected in the mixture, but a higher in the pure layer. In order to get the desired flatter hotspot profile, an easy solution would be to just increase the HTF temperature. However, the temperature in the mixture in the tubes without multitubes is actually higher and the temperature in the pure lower. Not knowing that the diameter difference causes this influence, the catalyst in the mixture can be operated at an

undesirable (too high) temperature. So the size of the multitubes matters!

The hotspots are particularly useful when starting up a catalyst load and when making changes in the process related to the production rate. As a general rule of thumb, average hotspot temperatures are normally 30 – 100 °C higher than HTF temperatures, depending on the productivity (methanol inlet, gas velocity and system pressure) of the reactor.

When increasing the MeOH inlet or the HTF temperature, the hotspot temperature will usually increase and the position will move up. A reduction in MeOH inlet or HTF temperature will have the opposite effect. The hotspot temperature and position will also increase and move up if the process gas flow is reduced and the MeOH inlet is maintained. The opposite will happen if the process gas flow is increased.

The hotspot position, in general, then moves slowly downwards in the tubes over the catalyst's lifetime even if the HTF temperature is properly increased on a regular basis.

With our introduction of CAP loading plans (CAP 1, CAP 2.0 and CAP 3.0) it has become even more important to monitor the whole hotspot matrix – and not only look at the (calculated) average hotspot temperature and position. In the second half of the lifetime of a catalyst load, the hotspots' average position and temperatures can drastically change and increase. Normally the change is due to one or a few high hotspots moving up to the upper part of the tubes. This can be due to one or more of the following reasons:

- 1) A TC or multitube containing ageing and disintegrating catalyst
- 2) HTF level in the reactor being too low – or insufficient heat removal
- 3) An uneven distribution of MeOH over the reactor
- 4) Too slow of an increase in the HTF temperature earlier during the catalyst run

Ageing of the catalyst is the most common reason. The catalyst in the tubes with multitubes age more rapidly due to the

presence of the multitube and containing slightly less catalyst. When comparing the catalyst inside tubes with multitubes and the surrounding tubes, the catalyst is more aged in the multitube containing tubes. Therefore, the temperatures seen in these multitubes can be very high – even greater than 450°C. In most cases, they are not representative for the whole of the reactor, only for the tube with the multitube in question – and this is due to the presence of the TC or multitube inside the tube. This means that the information provided from the hotspots is more tricky to interpret and less accurate compared to before when the catalyst has passed half of its lifetime, and thus should be observed and treated accordingly. High hotspot temperatures can be treated in different ways and are dependent upon the design of the plant, hotspot logic and safety philosophy. I will mention a few words on the logic.

For a few years now Formox has improved upon its earlier hotspot logic, allowing for more hotspot temperatures to reach higher values as well as also evaluating patterns in order to avoid loss of plant productivity based on one or a few single temperatures in the reactor. As long as operating at high temperatures will not have any negative impact on plant equipment or safety, there is no reason to lower the productivity of the plant. Other means to determine this could be to use the reactor outlet temperature versus the HTF temperature, which would show a general change of reaction zone. Together with values from yield, CO or GC measurements, it could be confirmed that the high temperature should not be regarded as a widespread phenomenon, but rather one restricted to one tube out of thousands.

Please contact your Formox representative for advice on how you can use hotspot temperatures in your plant to maintain high plant availability.

BY



Ronnie Ljungbäck  
Global Market Manager -  
Catalysts  
Formox AB



# ECS catalyst development

## – past, present and future

It may seem obvious that better performance — in terms of higher productivity, lower production costs and more reliable operations — are driving forces behind the development of the iron-molybdenum oxide catalyst. But what about catalysts used in the Emission Control System (ECS)? Which forces affect its development? Is there a need for development? If so, what kind and why? In this article I provide an overview of factors that have driven past developments and those currently driving the development of Formox total oxidation catalysts.

The ECS story begins in the early 1980s. As a result of an increasing focus on environmental awareness during that decade, Formox began providing ECS units to our plants. Besides converting process by-products plus the slip of methanol and formaldehyde from the absorber, the ECS also improves the overall economics. One brilliant side-effect when operating the process with an ECS is that stored chemical energy is released as residual gases are converted into carbon dioxide and water, which creates more steam and thereby lowers Direct Variable Cost (DVC). Ever since the first ECS was installed, Formox has provided catalysts for converting carbon monoxide (CO) and volatile organic compounds (VOCs), mainly using spherically-shaped platinum based catalysts. Our main product today is now called PPt-47 and was developed by Formox

“Therefore, to be able to reach the full potential of your formaldehyde reactor and plant, it may be necessary for you to cool or modify the operating conditions of the ECS reactor.”

several years ago. Its shape, size, active surface area and metal loading was specially adapted to the components and reaction conditions present in the ECS reactor used in a formaldehyde plant. Its 30-year track record proves that this catalyst has been a huge suc-

cess and even today remains the best choice for most of Formox customers!

However, new problems — or as we say “demanding challenges” — have emerged in more recent times. One such current challenge is how to tackle higher temperatures that occur due to higher concentrations of COs and VOCs that are now entering emission control systems as a result of increasing productivity in Formox plants. Therefore, to be able to reach the full potential of your formaldehyde reactor and plant, it may be necessary for you to cool or modify the operating conditions of the ECS reactor. So, how can you accomplish that? While there are a few options to consider, as long as the cooling demand is moderate, the most attractive choice is to use a low-temperature active catalyst in the inlet zone of the reactor. This enables you to decrease the inlet temperature, which allows for a higher delta temperature. This is why Formox developed such a catalyst — called PPd-47 — and launched it at the Formaldehyde Americas seminar in San Francisco back in 2011. The PPd-47 catalyst looks very similar to the PPt-47 catalyst. However, the catalytically active component in the PPd-47 is palladium oxide (PdO) instead of platinum (Pt), which results in totally different catalytic properties at low temperatures as CO is a considerably weaker bond to the PdO than are the metal clusters of the Pt, thereby making them accessible for reaction. As a consequence, the light-off temperature when using the PPd-47 catalyst in the inlet zone is some 40°C lower than when the PPt-47 is used.

That covers the early and relatively new history of ECS development. But which challenges lay ahead of us? As in the past, even tomorrow's formaldehyde producers will strive to reach higher productivity per unit of steel or plant volume. And as we continue to further push the limits, the amounts of residue gas that enters the ECS and the product distribution of the stream will be affected. So a very likely scenario is that more dimethyl ether will be formed, which will increase the temperature rise over the catalytic bed since stored chemical energy in DME is conside-

rably higher than in CO. This will definitely increase the need for catalysts that enable operations at ever lower inlet temperatures.

How to reduce the pressure drop over the catalytic bed is another challenge gaining more attention. Today, with our proven turbo-charger concept, it is now also possible to recover the kinetic (pressure) energy of the

“We are confident that we will succeed in developing new products that - as always - are tailor-made for the Formox process.”

gas that exits the ECS. This dramatically reduces the electricity consumption in plants and more or less results in cost-less pressurization of the plant (see Informally Speaking spring/summer 2012). However, as a result of the relatively high pressure drop that is obtained over the catalytic bed of the ECS reactor today, a large fraction of the kinetic energy is lost before entering the turbine. In these cases, using catalysts that can give a lower pressure drop certainly makes sense.

As you can see, there is certainly a need for further development of ECS catalysts and we are confident that we will succeed in developing new products that - as always - are tailor-made for the Formox process. One reason for our confidence is the strengthening of our development team with new skilled colleagues from Johnson Matthey, which adds competence in new areas. New ECS catalyst development work has already started and we continue on with great enthusiasm in order to obtain the best solutions for you. So keep your eyes open for new catalyst system improvements.

BY



Robert Häggblad  
Associate Specialist  
Formox AB

# How to make the most money from your spent

Although the price of molybdenum has decreased since 2008, it still makes sense both to repurchase and recycle spent catalyst after usage as well as to produce new catalyst based on the recovered molybdenum. The aim is to keep a relatively stable part of the catalyst produced based on recovered molybdenum. Of course, this requires a certain inflow of spent catalyst. Inflow (quality levels, yield, cycle rates) varies because the time for reloadings globally is not evenly distributed and the time for returning spent catalyst after reloading is not the same at every customer site. Over the last few years we have experienced more difficulties in receiving spent catalyst due to updating of legislation and rules regarding handling and transportation of waste in various countries – although we do not see it really as waste; it is a valuable raw material to us.

Which, of course, also benefits you: we pay you for spent catalyst based on the molybdenum we are able to recover. Either in the form of direct payment or issuing a credit invoice which is balanced against future purchasing. We purchase both spent KH/iron-molybdenum catalyst as well as spent PPt-47/PPd-47 catalyst. However, please do not mix the types when you return your spent catalyst. Another benefit is that when we receive your spent catalyst - including the ceramic rings – we take care of your “waste” in an environmentally safe and responsible

manner. And we separate and clean your ceramic rings for a minimal fee.

However, we do not want to receive any waste other than your spent catalyst – you should take care of any other waste or garbage locally and not send it to us. Of course, we do not want to receive pens, screws, bolts, gloves, cigarettes or similar waste items in the drums with the spent catalyst. This also means that we do not want to receive any drums containing HTF or paraformaldehyde, this must be handled on your site. If you have had a leakage of HTF oil, in the reactor and thus have contaminated the catalyst, we can still take care of the spent catalyst. But in such instances, please inform of prior to shipping so that we can prepare to separate out these drums containing HTF contaminated catalyst and not pollute the air and water in the catalyst recycling facilities.

We accept spent catalyst either in drums or in big bags, lined and UV-resistant. While we prefer big bags, it is of greater importance that your spent catalyst has been protected from rain. This is because when the catalyst comes in contact with rain, it will start to fuse together and can form large cake lumps - which are very difficult, if not impossible, to handle. These lumps will we then not be able to treat in our process – which results in a loss of recovered molybdenum for us as well as lost compensation for you. Furthermore, in regards to packaging, big bags

should have self-emptying spouts in the bottom for easy emptying and not be filled to contain more than one ton, which is our maximum lifting weight. For drums, please ensure that the lids are tightly secured and that they are securely placed on pallets. Big-bags should of course also be securely placed on pallets. We have a few times received drums just stuffed in containers, not being put on any pallets, which will delay and increase our costs for the recovery. Another very important aspect is to ensure you properly tighten drums on the pallets. Opening of containers, sometimes the drums have not been securely tightened, which has resulted in a few incidents at our catalyst plant that have caused minor accidents and milder personal injury. Again: please make sure that your drums are secure before closing the container.

The advice given in this article is for the best of all parties. You will gain the most compensation for your spent catalyst by enabling safe and efficient handling of it during your unloading and temporary storage. We achieve smoother operations of the recycling unit at the catalyst plant. And this maximizes the output of molybdenum from the spent KH/iron-molybdenum catalyst.

BY



Ronnie Ljungbäck  
Global Market Manager -  
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Formox AB

## Training, training & training



At the seminar Formaldehyde China 2013, the last afternoon was dedicated to in-depth technical training focusing on the Formox catalysts, catalyst and plant performance as well as absorber operation.



A full day of training at the Formaldehyde São Paulo 2013 was attended by most of the participants.



A group of engineers from Shaanxi BDO Chemical Industry Co., Ltd., China, was in Perstorp a sunny and cold week in January for training for their second Formox plant.

## Projects & start-ups

### New Projects

- Xinjiang Markor Chemical Industry Co., Ltd. has signed up for a third plant (a Formox FT3) to be built in Korla, China.
- Xinjiang Tianzhi Chengye Chemical Industrial Co., Ltd (part of Xinjiang Tianye Group) has signed up for two FT3 plants being built in Shihezi City, China.

### Ongoing projects

- Works on a FT3 plant to be supplied to a client in China is in the design phase.
- The FS2 UFC project for Campact UK (a subsidiary of Egger) in progress.
- The FS3 plant for ISP Marl GmbH (a affiliate of Ashland Inc.), Germany is in the shipping phase.
- The project with a new FS1 UFC plant to a client in the Middle East is in the shipping phase.

- The FT2 plant to be supplied in the Middle East is near the shipping phase.
- The supply of an upgraded reactor to a client in South America is in the shipping phase.
- The project with two FT3 for CHONGQING CHANGFENG CHEMICAL INDUSTRY Co., Ltd, Chongqing, China, is approaching start of construction.
- The new FT3 plant to be supplied to Yantai Wanhua Polyurethane Co. Ltd., China has started the construction phase.
- Works on two Formox plants (FS3 + FT3) for Polyplastics Asia Pacific SDN. BHD, Malaysia, progressing with construction.
- The second FS3 plant for Henan Coal & Chemical Industry Fine-Chemical Co., Ltd., Hebi, China, is in the construction phase.

- The FT3 plant for Shaanxi BDO Chemical Industry Co., Ltd., China, is in the construction phase. This will be their second Formox plant.
- Works on the FS3 plant for Tangshan Zhonghao Chemical Co., Ltd., China, is in the construction phase.

### Start-ups

- A new FS3 plant located in Asia, went on stream in July.
- A new UFC plant being supplied to an existing customer in the Middle East has been successfully started.
- The project for an FT3 plant for Xinjiang Markor Chemical Industry Co., Ltd. in Korla, China, went on stream in November. This is their second Formox plant on this site.

## new...



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We are glad to have had Daniella, Christian, Mikael, Martina and Tommy as our colleagues and wish them the best of luck in their coming challenges.

### A formaldehyde magazine from Formox

The newsletter informally speaking aims to provide information about formaldehyde in an informal forum and is published twice annually by Formox 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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