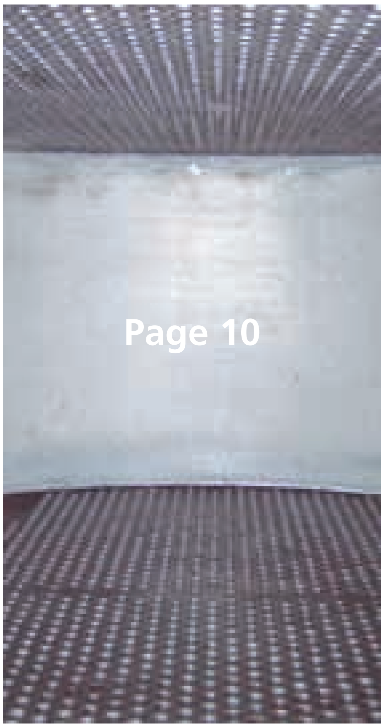
informally speaking

THE FORMALDEHYDE NEWSLETTER FROM FORMOX autumn/winter 2009

Introducing CAP 2.0!



Clean up & run right!

FormaCare, MeOH and much, much more…

Time to get ready…

Winter is rapidly approaching, which means cold and darkness in Sweden. Thankfully, not everything is as dark as a Swedish winter; every day there are more signs that the global financial crisis is abating. Although some bumpy road may still be ahead of us, I think it's clear that we're entering this winter with signs of an economic spring shooting up everywhere.

What better time to start preparing for a stronger, brighter future? And in terms of your formaldehyde production, to assure that your plant is in top shape for what lies ahead? As usual, informally speaking contains useful advice on things you can do to assure optimal operation. For example, I recommend you to read about our new loading plan – CAP 2.0 – which is designed to further improve your DVC and may also enable you to increase your production rate. Now could also be a good time to review your routines and procedures for cleaning during a reloading standstill. Sometimes some relatively simple measures can save you a lot of money!

Another bright spot ahead is Bali – the Formaldehyde Asia 2010 conference – and we hope you're not going to miss it! They say that "third time's the charm," and this is the third time we've planned a seminar on Bali, only to have to relocate the first two. Now it looks like we'll make it, and we hope you will too, as you can expect to gain access to a lot of information that will enable you to strengthen your position in a growing market. Even though you can read interesting articles in this newsletter and elsewhere, nothing quite takes the place of face-to-face – the chance to discuss questions and problems (and not only with Formox people, but with other formaldehyde producers like you). Read more on the back cover – then meet me on Bali!

Marie

Marie Grönborg
General Manager
Formox AB

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Introducing CAP 2.0!

by Ronnie Ljungbäck

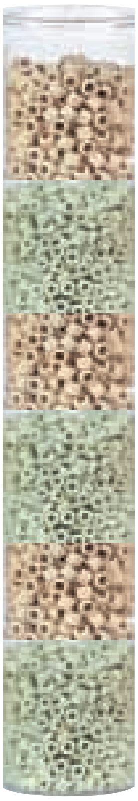
Customers frequently ask us about our catalyst development; like us, they are impatient to get their hands on the latest catalysts and loading plans. Unfortunately we both sometimes need to be patient; even though this type of work is going on constantly in our offices, labs, catalyst plant and reactor systems in Sweden, it can take a long time to take a new concept through our rigorous testing program. But now we do have something new. Now we have CAP 2.0!

Great expectations

CAP (catalyst activity profile) was a major advance; it built on our long experience with mixed catalysts. With CAP we aimed for a continuous gradation of activity along the tube, i.e. an activity profile – hence the name. The objective was to spread the heat load along the tube, reducing the temperature peaks and flattening the profile. And the original CAP was a step in that direction. We said that it would enable higher capacity in your existing plants with only minor modifications, and that turned out to be true. In many cases it also gave an improvement in yield. As if this was not enough, we have subsequently shown that it also could be operated at lower capacities without suffering in terms of performance. The new CAP 2.0 takes this process one stage further and uses more layers with different activities. Depending on the tube length, it is possible to decrease the reaction temperature substantially.

The idea of using more catalyst layers is in itself not new and has been tested before. For example, we have been using the clean-up concept, i.e. a layer of more active catalyst in the bottom of the reactor tubes, instead of using an adiabatic bed. However, the target then was to reduce the residual MeOH; the objective now is to use the same principle to take CAP technology even closer to the ultimate aim of evenly spreading the heat load.

With CAP 2.0, the main improvement appears to be in the form of lower power consumption, but thanks to better control of the reaction temperature, we are also expecting and still exploring the original idea of being able to operate at even higher MeOH inlets – and we may even be able to improve the yield slightly in some cases.



The expected advantages are thus:

- Decreased total loading height, which together with lower reaction temperatures gives a lower pressure drop and especially less pressure drop development.
- Possible higher production rates in the future. We are currently investigating what the impact on the lifetime will be.
- Increased control over the reaction rates, which promotes a longer catalyst lifetime.

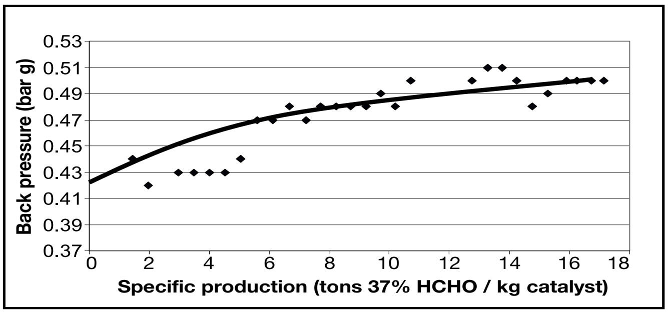
Note that there is the same possibility to vary the reaction conditions as with previous High Inlet CAP loads.

Since CAP 2.0 means yet another layer to be loaded in the reactor tubes, careful loading is more important than ever. In order to be able to continue providing you the same accurate loading service that many of you rely on, we have built new loading machines to handle the new loading plans and assure that the procedure will be as smooth as before.

CAP 2.0 in practice

The basic idea behind the concept of increasing control over the reaction rates is that it will result in extended lifetimes and thereby increase the ability to maintain a high production rate for a long period of time, without having to decrease the feed rate of methanol (often experienced as the load ages). It should also open up possibilities for further increasing the methanol inlet. When consecutive mixed layers with different catalytic properties are used, there is also a moderating effect on catalyst ageing, reducing the need for HTF adjustments. The effect is expected to prolong the period of normal operation. This has already been verified in practice; the loads that have been in operation so far have reached the expected specific production targets without having to decrease the production rates.

All loads tested in our reactors in Sweden so far have resulted in lower pressure drop and slower development of the pressure drop, with reduced power costs as a result. The initial increase is a result of the molybdenum subliming from the top of the load, while the increase during the later part of the load is primarily due to the disintegration of the catalyst rings. A modest pressure-drop development, as shown in the graph, confirms that the disintegration rate is relatively slow. The specific load indicates an increase in the back pressure of only around 0.03 bar between a specific production of 6 and 17. (For the uninitiated reader, specific production means tons of 37 wt% formaldehyde produced per kg loaded catalyst.) The increased back pressure at a specific production of around 6 is due to an increase in the methanol feed from 9.9-10.0 vol% to 10.2-10.3 vol%. As mentioned earlier in the text, increased control opens up possibilities for higher methanol inlet. Unfortunately, however, we have not been able to take this step up to an even higher methanol inlet – yet. Maybe that will be our next big breaking news – CAP 3.0?!



What it means for you

Are you operating CAP at a high (~10 vol%) methanol inlet? Whether you are or not, if you want to improve the performance of your plant, it's now time to ask for the next generation – CAP 2.0. We will be happy to help you find the type of loading plan that best suits your plant and operating conditions. And we can offer you our fast and consistent loading service with our new 5-layer loading machines, assuring that you and our new CAP 2.0 get the most out of your plant!

Name changes

For many, many years we have been in the (bad) habit of calling the Formox iron-molybdenum catalyst a "formaldehyde catalyst". As several customers have pointed out, the catalyst contains no formaldehyde – despite its magical powers to transform methanol into said molecule. And given the concerns (often exaggerated; see the FormaCare article, page 7) with which some people respond to the word "formaldehyde", there seems little point in continuing to use that misnomer. As from now, we will refer to our iron-molybdenum catalysts as, for example:

Formox™ KH-26 catalyst

and corresponding wording for the other catalysts in the Formox KH family. The same applies to our platinum-based catalyst for elimination of VOCs, henceforth under the name

Formox™ PPt-47 catalyst

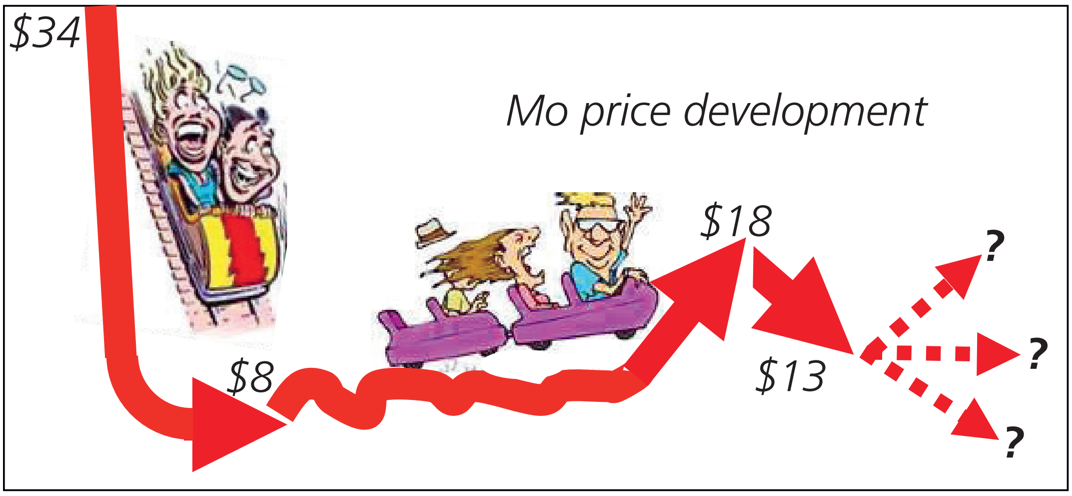
Old labels are being phased out. There is reason to believe that in some countries, the name change will have the added benefit of facilitating customs procedures….

CONTAINS NO FORMALDEHYDE!

Mo UPDATE

Due to the economic downturn, starting in second half of 2008, we saw a drop in Mo price starting in October 2008. During this year, the Mo price has been relatively stable, despite other raw materials having behaved more buoyantly. We wrote in the previous issue of informally speaking that the analysts believed that we would see Mo prices in the range of US$ 10-20/lb during 2009. Looking from June, so far they seem to have been right, having risen from $7.70/lb in May and peaking at $18/lb in August, followed by a slow drop back to $13/lb in mid-October.

Depending on which analysts and "fortune tellers" you listen to, we have either reached a plateau or will see further drops in pricing; or an even more buoyant situation again next year, when Mo will be listed on the London Metal Exchange (LME). In other words, no one can tell for sure what the future has in store for us, but you can be sure that we will maintain reasonably stable net prices, thanks to you returning spent catalyst and thanks to our catalyst recycling system!



informally speaking as pdf files!

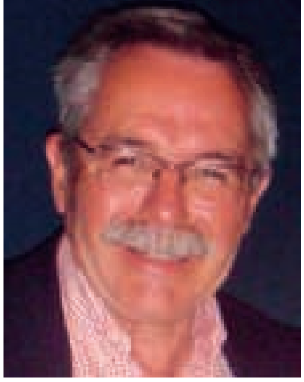
Did you know that all back issues of ***informally speaking*** are available as pdf-files on our website (formox.com)?
Just click on "NEWS" and "**informally speaking**" and you'll find the complete list. The most recent issue is available about a month after the hard copies are distributed.

By the way, Formox customers might want to check out our new, easier-to-navigate CUSTOMER CENTER on the upgraded website.

Another history lesson

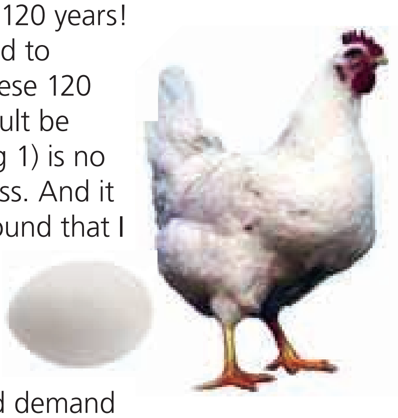
or MeOH & HCHO: a Chicken & Egg Story

by Bob Crichton



As remarked many times in these pages, 2009 has been a significant year for Formox (50th anniversary and all…). However, we somehow overlooked the fact that 2009 marks 150 years since Butlerov first identified formaldehyde. The latter event took place in 1859, though it would be another 8 years before formaldehyde was synthesized by Hoffman. Even then the first commercial plant (near Hannover, Germany) was not built until 1889 – another anniversary, this time 120 years!

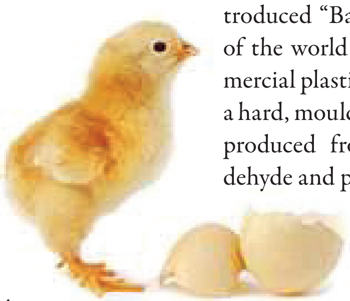
So what has happened to formaldehyde over these 120 years? Well, it is difficult be precise; the graph (Fig 1) is no more than a best guess. And it is against this background that I would like to tell the story referred to in the title. Just like the chicken and the egg, which came first – did demand for formaldehyde drive methanol or did methanol availability drive formaldehyde?



Regular readers of ***informally speaking*** probably think they know the answer, as a recent edition contained the bold assertion that the panel industry as we know it today would not have existed without the introduction of "synthetic" methanol in the 1920s. However, it is not quite that simple, as we shall see; so let's go back 120 years and look at the way formaldehyde demand has developed.

In the very early days, the product found application as a disinfectant and in the hardening of gelatin films in the photographic industry. Paraformaldehyde and hexamine were also marketed. Though polyoxymethylene (POM) was known, it was to be another 60 years before this developed as a commercial product. Perhaps just as well; at this time the global formaldehyde capacity was only 190 MTPA (37% basis)!

In 1901 Hoechst patented the use of formaldehyde in the manufacture of phenyl glycine (an indigo intermediate); this markedly increased demand. And in 1909 the market received another stimulus when Baekeland introduced "Bakelite", one of the world's first commercial plastics. This was a hard, mouldable plastic produced from formaldehyde and phenol.



It is now 1910, but we are barely on the graph (Fig 2). The main reason is a shortage of methanol, which in these early days (indeed since the time of the Pharaohs) was obtained as a by-product of wood carbonization. Synthetic methanol from mixtures of carbon monoxide and hydrogen derived from coal (synthesis gas) did not appear until 1926.

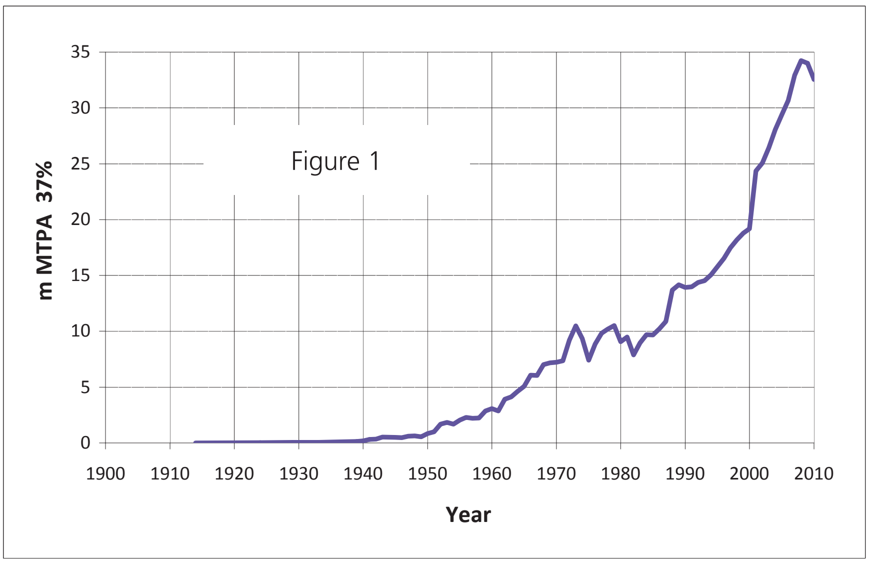
UF resins developed strongly about the same time; which begs the question: Why did it take so long? The basic chemistry, not so much different from PF, had been known for many years. The answer is again availability of raw materials – not only was methanol in short supply but also urea. Whereas phenols were available as by-products from coal gas and coke plants, urea was not; a commercial urea process had to wait first for the Haber-Bosch ammonia process (1913) and then the Bosch-Meiser urea process (1922). When both materials became commercially available, UF resins became viable and soon after (1930) made their first appearance as a plywood adhesive, replacing protein-based resins such as those based on casein. As remarked in a previous article, their ready acceptance was based on superior performance, not lower cost. And this class of product was to go on to consume around half of all the formaldehyde produced in the world.

The 30s also saw the first "oxide" or lean-phase oxidation patents. As the curve starts to rise through the 40s, another sad truth emerges: war drives demand, in this case for explosives derived from hexamine and pentaerythritol. However, the war also produced particleboard, a response to wood shortages in Europe. This product, along with the newer composite boards, such as MDF and OSB, is still driving the formaldehyde industry today.

So let's recap with this zoomed view (Fig 2) of the first sixty years:

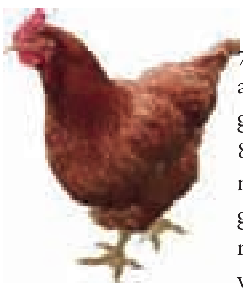
- Negligible rise over the first 15 years, limited by methanol availability:
- Faster growth as synthetic methanol and urea become available, leading to new uses (plywood resins):
- "Explosive" growth through the 1940s.

The graph also shows the post-war slump before growth resumed in the more prosperous 50s.



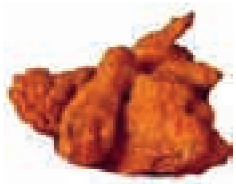
This takes us to 1959 (Fig 3) and the first appearance of a commercial "oxide" or "lean-phase" process. Though commercialized by Perstorp, this process was pioneered by Reichhold in the United States. But why should this process suddenly burst on the scene, given that the chemistry had been known since the 1930s? To find the answer, we need to look at the politics. At this time, oil (the synthesis gas feedstock of choice) was relatively expensive in the USA. To protect high-cost US producers, lower-cost Middle East oil was simply not available. This in turn made methanol expensive and high-yielding processes even more attractive. In addition, power was relatively cheap; it mattered not that the lean-phase process had to push a larger volume of gas around the system. *[Editor's Note: In today's Formox process, the gas rate is much reduced – and the power consumption much less.]*

In the 1960s, steam reforming, combined with improved methanol technology, revolutionized the methanol supply side and fuelled a steep growth in consumption through to the early 70s. This was driven not only by the composite board industry but by the emergence of new types of plastics such as POM and polyurethanes. UF and PF products, particularly moulding compounds, came under severe pressure from the newer materials introduced over this period and never really recovered.

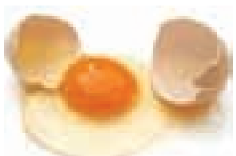


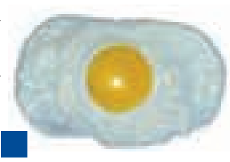
And formaldehyde hardly moved during the 70s – losses matched gains during this lost decade. But all this was to change with the emergence of "mega" methanol plants through the 80s and 90s. And it is significant that though energy prices were in turmoil, methanol, by comparison, was relatively stable. The key here was the availability of gas distant from the premium fuel market – so-called "stranded gas". For such locations, the option to convert to methanol and ship was, at least at that time, less expensive than liquefying and transporting the gas in refrigerated vessels. As a consequence, the methanol price was relatively steady for many years, low enough to promote demand and boost not only the emerging panel industry but the chemical industry, where such formaldehyde-derived products as MDI, Butane 1,4-Diol and POM were growing fast. And with very few exceptions, most notably 1989/90 and the last few years, growth was rapid – with China being the main contributor over recent years.

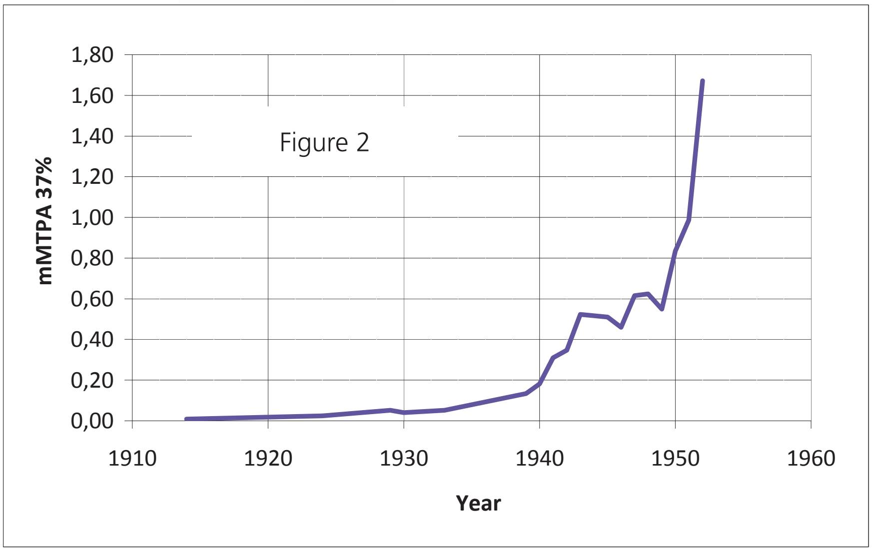
The moral of the story is clear, without the availability of cheap raw materials, and in particular low-cost methanol, formaldehyde would not have developed to the extent that it has.

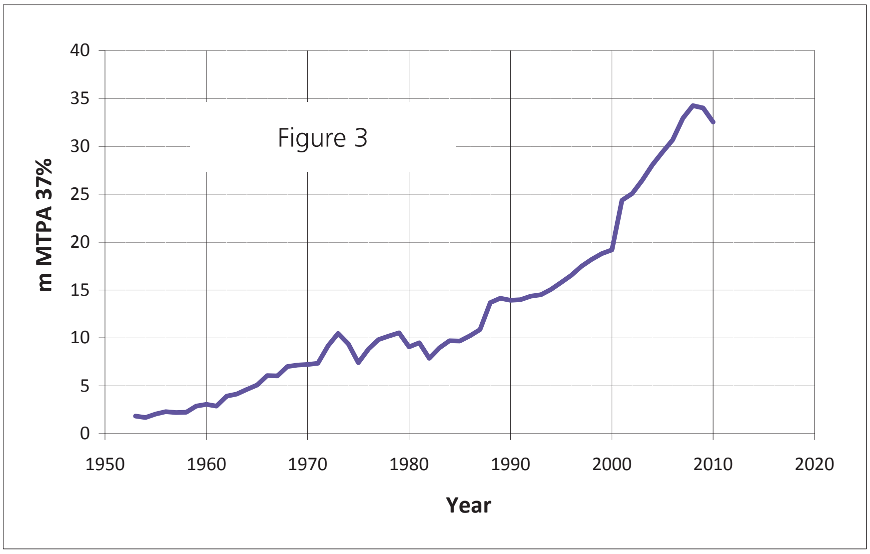


So what about the future? With energy prices reaching the point where liquefaction is (almost) competitive with conversion to methanol, the gas that made low-cost methanol possible is no longer quite so stranded; the price at the point of extraction is rising and the price of methanol is trending up. So with more expensive methanol a real possibility, does that mean that growth will now slow? The answer is yes and no; clearly formaldehyde-derived products will become more expensive (and high-yielding processes like Formox will become stronger as a result), but the simple fact is that these products are now well established on a worldwide basis, growth will return when GDP/capita once again starts to rise. Panel products continue to benefit from the way IKEA has changed lifestyles around the world, while the need for lighter components and energy savings drives formaldehyde-derived plastics. And these industries will continue to need formaldehyde, as for the most part there is no viable alternative. So yes, perhaps a slightly slower growth rate than we have seen in the recent past, but not noticeably so. Besides, formaldehyde has another advantage in that methanol, unlike many raw materials in the chemical industry, can be synthesized from almost any carbon source. So even after fossil fuels have disappeared, methanol and hence formaldehyde will still be available, albeit at a much higher price. Perhaps we shall end up back where we started 120 years ago, but with better technology to derive the all-important methanol. ■









2009 methanol market

by Candice Petrovic, Product Manager Europe, Methanex

The economic crisis that hit the world in the second half of 2008 hasn't gone by unnoticed by the methanol industry. Since the demand crashed at the end of last year, the methanol world has experienced 4 unstable and unusual quarters.

This incredible cycle started in the end of September 2008, when global methanol demand was around 41 MMT annualized. Spot prices were about US$400/MT in Asia and Europe while North America was at $470/MT. In this high priced environment, China was operating at high rates and imports were at ~ 200 kMT per quarter.

At the end of December, one could observe the damages of the global crash on the methanol market. Global demand was down ~ 15% compared to the previous quarters, spot prices were down to $150-170/MT and global inventories had increased significantly over the last quarter of the year. The large inventory build-up was a result of the slow supply response to the rapidly declining demand.

As a result of lower demand and high inventories, first quarter contract prices dropped significantly in all regions, pushing several high-cost producers to shut down or reduce operating rates. Eastern European and Chinese suppliers were the most impacted, with the average operating rate dropping to 50% and 25% respectively. As a result of the massive production drop in China, the country started importing enormous methanol quantities (imports in the first quarter were equal to full-year 2008 levels). The impact of supply reduction and increasing China imports was that the "overhang" of global inventories started to diminish.

The second and third quarters of 2009 witnessed stronger market conditions and higher prices. Although still below the 2008 level, demand continued to increase in all regions, with Asia-Pacific as the main driver. Against this backdrop of increasing demand, the industry experienced further tightening with ongoing shut-in of high-cost production and very low operating rates due to both planned and significant unplanned outages. The on-going production challenges at the two new mega facilities in Malaysia and Iran have further hampered supply availability. Thus, after three quarters of inventory draw, the world inventories levels entering Q4 are very low and world prices are increasing, as more high-cost production is required to meet global demand.

Next year's demand is expected to grow further and be in the range of 42 MMT. Although European and North American demand will not recover fully to pre-crisis levels, China's demand is expected to experience significant positive growth driven by energy applications and economic expansion backed by governmental support.

Methanex Egypt plant under construction

Photo courtesy of Methanex

Several new plants are expected next year: Methanex Egypt (1.3 MMT), MGC Brunei (0.9 MMT), Salalah Oman (1 MMT) and Meteor 2 Venezuela (0.9 MMT). The expected production for next year is around half the capacity, given scheduled start-up times. These extra molecules are expected to be absorbed by rising global demand and rationalization of high cost production.

Another exciting year is in front of us.

When you stop to consider…

…the kinds of demands being placed on formaldehyde and the formaldehyde industry, don't you become curious to know why the people placing demands don't seem to stop to consider something else: the facts?

For example, nobody is disputing the fact that formaldehyde is a highly toxic chemical that must be treated with the greatest care and caution. But a look at another fact reveals that the *concentration* of formaldehyde at a typical HCHO plant is no greater – or even less – than in your typical forest!

See the article from FormaCare, next page.

FormaCare update

A European perspective on a global commodity

by Reinhard Strupp, Secretary General of FormaCare

Let's start with the basic facts: People benefit every day from products that contain formaldehyde – a natural substance found in the very air that we breathe. Apples and other fruits contain rather high levels of formaldehyde. And formaldehyde is a key building block in major sectors of the economy: from residential construction, aircraft and automobile industry to healthcare applications. Yet very few people are aware of these facts. The role of FormaCare is to contribute to this awareness. Together with our members, we aim to promote the sustainable use of formaldehyde and formaldehyde-based products, with all due regard to health and environmental care.

Value to the economy and society

We strongly believe in formaldehyde as a safe and widely used chemical that benefits society via a great variety of everyday products. Moreover, in socio-economic terms the use of formaldehyde and its derivatives rather than alternative products saves more than €29 billion per year – and that's just in Europe. No fewer than 1.7 million people are directly employed throughout the European formaldehyde value chain.[1]

Today we are all operating under much pressure in a very challenging economic environment. While latest figures suggest signs of recovery in the EU chemical industry, it is clear that it will take years before industry gets back to January 2008 levels. Unfortunately, formaldehyde continues to be on the agenda of regulatory initiatives worldwide. In 2009 this has been very evident in Europe and in the US, where our industry is under constant pressure to bear the burden of proof. Needless to say, regulatory activities increase the pressure on our business.

Because these activities are not going to disappear or be put on hold, they need to be handled with care and determination – especially in difficult times. FormaCare strongly feels that new rules must seek the right balance between all aspects and must not be adopted prematurely – especially when scientific evidence is not entirely clear. FormaCare therefore advocates a regulatory policy based on balanced scientific evaluation. Creating an open and solution-oriented dialogue with both European and national authorities and downstream users is one of FormaCare's key targets and *raisons d'être.* And we represent an industry that is very serious about risks to human health and has always invested in research that aims to reduce scientific uncertainties.

In Europe, there are no fewer than four main regulatory challenges currently facing our industry:

1. **Harmonized occupational exposure limit (OEL) values for formaldehyde**
   July 3, 2009 marks an important day in our history. On this day the European Commission started a written procedure to achieve a vote on the pending 3rd list of indicative OEL values. The procedure included a revised proposal (the result of many months of science-based exchange with the Commission and individual member states) to remove formaldehyde from the annex, pending new study results. The Commission explained this decision with the concern that had been expressed by member states regarding the numerical value of the proposed OEL values for formaldehyde. Also key to the decision was a new study on human volunteers exposed to formaldehyde, which is currently underway with results expected in 2010. While this does not mean that the substance is entirely removed from the regulatory focus regarding OEL values, it is a big success for us, and for formaldehyde producers and users. We are confident that the study results will ensure a much more balanced re-evaluation of formaldehyde.

2. **Harmonized limit values for formaldehyde in indoor air environments**
   The Commission's Institute for Health and Consumer Protection (IHCP), which is part of the Joint Research Centre (JRC) of the European Commission, is still reviewing their INDEX project of 2005, which lists formaldehyde among the highest priority substances for new regulations regarding indoor air. Meanwhile, a draft report on a "harmonization framework of indoor air material labelling schemes in the EU" was circulated by the JRC. At the same time, this topic is being discussed at the WHO level, where new guidance on indoor air is also expected, and will probably be taken into account by the Commission. Hence, there are several interdependent initiatives in place (at WHO, EU and national levels), but there is still no clear approach combining the various strands. What is clear, however, is that formaldehyde features in all approaches, which is why FormaCare has taken a pro-active approach vis-à-vis regulators in 2009, suggesting open and transparent cooperation on scientific and technical questions in close coordination with CEFIC.

3. **Harmonized classification and labelling for formaldehyde under CLP**
   The new EU regulation (EC) No 1272/2008 on classification, labelling and packaging of chemical substances and mixtures (the so-called CLP Regulation) entered into force on 20 January 2009. Under this regulation, member states may send proposals for the harmonized classification of substances that are carcinogenic, mutagenic, toxic for reproduction or respiratory sensitizers. France is working on a new proposal for harmonized classification and labelling for formaldehyde. We expect the submission of this proposal, the so-called Annex XV dossier, by the end of 2009. FormaCare is currently in personal contact with the competent authorities in France to establish as much information on the dossier as possible with regard to its targets, lines of scientific argumentation and timing. The discussion of this proposal will undoubtedly keep us very busy in 2010, in particular against the background of a recent IARC review of formaldehyde. Despite the responsible Working Group being almost evenly split on the evaluation, IARC concluded that there is sufficient evidence in humans of a causal association of formaldehyde with leukemia. FormaCare disagrees with IARC's findings and believes that the weight of scientific evidence does not support such a determination.

4. **Obligations under REACH**
   Our group is making a major effort to help our members to fulfil the REACH requirements, who are fully mobilized to comply with REACH and demonstrate the safe management of chemicals in commerce and in the supply chain. To do so, FormaCare members are organized under a REACH Platform and in five groups: formaldehyde, polyols, hexamine, para-formaldehyde and aminoplast glues and resins. Consortia Agreements are in place and the preparatory work is well underway to meet all registrations deadlines.

FormaCare cooperates closely with the Formaldehyde Council Inc. (FCI) in the US, where formaldehyde is much more in the public eye, to align all scientific and advocacy targets and activities between US and Europe. This alignment is also taking place to a lesser, but growing extent, with our industry partners in Brazil, represented by the Associação Brasileira dos Produtores de Formol e Derivados (ABRAF).

We encourage readers of *informally speaking* to visit our new website (www.formaldehyde-europe.org), which not only features a new layout but also an improved, easy-to-navigate structure. Information on formaldehyde is readily available, as well as a new flash animation of the "House of Glues".

[1] Taken from research to quantify the value of formaldehyde to consumers and the contribution of the industry to the economies of the European Union and Norway ("Socio-Economic Benefits of Formaldehyde to the European Union [EU 25] and Norway", June 2007, Global Insight)

Meet our PRODUCERS!

Working quietly (mostly) behind the scenes, Formox has a team of nearly 20 guys (and a gal) whose job it is to actually produce the catalyst that magically turns your methanol into formaldehyde. The editor of informally speaking attended one of their "Friday meetings" to listen and chat. Here's the story of a truly dedicated team.

Every Friday

Every Friday morning, all production personnel on duty gather around the coffee table. The meetings are informal in form, but highly serious in content, touching base on every issue during the week. This includes status reports and follow-ups on every detail of production, from machine maintenance to quality control.

"The follow-ups are extremely useful in helping us get the best results," says **Michael Svensson**, the operations engineer for catalyst production. "So we look carefully not only at every deviation, but also at what works best. The idea is to get as much control as possible. By recording all values, we can see trends, and this helps to give us a clear understanding of the process – and understanding is what drives our continuous improvement."

Another purpose of the Friday meetings is to keep up to date on production planning.

"It's essential to plan ahead, particularly now when we're beginning to see an increase in demand after the economic downturn," says **Eva Lindgren**, head of Formox catalyst production. "There are signs that more and more formaldehyde producers are starting to rev up their production again, and we have to be ready to ship as soon as they need catalyst."

(1) Eva at her desk.

(2) The informal Friday meetings are an important forum for keeping everyone informed and preventing small problems from becoming big ones.

(3) Like many of the guys at the plant, Michael takes his work very seriously – and brings decades of experience to the job.

(4) From left: Oscar, Rolf, Glenn Johansson (maintenance technician) and Eva believe in the value of open discussions.

Heart and soul

One thing quickly becomes clear: these guys (and Eva!) have their heart and soul in what they do and what Formox stands for. "Being part of the Formox team means a lot to us," says **Glenn Johansson**, maintenance technician, and the others around the table are quick to agree. "We don't just produce catalyst. We get briefed by our R&D guys, so we get to know some of the hows and whys. We talk to our sales team and get to know what our customers are looking for, so we'll be in a better position to see that their satisfaction is on top. What goes into those blue drums has got to mean value for our customers. Yes, we're really proud of what we do. But we're determined to become even better!"

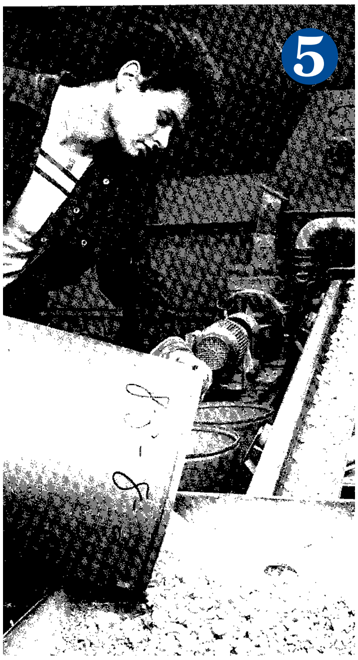
6 key points

When asked what makes them tick on the job, they all began discussing the most important points, which boiled down to these:

1. Turning out a top-notch product.
2. Always striving to become better.
3. The thrill (!) every time another shipment goes out.
4. Having the right machinery to work with and the right premises to work in.
5. Knowing that we're doing our bit to recycle and assure environmentally responsible handling and waste management.
6. The teamwork – the extremely positive and friendly environment – that makes us willing to give that little bit extra.

Experience counts

Most of the guys have been working with catalyst for many years – some for decades – and have gained tremendous experience that contributes to the great feel they have for making catalyst. They've also seen a lot of development over the years. "The difference between today and 30 years ago is like night and day," laughs **Mats Lantz**. "Back then we used to mix everything by hand. Now it's all



(5) 25 years ago, Peter Nemeth had to do a lot by hand.

(6) Now Peter (middle), together with operators Martin Landerup (left) and Petter Englund have powerful computers at their disposal.

(7) And the machine does the lifting for Sauli Kallio, seen here emptying a return drum of spent.

(8) From left: Glenn, Eva, Daniel Larsson (technician and occasional photographer for *informally speaking!*), Oscar and Petter always have time for a laugh too!

(9) Michael, Oscar and Eva preparing the next load for delivery. Could it be yours?

automated, of course, so consistency and accuracy are not big issues any more. But we've always felt just as involved, and we've always had lots of fun!"

"Here we are, a small team of guys in this small village in southern Sweden, producing catalyst that makes more formaldehyde than anyone else in the world," adds **Peter Nemeth**. "It's kind of awesome."

Insightful leadership

Eva Lindgren is the boss, and her team doesn't hide the fact that they look up to her – for her seemingly boundless energy, her sense of humor, her great knowledge, and – not least – the insight she brings to the job from having a history at Formox that goes back to 1994, when she was working on plant projects. "Those years meant a lot to me," says Eva. "And they still do. Being out there and meeting the customers has helped me to understand how it all fits together. It's a great advantage knowing about everything from the catalyst to the process, to plant operation and the formaldehyde product."

This isn't just historical knowledge. Every technical visit to a customer by someone from Formox is documented in reports that Eva reads – and passes along to her crew. Should there be any complaints or concerns, these are discussed, reviewed and acted upon.

Keeping it clean

Environmental matters are high on the agenda in the catalyst plant, and it goes further than taking back and reprocessing the spent catalyst. "For example, we have our own wastewater treatment right here in the plant," notes Eva. "In this way we can maintain strict controls on all emissions of molybdenum. If there's ever anything over a certain very low limit, it has to be reported to the authorities. We believe in being open and truthful – it only comes back and gets you if you're not – but in fact we almost never have anything to report!"

There is also a scrubber for removing any airborne chemicals, and there are strict controls on all handling of spent catalyst.

"The environment isn't just one person's job," claims Eva. "Every one of us is involved, and it matters."

It's in the air

If the guys at the plant didn't look so different from each other, you might think you'd walked in on a family reunion. "We're pretty close," admits **Sauli Kallio**, one of the operators. "Our friendship means that we have fun together, that communication is easy and effective, that we're all pulling in the same direction. I guess it doesn't hurt knowing we're on a winning team!"

EVA'S TIP

There's no doubt that it's a very clever idea to use wires to mark the thermocouple tubes in your reactor when you load. BUT – please make sure that these wires don't get into the spent catalyst that you return to us. In other words, treat the spent catalyst as a valuable raw material for your next load!

WHY clean your vaporizers?

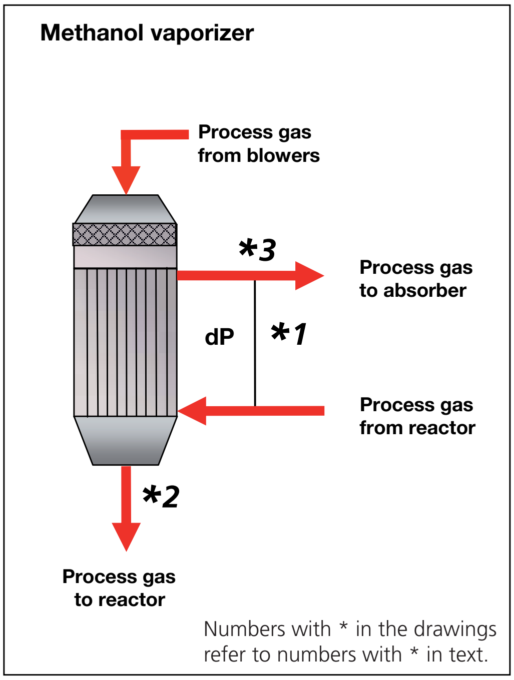
by Mattias Fridolf

It's expensive to have to repair or replace damaged vaporizers, but these are costs that can be avoided by good practice and maintenance. It's better to be safe than sorry! The cost of poor maintenance is high!

As many of you know, paraformaldehyde is formed when formalin polymerizes. The polymerization can be initiated by small paraformaldehyde particles or low temperatures. The paraformaldehyde appears as a white pulp with a strong smell of formaldehyde. Evaporating fumes from paraformaldehyde affect humans in the same manner as formaldehyde, and hence the same safety precautions should be observed.

Paraformaldehyde can appear in different locations in your plant, e.g. in the vaporizers. The consequences of paraformaldehyde formation in the methanol vaporizer (gas-gas vaporizer) may include:

- poor heat exchange
- overheating of the shell side
- fire
- insufficient methanol vaporization
- reduced vessel lifetime
- stress and leaks in the tubes



Numbers with * in the drawings refer to numbers with * in text.

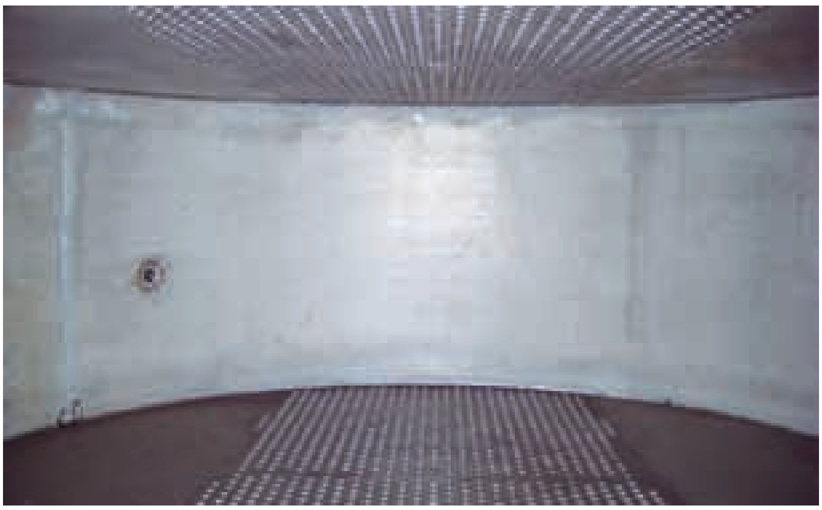
Key indicators

During operation, there are three main indicators that indicates on paraformaldehyde in the vaporizer:

- an increase of pressure drop over the vaporizer shell side (*1 in the diagram)
- a temperature decrease before the reactor (*2)
- a temperature increase before the absorber (*3).

How to remove paraformaldehyde in a Formox vaporizer

First of all, it is of the utmost importance that the proper safety equipment is used: protective gloves, rubber boots, helmet, full-cover body suit and gasmask to protect the personnel. Other rec-



ommended equipment includes a hose that is approved for chemical use, as well as couplings with leak-tight fittings. It's also important to close off the working area and inform the personnel that the work is going on.

Paraformaldehyde can be removed by circulating hot water and caustic over the shell side. The Formox vaporizers are equipped with blinded nozzles to be used for this purpose. Detailed instructions for removal of paraformaldehyde are included in the Operating Manual supplied with the project and you are always welcome to contact your Formox representative to discuss this further.

Check your demister too!

For many years, the design of Formox vaporizers included a demister in the top, and deposits can also appear there (as shown in the picture), as well as in the tube side of the vaporizer and prevaporizer. They usually come from impurities in the methanol or from formaldehyde leakages. You should therefore carefully inspect the tube side as well. If you find any traces of deposits, make sure to clean the demister with a high-pressure water jet. If leakage in the vaporizer or pre-vaporizer is confirmed, you should also clean the demister from above.

We also recommend checking the methanol spray nozzles during every reloading. Make sure no nozzles have fallen off or are loose and that there are no deposits or dirt in them.

Clean means money!

Cleaning your equipment isn't about winning a beauty contest. It's a simple fact that clean equipment performs better, lasts longer, and makes you more money! And your Formox representative is always ready, willing and able to offer helpful hints and instructions about cleaning procedures.

The importance of the correct HTF level – at all times by Martina Skantz

As you certainly know, there is a lot of heat released in the reactor from the reaction to form formaldehyde. A Formox plant uses a heat transfer fluid (HTF) in the form of oil (biphenyl & diphenyl oxide) to remove the heat and cool the reactor and its tubes. To do this in the best manner, it is very important to have the correct level of HTF. Since HTF expands with the temperature, due to change in density, it is important to read the level not only at start-up, but also keep an eye on it until the reaction has been stabilized for a while, and also after every process change.

In Formox plants designed after 2004, the reactor is positioned so that the tube plate is at approximately the same height as the bottom of the HTF condenser. The pipes between the condenser and reactor are angled to ensure that the reactor is always filled before the condenser. In this way, the HTF level can be read on the HTF condenser and easily translated to the reactor level due to basic physics.

A suitable HTF level in the HTF condenser is a minimum of 10 cm above the reactor tube sheet when pumping up the cold HTF. At start-up, the HTF level will have increased further due to the change in density when the HTF is heated up. When the reaction takes off in the reactor, the HTF will expand and hence show an even higher level.

The methanol feed also makes a big impact on the level of HTF. When you go from low methanol feed to maximum, you also get a change in the heat generation in the reactor and therefore you need to increase the cooling. This can be spotted on the HTF level, since its density will change, as mentioned earlier.

With mixed layers of catalyst in the tubes, more of the tube is utilized for heat removal and it becomes even more important to have a sufficient volume of HTF in the system.

Why is it so important to have a correct level? Well, if the level is too high, the thermosiphon, which controls the flow between the condenser and reactor, may be interrupted by liquid HTF flowing backwards in the vapor pipes. This in itself is not an alarming situation, but it does need to be corrected. It will be spotted by problems in controlling the HTF pressure/temperature. The HTF level in the HTF condenser may also vary. If this occurs, you must drain the HTF into the HTF tank very carefully until the HTF level is about 10 cm below the HTF vapor pipe.

The alarming situation is if the level in the reactor is too low at a high methanol feed rate. Then there is a big risk of not getting enough cooling in the reactor. When the cooling is insufficient, the reaction increases and the temperature increases. This will lead to an even higher reaction rate and higher temperatures. The increasing heat load also increases the HTF circulation rate, which results in an increase in the HTF liquid level in the HTF condenser and a decrease in the level in the reactor, thereby exposing more of the tube length to insufficient cooling. The overheating of the tubes may eventually lead to HTF leaks, which can lead to an HTF fire in the reactor. The picture here shows a good (or bad!) example of tube rupture after such a fire. Overheating can also cause HTF to coke on the outside of the tubes and reduce the cooling even more.

So take the time to verify your HTF level frequently! If you suspect that your HTF level is inaccurate or there are other questions about it, don't hesitate to contact your Formox representative.

Commissioning

by Daniella Cheng

Commissioning is the last part of our involvement in a plant project before the plant is handed over to the customer. During this final phase, the Formox commissioning team works closely together with the client's commissioning team. Our goal is to help the client start up the plant. When we leave the site, we know that the plant we just started fulfils the safety and process requirements, and that our client is satisfied with and confident about operating the new plant.

Who does what?

The Formox commissioning team normally consists of four persons: a site supervisor, an instrument engineer, an electrical engineer and a process engineer. Each of them covers the respective functions. Although the commissioning and the start-up is the client's responsibility, it is very important for us to ensure that we deliver plants where performance meets guarantees and expectations. Our extensive experience from delivering and commissioning more than 100 plants worldwide enables us to play an important and helpful role in the commissioning.

The site supervisor's main responsibility during commissioning is to check the final erection. However, the site supervisor has already been to the site several times since the start of erection, and usually knows everyone who works there quite well. It is important that the erection of the plant fulfils the process criteria, fulfils the safety requirements and complies with the local stipulated standards.

Check first

A common misunderstanding is that when the erection of the plant is done and all the equipment is in place, the plant is ready to start up. This is far from reality. To ensure the good performance and safety of the plant, everything that can jeopardize it must be checked. The electrical engineer must inspect the cable connections from the field to the motor control and electrical cabinet, making sure that they have been done correctly and that all electrical equipment can be started safely in accordance with the suppliers' instructions.

The instrument engineer must make sure that all instruments are in place and have the right calibration. In a lot of cases, the instruments need to be recalibrated. The loop test of signals from the instruments to DCS is another important step, as is the testing of the alarms and trip functions. The process engineer needs to test all process equipment to make sure that the plant fulfils the process requirements.

No leaks, please!

Leakage test of the reactor and absorbers are some examples of inspections that a process engineer does during the commissioning. These vessels have already been tested by the supplier and inspected by Formox before delivery, but some manufacturing imperfections are not possible to detect unless the vessel is in vertical position and filled with some kind of liquid. That is why leak-testing of some major vessels is a necessary step during commissioning. There's a little detective work involved in finding possible leakages and manufacturing imperfections in these vessels. In fact we sometimes find other things than manufacture errors in the vessels: forgotten tools, bolts, even shoes and spiders!

Before the plant is ready for start-up, all systems will be test-run separately. The process gas system is tested by blowing fresh air through the system, the HTF system by heating and circulating the HTF, the absorber system by water test etc. During these tests, we can monitor different cases and see if the equipment, the instruments and the control and safety systems are responding as they should. Any abnormal noise and response will be noticed and fixed.

Many involved

The Formox engineers are very involved in all the practical work during commissioning. This enables us to share our knowledge with the client. After all, it is also in Formox interests to have a successful plant project and another satisfied client!

As there are many steps and people involved in a commissioning, communication becomes an important ingredient in our work. It is not unusual that our client has a different opinion about how things should be done. However, when we succeed in explaining why it is important to follow certain instructions and when both

Martina and Michel making pitot tube measurement during Nafta commissioning

Eva-Lena and Henrik together with plant manager and operators from Silekol during the commissioning parties understand each other's point of view, most things work out very smoothly. Furthermore, once the plant has been commissioned and started, most customers are positively surprised at how easy the start-up goes and how smooth the operation is – and how few (if any) problems remain!

Hard work and good fun

Some mistakes may occur at the site, but they are really easy to prevent. For example, all rotating equipment needs regular maintenance. If it has stood still for a longer period of time without maintenance, a major overhaul must be done before it can be started. It is also important to protect the heaters from the weather while in storage. Moisture in the junction box can make it very difficult to start up the heaters. Most of our clients already know that the HTF system must be kept above 20°C once the HTF enters the system. But when performing a winter commissioning in a cold climate, the tracing system may not function properly. Dissolving solidified HTF on a cold winter's day (or night!) is both difficult and time-consuming....

Tommy Nordstedt, Mattias and Daniella waiting for transportation to the hotel after a working day during Yuntianhua III commissioning

But commissioning is not only about hard work; there are also lots of joyful moments. During the commissioning, we have the opportunity to get acquainted with the local people and make a lot of new friends. Unlike an ordinary vacation abroad, we are able to experience the local customs, taste different kinds of food and visit some amazing places that the tourist buses never reach. And it's amazing to see that an identical problem can be solved so differently in different countries. These impressions and experiences enrich all of us!

Q&A about commissioning

Q: How long does a commissioning take?
A: Commissioning normally takes 4 weeks, but it can be shorter or longer depending on how prepared the plant is.

Q: What's the difference between commissioning and start-up?
A: Commissioning refers to the period during which all equipment and systems in the plant are tested. During the start-up, methanol is fed into the system and formalin production is started.

Q: Does the client pay for Formox commissioning work?
A: The commissioning work is normally included in the contract for the plant project.

Q: What happens if something goes wrong?
A: To assure that nothing goes wrong during commissioning and start-up, it is important to follow certain instructions and test procedures. But if something goes wrong – which happens very rarely – the Formox engineer will stay at the site and assist the client to solve the problem. Our commitment in the commissioning is not ended until the plant has been started safely and the plant operation is stabilized. Moreover, our technical support extends beyond commissioning; we continue to offer you advice for optimal plant operation for as long as you need it!

Warning! Unloaded reactor tubes!

by Ola Erlandsson

Good reactor performance is always dependent on making sure that all the reactor tubes are properly loaded with catalyst. This is an old truth that still applies. However, if you are operating with a loading plan where the top section of the tubes is empty, the risk of unloaded tubes has increased. This is because a totally empty tube has a very low pressure drop, which gives a very high gas flow compared to a filled tube. We estimate that the gas flow through an unloaded tube is 200 times higher than for a loaded tube. The result is that a lot of gas containing methanol is passing through the reactor without being converted to formaldehyde – which means a bad yield and high methanol content in the product.

The risk of having a totally empty tube is low if you use a loading plan where inert rings are spread on top of the tube sheet. Then, at least, tubes without catalyst will be filled with inert rings (unlike the tube in the center of the picture!). However, some reactors and loading plans make it necessary to have a void at the top (to prevent excessive pressure drop), and in such cases Formox strongly recommends that every single tube is checked visually after reloading.

Think about this: Two hours of extra checking can save as much as 1% of the methanol cost for your next year of operation!!

Gas flow measurements

by Anna Wemby Björk

The process gas flow is an important parameter in formaldehyde production, since it determines the gas velocity through the catalyst in the reactor and is used to calculate the methanol inlet concentration. In Formox plants, it is measured continuously by a process gas flow meter, often an Annubar. During commissioning of a Formox plant, the process engineer always verifies the Annubar reading by using a pitot tube.

A Formox plant is equipped with two gas flow valves (GFV), 90° apart, in order to measure the flow velocity profile along two different axes. The pipe is divided into 16 equal-sized areas (fig. 1) and the dynamic pressure is measured by a pitot-static tube, also called a Prandtl tube (fig. 2).

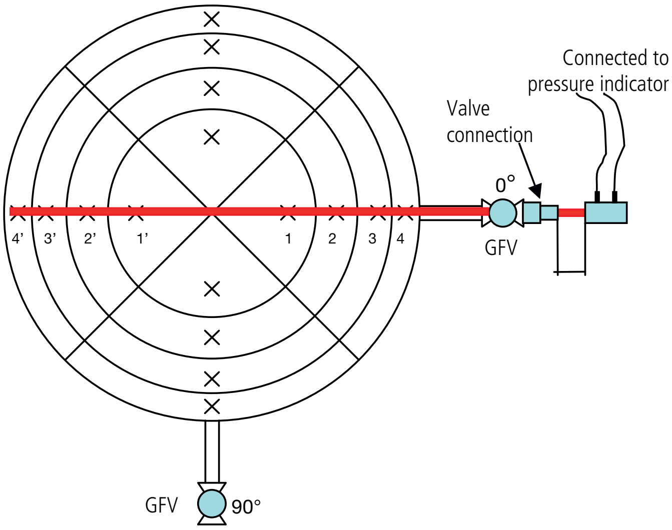


Figure 1: Cross-section of the pipe with measuring points in 16 equal-sized areas.

Once we have the readings, we calculate the flow velocity using Bernoulli's equation for velocity. The dynamic pressure is the difference between the stagnation pressure and the static pressure.

From the pressure difference, the fluid velocity is calculated for each area. To see if the flow is evenly distributed, the velocity profile should result in a symmetrical, quite flat profile with a lower velocity at the walls. The mass flow is finally calculated by the average gas velocity, the gas density and the area of the pipe.

The calculated mass flow is then compared with the mass flow given by the Annubar. Any major difference between the Annubar

Figure 2: A pitot-static tube (Prandtl tube) used for measurements.

reading and the pitot tube measurements may be the result of dirt on the Annubar, condensate in the flow transmitter or an uneven flow distribution caused by elbows and fittings or the fans.

If you want help in verifying your process gas flow meter with help of a pitot tube measurement, please contact your Formox representative.

Bernoulli's equation

$$v = \sqrt{\frac{2 \cdot (P_t - P_s)}{\rho}}$$

where
v = fluid velocity
P_t = stagnation or total pressure
P_s = static pressure
ρ = fluid density

Mass flow equation

$$M = \rho \cdot v \cdot A$$

where
M = mass flow [kg/s]
ρ = gas density [kg/m³]
v = average fluid velocity [m/s]
A = area [m²]

DEFINITIONS

A **pitot tube** (invented by the French engineer Henri Pitot in the 1700s) is a pressure measurement instrument that is pointed directly into the flow to measure fluid flow velocity. Bernoulli's equation is used to calculate the dynamic pressure and hence the fluid velocity.

An **Annubar**, also an insertion device, is a type of multiple port pitot tube (MPPT).

Annubar® is a registered trademark of Emerson Process Management (www.emersonprocess.com)

Hand-held CO instrument

All new Formox plants are equipped with an on-line CO-analyzer, which greatly enhances your ability to optimize the yield. But what if you have an older plant without this feature? Formox now also has hand-held instruments that our technical-support team can bring to your site to further improve our ability to give you advice on catalyst performance.

PROJECTS & START-UPS

In spite of the tough financial climate, Formox has a number of major projects underway, in various stages of completion. Here's an update:

New projects

- An agreement for the first reactor line in an FT3 plant has been signed with **Ningbo Wanhua Polyurethanes Co., Ltd**, China. This will be their second Formox plant on this site (The first plant was started in 2005, and then expanded in 2007.)

Ongoing projects

- Work on the basic engineering package for an FT2.5 plant for a client in Asia is in progress.
- The new FS2.5 plant for **Kanoria Chemicals & Industries Ltd.**, in Visakhapatnam, on the east coast of India, is in the procurement phase. The start-up of the new plant is scheduled for 2010.
- In Hohhot, Inner Mongolia, China, the new FT2.5 plant for **CNOOC TIANYE Chemical Ltd.** (part of the China National Offshore Oil Corporation), is on track for the scheduled start-up in early 2010.
- The formaldehyde and resin plant for **Duratex** in Brazil has now entered the construction phase. The new facility is scheduled to go on stream in early 2010.
- In the major project for **Ticona** in Germany the detailed engineering phase is complete and construction activities are proceeding well.
- The UFC plant for the **Qafco 5** complex in Qatar, in cooperation with Saipem and Hyundai, is progressing well.

Start-ups

- A new methanol vaporizer for **TOA Dovechem Industries Co., Ltd.** went on stream in August.
- The FS2.5 plant for **Formosa Plastics**, Taiwan was successfully started in September (see photo from start-up).
- The FS2.5 plant for **Yunnan Yunwei**, in Zhanyi, China, was started in October (see photos).
- The FS2.5 plant for **Karbodin** in Russia is scheduled for start-up in the early part of 2010. (Karbodin is a joint venture between Metafrax and Dynea.)

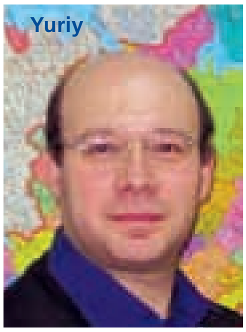
The brand-new plant for Yunnan Yunwei was festively decorated for the opening.

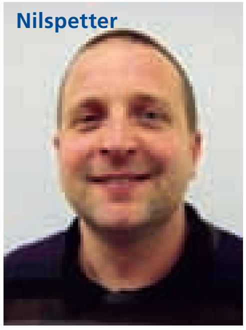
The people from Yunnan Yunwei and from Formox in China and Sweden had every reason to be proud of their work.

The successful start-up of new plant for Formosa Plastics was the result of great teamwork.

A delegation from CNOOC TIANYE Chemical Ltd came to Sweden in October for a a week of intensive training.

Faces & places





There have been a number of staff changes since the last issue of ***informally speaking:***

- **Philippe Thevenin** from our Technology group has now joined our team of Account Managers. Philippe will be working primarily with clients in Europe.
- **Yuriy Babkin** is our new, dedicated Formox representative for Russia and the CIS countries and is stationed in Moscow. Yuriy has a Ph.D. in chemistry, and has extensive experience from the Russian chemical industry.
- **Bengt-Arne Hagsten** holds a new position where he is working mainly with projects related to catalyst and catalyst plant improvements. Bengt-Arne first began at Formox way back in 1975!
- **Nilspetter Sandén** is a new reinforcement for our team of mechanical engineers, focusing mainly on plant projects.
- **Eric Li** (Duo Li in China) has joined our team in Beijing, taking over as Commercial Manager from **Jennifer Wu**, who is moving on to new challenges. Eric has an MSc in applied chemistry from Beijing University of Chemical Technology, and has more than a decade of experience in the chemical industry.
- **Maria Yngvesson** & **Martina Skantz** (see page 11) are both off on parental leave, while **Eva-Lena Ekblad** and **Erik Timander** are now returning from parental leave.

All of us at Formox would like to wish our customers, suppliers and other readers of ***informally speaking*** a joyful holiday season and a prosperous and peaceful 2010.
Again this year, we'll be making a donation to Doctors without Borders (a.k.a. *Médecins Sans Frontières*) to help them in their laudable efforts to alleviate human suffering under difficult conditions (see www.doctorswithoutborders.org).

Seminar news

If you are a Formox customer, you may have already received an invitation to Formaldehyde Asia 2010, to be held for the first time ever in Bali, Indonesia, on March 2-3. If you have not received your invitation, but would like to attend, please get in touch with your Formox representative without delay. All Formox customers are welcome!

The conference will cover many topics of interest – including new improvements that can save you a great deal of money – as well as many opportunities for discussions and networking. The conference will be followed by an advanced training program. Details are to be found in the invitation.

Looking ahead, the conference rotation program looks like this:

- **Formaldehyde Americas 2011**
- **Formaldehyde Europe 2012**
- **Formaldehyde Asia 2013**

The dates and venues for these three conferences have yet to be decided. Watch our website (www.formox.com) for further details!

informally speaking

The newsletter ***informally speaking*** aims to provide **inform**ation about **form**aldehyde 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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