A formaldehyde magazine from Formox

INFORMALLY SPEAKING

spring/summer 2011

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Optimism in the air

It was not only spring that was in the air at the recent Formox conference in San Francisco; optimism was also there! For example, Bob Crichton assured all of us working in the formaldehyde industry that, provided we can rise to the challenge of more legislation, we will all have jobs for many years to come; the prediction is that the market will continue to expand well into the future. You can read more about this and other presentations from the conference in this issue of *informally speaking*. And I look forward to welcoming you to our next conference, which will take place in Helsingborg on May 7-9 next year.

The most important thing for us at Formox is you, our customers. This spring has been very dramatic and difficult for many with political unrest in North Africa and the Middle East and the massive earthquake and tsunami in Japan. Our thoughts at Formox have been with our customers and their families. Fortunately no-one has been seriously injured, and even though several people have been affected by minor damage, power disruption etc. they remain optimistic about the future.

Given the results of our recent customer survey, we also feel optimistic about the future working with you. It is not enough to simply say that customers are important, we must be able to demonstrate this by our performance. I'm pleased to say that the latest customer survey shows that for the most part you are very satisfied – but please read all about this and what we intend to do to further improve on page 19.

We look forward to continuing to travel to meet you face-to-face, to understand your needs and discuss opportunities for the future. Can we help you do better and perhaps expand on the market? Possibly our new loading plans or new plant range could be of interest? You can read all about these and other opportunities in this issue.

To be prepared for the increase in demand we are also expanding the Formox organization, which means you will meet several new Formox faces in the near future. On that note I would also like to welcome Hedvig Ekman to the Formox family. Hedvig is taking over from Stan Erisman as our new Market Communications Manager as well as the Chief Editor of *informally speaking*. Stan is a hard act to follow but we hope you like her new format and welcome any feedback.

Finally, I hope the optimism of spring will blossom into a very good summer; not only in business terms but hopefully that we will all be able to find some time for relaxing!

Have a good read!

Marie Grönborg
General Manager
Formox AB

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CAP 2.0 & CAP 2.0T

In the previous edition of *informally speaking*, I gave an update on the development and experiences from our CAP 2.0 concept. I also gave a hint that this year we would introduce an improved version of CAP 2.0, which would give a higher yield. Promise kept, since we did that in San Francisco – CAP 2.0T! So what is the difference between CAP 2.0 and CAP 2.0T and how do we manage to improve the yield, and more? Read on and you will find out.

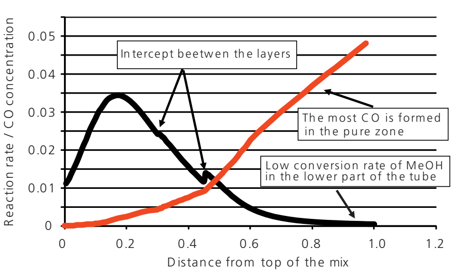
Table 1 Comparison of different CAPs	CAP 1	CAP 2.0	CAP 2.0T
Layers to load	3-4	4-6	4-5
Yield (MeOH to HCHO)*	92.3-93.2	92.5-93.5	93-94
Savings in yield, kEUR (300 MTPD plant)**	Base case	+ up to 39	+ up to 116
Power consumption (blowers)***	100%	91-99%	89-98%
Savings in power, kEUR (300 MTPD plant)****	Base case	7-50	10-60
Lifetime in S.P.@ 0.3 bar g & 10 vol% MeOH*****	20-28	20-30	20-30

*Average over economical lifetime
**350 operating days and methanol @ EUR 325/tonne
***Reference value 65 kWh/tonne 37%
****350 operating days and EUR 0.09/kWh
*****Depending on requirements for yield & MeOH in product

Our work on the CAP 2.0 concept started some 4 years back and was introduced to the market in 2009. We wanted to achieve a longer catalyst lifetime and also to be able to increase the methanol inlet and thus the specific plant capacity further. This should be possible to achieve with more catalyst layers, all with different activities. Such a system would enable better control of the reaction rates and the hotspot temperatures, as well as a slower pressure drop increase.

Indeed, as also reported in San Francisco, the experience from CAP 2.0 so far is that we do see lower and more even hotspot temperatures and a slower pressure drop development. This means better control of the reaction rates and temperatures, better production economy, and on top of that a somewhat longer catalyst lifetime should also be expected. Nearly all customers have happily reported these experiences. What we have not seen so far is the possibility of increasing the specific plant capacity further with CAP 2.0, but we have another concept in the pipeline, also hinted at last year, with very promising results, taking care of that. We are sure we can soon push the limits further.

Fig. 1 Typical concentration profile for CO and reaction rate in the reactor tube



However, what we also have seen with CAP 2.0 is an increased yield, both short- and long-term. The improvement in yield, reported by many customers, has been up to 0.3%, and in some cases much higher. This has helped improve the overall formaldehyde production economy even more than expected. This is not all, with the next development of our CAP concept, CAP 2.0T, we are improving the yield further – as well as lowering the pressure drop and power consumption. But how do we accomplish this? Well, to explain this we need to look at the catalyst reaction mechanisms in the reactor tubes.

Fig. 1 illustrates the CO formation in a standard CAP 2.0 concept catalyst load at 10 vol% methanol and shows that the major part of the CO is formed in the bottom part of the reactor, primarily in the pure layer. Basically, CO is formed from re-adsorbed formaldehyde species reacting further to CO; the parameters affecting this reaction are primarily the concentration of formaldehyde, the type of catalyst, the temperature and the oxygen concentration. The reason why the formation of CO is most pronounced in the bottom of the tube is mainly due to the high concentration of formaldehyde present.

Therefore, the type of catalyst used in the bottom part is very important; it would seem advantageous to have a very selective catalyst in the bottom of the tube and aim to use a catalyst that gives less CO, while obtaining sufficient conversion of the methanol. And, after scrutinizing our catalyst spectrum, we found that a previously produced catalyst type would fit perfectly;

KH-26T. This catalyst has a higher selectivity and yield compared to KH-26L and KH-26. So, by combining the slower pressure drop developing CAP 2.0 with the higher yielding KH-26T, we got a perfect match – CAP 2.0T!

With the new CAP 2.0T we see an increased yield of up to 0.5%, depending on the operating conditions. This is thanks to the shorter diffusion distances in the catalyst used in the pure layer, resulting in lower CO formation. Furthermore, due to a lower packing density of the pure catalyst used, it will give yet a lower pressure drop, meaning a further lowering of the power consumption. Please see table 1 above where CAP 1, CAP 2.0 and CAP 2.0T are compared.

The CAP 2.0T type of loading plans have been and are being used at the Perstorp site in Sweden, in both pressurized and non-pressurized plants, and currently also at customers' sites. If you are using CAP 1, then in some cases maybe the advantages of the CAP 2.0 are less pronounced (in case of shorter tubes, lower gas velocity), but then it is also possible to improve the performance of CAP 1, by exchanging the pure catalyst layer to KH-26T. We have already taken this step too and therefore besides CAP 2.0T, we also have CAP 1T as an upgrade option.

When you receive the next issue of *informally speaking*, I'm sure I'll be able to give you a positive update from our experiences so far with CAP 2.0T. In the meantime, when you plan your next catalyst change, do not hesitate to ask for a quotation of our latest development in catalyst systems – CAP 2.0T!

BY

Ronnie Ljungbäck
Product Manager Catalysts
Formox AB

Formaldehyde Americas 2011

Spring in the air in SF

The annual Formox seminar was held in March and this year it was the turn of the Americas. It took place in San Francisco and attracted 60 attendees from 15 countries. The key theme was optimal operating strategies; day 2 was devoted entirely to this topic, while day 1, as is usual, set the scene – covering Health and Safety issues as well as reviewing the state of the market. Here follows a brief summary of these eventful two days.

Day 1: Setting the scene

Formox update

Formox General Manager **Marie Grönborg** opened the conference by welcoming all the participants and bringing us up to date on what had been happening in Formox (and the wider world) since the 2008 seminar in Toronto.

We learned that Formox is once again a separate company within the Perstorp Group; Formox is now Formox AB and functions such as R&D and catalyst manufacturing are once again under our direct control. The detailed engineering functions are also part of this new organization, rather than, as previously, shared with the Perstorp Group. As Marie said:

> **"We feel we are in better control of our own agenda, and all resources are focused on the Formox common goals and nothing else.**
>
> **And as a member of the Perstorp Group we have a unique advantage; we are not only technology and catalyst providers but also major producers – we understand and appreciate all parts of your business. So when you buy catalyst from us you buy the complete package: service for your plant as well as your catalyst".**

Marie ended her presentation with some reflections on the broader world picture. How Perstorp as a group and Formox in particular have come out on top and are looking forward to new developments and new business.

Market update

Then it was time to take a look at the markets and first up was **Bob Crichton** who shared with us his views on formaldehyde's prospects to 2020 and beyond. Early on in the presentation he demonstrated that in the past his projections had been more often right than wrong – though not always for the right reasons! And to make sure he stood a more than even chance of being right in the future Bob concluded by giving us three possible scenarios through to 2030. An abridged version of Bob's presentation can be found on page 10 of this issue.

After a well earned coffee break, next up to the podium was **Karine Delbarre** from Methanex. As well as providing an insight into her company, Karine also made it clear that in the longer term formaldehyde's position as the key methanol consumer could be under threat from such applications as MTG – methanol to gasoline and MTO – methanol to olefins. Fuel blending had also increased! Reassuringly, however, the reported methanol demand for formaldehyde in 2010 was in good agreement with the data presented by Bob in the earlier presentation. (For the up to date situation in the methanol market see the article by Methanex on page 12).

HSE topics

The next topic was Health, Safety and the Environment and the block was introduced by **Ola Erlandsson**. The subjects were broad ranging covering not only different aspects of the classification debate but also news about the Formox ECS (Emission Control System) unit and, as is customary at the North American seminar, a lively debate on safety issues.

ACC

The first speaker was **David Fischer** who introduced us to the American Chemistry Council (ACC) – America's new representative for the interests of the formaldehyde-based industry. As with Formacare in Europe, this group are working diligently to assure that formaldehyde's case is well represented within the appropriate regulatory bodies.

MoO_3 and formaldehyde classifications

After the lunch break, Ola Erlandsson informed the participants about the nature and implications of the latest classifications for MoO3 and HCHO.

No matter if you are in Europe, the US or Asia the trend is the same, HCHO is already termed "possibly carcinogenic". According to Ola we have to get used to this fact; "industry should focus on making sure exposure limits are set correctly, based on solid research, and work towards achieving them".

We also learned that there are exposure limits for MoO3 dust. And for this reason, Formox has carried out measurements during loading and unloading of a formaldehyde reactor. Even with only one fan for ventilation, the results for both operations were below the exposure limit. Based on these findings, it is not necessary to wear respiratory equipment in the reactor. However, Formox recommends gloves and safety glasses and to have sufficient ventilation.

Ola rounded off by emphasizing how important it is to meet the fear of formaldehyde correctly, by behaving responsibly and meeting accusations in a serious and informed way.

Don't blame people for mistakes based on not having given them the right information!

The ECS

The ECS session was opened by **Anna Wemby Björk** who looked into possible performance issues – particularly low conversion and high exit temperatures. As regards the latter, Anna explained that Formox had been a victim of its own success. What she had observed was that some older ECS units on upgraded Formox plants were seeing high exit temperatures. Given that these units are processing up to 50% more tail gas than the design case, perhaps this was not surprising. This was a problem because, in some circumstances, the exit temperature was close to the design temperature for the ECS reactor metallurgy. Anna's solutions included fine tuning the absorber and the main reactor to reduce the load on the ECS; failing that then a fresh catalyst (lower inlet temperature) might be required. In an extreme case dilution air could be used to reduce the exit temperature.

On the subject of low conversion, Anna cautioned that operators should make sure that the unit was sound with no holes in the net or other material problems. Catalyst ageing was another possible reason for low conversion and this was a topic covered in detail by the next speaker, **Johan Holmberg**.

Johan gave an erudite presentation on catalyst ageing mechanisms and how they could impact on ECS performance. The principle mechanisms were sintering and poisoning. Whereas the former was largely irreversible, poisoning could, at least in some cases, be reversed. But when this was not possible the effect of poisoning was the same as with sintering – a need for a higher temperature to achieve the required conversion. The consequence was a higher exit temperature – sometimes too high. But Johan added one more solution to those proposed by Anna; use a different type of catalyst – one with an intrinsically lower ignition temperature. This led neatly into the last presentation by **Ronnie Ljungbäck** who announced just such a catalyst – PPd-47.

This new catalyst is based on the same alumina oxide carrier as PPt-47, but instead of platinum uses palladium as the active noble metal. It has already been tried and tested on the full scale and is available now. Though it was currently more expensive than PPt-47, Ronnie had high hopes that price levels would be more comparable when production was brought completely "in house" and a new version with a lower Pd content was fully developed. But Ronnie did not stop there; he also disclosed that a new catalyst system, combining the best features of Pt and Pd, was close to being commercialized. He also announced that Formox is working on developing a new low pressure drop version of the ECS; clearly the aim is to continue to keep the Formox ECS in a leading position!

Safety experiences

Then it was on to the important topic of plant safety. This was introduced by Ola Erlandsson who also made the first presentation. This concerned an incident on Perstorp No 5 Plant in 2009; such a rare occurrence warranted a thorough investigation, especially as there was more than one deflagration – first the reactor discs then the prevaporizer.

The starting point of the story was a leak in the methanol prevaporizer. Formalin had entered the gas stream and caused fouling of the methanol vaporizer (shell side) and the top reactor tube sheet. In accordance with standing instructions, the plant was stopped and cleaned from the manholes; but soon after the restart there were two deflagrations. Inspection of the methanol vaporizer showed that the pall rings in the top layer of the demister had melted in one area.

The analysis concluded that formalin from the leak had contaminated the demister in the methanol vaporizer. As cleaning from the manhole could not reach the pall rings in the top layer then the contaminants, possibly due to a catalytic reaction involving the steel pall rings, caused the methanol to burn on part of the demister. As the rings were deformed, clearly the temperature had exceeded the melting point of the steel. The higher temperature lowered the explosion limit for the methanol/air mixture in the reactor and caused the first deflagration. The secondary deflagration was caused by air entering through the open reactor rupture discs.

The moral of the story was "Don't blame people for mistakes based on not having given them the right information!" The instructions have since been changed:

- **Inspect the methanol vaporizer demister – from the inside of the vessel to detect problems with the pall ring packing – clean as required.**
- **Clean the methanol spray areas in the methanol vaporizer/prevaporizer during every catalyst reloading using a high-pressure water jet.**

Day 2: Strategic choices

More safety from Momentive

Continuing on the same subject, **Scott DuBree** from Momentive Specialty Chemicals, the world's largest formaldehyde producer, talked about an incident at one of their plants. The incident pivoted on a series of circumstances during a shutdown where there was an undetected methanol leak into the process. The leak filled the vessels with methanol vapors that eventually entered the emission control system (ECS) during the pre-start-up activities. It was during this period that the methanol started reacting on the platinum catalyst in the incinerator and started a fire. The flame front eventually traveled back to the main process equipment and initiated a process wide deflagration.

Scott's conclusions;

- **Research after the incident revealed that under the right conditions, platinum catalyst can act as an ignition source for methanol vapors at room temperature. So, anytime you get methanol in the incinerator, you are at risk.**
- **The only real prevention is to stop methanol intrusion into the plant during a shut down.**
- **If you suspect methanol is in the plant, look, make sure, don't make assumptions.**
- **When doing safety evaluations, remember, just because it has never happened before doesn't mean it can't happen.**

Dale Valach, also of Momentive, then described how the company has revisited its formaldehyde plant safety standards and procedures following the incident. This was addressed by developing a quantitative fault tree that covered all metal oxide process components in steady state conditions, and also in the special cases of start-up and shutdown. The resulting tool was used to identify areas where additional protection may be needed and the optimal method for achieving safe conditions. The effort also identified legacy devices that provided only negligible risk reduction and therefore could be removed without impacting safe operations. Though the overall project was resource intensive, Valach said the company views it as a great investment in ensuring plant safety and preventing process safety incidents.

This year's conference was extended to two full days in order to give more time for informal discussions among participants, getting to know one another at a somewhat more relaxed pace. The day was given over to a review of operating strategies; one group of presentations concentrated on the role of plant operating variables while the final group looked in detail of the role played by the catalyst; the sessions were introduced by **Lars Andersson**.

The role of plant operating variables

The first speaker of the day was Ronnie Ljungbäck, this time on the subject of the different ways a formaldehyde plant can be operated and how best to tune the plant to meet different scenarios – illustrated by how you might select different cars according to what you wanted to do and how you wanted to drive (or what you could afford!). The key message, as far as reducing costs was concerned, was to operate at the highest possible inlet. This applied even in a low production case as a) the power cost was less and b) more steam was produced. But Ronnie also looked at cases, e.g. twin line plants operated at lower rates or when quality (methanol content) might be an issue. He also considered possible downstream constraints – such as a need to run for 12 months to coincide with a site shutdown.

But as Ronnie warned, each individual case would be different; clients were invited to make use of Formox expertise and to discuss their particular situation. And as Marie had remarked earlier, we were in a unique position to help given that Formox were not only catalyst suppliers but also plant designers and suppliers.

Optimizing performance

Anna Wemby Björk then returned to the podium to offer some useful tips on optimizing plant performance. Anna gave some examples showing the importance of optimal operation then posed a series of questions. Do you know how well you are operating? Do you know the financial consequences of your actions on a day to day basis or do you have to wait for the month end report?

Anna's answer was to optimize the plant in real time using the Formox Performance Package. This system, standard on all new plants, shows the following data (with or without cost data as required) in real time:

- **Production rate**
- **Yield / methanol consumption**
- **Power consumption**
- **Steam production**
- **Specific production (catalyst age)**

And if the appropriate signals are available on your DCS, then a retrofit is possible.

Old or new? And what is NPR?

With the economy rebounding in many parts of the world, some formaldehyde producers are seriously reviewing their options on how to meet a surge in demand. Should you expand and upgrade your existing plant? Or go for a new one? And if you go for a new one should it in turn be expandable? This was the topic of the presentation by Lars Andersson, who also introduced NPR – the new plant range from Formox.

The first part of Lars's presentation was concerned with the equipment required to realize the operating strategies discussed by Ronnie. And Lars demonstrated how this could be done with relatively few modifications. By such means an older plant could be improved; becoming more productive, more flexible and better able to meet the demands of a volatile market. Failing that, Formox could offer its competitive new design, the NPR.

The aims of the new design were:

- **to be able to cover a wide capacity range with a few standardized reactor sizes**
- **to make a more cost effective design without prejudicing performance, flexibility and safety**
- **to make the layout more flexible regarding tie-ins and incorporation of extra equipment**
- **to make a more compact design requiring a smaller footprint, without sacrificing equipment access for operation and maintenance**
- **to be universally applicable; able to satisfy the needs of a diverse range of formaldehyde producers.**

To illustrate the last point Lars showed the different configuration choices available to meet a demand for 300 MTPD (37% basis). These ranged from low cost solutions through to energy efficient designs using a turbo-charger to pressurize the plant.

Lars concluded by saying that the Formox plant

Should you expand and upgrade your existing plant? Or go for a new one? And if you go for a new one should it in turn be expandable?

range covers a lot of ground: a huge capacity spread, a highly flexible selection of operating styles, an affordable choice of capital investments – all with reliable and outstanding performance and backed by lifetime service and upgrade opportunities.

"We're here to enable your trouble-free and cost-effective formaldehyde production. We'd like to help you find the best answer".

The role of the catalyst

The ability to adopt a particular strategy depends not only on the plant but also on the catalyst used and the loading plan selected and in the first presentation Johan Holmberg showed some of the hows and whys.

He described how Formox's loading plans had progressed over the years and how development and feedback from our clients had resulted in the current broad spectrum, each of which could be customized to meet the requirements of customers with a diverse range of equipment and needs.

A recap of CAP 2.0

It was then Ronnie Ljungbäck's turn to share the latest experience with CAP 2.0, the most recent development of the CAP concept. Had it been the success that Ronnie hoped when it was first announced at Formaldehyde Europe in 2009? Have Formox been able to deliver on earlier promises and expectations? The answer was a resounding yes with CAP 2.0 now in use at many sites around the world and delivering lower costs through lower pressure drop and in many cases, higher yields.

Taking it a notch up – CAP 2.0T

After lunch, it was time to look to the future – and starting with the immediate future – as Johan Holmberg reported on a new CAP development: CAP 2.0T. Johan described how a better understanding of CAP and recent work into the ageing process had enabled Formox to revive a catalyst type which had not been on the market for some time. Incorporating this catalyst into the new loading plan is advantageous, resulting in higher yield and low pressure drop. For Johan this was the best option for most, if not all, clients. Having said that, he went on to announce that CAP 3.0 was already under test!

Closing with an open forum

Although Johan's presentation was the final formal presentation of the conference, it wasn't quite over yet. First Bob Crichton gave a succinct summary before Ola Erlandsson took over to moderate the final act of the San Francisco session – an open forum. The main interest here appeared to be in the turbo-charger concept and a number of interesting questions were asked – and answered. But for more news on this you will need to wait until the first full scale unit comes on stream later this year.

Formaldehyde Americas 2011. An optimistic group of 60 attendees from 15 countries gathered in San Francisco to network, discuss and exchange information related to the formaldehyde business and operation of formaldehyde plants.

Formaldehyde Europe 2012

Read more about the next conference in the autumn/winter issue of *Informally Speaking* or talk to your Formox representative.

Continental Disc protects equipment & people… through failure!

Rupture discs used to protect reactors from damage in the event of methanol deflagration are extremely important to the safety of your plant, and should never be taken for granted. That's why we are very particular about where we get our rupture discs from, and about making sure they are handled in the correct way – not just in Perstorp, but also at our customers' sites.

For over 10 years Formox has turned to Continental Disc Corporation for obtaining the rupture discs installed in our plants. But who is Continental and what makes their products so special? We recently caught up with Mike van den Bos, Regional Sales Manager at the company's European office in The Netherlands, to get his response to a few questions we were just 'bursting' to ask…

Continental will turn fifty in 2015. If you were to celebrate that milestone today, what are some of the things you might highlight?

Well, we've come a long way since we first started out with only a handful of people in the U.S. and just two basic rupture disc designs. Today we are over three hundred team members worldwide serving nearly forty different industries with different types of rupture discs and related products. Our growth over the years is due to a combination of successful product innovations and strategic acquisitions, such as LAMOT® in 1990 and Groth® in 1999.

How many different types of rupture discs do you make, and where are they manufactured?

We make over thirty rupture disc products, which fall into three main categories: Reverse Acting, Specialized Rupture Discs and Tension Type. This last type is what we supply Formox with, designed for systems where the pressure of the process media is exerted against the concave side of the rupture disc. All discs are manufactured at our main production facility in Liberty, Missouri, which is where our corporate headquarters, with sales, engineering, quality assurance and other major departments, are located. We also make valves and flame arrester products at facilities in Houston, Texas and in India.

Why do you think your customers choose Continental?

Our business is about saving lives, protecting equipment and even protecting the environment. All of these things are important to our customers, who, according to an independent survey, have ranked us No. 1 in the market for the fourth straight year, based on our product quality and our ability to meet their delivery promises.

Unlike most products, yours are actually designed to fail. How do you know they will fail when they are supposed to?

Rupture discs are one of the few devices that are individually specified to meet the demands of each application. This takes a lot work on the part of engineers, often involving a detailed hazard analysis, to determine the ideal specification to protect plant equipment, plant personnel and the environment. The specification will typically summarize rupture disc size, material of construction, burst rating and temperature, acceptable ranges and tolerances, certifications required and various options such as linings, coatings, cleaning or special testing requirements.

And how do you go from specification to reliable rupture disc?

An engineering review and a special computer configuration program evaluate the specification. The program selects the proper material thicknesses and supplies a bill of material for the disc and holder. Preliminary tests are done, adjustments are made, and then a disc maker takes over. During the process everything from material thicknesses to the length of slots are optimized in order to make sure the disc will burst within the agreed range, at the specified temperature and without fragmenting, and will also be able to withstand full vacuum.

Continental Disc Corporation's R-L-CDCV composite type rupture discs consist of 5 components. The protective ring, domed top section and vacuum support are made of 316 stainless steel, while the slot cover and seal are made of Teflon for additional corrosion resistance.

You mentioned testing. What more can you tell us about that?

Once all criteria are met in the dies and press, the final test breaks required for certified rupture discs are performed in holders and flanges similar to those used at the plant site. The final testing is frequently performed in an oven at the specified burst temperature. All test breaks must fall within the specified manufacturing range to qualify the lot of discs for shipment. Any break outside the specified range requires the lot to be remanufactured. Everything is witnessed, signed off and documented, and each lot of rupture discs includes a Burst Test Certificate verifying the specification and providing the results of the final lot tests.

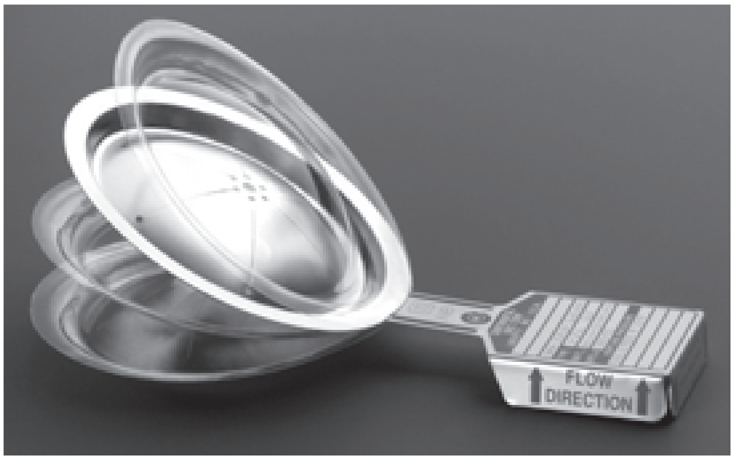
Why does the Burst Test Certificate often indicate different burst temperature and pressure compared to design values?

The actual stamped rating of the discs is determined by averaging the minimum of two test break values. For this reason the actual stamped rating will likely vary slightly from the nominal specified rating, but will always fall within the manufacturing range originally agreed upon.

The discs also come with installation instructions in the package, but if I were an installer, what specific issues would you caution me about?

There are many things to keep in mind when

Unlike most products, rupture discs are actually designed to fail. As the process pressure increases beyond the allowable operating pressure the tensile strength of the material is reached and rupture occurs.



Rupture disc. Different layers from bottom-up: Vacuum support, Seal, Slot cover, Top section and Protective ring (optional).

The rupture disc's specifications and flow direction are clearly labeled on the tag to ensure correct installation.

installing a disc, and some are really important to pay attention to, like the flow direction. The rupture disc is provided with a J-Hook or 3D-flow direction tag so you can be sure to correctly install the rupture disc relative to the flow. Secondly, never install the disc if the dome area shows any signs of damage, and avoid reinstalling discs. Always use a torque wrench and tighten according to the recommended torque values.

What about the film covering the top of the discs?

Good question. Some people mistake the thin Teflon of the liner for a protective packaging film and remove it. But actually it is a component of the disc and should not be removed. It is there to add corrosion resistance. We do sometimes use "shipping protectors," usually made from aluminium, to protect our more fragile discs during transit. But these are always clearly marked "DO NOT USE."

You also mentioned torque and using a torque wrench. Why?

Most rupture discs work together with a holder designed to help control bursting characteristics and provide a leak-tight seal. The mating flanges have to apply the right amount of clamping load in order for the unit to function and seal correctly. Otherwise there is a risk for leakage, disc slippage and increased variation in burst pressure. Even permanent damage to the holder.

The clamping load is affected by alignment of the pipe flanges, type of flange gaskets and lubrication on studs, and of course, the torque applied to the studs. Installers can find the recommended torque on the rupture disc tag or in the instructions, and should use a cross-torquing sequence in increments of max 20% of the final torque for even tightening. We also recommend re-torquing the studs after a period of time and after bringing the system up to operating temperature, to compensate for normal relaxation of bolt loads.

So leakage is also an issue. How are bursting and possible leakage detected?

A disc that has burst is usually obvious, but burst detection accessories can also be used to trigger a remote alarm, valves, pumps, etc. in the event of bursting. Leak detection can be done in many different ways, like installing two discs in series with a gauge in between for creating a redundant, zero-leakage system.

What about the lifetime and maintenance of your rupture discs?

There is no one correct answer to this question as disc life is influenced by the history of temperature and applied pressure over time. We normally recommend replacing every disc every year, but it's not unusual in some cases for maintenance managers to stretch service life to three to five years. Things to consider when developing a maintenance plan are the severity of the conditions the disc is subjected to, including corrosion, pressure, cyclic duty and so on, a possible history of premature failures, and how much a premature outage might cost compared to the cost of replacement during scheduled downtime.

Charles Hodgdon
Contributing Writer

New plant capacity – same rupture discs

Formox has developed a method for increasing the capacity of older reactor installations by increasing the methanol concentration. This does not affect the rupture discs however, so old discs can still be used. That's because disc sizes are determined by the volume in the reactor and assuming the worst possible gas mix. The design assumes the highly conservative case of stoichiometric methanol concentration in pure air. The plant relief valves still need to be checked after increasing the capacity.

Formaldehyde future
Revisited

In preparation for the Formaldehyde Americas seminar in San Francisco (see page 4-7) I looked back over the formaldehyde consumption forecasts made at previous seminars. At the very first presentation at Formaldehyde Americas, New Orleans November 1995, it was said that demand by the year 2000 would reach 20 m MTPA (37% basis). By the time of the Miami seminar in 2003, we were looking 7 years ahead to 2010 (30 to 32 m). As it turned out, both these estimates proved to be more right than wrong (within 10%) – but perhaps more by luck than good judgement!

I say luck because in China a lot had been happening under the radar, a fact that we commented on at the Formox seminars in Bangkok (2007) and Toronto (2008). At these seminars the forecast was that consumption would hit 37 m MTPA by the time of the recent San Francisco seminar. As it happens this was about right. Consumption was expected to go on to break the 40 m barrier by 2013/15. However, we cautioned that, as always, the actual path taken would depend on the wider economy. And given what happened soon after the Toronto conference, this was a warning well worth heeding.

So what do we think now, one year on from Bali? And what do we expect to happen beyond 2020?

These questions were visited in the last issue of *Informally Speaking* and this piece is a further development of that article – Formaldehyde's Future: Shock or No Shock?

It is self evident that formaldehyde's future prospects are only as good as those of its many and varied derivatives; but for reasons explained in *Informally Speaking* (Spring 2010 – Behind the Smoke and Mirrors) we can simplify the analysis as most downstream products can be categorized as either being "Wood" or "Chemical" related. Having said that there are a host of small volume outlets that are difficult to track; these are accounted for partly in the chemical category as "unidentified" while the rest are lumped together as "others".

"Wood" comprises formaldehyde used in binders and overlays for wood based panels and related products such as laminate flooring and furniture. "Chemicals" represent the use of formaldehyde as a chemical intermediate in the manufacture of, for example, plastics, coatings, textiles and herbicides. Over the years both "wood" and "chemicals" have used about the same amount of formaldehyde – though the percentage has changed from time to time (Fig. 1) in response to both macroeconomic factors and the economic health of particular product sectors. For example, the relative importance of wood fell in 2008 due to the disproportionate impact of the recession on the building industry, particularly in North America.

Our current best estimate of consumption over the past ten years is shown in Fig. 2. As you can see the 1995 projection, 20m by the turn of the century, was not so far out; neither was the 2010 forecast made in 2003 – 32 to 34 m – but we have the recession to thank for that!

At the time of Formaldehyde Asia last year all the signs were that consumption had trended down. Why then did 2007, 8 & 9 turn out to be more or less flat? Given the impact of the recession on the wood panel business in particular, then, at least from the perspective of North America (and indeed much of Europe), this was not what was expected.

Several factors appear to have contributed to this unexpected result, for example:

- While the recession was truly global, in much of Asia, parts of Europe and South America, it was short lived; on an annual basis the fall in formaldehyde consumption was much less severe. Indeed only North America and Western Europe were slow to recover.
- As can be seen from the global data superimposed on Fig. 3 (right hand scale), the 0.5 m MTPA fall in North America contributed half of the entire global fall in wood sector consumption. Clearly falls in other parts of the world were less severe.
- The forecasts underestimated chemical growth in China, particularly as regards butanediol; contrary to expectations (see "Reppe Rides Again – *Informally Speaking*, Autumn 2006) the formaldehyde consuming acetylene route contributed almost all the global expansion for this high growth chemical.

A snapshot for the coming year – based on downstream capacity and estimates of the likely running rates – modest for Europe and North America, better for Asia and the rest of the world – anticipates a return to growth with a usage of 40 m MTPA – up from an expected 38 m in 2010. If this proves correct, then capacity in 2011 will be on average 74% utilized – a big improvement compared with recent years and a remarkable result in the circumstances. And the signs are good; demand for new plants has already started to pick up. The anticipated regional split is shown in Fig. 4; Asia has by far the largest share – 47% and rising compared with 37% at the time of the Toronto seminar.

For much of the world the factors driving demand, at least over the next ten years, will be much the same as in the recent past; plastics will continue to substitute for metals and "real" wood will be replaced by engineered wood and panels. And these industries will continue to need formaldehyde as, for the most part, there is no viable alternative. But there are short to medium term issues such as low construction activity; will this persist?

The conventional view is that the underlying demographic reasons for building new homes remain unchanged; rather the trend has been obscured by financial and other factors. In the USA, for example, an eventual return to 1.6m housing starts is expected when the dust finally settles. Having said that, the overall effect on the US formaldehyde industry was not as severe as the drop in housing starts suggests; though housing starts fell by 76% between 2005 and 2009, formaldehyde usage in the wood industry "only" decreased by 20% (see Fig. 3).

Globalization has spread the new generation of materials into the wider world; in many regions it is new demand that is being created and GDP/capita is the main driver; greater prosperity means more cars, more homes – and more IKEA products in those homes. For example, in the 15 years since we first started looking in detail at the different regions, panel consumption has soared in Eastern Europe, China, Brazil and Russia. India is also starting along the same path. In such regions GDP/capita will continue to rise in the short to medium term, creating new demand for formaldehyde derived products. But longer term, beyond 2020, the assumption that GDP/capita will continue to rise and that formaldehyde usage will increase in tandem, needs to be challenged. Last year China overtook Germany as the world's largest exporter, it also became the world's second largest economy, overtaking Japan; by the mid 20s it will be the world's largest economy.

This will be a difficult transition and a more developed Chinese economy will also mean slower growth; an ageing population will be a further economic drag – a problem that Japan and many western countries will also experience. While India and other parts of the world may compensate, it is a distinct possibility that growth in formaldehyde demand will slow between 2020 and 2030.

The growth rate will also slow if maturing products are not replaced; but unfortunately there are, as yet, very few new applications for formaldehyde.

The recent boost provided by butanediol in China may not stand the test of time; the acetylene route used raises some environmental issues. Also laminate flooring, a significant driver for many years, is maturing. Given that volume products are based on thin MDF – a high resin consumer – flooring has had a significant effect on formaldehyde demand. In fact, to a first approximation, laminate flooring now accounts for around 3% of all the formaldehyde consumed in the world. With no new products waiting in the wings, formaldehyde growth rates will eventually come under pressure; unlike in the past, a loss in one area cannot be offset by growth in another.

But maturing economies and maturing products are not the only uncertainties. Formaldehyde itself may become increasingly unacceptable; we can also expect continuing pressure on energy prices; this will inevitably impact on methanol and formaldehyde derivatives will become relatively more expensive.

Formaldehyde has emerged as an emotive topic more than once over the last 40 years; however, this time around the pressure has been more sustained. Hence it is likely that for most of us

Fig. 1 Split between sectors

%	2008	2009	2010
Wood	44.2	46.2	47.0
Chemicals	48.8	46.9	46.0
Others	7.0	7.0	7.0

Globalization has spread the new generation of materials into the wider world.

Fig. 2 Estimated formaldehyde production (37% basis)

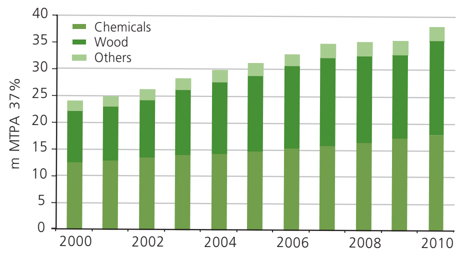


Fig. 4 Distribution of consumption by region

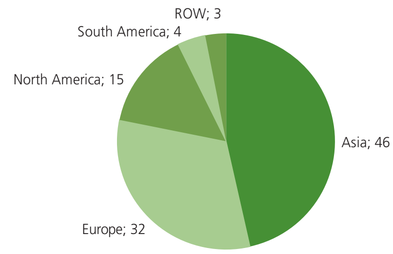


Fig. 3 Formaldehyde consumption in the wood panel industry

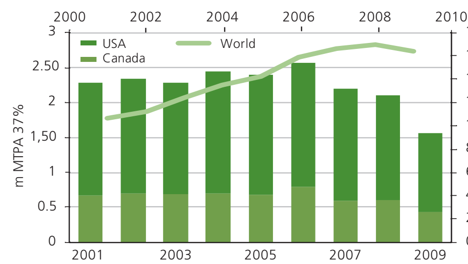
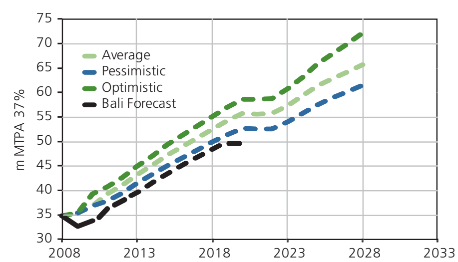


Fig. 5 Latest forecast



formaldehyde will be more tightly controlled. Though this is unlikely to have any effect on the "chemical" sector, where formaldehyde is an intermediate, it will, as happened in the past, have a bearing on the way the wood sector develops. However, as most of the growth in the wood sector will occur in regions where formaldehyde is a much less emotive topic, the effect may not be as pronounced as you might think.

There is enough uncertainty around to suggest caution when making our forecast. And the effect of several scenarios is shown in Fig. 5. The top line, the optimistic forecast, is "business as usual", a continuation of global economic growth (with the exception of an assumed 2020 turndown!); continued growth in the chemical sector and further penetration by wood panels in global markets.

The lower or pessimistic forecast, assumes wood panel penetration rates will slow as equilibrium is reached and products like laminate flooring mature; lower economic growth rates are also factored into this forecast. Of note is the fact that the Bali projection made 12 months ago now coincides with the pessimistic line – illustrating an old adage that the future always looks bleaker from the bottom of an economic trough! As stated earlier, the Bali conclusion was annual formaldehyde consumption rising to 50 m MTPA by 2020; now this is very much at the lower end of the spectrum – optimistically it could reach 59 m and go on to top 75 m by 2030. Pessimistically 2030 may only achieve 60 m, a lower growth than in recent years – but not unknown in the not so distant past. However, we can expect the actual demand path to meander between these two extremes; the average, the black line in Fig. 5, would be a safer bet.

BY

Bob Crichton
Formaldehyde Specialist
R.S Crichton & Associates

Global methanol market update

As we are entering the 2011 summer, the methanol industry continues to experience a very healthy demand. Since the financial and economic crisis during the second semester of 2008, the global methanol demand has increased by ~6% on an annual basis, demonstrating a higher growth rate than the global GDP rate and will reach close to 50 MMT this year.

Methanol is a building block of the modern chemistry and is used in a variety of derivatives: the so-called "traditional derivatives" representing 65% of the demand and the emerging "energy applications".

Formaldehyde is the main outlet for methanol; the 37 MMT of formaldehyde produced globally require approximately 15.5 MMT of methanol. Acetic Acid, Methylmethacrylates, Methylamine, Silicones and other solvents are making up the remaining demand for chemical derivatives.

In recent years, methanol has also emerged as a viable alternative transportation fuel and source for energy applications, including methanol-blended gasoline and fuel additive, and is used in the production of biodiesel and dimethyl ether (DME).

Supported by a strong energy environment both in terms of growth and crude oil prices, methanol has increasingly provided a cost competitive alternative to oil and gas derivatives. China with its strong appetite for energy products is leading the way for methanol usage in fuel blending and DME. Similar to China, several countries are developing DME/LPG blending for cooking and heating purposes.

On the supply side, during this past year, there has been capacity additions both in China as well as in Egytp [eMethanex, 1.3 MMT capacity], in Oman [Salalah, 1 MMT], in Brunei [MGC, 0.9 MMT] and in Venezuela [Metor II, 0.9 MMT]. Most recently Methanex restarted its idled methanol plant in Medicine Hat, Canada. Following months of site preparation work and environmental improvements, the 470 KT per annum plant was restarted on target in April 2011. This plant was idled in 2001 due to the rising cost of natural gas feedstock. Recent changes in the North American natural gas market, mostly related to shale gas and the resulting lower price environment made the plant a competitive supply source for North American customers.

While these new capacities have added additional methanol supply, the methanol industry keeps facing planned and unplanned outages, related to technical challenges or feedstock and utilities restriction. These outages combined with the ongoing demand growth are requiring the Chinese methanol plants to operate at higher rates. As China is the marginal producer with a fragmented, high- production cost industry that needs to operate to balance the global markets, methanol has experienced several months of firm price environment.

2011 is definitely another fascinating year for the methanol industry

BY

Karine Delbarre
NA Product Manager
Methanex Corporation

The ACC formaldehyde panel

Challenges in 2011 & beyond

At its June 2010 meeting, the American Chemistry Council (ACC) Board of Directors approved the formation of a new self-funded formaldehyde panel to represent the producers, suppliers and users of formaldehyde and formaldehyde products. The Formaldehyde Panel is housed within ACC's Chemical Products and Technology Division.

The Chemical Products & Technology Division (CPTD) provides unique scientific, technical and management services on chemical specific issues to chemical companies that participate on self-funded chemical groups, such as the Formaldehyde Panel. CPTD services are available to both ACC member companies and non-member companies, including large and small manufacturers, formulators, downstream users and distributors.

Since its inception, the Formaldehyde Panel has been actively engaged in advocacy issues critical to the industry. For example, the Panel provided extensive comments to the National Research Council (NRC) in its independent scientific review of the U.S. Environmental Protection Agency's (EPA) draft risk assessment on formaldehyde.

EPA's draft assessment attempts, in part, to identify the level at which formaldehyde presents a potential risk for adverse effects on human health. For example, EPA's proposed cancer risk value is 0.008 parts per billion, yet this risk value is orders of magnitude lower than the amount of formaldehyde normally found in human breath, which according to the World Health Organization ranges from less than 0.8 to 8 parts per billion. EPA's proposed risk value, therefore, leads to the scientifically implausible conclusion that human breath poses an unacceptable cancer risk.

The NRC issued its much anticipated review in early April, 2011. The NRC committee did not mince words in harshly criticizing EPA's draft risk assessment:

"In general, the committee found that the draft was not prepared in a consistent fashion; it lacks clear links to an underlying conceptual framework, and it does not contain sufficient documentation on methods and criteria for identifying evidence from epidemiologic and experimental studies, for critically evaluating individual studies, for assessing the weight of evidence, and for selecting studies for derivation of the RfCs [reference concentrations] and [cancer] unit risk estimates."

The NRC committee's report contained numerous other criticisms, too many to delineate in this article. The committee's discussion of leukemia, however, is particularly noteworthy. The committee criticized EPA's assessment for grouping various types of leukemias and lymphomas together, because the cancers are not closely related. Specifically the NRC committee writes, "The committee does not support the grouping of 'all LHP cancers' because it combines many diverse cancers that are not closely related in etiology and cells of origin."

Moreover, in rejecting EPA's causality determination for leukemia, the NRC committee noted, "[EPA's] conclusions appear to be based on a subjective view of the overall data, and the absence of a causal framework for these cancers is particularly problematic given the inconsistencies in the epidemiologic data, the weak animal data, and the lack of mechanistic data."

Importantly, the NRC committee's criticisms extended beyond the formaldehyde risk assessment. As noted by the committee: "Many of the problems are similar to those which have been reported over the last decade by other NRC committees tasked with reviewing EPA's IRIS assessments for other chemicals. Problems with clarity and transparency of the methods appear to be a repeating theme over the years, even though the documents appear to have grown considerably in length." In an attempt to remedy this untenable situation, the NRC committee delineated numerous critical steps for the development of scientifically sound risk assessments.

The Formaldehyde Panel has also been leading advocacy efforts to urge U.S. Health and Human Services (HHS) Secretary Kathleen Sebelius to revise the current draft Report on Carcinogens (a report periodically issued by HHS), so that it fully reflects the conclusions of the NRC committee's report on formaldehyde. As noted above, the scientific evidence as reviewed by the NRC fails to support reclassifying formaldehyde as a known human leukemogen or any other lymphohematopoietic cancer.

As with 2010, 2011 and beyond will pose significant advocacy challenges for the Formaldehyde Panel. The EPA, for example, plans to finalize its draft risk assessment on formaldehyde that ultimately will guide governmental policies and risk management. Given the NRC's sweeping criticisms and recommendations, however, EPA faces a daunting task, and a revised and scientifically supported assessment is not expected any time soon.

The governmental and policy decisions made in the coming months and years are expected to have long-term impacts on the formaldehyde industry. The Formaldehyde Panel can most effectively address these challenges through a unified and coordinated effort of a diverse membership, representing producers, suppliers and users of formaldehyde and formaldehyde products. Please feel free to contact me with questions regarding membership or the Panel's current activities.

I can be reached at david_fischer@americanchemistry.com or 202-249-6717.

BY

David B. Fischer
M.P.H., J.D.
American Chemistry Council

POM

– an excellent engineering thermoplastic

POM is short for polyoxymethylene, and is also called polyacetal, acetal resin or polyformaldehyde. As a lot of other interesting materials POM was invented in Germany in the 1920's. At the early stage there were problems getting the material stable and it was not commercialized or patented until some 30 years later when it was successfully synthesized by DuPont.

All acetal resins are derived by polymerization of formaldehyde or trioxane. The generic formula is $HO(CH_2O)_nH$. This might be familiar for you as being the formula for paraformaldehyde and when n is in the range 8 to 100 the product is in fact paraformaldehyde; but when n is above 600 acetal is the common name. Either going the formaldehyde or trioxane route, the acetal resin is quite difficult to produce in good yield and quality. This is one reason why there are not a lot of manufacturers in the world, the number is probably still less than 20.

The first POM plant was built by DuPont in 1956 in the US. They use the so called homopolymer route and their product is named Delrin®. Some six, seven years later Celanese started the production of their products, called Celcon® and Hostaform®, using the co-polymer route.

In the homopolymer route, chain growth is based on formaldehyde. The purified formaldehyde is polymerised under carefully controlled conditions until the desired chain length is reached, the chain is then capped to stabilise the molecule. Acetic anhydride is a commonly used stabilizer. Other compounds such as antioxidants may also be added to the capped monomer.

In the case of the co-polymer route, formaldehyde is trimerised to trioxane under acid catalysis. The trioxane is first purified, then polymerized. The co-monomer is typically dioxolane but ethylene oxide can also be used, the final product is essentially a polyoxymethylene and hence similar in structure to the homopolymer.

POM is characterized by its high strength, hardness and rigidity. Due to its high crystalline composition it is intrinsically opaque white but it is available in all colours. These properties makes POM an excellent engineering plastic well suited for high strength at moderate temperature applications. A good example is gear wheels because it's a tough material with a very low coefficient of friction. However, it is susceptible to polymer degradation under certain conditions, which is why both polymer types are stabilized.

Polyacetal resins have the highest balance of strength and stiffness among unreinforced thermoplastics and also have very good dimensional stability. Due to these properties a common and important usage is to replace metals in mechanical components of appliances, motor vehicles and other industrial machinery. There is also a big variety of other consumer goods such as aerosol valves, pens, zippers, knife handles, sports accessories, locks, hinges, etc.

POM is typically supplied in a granulated form and is then formed into desired shapes by normally using injection molding and extrusion. Both methods require applying of heat and pressure.

High performance engineering components are typically injection-molded but the material is also commonly extruded as continuous lengths of round or rectangular section which then can be cut to length and sold as bar or sheet stock for further machining.

Today there is a big focus to reduce weight (and by doing that reducing fuel consumption) within the industrial automotive production. In this field POM plays an important role and more and more components in our cars are substituted. Relatively heavy components traditionally made from metals are now frequently replaced by plastic components.

Market penetration and market share in this business is all about developing new applications. This is the reason why we for the last decade or so have seen a shift from Europe and North America towards Asia (fig. 2). Growth in the longer term is likely to be in the Far East and is likely to be met from local production – local producers as well as the majors are setting up production capacity, particularly in China.

The very strong (~7.5%) average growth rate we saw during the 90's slowed down somewhat and for the past 10 years the corresponding average has been below 5%. Thanks to further development of the acetal resins properties and the demand from the automotive industry for strong, light and comparable cheap materials we now see a stronger growth again (>7%) which is likely to stay over the coming 5 years or so.

Good and stable formaldehyde quality is essential to have a successful POM production. High concentration and low methanol content is beneficial as well as a high and consistent purity. The total formaldehyde demand for POM globally is today ~4 m MTPA 37%. Almost 45% of this formaldehyde is produced with Formox formaldehyde technology which probably is an indication of something.

We think this is one of the best ratings our formaldehyde technology and our plants can get.

Fig. 1 The Co-polymer route

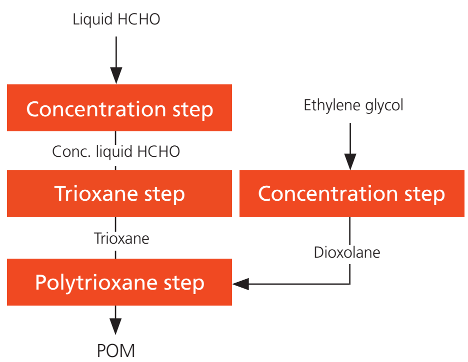
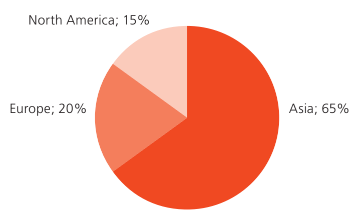


Fig. 2 POM production – regional split



BY

Lars Andersson
Plant & Catalyst Sales Manager
Formox AB

Dust & catalyst reloading

There can be a dust problem during catalyst reloading if the ventilation is insufficient. The molybdenum trioxide in the catalyst is classified and has an exposure limit of a maximum 10 mg/m^3, counted as Mo in many countries.

Formox took measurements during the reloading of a reactor at Perstorp in 2010. The ventilation was set up in the recommended way, with the top reactor manholes open and a portable ventilation fan drawing out air through one of the bottom reactor manholes. Measurements were taken during the vacuuming out of the old catalyst and during the machine loading of the new catalyst. Personal sampling equipment was carried by some of the people working in the reactor. The conditions can also be compared with hand loading and using a tent in the case of older reactor designs without top dome manholes.

All measurements are well below the maximum exposure limit of 10 mg/m^3.

Unloading gives very low exposure values. This is probably due to the use of vacuum during the unloading that also removes the dust. The values cannot be used if a different method is used for unloading.

The values for loading are higher but still well below the limits. The extraction fan creates a draft down through the tubes minimizing the dust problem.

By Ola Erlandsson
Technology Manager
Formox AB

Worker	Molybdenum, mg per m^3
Unloading	
Claudio	< 0.02
Micke	< 0.02
Oskar	< 0.02
Loading	
Stig	1.2
Tom	2.0
Tom	1.2

Conclusion

Dust & catalyst reloading

The recommended ventilation with one fan extraction air through the lower reactor manhole gives sufficient ventilation to work without additional respiratory protection during catalyst reloading.

Mo update

The molybdenum (Mo) price has been relatively stable the last 5 months, from December 2010 until beginning of May, the price has hovered between 16 and 18 USD/lb and there has been a weak tendency for increasing price. Still, we are a bit behind the predicted 24-28 USD/lb as discussed in the spring/summer edition of *informally speaking* last year.

There may be some reasons why the Mo price will shoot up; one is the new capping in China of mining of certain metals, where molybdenum is one of the strategic metals. Due to China being the largest steel manufacturer at present time, where the car industry is an important consumer of steel, this will lead to import of molybdenum from outside China, which in turn should push the world market price level of molybdenum up.

Another reason for an increase in Mo price could be the new usage of Mo in nano-technology or as catalyst for producing hydrogen. If these uses are successful, the demand for Mo should rise and this normally leads to a price increase – unless the market is prepared for it.

Of course, what lies in the future, no one can tell for sure, but what you can rely on for sure is that we can keep reasonable stable net prices, thanks to you returning spent catalyst and thanks to our catalyst recycling system!

By Ronnie Ljungbäck
Product Manager Catalysts
Formox AB

Boiler feed water pumps

– Net positive suction head, friction losses & fixes

The availability of high quality boiler feed water is crucial for any steam-generating system. The water must both be free of major sources of contaminants and enable pumping to the steam generating vessels. This article deals with the latter. That being said, if the water fed to the plant is of inferior quality it will only be a matter of time before production has to be stopped and heat exchangers cleaned or even replaced.

When experiencing issues with the boiler feed water pump system the reason in almost all cases is one of the following:

- Poor operation
- Substandard maintenance
- Design faults

When designing a pump system various factors must be taken into account, the most important of which is the Net Positive Suction Head (NPSH); the actual pressure head at the pump suction flange. Understanding the concept and importance of NPSH is vital for proper design and operation of a pump system. The first thing we must understand is that a boiler feed water pump is designed to move liquid water. If at a given temperature the water attains a pressure lower than its vapor pressure it will vaporize, causing the pump to cavitate. The concept of cavitation involves a partial or complete vaporization of the liquid phase. In turn this results in reduced pump capacity and at worst damage to the pump impeller caused by the collapse of vapor bubbles formed during the phase change.

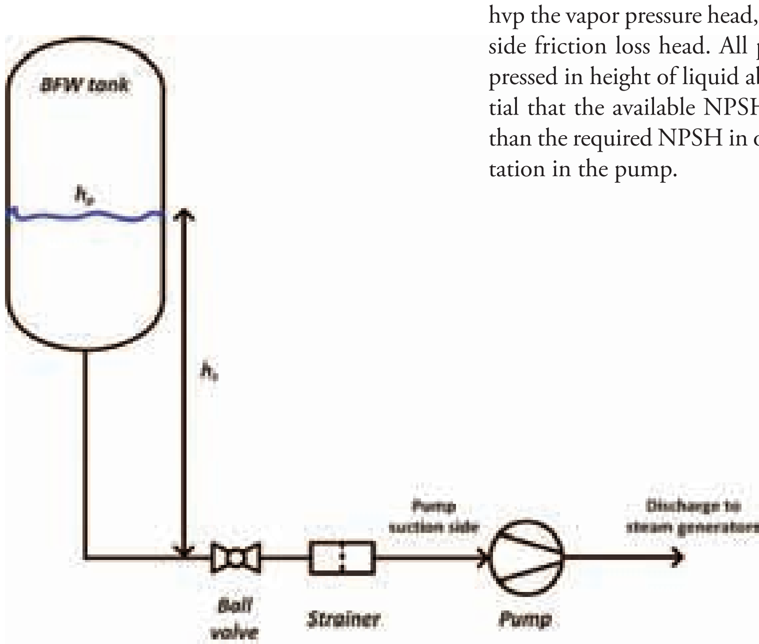


Fig. 1. Boiler feed water system from a Formox formaldehyde plant.

In order to avoid this, pump vendors specify the NPSH needed by the pump for a given volumetric capacity. This is called NPSH required ($NPSH_r$). $NPSH_r$ is a function of pump design and varies with the flow rate (shown in the pump curve). As users we specify to the pump vendor how much NPSH he has access to when choosing the proper pump.

The NPSH accessible is better known as NPSH available ($NPSH_a$). $NPSH_a$ is a function of the process system in which the pump should operate and forms the basis for pump selection. It can be calculated by the below equation:

$$NPSH_a = h_p + h_s - h_{vp} - h_f$$

where hp is the pressure head in the suction vessel, hs the static suction head (vertical distance between liquid surface and pump center line), hvp the vapor pressure head, and hf the suction side friction loss head. All parameters are expressed in height of liquid absolute. It is essential that the available NPSH always is greater than the required NPSH in order to avoid cavitation in the pump.

How can this then be applied to an existing pump system?

Let us study an example of a boiler feed water system in a Formox formaldehyde plant equipped with a boiler feed water tank and pump (Fig. 1). The pressure at the liquid surface in the tank is approximately 1.2 bar a or 12.2 m water. The boiler feed water tank is placed ~4 m above the pump centreline and has a liquid level of ~2 m, resulting in a static suction head of 6 m. If the temperature before the pump is 100 °C, the vapor pressure is 1.01 bar a (10.3 m). The friction losses will depend on the flow rate, for 30 m^3/h as value approximately 0.05 bar (0.5 m) is reasonable; this then includes friction losses in pipes, bends, valves, and strainers. Summarizing gives $NPSH_a = 12.2 + 6 – 10.3 – 0.5 = 7.4$ m.

A pump with a required NPSH for that flow rate of 3 m has an additional 4.4 m in margin. If instead the boiler feed water tank has a low liquid level, 0.5 m, the strainers are clogged increasing the friction losses to 0.5 bar (5 m) the available NPSH becomes 1.3 m and we end up in a situation where the available NPSH is less than that required by the pump and could therefore experience cavitation.

In this case it is the effect of both poor operation (low liquid level) and poor maintenance (clogged strainer). The clogged strainer could also be the result of poor quality boiler feed water. The conclusion that can be drawn is that operation should always be monitored, not neglecting proper maintenance routines, and ensuring the boiler feed water entering the plant is of high quality.

BY

Christian Andersson
Process Engineer
Formox AB

Paradrill – The solution to plugged valves

Our recommendation is that once a month you measure the pressure drop over the main vessels in order to detect any abnormal increase. But every now and then when you open the gas sample valve you may realise it's blocked with paraformaldehyde.

The solution may be to take a tool, for instance a screwdriver or similar, and force it in. This operation is hazardous as it's uncontrolled and you may be exposed to process gas. There is also a risk of getting the tool stuck or damaging the valve, with the result that you can't close the valve again.

How come paraformaldehyde pluggs the valves?

Plugged valves mainly occur after the reactor and vaporizer (shell side), where the concentration of formaldehyde is high. The gas sample valve is placed on a small pipe that is located on the process gas pipe. Paraformaldehyde formation often occurs due to low temperatures where the gas stands still, which is the case in the nozzle for the gas sample valve.

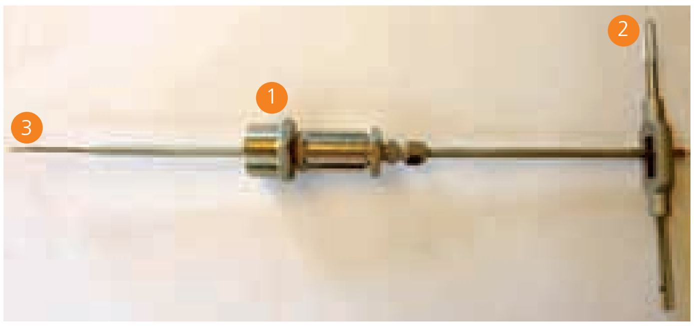
With the paradrill you can open the valve safely, with no risk of emissions or damage to the valve. Simply screw (1) the paradrill onto the threads of the valve, open the valve and start drilling by screwing at (2). The edge (3) will screw into the paraformaldehyde.

Once you are through the paraformaldehyde plug, unscrew the drill and close the valve again. Disconnect the paradrill from the valve and now you have a functioning valve again and can easily perform the pressure drop measurements.

Even though the paradrill makes the opening of a plugged valve safer, you will still need the same personal protective equipment as always. Your personal safety should never be jeopardized.

The paradrill is easy to buildyourself or you can purchase it from Formox for EUR 200. Please contact your Formox representative for more information.

By Eva-Lena Ekblad
Process Engineer
Formox AB



In remembrance of Robert Walker

We were sad to learn that Bob Walker, a good friend of Formox and one of the pioneers of the Formox process, has passed away. Bob´s experience with the Formox process dates back to his time with Reichhold Chemicals (Western division), the company he served for many years until he retired in the late 80s.

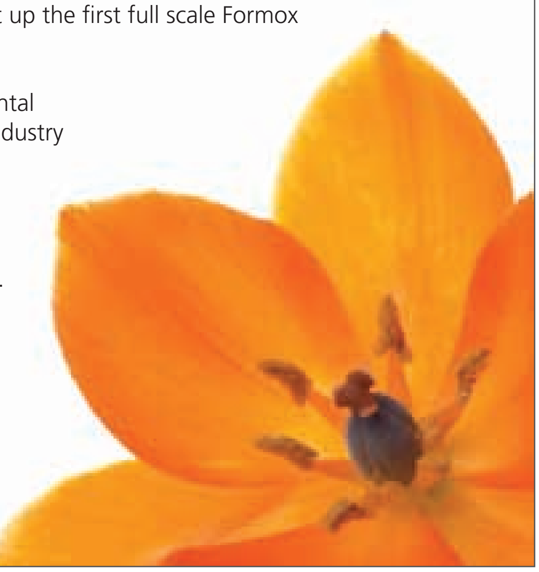
Bob´s recollections of those early years were described in an article he wrote for an early edition of *Informally Speaking* (autumn 1996). He also talked about his time at Perstorp, when he helped to start up the first full scale Formox plant in August 1959.

After his retirement he served Formox in a consultancy capacity and was instrumental in developing our catalyst business in North America. He was well known in the industry and Max Henning knew him and his wife Laureen better than most. Max has the following comments about him:

"Bob was a friend for many years. I tried, but failed to contact him a couple of years ago regarding our 50th anniversary and to find out if he could join the party. Apparently he was taken ill around that time and unfortunately never really recovered. We were therefore very glad that Bob and Laureen had been at our 40th anniversary, where most of our pioneers joined us."

"Bob was a true character and an inspiration to many people, including us. He will be sadly missed. Our thoughts are with Laureen and her family."

By Max Henning and Bob Crichton



Training, training & training

1. QAFCO
Ola Erlandsson gave a two day operators training on site for the new QAFCO 5 project in Qatar. The training was given already in 2003 for the QAFCO 4 project by the same teacher at the same place with some of the same participants.

2. Egger
In May, this delegation of trainees from Egger (Romania) came to Sweden to learn how to operate their new formaldehyde plant, which will soon be ready to go on stream.

3. Refresher training
A four-day refresher training was successfully held at Formox in Perstorp on April 5-8th. Nine people from Germany, Finland, Belgium and the US participated – all with different experience of the Formox process. Apart from learning about news and best practice in the class room valuable time was spent on networking and learning from other participant's experiences.

4. San Francisco training
An advanced training program was held in connection with the formaldehyde conference in San Francisco in March this year. 17 people attended from 9 different companies and focus was on optimal catalyst and plant operation.

How do Formox's customers rate us?

Formox has traditionally carried out a customer feedback survey every third year. However, the response rate was historically low and we felt the survey didn't let customers give a fair view of us.

So, the old Customer feedback survey was replaced with the Customer Opinion Survey.

A few criteria were important to us when we created the new survey: answers should be anonymous, Formox should not be involved in carrying out the survey, or involved with formulating the questions.

Customers were divided into 2 groups: Western Europe/US and the rest of the world. A professional company was hired and the survey was carried out in the autumn of 2010 and covered everywhere except Western Europe and the US.

55% of the contacts resulted in interviews over the phone for both quantitative and qualitative questions. The response rate was satisfying and hopefully this article can help increase interest and willingness in providing feedback for the next survey.

To conclude – which areas should we focus on to achieve a better score next time? This is what you think:

1. some of you think it is too complicated to do business with us
2. we are not as good as our competitors at communicating prices and price developments
3. it sometimes seems to be difficult to reach the person you are looking for at Formox
4. some of you would like to see us, or hear from us, more frequently
5. we should be better at handling complaints and communicating about them
6. lead times and communicating about delays in delivery should be improved

Actions taken already!

- We are expanding our organization and as a result you will hear from us more frequently.
- A smaller organizational change has led to Lars Andersson focusing even more on improving our technical support, both in content, but also response time and easiness of doing business with us.

Question	Average
How satisfied are you with the knowledge and competence of the sales rep	4.50
How satisfied are you with the lead time for Formox to handle a complaint	4.45
Formox's deliveries are complete and arrive on time	4.41
How satisfied are you with Formox's ability to effectively eliminate the reason for the complaint	4.27
When contacting Formox, you easily and quickly reach the person you are looking for	4.25
How satisfied are you with invoices, analysis certificates and other documentation	4.24
Overall, how satisfied are you with Formox as your supplier and partner?	**4.24**
Communication about orders and delivery inquiries	4.23
The quality of response from the Technical service department	4.20
The response time from Formox Technical service department when having technical inquiries or asking for samples	4.11
How satisfied are you with the product quality	4.09
The frequency of contact with the sales representative	4.07
If you have experienced a complaint regarding supply from Formox, how satisfied are you with the communication regarding a complaint	3.92

4.0 was our goal for the overall satisfaction so exceeding this with 0.24 is very encouraging for us and will be a bench mark in future surveys.

What next?

Those of you who didn't hear from us this time can look forward to being contacted for the next survey sometime later this year. We hope that you will take the opportunity of giving us your input. By doing so you help us learn about areas where we can improve and hopefully where we are doing quite well too.

Finally, a big thank you to everyone who contributed input to the 2010 survey.

new projects & start ups

New Projects

- An agreement has been signed for a Formox plant to Henan Coal Chemical Industry Group Fine Chemical Industry Co., Ltd., Hebi, China.
- Nantong Jiangtian Chemical Co. Ltd., Nantong, China, has signed an agreement for a Formox plant. This will be their third Formox plant on this site.

Ongoing projects

- The plant for Kolon Plastics in Kimchon-Si, South Korea is in the construction phase with scheduled start-up this year.
- The project for an FT3 plant for Xinjiang Markor Chemical Industry Co., Ltd. in Korla, China, is getting underway.
- The new Formox FS3 plant for Egger Technologia SRL in Radauti, Romania is in the construction phase, with start-up scheduled later this year.
- Work on the basic engineering package for a Formox FT2.5 plant for a client in Asia is in progress.
- The new plant for Ticona in Germany is approaching mechanical completion, with expected start-up 2011.
- The Formox UFC plant for the Q5 complex in Qatar, in co-operation with Saipem and Hyundai, is continuing to make good progress, with scheduled start-up 2011.

Start-ups

- The new Formox FS2.5 plant for Kanoria Chemicals & Industries Ltd., in Visakhapatnam, on the east coast of India, went on stream successfully in December.
- The first reactor line for a Formox FT3 plant for Ningbo Wanhua Polyurethanes Co., Ltd, China went on stream in January. This will be their second Formox plant on this site.

new...

Christian Luckmann
Consultant Engineer, Mechanical

Hedvig Ekman
Market Communications

Henrik Hansson
Process Engineer

We are pleased to welcome Henrik Hansson back to the Process Group, adding valuable knowledge and experience to the department.

Patrik Lindkvist
Manager Detailed Engineering

Ronny Lindsjö
Mechanical Engineer

Simon Smrtnik
Process Engineer

Sten Schmidt
Mechanical Engineer

Tomas Nelander
Process Engineer

Zhang Jianguang
Technical Support
Beijing office

Åsa Hallberg
Sales Coordinator

...& left

Andreas Wickman
Process Engineer

Henrik Lendrup
Process Engineer

Anne Rundström Eliasson
Sales Coordinator

Mattias Fridolf
Process Engineer

We are glad to have had Andreas, Anne, Henrik and Mattias as our colleagues and wish them the best of luck in their coming challenges.

new editor – new look!

With a new editor also comes a new look – I hope you'll find it refreshing! The scope is however still the same with market updates, news from Formox and articles on best practice etc. I welcome your feedback on both lay-out and content. Please feel free to contact me if there is something you would like to see more of or perhaps less. This issue is also available as a reader friendly version on our website, formox.com.

I look forward to hearing from you!

Hedvig Ekman

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.

Editor: Hedvig Ekman, tel +46 435 38174
hedvig.ekman@perstorp.com
Publisher: Marie Grönborg
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Formox AB
SE-284 80 Perstorp, Sweden
Phone: +46 435 380 00
E-mail: formox@perstorp.com

Perstorp Formox