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Discussions

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EDITOR'S NOTE

This volume contains the summaries of the discussions of the papers presented at the 2000 IFA Technical Conference, held from 1 to 4 October 2000 at New Orleans, United States.

It also contains the texts of the papers which were not available when the proceedings of the Conference were published earlier.

IFA accepts no responsibility for the data presented or views expressed in these papers and the discussions.

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PLENARY SESSION: "GENERAL"

Chairman : **Saif Ahmed Al Ghafli**, Fertil, United Arab Emirates
Rapporteurs : ***B. Damak**, Imphos, Morocco*
***A. Cadet**, Fertil, United Arab Emirates*

PAPER 1 Risk based verification of greenhouse gas emissions for emission reduction and trading
Kelly Holmstrom and Philippe Comer, Det Norske Veritas, United States

Q – S. Ghosh, Duncans Industries Ltd., Kanpur, India.

In ammonia/urea manufacturing plant, emission of CO2 and CH4 is there whenever urea and ammonia plants start-up and upset conditions. CH4 can be burnt through flare stack, but what about CO2? Is any thinking in this direction; how to reduce CO2 emission?

Ans. No thinking on this subject; nevertheless minimizing the duration and the numbers of upset conditions will save energy/CO2/and other emissions.

Q – S. Muruganandam, Southern Petrochemical Industries Corporation Ltd., India.

What is the extent of CO2 trading practiced in the industries situated in USA?

Ans. Nothing is already in place; nevertheless in large industrial complex, we assist to some exchange between the actors as good relationship.

Q – Saif Al Ghafli, FERTIL, U.A.E.

What about the other industries concerning CO2 emission - such as automobile release Limit Control Action?

Ans. Nothing is available as of measurements and limit. The speaker is aware about it. Been known to other specialist.

PAPER 2 Hypoxia in the Gulf of Mexico and fertilization facts
C.S. Snyder, T.W. Bruulsema, A.E. Ludwick, T.S. Murrell, H.F. Reetz, W.M. Stewart, N.R. Usherwood and P. Fixen, Potash and Phosphate Institute, U.S.A.

Q – S. Ghosh, Duncans Industries Ltd., India.

What is the impact in reducing nitrogen and nitrate content in river water by using urea granule and coated urea? Is there any data available in this regard?

Ans. No data are available on this subject.

PAPER 3 Prelude to the Kyoto protocol - The intensification of the greenhouse effect as a result of human activities: a real danger or a scientific error? A sincere error or a subversive one?
A. Davister, Belgium.

No question.

PAPER 4 Feed stock; availability and option: global scenario

M.J. Vaidya, Gujarat State Fertilizers and chemicals Limited, India

No question.

***PARALLEL SESSION I*: "NPK and Granulation"**

Chairman : **Bjarne Christensen**, Kemira Agro Oy, Denmark
Rapporteurs : ***Y. Barajakly**, Arab Potash Company, Jordan*
***M. Perälä**, Kemira Agro Oy, Denmark*

PAPER 5 Revamping of an AN/CAN prilling plant to produce a granular product of higher product quality
Pan Orphanides, Orphanco, Greece

Q – A. Van Brempt, Kemira, Belgium

1- Are all "quality additives" added in the melt to prilling tower and nothing into the fattening stream? Any particular reason for this?

Ans. No! The additives which should give the thermal stability, strength and non detonability properties are added both to prilling tower and to envelope. Filler only to the envelope.

2- What is the calcium nitrate content in the ammonium nitrate solution coming from ODDA process?

Ans. The calcium nitrate content is 0,3 - 0,6 % depending of attention of NPK people. Even with high Ca content of 0,6% the quality of final product does not suffer.

Q – D. Ivell, Jacobs Engineering, USA

What is the overall concentration of ammonium nitrate fed to fattening drum?

Ans. The melt coming from the final concentrator has a concentration around 99,5% and melt sprayed to granulator has a concentration of 98%, because excess water from scrubber is recycled to it.

Q – G. Magnuson, A.J. Sackett & Sons Inc, USA

Are you using both MgO & $Al_2(SO_4)_3$ as additives?

Ans. No MgO is used, because better solutions exist. MnO gives the grain thermal stability, but makes the product more hygroscopic. You have to use aluminium sulphate together with, for example, gypsum, ammonium sulphate or iron sulphate. Sulphuric acid is still the easiest way, because there is no problem; solid addition can block pinning device or prilling device.

Q – B. Tricklebank, Kemira Agro, UK

The vibrating granulator, which is a vibrating bucket, was used to give a tight size range of the prilled seeds used for the granulator. What is the size range of the prills from the vibrating granulator?

Ans. Depends where the melt is coming from. Pure ammonium nitrate coming from neutraliser can obtain up to 95% between 2 and 4 mm. D50 value is 2,2 - 2,4 mm and average is 2,3 mm. Fines < 1mm is less than 1%.

Q – L. K. Rasmussen, Kemira Agro, Denmark

1- Are you going to stabilise CAN thermally?

Ans. It is not needed, but they will do it.

2- What is special by the crushers?

Ans. Nothing special, old Russian crushers.

3- If D50 of 3,5 mm was required, would you also recommend the prill-fattening process?

Ans. If D50 of 3,5 mm is not general requirement for whole production, this process can be recommended. Bigger granules lower the production capacity. Other option is production of bigger size prills with narrow spread.

Q – B. Christensen, Kemira Agro, Denmark

1- Did environmental performance have any significant importance in the process selection?

Ans. Granulator effluent and dedusting air is scrubbed in a high efficiency scrubber. FBC air is blown directly to the air. Prilling tower emission is reduced by 50-60% due to lower capacity and less fines by the prilling device.

2- Does the process guarantee cover granule hardness and thermal stability?

Ans. Yes.

PAPER 6 Study and evaluation of hygroscopic behaviour of phosphatic fertilizers, ammonium nitrophosphate (ANP) and calcium ammonium nitrate (CAN) by using different anticaking agents, at 80/90% RH. A case study at GNFC
R.K. Sharma and L.R. Patel, Gujarat Narmada Valley Fertilizers Co. Ltd, India

Not presented, standby paper.

PAPER 7 Current developments in antipollution control in the fertilizer industries illustrated by case studies in urea granulation and T.P.P.P. plant
Philippe Goossens, Socrematic, France

Q – G.G. Vaghela, Gujarat State Fertilisers & Chemicals Ltd, India

1- Space requirement of urea granulator vs. prilling tower?

Ans. No straight answer. Depends on all possible design parameters. (this answer can be valid for all 3 questions).

2- Fines in urea product at farmer's end?

Ans. No answer received.

3- Capital investment costs for new prilling tower vs. granulator?

Ans. No answer received.

Q – P. Orphanides, Orphanco, Greece

This presentation is based on only one granulation technology. Do you have experience with other processes than for urea granulation?

Ans. First scrubber installed 1979 and about 18 major differences to design have been made after that. This scrubber has been installed also to ammonium nitrate, iron sulphate and aluminium sulphate production. Possibilities for use in phosphate rock crusher and mill is now under design. In case of new solution a granulometry test in similar plants is needed.

Q – Anonymous

BAT for new plants is 50 mg NH3/ Nm3, which is only possible with acidic scrubber. Usually there is a need for liquid fertilizer or NPK plant to utilise effluent from the scrubber. Where to use scrubbing liquid in Gulf area in case of urea plants?

Ans. Customers in Asia can use effluent in the whole fertilizer plant. The liquid coming from scrubber is not very big amount, just few cubic meters/hour. Problem is still where to use it.

PAPER 8 Design and operating data from the world's biggest and newest hemi-hydrate phosphoric acid plant
John Gobbit and Kees Van Ede, Hydro Fertilizer Technology BV, Belgium

Q – Rob Fowles, Foskor, South Africa

1- With the high iron value in the rock and in the subsequent phosphoric acid product, lot of iron phosphate compounds (x-compound) would precipitate. What are they along with all that iron phosphate precipitate?
2- Have they thought about removal of the iron with a whiner prior to reaction?

Ans. Iron is a problem but there are areas in the mines with lower iron content in the rock, as for the iron removal stage, there is some iron phosphate precipitation particular in storage and even after the evaporation stage and all this goes to storage to an agitated tank and so it is fed forward and down stream to the DAP plant and there is no real treatment or removal in the phosphoric acid plant or the storage area and I am not sure what form is iron in and it is possible to be removed magnetically and if it easy to do, they will do it .

Q – G.G. Vaghela, Gujarat State Fertilizers and Chemicals Ltd, India

1- Where gypsum is disposed finally?
2- Whether gypsum storage area is lined with impervious lining?
3- What is the concentration of heavy metals and radioactive materials in gypsum, is it environmentally safe?
4- Are you monitoring underground water source around the gypsum stack for heavy metals?
5- Very low concentration of P2O5 in rock, can it make the plant economically viable?

Ans. Gypsum of the hemihydrate is discharged by conveyors to slurry tank and pumped to stacking area where it is dewatered and it stayed and not used and eventually build as stack and remains in the normal way as it is done in central Florida, but gypsum is not used neither sold, but the stacking area is large enough to build the stacks. Because of the acidic water it is necessary to have rubber lining to these stack systems. As for the leakage of the heavy metals there is an impermeable membrane so there is not much leakage of heavy metal out of the stacks but there is possibility of gaseous leak of some radioactive compound from stacking of gypsum and this is well known.

PAPER 9 Start up of one of the world's largest DAP plant – WMC Fertilizers
David Ivell, Jacobs Engineering, USA **and M. Blackwell**, WMC Fertilizers, Australia

Q – S. Muruganadam, South Petrochemical Industries – India

What is the effect of the impurities present in the phosphoric acid, particularly high iron content on the granulation?

Ans. In fact the impurities have advantages and disadvantages. If you have no impurities at all then it would not granulate and if you got too many impurities then it will tend to over-granulate. The spherical nature of the granules have nothing to do with the high iron levels, although this have some disadvantages as it makes it more difficult to dry and result to a higher recycle ratio as it

tend to over granulate. Of course it has an effect on the chemical quality of the plant and during the commissioning we struggled to achieve a chemical quality on the plant. The minor element ratio of the 40% acid produced is about 0.09 and this is border line for the product quality. In the last few months the rock quality have improved slightly and now it is sufficient for WM to achieve a chemical quality with no problem.

Q – Martina, Schmitz, Krupp UHDE , Germany

Where were the emission figures to be guaranteed and what were the actual results?

Ans. The emission levels are:

Particulates	5 mg/m3
Ammonia	20 mg/m3
Gaseous fluorine	1.4 mg/m3

Q – Avie Van Der Meer, Kemira Agro Oy

1- How did you train the inexperienced operators?
2- What were the results in terms of on-stream factors during the last months and what capacities were reached on average after the commissioning?

Ans. We identified early and before the contract was awarded the lack of experience and it was part of the turnkey contract that in this case Jacobs Engineering to provide theory training and have excess to an operating facility and we went to Brazil and Florida and we took a group four key operators and we recruited everybody from scratch and in the period of 6 months we recruited some 250 people for the operation. We took a team of four to Florida in Jacobs office for a week and when we came back to site those people have the ability to pass the information to the rest of the people. As for the on-stream time there is no exact figure.

PAPER 10 The role of coating and additives in improving the performance of fertilizers products
Victor Granquist, CFPI – Nufarm and Lobeco Products Inc, USA

Q – P. Orphanides, Orphanco, Greece

HDAN process additives GR23 , can it give the same thermal stability as MgO gives ? Can one offer HDAN in USA without MgO, but only GR235 in?

Ans. The magnesium nitrate is a particular case which does a good job for thermal stability but unfortunately have a disadvantage of increasing hydroscopicity which is a problem in places in Southern US and in places with high humidity areas, the additives do improve thermal stability but not the degree to the magnesium nitrate but the benefit of less hydroscopicity tendency offset that, and we found in one test were piles made of GR additives and magnesium nitrate, the one with GR is much better because of the moisture, with time the magnesium nitrate product picks up moisture and starts to degrade even thought the thermal stability is good in this case .
As for quantity applied, we are applying between 500 –1000 ppm and the cost is less in the case of magnesium oxide.
As for the aluminium sulphate, we don't see at least in USA it is used for fertilizers, as when you go into a blend tank with other materials it cause problems in fluctuation and precipitation on other materials that the farmer does not want to put in the blend tank and we did not see farmer in this country (USA) use aluminium but maybe in other part of the world.

Q – Arthur Van Brempt, Kemira, Belgium

1- Concerning your current additives GR, for fluidised bed granulation and fattening, is the additives acting as a crystal modifier?
2- What is the recommended dosage and what is the impact on bulk density?

Ans. There is a crystal habit modifier effect related to the hardness improvement, and this the main effect you see in the prilling, but in the granulation a very important factor is a better spreading of

the melt on to the seed materials, we can produce a more uniform size increase in the granulator so that you have less over size and less recycle so if you have a good seed coming in you can have a better spreading and slight delay in the crystallization and that account for the particle size distribution to be more narrow and as for the density it is about the same.

Q – K. Shah, Terra Nitrogen Ltd, UK

Have your additives and coating agents been assessed for environmental input in application in the soil? Would they biodegrade? Are they environmentally acceptable?

Ans. Yes we have been very careful in developing these product lines and it has been extensively tested for the approval in different countries and most recently we went for the Canadian approval which included quite extensive test requirement and we ensure that anything were using will be acceptable in the application to the crop situation.

***PARALLEL SESSION II*: "Software and Production”"**

Chairman : **V. Astley**, IMC Global, United States
Rapporteurs : ***B. Blythe**, Jacobs, United States*
***M. Walters**, Kemworks, United States*

PAPER 11 Gaining efficiency in your plant with Asset Management Software
Krisi Bailey, Fisher Rosemount System Inc., United States

Q – Taisto Koivumaki, Kemira Agro, Finland

1- I would like to know if you compared the price of traditional instrumentation plus this follow-up system to this management system how much more expensive is the investment and also what kind of operational costs after the investment that you can expect.

2- If we intend to utilize this kind of system in developing countries can you see that there would be problems with the education level or is there possibilities, for example, for Fisher Rosemount to undertake the maintenance of the systems on a contract basis

Ans. Thank you for the questions. The first question was the cost of the software vs. traditional ahead and you have a chance, you can go to our web site and there's a tool that's being created that walks through how to calculate the return on investment and most people have recognized that return particularly during start-up in two to three months' time which is a really good return on investment. For specific pricing and cost it really is going to vary depending upon the size of plant and how much instrumentation. The software is priced on a per point system so the incremental cost would depend upon the size of the plant that you're considering or the size of the system. I can provide you with more specific pricing information when I have more details of your application.

As far as training and utilizing the system is concerned that we have been told by many people that it is a very intuitive user-friendly system very similar to Word and Excel (Microsoft). We have tried to make it as a Microsoft familiar as possible and fairly intuitive. So from the capability of using the software, the feedback has been that it is very user-friendly. We would also be willing to look at doing something where we will we would manage it remotely using the asset management system. If you wanted a process control company to do that for you the rather than having it done at the facility itself, that's something we could certainly look at.

Q – V. Kaushik, Duncans Industries Limited, India

For a setup that already has a control system and you want to introduce this asset management system would it involve only software, or are some hardware changes also envisaged.

Ans. That's a very good question. If the facility happens to have a Fisher Rosemount control system (Delta V, Provox or RS3) then no additional hardware is required. We have created interfaces where you can talk to the software via the interface. If it is a non Fisher Rosemount control system it is still very possible to do that. Then you would have the multiplexor solution that would tie into the DCS and our multiplexor vendors in many cases have created footprints very similar to the trim panels of the DCS. Then you can just replace rather than having to parallel wire over again all your devices. They created solutions for a lot of competitive DCS’s like FoxPro, Bailey-I don't want to list them all-but there are several that have been created to help reduce the amount of rewiring that is needed.

Q – R.B. Strait, Kellogg Brown and Root, U.S.A

1- How about a question of obsolescence? With the things changing so rapidly when was this first implemented and what is your estimation in how long it will be the standard.

Ans. Our particular asset management software was introduced in 1994 so it's been around for about six years and currently it supports the HART and foundation fieldbus protocols so the HART

rotocol we would anticipate would continue to be around for the next 10 years, or 20 years, or two years. That's kind of a judgment call. That's a personal opinion question. Our estimate is probably 10 years and foundation fieldbus we expect to be around for a substantially longer period than that.

2- If you make a change to your plant, for example, put in more instruments or take instruments out are you required to use Rosemount or Fisher Rosemount to modify the system or can the plant people do it.

Ans. That's a good point that I didn't highlight very well. The asset management solution supports 188 instruments that are from 50 different vendors. So it's not just just Fisher Rosemount Instrumentation that is supported. It's all of the large Instrumentation Vendors that provide HART protocol as well as fieldbus protocol devices. So if there is a change to the plant you can do that internally, you don't need assistance from Fisher Rosemount. You're not dependent on us to make those changes. I do have the literature on which device companies we support if anyone is interested.

Q – R.M Chopde, Kribco, Surat, India

1- Can there be a single software solution for all of the complex. We have 3 Ammonia plants and 4 urea plants.

Ans. How far apart to are they logistically?

2- In an area of one kilometer

Ans. Yes we could develop an architecture for you so that you could have all of those on one system and look at the information from that. I can go into more detail, or one of our representatives could walk through how the architecture would be laid out.

Q – S. Ghosh, Duncans Industries Limited, India

We are using your Rosemount Transmitter and we find the obsolescence is very fast because after five years you have to go to a different design or model.

Ans. Yes, I guess I was particularly talking about the protocol piece of it – that the device was hard to protocol and we've produced HART devices since about 1990 and expect to continue producing those quite for sometime in conjunction with new technologies that come along, but like I said that's the best estimate a lot of that is driven by what industry wants. Do they want to stay with HART protocol and with older plants we are going to continue to support those, but there will be the new technologies with field bus and PROFIBUS and whatever protocols are supported.

V. Astley, IMC Global, United States

Any further questions? *OK, I'd like to thank Ms. Bailey for an excellent presentation on "The Advantages of the Asset Management Software" by Fisher Rosemount.*

PAPER 12 Simulation of turbo-compressor train in nitric acid plant for performance monitoring
D.D. Patel, N.N. Patel and M. Bhakta, Gujarat Narmada Valley Fertilizers Co. Ltd., India

Not presented, standby paper.

PAPER 13 Risk-based inspection prioritization applied to an ammonia plant
L.C. Kaley, L. Sweet, R.R. Valbuena and A. Warnock, DNV, United States

Q – S. Al-Ghafli, Fertil, United Arab Emirates

1- I want to have more information regarding the plant. You use as an example where these plants were located, how old the plant is and what was the period between 2 turnarounds.

Ans. We originally had planned to do this as a joint paper, but we got pushed on the deadline, so I'd rather not say whose plant it was because we didn't get their approval ahead of time - 1970's vintage.

2- This looks like a quite heavy program to review all the plant and all the risk and very often you reach results which can be disappointing and at least you are going to modify your program of inspection, but because you don't know what's going to happen really at the end. So I think this is quite new in an ammonia plant. Do you have a direct report in the petroleum industry, which is showing improvement in terms of running operations and a real decrease in cost?

Ans. There have been several papers presented as I mentioned before the improvements that people are seeing is that they are using their inspections money for inspection instead of related maintenance activities. That's probably one of the biggest results that we've seen.

Q – Bryan Blythe, Jacobs, United States

Several ammonia plants have suffered fairly catastrophic failures in the pipework systems. The manifold at the exit of the primary reformer, downstream of heat exchangers in which process condensate is condensing and also downstream of the control valves in the amine/CO2 removal systems.
Did your analysis program, your inspection program, address pipework as well as major equipment items?

Ans. Yes, it does.
We don't do furnaces. We don't do reforming type furnaces. When I had tubes up there those were really none of a refinery type furnace, but relating to pipework, yes we do address that again we do fixed vessels and piping, damage mechanisms if you know what's there and we can account for it.

Q – Hassam Lari, Fertil, United Arab Emirates

You're only doing fixed vessels, but not any rotating equipment, right?

Ans. No, we're not doing rotating equipment at this point.

Q – S. Ghosh, Duncans Industries, India

1- Now you have highlighted definitely these inspections of the various vessels or heat exchangers where there is high temperatures or it is highly toxic, particularly the corrosive environment. It has been found that the external corrosion is a problem under the insulation. In several pipelines failure has taken place where the temperature of the fluid is very low and the corrosion takes externally not internally.
What sort of schedule of inspections do you recommend in this area?

Ans. Corrosion under insulation - the software if you have a feel for what you can assign to a piece of piping it can handle that, but to know that you have a problem you really won't know until you take the insulation off and look at it.

2- What I mean to say is there any data available or related to the temperature of the fluid?

Ans. In a very generalized way we can give some direction as to what temperatures are areas of concern, but then again it wouldn't be as specific as I think you're looking for.

Q – R.M. Chopde, Khribco, Surat, India

Can your technique be used for determining the residual life of fired heaters or coils?
Ans. I don't believe so. It's not really that type of analysis.

V. Astley, IMC Global, United States

I'd like to thank Ms. Sweet for an excellent presentation on the risk-based inspection program.

PAPER 14 Productivity improvement by methanol and ammonia plants integration – GNFC experience
G.K. Parikh and R.G. Rehani, Gujarat Narmada Valley Fertilizers Co. Ltd., India

Not presented, standby paper.

PAPER 15 An advanced system for optimizing the design of a chemical-production complex
R.W. Pike and T.A. Hertwig, Louisiana State University, Baton Rouge, United States, **A.B. Nagy**, University of Veszprem, Veszprem, Hungary

Q – I Ohri, IFFCO, India

How much reduction in consumption of imports or cost reduction will you be able with optimization?

Ans. We could create any kind of numbers. This was a study, we were fabricating things we could force a wide range of results. It was more a study of how you could shift the recommended complex design. What you could save would be a function of whether you come up with a better design than before and this will certainly help you get a better design. Now as in all cases, like this, the quality of the model says everything and the numbers that go into it.
We could create any kind of numbers. This was a study, we were fabricating things we could force a wide range of results. It was more a study of how you could shift the recommended complex design. What you could save would be a function of whether you come up with a better design than before and this will certainly help you get a better design. Now as in all cases, like this, the quality of the model says everything and the numbers that go into it.
This in effect was the simple part creating that model and is also important. This web site information, you still have to create the model that's the hard part, but these are tools to use once you have that model developed.
Thank you.

V. Astley, IMC Global, United States

Thank you Mr. Hertwig for that detailed presentation on the optimizer applications.

PAPER 16 Energy conservation measures: energy audit, process optimisation
Saif Ahmed Al-Ghafli, Hussain I. Bukhari and H.M. Lari, Ruwais Fertilizer Industries (FERTIL), United Arab Emirates

Q – Anonymous

1- You told us about the failures in the waste heat boiler that you replaced. What it syntheses in the converter or the reformed gas boiler.

Ans. This was the waste heat boiler downstream of the secondary reformer.

Q – Anonymous

2- And what was the difference in design when you changed that?

Ans. I don't have all the details, but we went for a little better material, better welding procedures for the tube to tube sheet, welding techniques and slightly bigger in size.

Q – Anonymous

3- Did you have metal dusting problems?

Ans. Yes, for the original boiler, but for the second boiler no.

Q – Anonymous

4- Why was the converter basket replaced?

Ans. It was reaching the end of its useful life and also the next turnaround was going to be in three years. We calculated that it would be the optimum time to replace it.

Q – Anonymous

5- Catalyst changes yes, but basket changes why?

Ans. For the same reason. It was a process recommendation.

Q – Anonymous

6- Do you have a wash tray at the top of the tower?

Ans. For CO_2 do you mean?

Q – Anonymous

7- Yes.

Ans. You're going deep into the process, I'm a maintenance man.

Q – Anonymous

8- Act 1 gives us some problems. UOP advised us in one plant to go for that, but in another not to because these would be more losses.

Ans. We do have reflux on the top so we have to have this to retain the Act. 1 carryover.

Q – Anonymous

9- Lastly, what is the energy consumption per ton of urea?

Ans. It's around 9 per ton of ammonia.

Q – V. Kaushik, Duncans, India

The question is regarding details of the boiler failure.
The solution as you presented was two-fold. One you installed a boiler of a better design and second that you improved the quality of the water. I was wondering-improved design would be better metallurgy or perhaps reducing the heat flux.
But the symptoms of failure by higher heat flux versus the quality of water, they would be entirely different. Since you went for both of the solutions it would be interesting to know what was the cause of the failure. Whether it was the quality of the water or the higher heat flux.

Ans. As I said, there were a lot of causes that were taken into consideration and to be very frank with you we could not pinpoint which one was causing which. So it was easier to decide to improve them all rather than doing an experiment and then having another failure.
So we tried to take care of all the causes we could think about at once and get it over with.
You're right, if you want to systemically pinpoint the causes, you go one by one, but in that case it would be very expensive to do.

Q – Bryan Blythe, Jacobs, United States

1- As regards the reformed gas boiler failure, did the original boiler have inlet ferrules, wrapped with insulation?

Ans. Yes

2- And it still failed?

Ans. If you would like some more details on that I can provide it to you later.

3- The second question, did you have any problems with the carbamate pumps in the urea plant?

Ans. Our carbamate pumps up to 1986 – 87, we had no real problems with them except from the seal system where we used an oil seal. They were plunger pumps so contamination of oil into the carbamate pumps was causing a lot of problems. In 1986/87 we modified the system to a water-based seal.
Since then we have had no problem whatsoever and we have shared the technology we are using with the operating companies around us and it has been shown to be very reliable.

Q – I Ohri, IFFCO, India

I would like to share the experience of IFCO - we are operating a Topsoe plant.
The inlet ferrules are there on the returned gas boiler. They were made of Incolloy 800 and we had metal dusting problems, and because of that we had to have two filters.
Now we have switched over to Incolloy 600 to avoid that metal dusting and of course we'll be replacing the boiler next year but that problem at the moment has been stopped.

V. Astley, IMC Global, United States

Thanks for a very good presentation.

I would like to thank all the speakers for doing an extremely good job and my two rapporteurs, Bryan Blythe from Jacobs Engineering and Marten Walters from KEMWorks Technology, Mr. XXX would you like to close the session?

Luc Maene, IFA, Paris

Ladies and Gentlemen, on your behalf I would like to thank Mr. Astley from IMC Global for chairing this session. Thank you very much Mr. Astley for the good job you have done and I would also like to thank your rapporteurs for reporting the questions.

PARALLEL SESSION III: "Nitrogen"

Chairman : **V. Kaushik**, Duncans Industries Ltd., India
Rapporteurs : ***S. Ghosh**, Duncans Industries Ltd., India*
***B. Swaminathan**, FAI, India*

PAPER 17 Revamp of an ammonia plant
S.Stalin, R.Muthumanoharan and S.Muruganandam, Southern Petrochemical Industries Corporation Ltd., India

Q – B.Strait, Kellogg Brown Root, USA

What is the energy consumption after the retrofit?

Ans. Energy consumption after the retrofit is 9.7 Gcal/MT i.e. a reduction of 0.8 Gcal/MT has been achieved.

Q – Bob Tricklebank, Kemira Agro, U.K.

Can you please tell the total cost of the two revamps?

Ans. The total cost of revamp was about 50 million US Dollars.

Q – E.Madnawidjaja, PT.Pupuk Kunang, Indonesia

1- When was the revamping executed?

Ans. The first stage revamping was carried out in 1996 and the second stage in 1998.

2- What is the capacity after revamping?

Ans. The capacity before revamp was 1100 tonnes per day and after revamp it is around 1150 to 1180 tonnes per day.

3- What is the payback period on an investment of US$ 50 million?

Ans. The payback period is 4 years.

4- What CO2 removal system is being operated after modification?

Ans. and The CO2 removal system in operation after modification is also vetrocoke system but non-arsenic based on different solution.

Q – R.N.Chopde, KRIBHCO, India

1- What was the reason for replacement of rotary air preheater?

Ans. Rotary air preheater was replaced due to air leakage of exchanger. Reliability is normally a problem however, in case of SPIC it was not a problem.

2- Could you accommodate plate type exchanger in available area?

Ans. Yes, the plate type exchanger could be accommodated in the same area. In fact the plate type exchanger is little more compact.

3- Who are the designers for the plate type exchanger?

Ans. The plate type exchanger has been manufactured in Korea.

Q – Mohamed M.Khalil, Abu Qir Fertilizer, Egypt

1- What was the pressure drop of syngas reaching the ammonia converter?

Ans. The pressure drop of the syngas reaching the converter before revamp was 205 bar and after revamp it is 185 bar.

2- What type of catalyst bed was used? Whether the bed was changed?

Ans. The original converter was 3-bed converter. The bed of the converter remains the same. However, the bed configuration has been suitably altered. The catalyst volume has increased from 46 to 54M3. Further, 2 exchanger configuration is used because there is no boiler at the outlet of the converter and the entire gas is heated from inside. Also the HP shell could not with stand high temperature.

3- Was there solution carry over at CO2 removal?

Ans. There was solution carry over from regenerator. In the regenerator, solution is transferred from high pressure to low pressure. The distributor had to be modified because of its inability to take high loading due to inadequate lines.

Q – Philippe Gry, Grande Paroisse, France

1- Why did you change the ICI design burner of secondary reformer?

Ans. The original ICI burner had holes and cracks propagated along the holes and hence it was replaced.

2- Who designed the new burner?

Ans. The new nozzle type burner is also of ICI design.

PAPER 18 Low Pressure Ammonia Solution Production using UAN Facilities
A.Laurinaitis, A.Ancuta, A.Senuta and A.Sostakas, Achema Stock Company, Lithuania

Q – Pan Orphanides, Orphanco, Greece

Could you please inform at what pH the AN plant operate? and what is the pH of the product?

Ans. At the neutralization stage the pH is kept around 4.8 because of further ammoniation has to be carried out. The pH has to be strictly controlled since it is related to safety problem. 10% solution of the product is also acidic and the pH is 4.8.

PAPER 19 Debottlenecking, Revamping and Improvements Carried out in World's largest single stream urea plant for sustaining high capacity utilization at the lower input consumption
A.K.Sahani and G.K.Parikh, Gujarat Narmada Valley Fertilizers Co.Ltd., India
(Presenter : B. Swaminathan, FAI, India)

Q – André Cadet, FERTIL, U.A.E.

1- What is the design capacity of the plant?

Ans. The design capacity of GNFC urea plant is 1800MTPD.

2- Is the plant running at design capacity?

Ans. This plant is running with minimum of 65% plant capacity to maximum 125% of plant capacity depending on the requirement and availability of raw materials and utilities. We do not face much problem in operation at lower and higher capacity.

3- Who is the licensor?

Ans. The licensor of GNFC urea plant is M/s.Snamprogetti, Italy.

4- What is the cost of this debottlenecking?

Ans. The debottlenecking has not been done in a single step by any revamp. Urea plant load was increased by overcoming the limitations one by one through some operational changes, implementing some in-house modifications and replacement of some of the limiting equipments. Whenever equipments were due for replacement, higher capacity and better design were selected for the equipments e.g. stripper, high-pressure carbamate condenser, ammonia pump and carbamate pump.

Q – Pan Orphanides, Orphanco, Greece

1- The new high efficiency trays are of what design?

Ans. In urea reactor high efficiency trays of M/s.Urea Casale have been installed.

2- The high-pressure carbamate condenser was of what design?

Ans. The new high-pressure carbamate condenser installed in lieu of 2 carbamate condensers is of M/s.Snamprogetti's design.

Q – Mohamed M. Khalil, Abu Qir Fertilizer, Egypt

The revamping was carried out to increase the plant capacity for economic reason or for plant problems?

Ans. The capacity of the plant was increased to have more returns from higher production. This also helped in reducing the cost of production.

Q – Mohammed Abdelrhaman Hassan, Abu Qir Fertilizer, Egypt & Ricardo Prado Santos, Ultrafertil, Brazil

How did you increase the capacity of prilling tower? What modifications were done in prilling tower?

Ans. The prilling tower operation debottlenecking was carried out by following modifications:
Bigger size bucket (new design) was installed for high load operations.
Bucket was modified to reduce overflow and smaller particles. This helped in increasing the average prills size too. Also bucket speed was at times increased for higher plant load operations.
Air throughput was increased by modifying the top louvers at the prilling tower top.

Q – Philippe Gry, Grande Paroisse, France

Did you ask the Snamprogetti or some other licensor to make a proposal for revamping or partial revamping?

Ans. No, the revamping was done on our own.

PAPER 20 New development in Stamicarbon Urea 2000 plus TM process
K.Jonkerst and Ralph Marx, Stamicarbon, Netherlands

Q – S. Chandra, Ministry of Chemicals & Fertilizers, India

1- Would you please quantify the energy saving due to installation of pool reactor and pool condenser?

Ans. Though it has been analyzed, the energy saving figures are not immediately available.

2- Is it possible to install pool reactor/condenser in old operating plant?

Ans. This concept is basically meant for grassroot plant. However, based on case-by-case situation, different aspects can be incorporated in older plants. The operations are all proven in the field and various portions can be used for revamping.

3- Has any Indian fertilizer industry based on Stamicarbon technology approached Stamicarbon for such modification?

Ans. There has been only discussions with Indian plants. However, since mid 90's pool condenser is in operation at Bangladesh while pool reactor has been in operation at Stamicarbon's plant site at Netherlands for the last 3 years.

Q – Pan Orphanides, Orphanco, Greece

What is the pressure of high-pressure decomposition stage?

Ans. The pressure of the high-pressure decomposition stage is roughly 18 bar.

PAPER 21 Granulation KT's progress using fluidized drum granulation (FDG) technology
P.Bouilloud and Marid-Astrid Kordek, Kaltenbach Thuring S.A., France

Q – G.G. Vaghela, Gujarat State Fertilizers & Chemicals Ltd., India

1- The older urea plant has 20% fines. Can it be used for granulation along with molten urea?

Ans. Depending on the size of fine we can use it as seed material in granulator. It is possible to simultaneously have prilling tower and granulation separated. However, it is not the optimum way to do it. We can have prilling tower and granulator separately. The objective of fattening is to maintain the prilling tower at half the capacity and use the rest of the capacity to spray over the prill to improve the quality in terms of larger size, better hardness and lower fiability.

2- What is the emission of urea dust from FDG?

Ans. The air from the FDG is treated in a scrubber to collect the urea dust. The emissions from the air scrubber are in accordance with local environmental regulations. The dust concentration in the air from the scrubber is therefore around 30 mg/Nm^3 of air.

3- What is the concentration of sulphur in sulphur-bertonite fertilizer?

Ans. The sulphur concentration in the sulphur-bentonite is around 90%.

4- Can you give details of by-product ammonium sulphate granulation from caprolactum plant having organics (for example, Benzene etc.)?

Ans. The product obtained has around 94 to 96% ammonium sulphate, 2 to 4% ammonium nitrate and 1 to 4% organics. The N content is 20% minimum.

5- What will be the cost of 1500 tpd urea prilling versus granulation?

Ans. Granulation is now preferred over prilling due to the final product quality and therefore we do not expect new urea prilling towers to be constructed. KT can also proposed the revamping of an existing tower to produce granular type product by fattening. We have evaluated that a fattening plant has around 40% lower investment cost than a grass root new granulation plant.

Q – I.J. Ohri, Indian Farmers Fertiliser Coop.Ltd., India

What will be the cost of conversion of 1500 MTPD urea capacity from prilling to granulation plant?

Ans. The cost of the conversion of prilling into granulation would be 15 to 20 million dollars.

Q – Paul Niehues, Krupp Uhde, Germany

1- What is the highest capacity in single line?

Ans. The maximum single line capacity is 2000 MTPD based on 95 to 96% urea solution. The largest plant in operation at present is the Mexican plant of 1875 MTPD.

2- Whether the urea formaldehyde resin product used is a new product, different from the products used by other technologies and how much formaldehyde content in the product?

Ans. Normally 0.4 to 0.5% of the formaldehyde is used for hardening the urea. However, the product used by KT is urea formaldehyde along with catalyst. Urea formaldehyde polymerizes to give a slow release product. Although it is not a new product, it is a new application.

Q – E. Madnawidjaja, PT.Pupuk Kujang Cikampok, Indonesia

1- What is the ratio between recycle and product?

Ans. The ratio of recycle and the final product is 1:1.

2- For urea plant of large capacity such as 1875 MTPD does the granulator need periodic cleaning and what is the duration between each cleaning?

Ans. The granulator does need regular cleaning. In the Mexican plant the duration between each cleaning has been 4 weeks.

3- Do you have any preference regarding the manufacture of drum granulator?

Ans. The drum granulator is a proprietary equipment and manufactured in accordance to our standards and supplied from France.
We would prefer to control it by our people. However, the supply of internals could be made by us and the drum could be manufactured at the country where the plant is to be put.

4- In case the dust is removed by scrubbing with water what is the concentration of urea solution?

Ans. The urea solution in the scrubber system is maintained at around 40-45% concentration.

5- How much quantity of the solution is generated by a 1850 tpd urea plant?

Ans. The urea solution recycled from the scrubber for a urea granulation is around 28 kg (dry matter) per ton of final product with a concentration of around 40-45% urea.

6- Whether the urea solution is sent to evaporation section of urea plant?

Ans. The urea solution obtained in the scrubber is either recycled to the existing urea concentration step or can be used for making liquid fertilizers such as UAN.

Q – S. Chandra, Ministry of Chemicals & Fertilizers, India

Whether the Mexican plant based on granulation technology also has a prilling tower?

Ans. Yes, the Mexican plant has prilling tower as well as granulator.

Q – Arthur Van Brempt, Kemira, Belgium

1- Are you able to produce in FDG LD porous quality ammonium nitrate with an oil absorption of 12 to 14% in addition to HT porous ammonium nitrate (8% oil absorption)?

Ans. The normal ammonium nitrate oil absorption obtained in the FDG granulator is around 8%, which is the figure required by most markets. Products with higher fuel oil absorption have not been made in our pilot plant developments.

2- Are the additives identical as used in prilling?

Ans. The additives used for the explosive grade AN granulation are similar to the ones used in the prilling process.

PAPER 22 The self sustaining decomposition of nitrate-containing fertilizers
Harri Kiiski, Kemira Agro Oy, Finland

Q – Boris Gordonov, Vicksburg Chemical Company, USA

1- What are the features of slow NPK decomposition at elevated temperatures (say 100°C) but still lower than the onset temperature of a fast decomposition stage? Can the onset decomposition temperature be affected by pre-heating the substrate for extended period of time at say 120-160°C?

Ans. The decomposition of NPK is time dependent. Higher the temperature the lesser the time it takes to initiate the decomposition. At 276°C, the ignition point the decomposition is instantaneous. At 160°C it takes 40 minutes to decompose. However, the decomposition is not linear but the whole mass will release the gas at the same time.

Q – Pan Orphanides, Orphanco, Greece

How can you deal with the Seveso II regulation where they would like to have clear-cut answers? Did you face real problem in applying and conforming to these regulation?

Ans. The limits given in the directives are quite high. We have to prepare a consequence analysis taking the worst case scenario. Different case scenarios having decomposition inside the building, inside the drier in warehouse, etc., has been studied and will be presented in the next Fertilizer Society Seminar. To create a worst scenario for example, for warehouse fire the time factor is important. The basic assumption for the warehouse fire scenario is, if you don't manage to stop the fire in first 4 hours then the fire will exponentially increase. The first 4 hours are critical and imposes the limitation on the size of the bin in the fertilizer plant.

2- The regulation do not recognize the precaution taken and the time available to avoid the self-sustaining decomposition and you have to take care of every possibilities. So the cost to prevent this possibility could be very high?

Ans. Fertilizer production has to have a basic safety system or you have to develop it. This is already a requirement by the authority. The worrying point is the location of warehouse of the distribution site in the middle of the city, having a consequence like in Holland with the fireworks.

PAPER 23 Ammonia emission abatement in a fluid bed urea granulation plant – First commercial applications

A. Kayert and W. Hamelink, Hydro Fertilizer Technology, Belgium, **P. Niehues and M. Schmitz**, Krupp Uhde, Germany

No question.

***PARALLEL SESSION IV*: "Phosphate"**

Chairman : **Paul Clifford**, Florida Institute of Phosphate Research, United States
Rapporteurs : ***M. Lloyd**, Florida Institute of Phosphate Research, United States*
***P. Zhang**, Florida Institute of Phosphate Research, United States*

PAPER 24 Bioprocessing of Rock Phosphate Ore: Essential Technical Consideration for the Development of a Successful Commercial Technology
A.H. Goldstein, Alfred University, United States

Q – R. Fowles, Foskor, South Africa

What in your view is the best engineering option to use for conversion of rock phosphate to phosphoric acid or conversion of rock phosphate to other fertilizer products such as DAP ?

Ans. Dr. Goldstein proposed two schemes for utilizing the biosolubilization of phosphate. One strategy is in-situ bioleach for slow release of insoluble phosphate. Another method is making higher-grade products by converting phosphate to phosphoric acid biologically followed by concentration of the acid and making DAP. Dr. Goldstein pointed out that because of many technical and engineering challenges, he would not expect the in-situ application to become reality any time soon.

What about the size of the plants utilizing the bioprocess and retention times?

Ans. That fermentation is a standard practice and that the reactors for bioprocessing of phosphate should be about the same as for other applications.

What about the economics? (He wanted ball park cost estimates)

Ans. Dr. Goldstein cited an economic analysis on bioprocessing of phosphate prepared by researchers with the Idaho National Energy and Environmental Laboratory prepared for the Florida Institute of Phosphate Research in 1998. According to that report, bioprocessing of phosphate could be competitive with the current wet acid process. Dr. Goldstein also talked about two of the economic advantages of bioprocessing i.e., the production of a saleable by-product, calcium gluconate, and reduction in costs for waste disposal.

PAPER 25 Igneous and Sedimentary Phosphate Rock Evaluation at Foskor's Phosphoric Acid Pilot-plant Facility
Rob Fowles and A. Kruger, Foskor Ltd., South Africa

Q – T.N.V. Satyanarayana, Indo-Jordan Chemicals Co, Jordan

1- Based on your experience, how long does the pilot plant need to be run to arrive at reliable operating data?

Ans. Mr. Fowles answered that their standard practice is to run the pilot plant around the clock for 4-5 days, and that they felt very comfortable with the data generated in that fashion. The data from the pilot plant are then plugged in a computer model, generating satisfactory prediction of commercial-scale operations.

2- Since the pilot plant is so small, small pumps are needed for pumping chemicals to the reactor at very low rates. Are such pumps reliable?

Ans. The answer is yes. These pumps, generally made in America, deliver 20-30 liters per hour of solution to the pilot plant consistently. The smaller pumps could deliver solution at a rate of 0.5 ml per hour.

3- Did the slurry circulation pumps choke?

Ans. Mr. Fowles said that he had never experienced such a problem.

Q – Arthur Van Brempt, Kemira, Finland

Are you currently using a crystal modifier? If yes:
a) what impact does it have on operations (P_2O_5 efficiency, capacity, scaling etc.)
b) type of organic additive and dosages"?

Ans. Mr. Fowles replied that no crystal modifier was used in the pilot plant since the computer model does not include the effect of modifiers. However, crystal modifiers were used in the production plant, and showed significant effect on filtration, and some impact on P_2O_5 recovery. The impact of modifiers is also dependent on feed characteristics.

PAPER 26 Use of Fines and Sub-commercial (60-65% BPL) Wet Rock Phosphate
Arjun Chari, B.K. and T.N.V. Satyanarayana, Indo-Jordan Chemical Company Ltd., Jordan

Q – Bryan Blythe, Jacobs Engineering, USA

Whether excessive foaming was observed in grinding when low-grade phosphate was used.

Ans. The answer was no. Mr. Satyanarayana further elaborated that no grinding is necessary in this plant. Foaming was observed in the acidulation process, but it had more to do with the source of the feed rather than with the feed grade.

Q – Paul Smith of Prayon, Belgium

In the DH (dihydrate) tests, the filterability was higher for the lower BPL rock due to higher Al_2O_3 concentration. What was the Al_2O_3 concentration of the four samples A, B, C, D, as the filterability was not affected in the HH (hemihydrate) process"?

Ans. Mr. Satyanarayana confirmed that the filterability was indeed higher for the lower BPL rock due to the higher Al_2O_3 content, with the Al_2O_3 content being around 0.6%. Detailed analyses of each feed may be found in the PDF copy of the presentation.

PAPER 26A New Corrosion Resistant Material for Better Performance
G. Meier, SGL Technik GmbH, Germany

Q – Rob Fowles, Foskor, South Africa

What about the price difference between the carbon fibre-reinforced tube and the standard graphite tube.

Ans. Mr. Meier pointed out that the price for carbon fibre-reinforced tube is about 10-15% higher than that for the standard graphite tube. However, this higher cost is quickly compensated for by the extended life of the tube and reduced shutdown time.

Mr. Meier mentioned in his presentation that there was generally no plant shutdown even when the new tube cracked.

Q – T.N.V. Satyanarayana, Indo-Jordan Chemicals Co, Jordan

Why?

Ans. The response was that, in most cases, these new tubes do not leak even when cracks form. Also, these tubes can be maintained without shutting down the plant.

Q – Alexander More, British Sulphur Publishing, United Kingdom

What about the vulcanizing conditions for the rubber seam material?

Ans. Mr. Meier answered that generally the material is cured for a few days. The curing time is shorter if 50^{o}C water is used for curing.

PAPER 27 Revamp of the Ultrafertil Phosphoric Acid Plant
Marten Walters, Kemworks Technology, Inc., USA, **Manoel Barreto Ribeiro**, Ultrafertil S.A., Brazil, and **John Sinden**, JEA Tech, Brazil

Q – Marco Riponiemi, Kemira, Denmark

1- What about the temperature of the phosphoric acid in the reactor both before and after the revamp?

Ans. Mr. Walters answered that the temperature did not change, remaining at about 78^{o}C.

2- What about the reasons for decreased P_2O_5 efficiency after the revamp?

Ans. Mr. Walters pointed out that the major reason is the increased capacity. Another reason is increased acid strength, from 27-34% P_2O_5. Yet another reason is the coarseness of the feed because the ultrafine materials were removed.

PAPER 28 Gypsum: a Profitable Saleable Product?
Paul Anthony Smith and **Tibaut Theys**, Prayon-Rupel Technologies, Belgium

No question.

PAPER 29 Operating Experience with different Rock Phosphates in a Nitrophosphate Complex
V.S. Joshi and P.A. Shah, Gujarat Narmada Valley Fertilizers Co. Ltd., India

Not presented, standby paper.

PARALLEL SESSION V: "Environment"

Chairman : **Hans Van Balken**, EFMA, Belgium
Rapporteurs : ***H. Hero**, Kemira Agro Oy, Finland*
***L.K. Rasmussen**, Kemira Agro Oy, Denmark*

PAPER 30 ISO 14001: the experience of ICS in carrying out an impact study and establishing an environmental action plan for phosphate mining and phosphoric acid production
Doudou Fam and **M. Bocoum**, Industry Chimique du Senegal (ICS), Senegal

Q – I. Oelius, Kemira Agro, The Netherlands

Why don't you want to certify your operations for ISO 14001, while you do use the standards and systematic of ISO 14001 for your environmental management system?

Ans. The immediate objective of ICS is in a first step to let the ISO 14001 inspire the company in getting started in an improvement process.
The follow up and evaluation of SME and PAE by independent environmental experts can based on the achieved results create the opportunity for a certification of the operations for ISO 14001 at a later stage.

Q – F. Kabbaj, OCP, Morocco

Why are you not utilizing the fluosilisic acid instead of sending it to the sea after neutralization?

Ans. ICS is very interested in finding ways to utilize the fluosilisic acid. We have up to now not yet found a viable solution based on the performed investigations or research activities. We are open to discuss any suggestions for the utilization of the fluosilisic acid with possible partners.
The discharge of fluosilisic acid to the sea has no negative impact on the environment as the acid is immediately neutralized by the sea water.

PAPER 31 The Arab Potash Company, operation and waste management system
J. Amira and **Y. Barajakly**, APC, Jordan

Q – H. Van Balken, EFMA, Belgium

The presentation was mainly dealing with solid waste. How are you going to deal with emissions to the air like NOx and SOx? What are the kinds of abatement you anticipate?

Ans. In future natural gas will be connected to our plant and the NOx and SOx will then be minimized. Presently we are using heavy fuel oil and there is very little we can do to reduce the emissions for the moment.
We are working now to obtain ISO 14001 and we are taking all measures required to obtain this certificate.

Q – A. Alexandron, Haifa Chemicals, Israel

How will the increased capacity of APC as well as DSW affect the decrease of the level of the Dead Sea (now it is 412m below normal sea level)?

Ans. The increase in production will only marginally affect the drop in the level of the Dead Sea. The average drop in the Dead Sea level is 0,85m/y. A flood can increase the level with 1-2 m. Maybe we will reach a stable situation by inflow from the bottom.

PAPER 32 Recovery of fluosilisic acid and fluoride bearing waters for the production of a mixture of silica and precipitated calcium fluoride usable for the production of cement

S. Di Lena and **M. Lavanga**, Fluorsid SpA, Italy, **S. Sullivan** and **A. Ingram**, Svedala Ltd, United Kingdom

Q – B. Christensen, Kemira Agro, Denmark

Did the selection of the cylindrical filters have any advantages or disadvantages compared to a conventional filter press?

Ans. The conventional filter press normally gives a product with around 50% water, which is unacceptable for the cement industry and difficult to handle.
The Svedala tube press gives a product with only 30-33% water, which is good for the cement industry and easy to handle.

Q – D. Fam, Industries Chimiques du Senegal, Senegal

Fluosilisic acid produced by the phosphoric acid plant always contain residual P_2O_5. Is this P_2O_5 a problem for your process? If yes, what is the max. P_2O_5 concentration acceptable?

Ans. Our product contains 0,3 - 0,5% P_2O_5 and is very well accepted by the cement industry.

Q – G. G. Vaghela, Gujarat State Fertilizers and Chemicals Ltd, India

1. After having converted chalk ponds to gypsum ponds 3 years ago, the bottom sludge (mud) of these ponds contain 24% fluoride. Can you suggest a suitable method of disposal or reuse?

Ans. I could imagine that you could add these sludges with fresh H2SiF6 solution in a homogenizer and feed the resulting slurry to a tube press plant like ours.
At the moment at Fluorsid, we have a deposit of 40000t of muds with 30-35% CaF2 and we are adding it to a solution of HF and H2SiF6 much more diluted than yours, so I think it is feasible.

2. What is the composition of a sludge suitable for the cement industry?

Ans. The composition of the flakes that we are providing to the cement industry is:

CaF2	50 - 65% Dry basis
SiO2	9 - 10% Dry basis
CaSO4	8 - 10% Dry basis
CaCO3	3 - 6% Dry basis
Al2O3	2 - 3% Dry basis
Fe2O3	1 - 2% Dry basis
MgCO3	1 - 2% Dry basis
L.O.I (450°C)	10% max
H20 (110°C)	30%

Q – K. Kabbaj, OCP, Morocco

How much CaF2 does the cement industry use and how much would this quantity represent compared to the CaF2 one could produce based on all the fluosilisic acid made in the world?

Ans. I do not have any numbers available here. But I could look into it when I am back in the office and send it to you.
In Italy we are selling approx. 20000t/a of the product.

PAPER 33 Upgrading plant capacity by integration and productive utilization of waste streams

G. K. Parikh and **P. G. Dave,** Gujarat Narmada Valley Fertilizers Co. Ltd., India
(Presenter: B. Swaminathan, FAI, India)

Q – A. Ancuta, Achema SC, Lithuania

What kind (method) of CO enrichment is used?

Ans. For the CO enrichment M/s GNFC used the Linde Cold Box Technology, which is a cryogenic method

PAPER 34 Ammonia plant: past accidents and lessons learnt

R. M. Chopde and **K. M. Patel**, Krishak Bharati Cooperative Ltd, India

Q – A. Cadet, Fertil, United Arab Emirates

1. *You did a lot of modifications to prevent that these accidents will happen again. Are these modifications done on your own or with your licensor?*

Ans. The major modifications to prevent recurrence of the old accidents and for any new accidents have been done in consultation with our process licensor M/S M. W. Kellogg Co, USA.

2. *The trip logic was by-passed during the accidents. Why in these cases to make modifications instead of going back to the normal operations (no by-pass of the trips)?*

Ans. The trip for fired heater was kept by-passed in consultation with the licensor during the commissioning stage. The actuation of the trip used to distable the other ammonia plant and the affected plant too. Now the trip system has been modified in such a way that it does not affect the other plant. Now the vent valve will open to such a level that it will protect the fired heater and the other plant will not be disturbed.

PAPER 35 Heavy metals and radioactivity in phosphate fertilizers: short-term detrimental effects

V.V. Smetana and Anatoly Kharikov, USFEC, Ukraine

No question.

***PARALLEL SESSION VI*: "Water and Energy Conservation"**

Chairman : **K. Shah**, Terra Nitrogen (UK) Ltd, United Kingdom
Rapporteurs : ***B. Tricklebank**, Kemira Agro Oy Ltd, United Kingdom*
***T.K. Jenssen**, Norsk Hydro, Norway*

PAPER 36 Environmental innovations in nitrophosphate technology
P.C. Mehta and A.T. Patadia, Gujarat Narmada Valley Fertilizers Co. Ltd, India
(Presenter: B. Swaminathan, FAI, India)

Q – Arthur Van Brempt, Kemira Agro, Belgium

Can you give us an indication what was the dust load (in Mg/m^3) at the outlet of your cyclones of the drying air after all the modifications you have made?

Ans. I can just give an indicative answer. The limit of emissions of particulates in India is about 150Mg/m^3 so initially when I said 2-5 fold that means it was around 300-750 Mg/m^3. After doing these modifications I think it should have been anywhere between 50-100 Mg/m^3, it could not have been much more.

Q – Kish Shah, Terra Nitrogen UK, United Kingdom

There are so many schemes you have presented, what was the basis of choosing, selecting or prioritizing these schemes and was any cost benefit analysis done. How was the decision taken that this scheme was worth going ahead with.

Ans. Every company keeps doing things in a continuous way. GNVFC has been one of the forward-looking companies who have been working in the field of environmental pollution control. They have a very good background and they have been controlling their system very well; but then every plant aspires to be excellent in their area and so they have continuously studied the plant to find what the emissions are. They have a system over there using 'suggestion schemes' involving the people themselves. Plant workers and other employees give their suggestions. They have a committee which takes all the suggestions into consideration and decide which is worth going in for. Every aspect is taken into account including payback period and then it is put to the management for implementation and this is vetted by a committee. This is the general system which prevails over there. I don't know why this particular system was chosen but this in general holds good for both energy and also environmental schemes.

PAPER 37 Hazardous Waste Disposal - Studies Taken Up by GSFC for safe disposal
G.G. Vaghela, Gujarat State Fertilisers & Chemical Ltd, India

Q – Tore Jenssen, Norsk Hydro, Norway

You talked about using gypsum as a soil conditioner in India. I suppose you have also a lot of old gypsum stacks, what is the requirement in India for closing old gypsum stacks. When you leave it do you have to protect it in some way like in the United States in Florida?

Ans. We have gypsum ponds. There are about 3 gypsum ponds, from the phosphoric group of plants. We have closed circulation of water and there are zero discharges of water. The storage ponds are allowed to evaporate and dry and then the gypsum is reclaimed on the impervious lime transit storage area and then it is transported to the different parts of Gujarat for soil application. This has been done since as early as 1967 and had there been any detrimental effect there would not have been the demand of gypsum for soil conditioning.

Q – Kish Shah, Terra Nitrogen UK, United Kingdom

This question is about calcium carbonate limestone being used for making bricks. In terms of long-term effects, would you be able to do any tests to check the claims in the paper that these bricks are superior to the normal bricks made from clay. Now clay has been used for making bricks for hundreds of years, whereas now you are bringing in a synthetic material from the chemical industry to make bricks. Have you given some thought as to the limitations and restriction in use and what are the long-term effects – is there anything considered in that regard.

Ans. We have made many tiles and bricks and some of these have been used in the factory area itself and they are in use for the last five years. But because of the cost impact we have not been able to test these and so we are setting up a demonstration plant to show that these bricks are superior to other ones. If we look at the new regulations for 2000, then they do not fall into the hazardous waste category.

PAPER 38 Benefits of an Energy Audit on an Integrated Fertiliser Complex

Ian Barton, Synetix, United Kingdom

Q - I.J. Ohri, IFFCO, India

1- In the streamlined HTS Shift Converter, do you use the same alumina balls or do you use a new support supplied by ICI?

Ans. What we have done is come up with a combination of a modified support material and a redesign of the gas collector system. The actual implementation will depend on the specifics of what is currently installed in the plant but to answer your specific question the support material is an improvement that has significantly lower pressure drop characteristics.

2- The ammonia plants based on naphtha find a problem of the pressure drop in the HT shift converter. Have you been able to find a solution to that ?

Ans. I think there are probably a couple of reasons why people have high pressure drop in the high temperature shift. One is the design of the support material that I discussed that can be addressed with a streamline innovation. The other thing that we do see is the occasional fouling of the top based on potash or other contamination that sits on top of the catalyst and we do have some ideas/innovations for material which does a better job of trapping that external contamination without causing a pressure drop build up; we have got a modified support hold down material which has been used in those applications so that you get less crust or build up on the top of the high shift. Then there is also the catalyst itself which we can make in a larger particle size to give a lower pressure drop too. So there are several ways we are trying to address issue of pressure drop.

Q – Anonymous

Has that been tried anywhere – the top support systems to remove contamination?

Ans. Certainly there are a number of ammonia plants where they have had history of boiler failures and boiler leaks and a lot of boiler solids getting onto the catalyst. There are probably a dozen or so plants where we have put this in, specifically to trap boiler solids that would otherwise damage high temperature shift catalysts.

Q – Anonymous

What was the volume of this compared to the total volume of catalyst?

Ans. Relatively small, you are just talking about 50 cm perhaps to sit on top of the catalyst and provide a shield. Something to filter out and trap external contamination – not a large quantity.

Q - Taisto Koivumaki – Kemira Agro, Finland

I have two questions:

Firstly, can you give some indications how many man-hours were required for this Indian Energy Audit, both external and internal?

Second question, how much additional measurement did you need, could you do this energy audit totally based on the existing measurements or did you need to install some new measurements in order to get the balances accurate enough ?

Ans. Good question. The actual man-hours and cost of a particular study obviously depends on the scope of that study and they do all vary. One study will not be the same as another, but for an in depth detailed analysis it may be 6 man months of engineering effort to do a full analysis and to do some screening evaluation of the different ideas that are generated. As far as new measurements, it is not very easy or practical to spend a lot of time putting in new measurements into the process, so our normal philosophy is to make do with the instrumentation and measurements that are there. It is somewhat unusual to have to go back in and do some special measurements. Occasionally that happens but it is quite unusual, it is normally a case of using basic instrumentation that the operating team have.

Q – Pan Orphanides – Orphanco, Greece

Ian, I presume the example you mentioned here was not a plant designed by ICI?

Ans. That is correct, yes.

Q – Anonymous

What was the plus ICI could offer against the designer/licenser of the plant, who has the results of the start up and the test runs, who knows the plant better than you, who has to spend much less time investigating the plant, so what was that plus point. It is not a complicated case, you isolated battery limits wise the two ammonia plants and the urea plant, and there were no complicated energy integration.

Ans. I am not sure that I can give you a definitive answer, I have not discussed it with the licensor of the plant, so I am somewhat speculating. I would say that when ICI is coming and doing these energy audits we are doing it from the point of view of a company experienced in operating plants. That means experience in looking at real operating equipment and being able to take data from the plant, reconcile the data (which is not trivial) and to come up with ideas for making improvements to operating plants. The licensors were technically very good at starting with a clean sheet of paper and designing a new plant but that is quite different to the skills needed to characterize an operating plant and identify the changes necessary to improve an operating plant. I think they are two different types of engineering skill that might be involved.

Q – Anonymous

These licensors offer that kind of service to check through the front end or the synthesis loop and then indicate where there is room for improvements or shift from optimum design conditions etc etc.

Ans. To be honest I would be speculating, I can't really tell you why they chose us but the fact is that they decided to use ICI to do this work.

Q – Anonymous

Is this so far the most complex audit you have implemented for a third party?

Ans. No we have done a number of similar audits for other plants.

Q – Anonymous

More complex cases where you have 10 production plants and large utilities cogeneration plants for production of energy, thermal and electrical etc. Do you have any kind of references in more complex plants?

Ans. Certainly within ICI, we have done a lot of work over the years looking at some of our large factories like the Billingham factory which used to operate with 4 ammonia plants, 2 methanol plants, urea plant, 2 ammonium nitrate plants and 7 nitric acid plants. So that was quite complex to evaluate a site like that, so yes there is experience of that nature.

Q – S. Chandra, Joint Adviser, Ministry of Fertiliser, Government of India

You have indicated many theoretical items and you say that there is an energy saving of about 12%. This is all theoretical. It was not your plant, but you have carried out energy audits there. What was the scope there and ultimately what was the energy saving ? Can you quantify in terms of Million Kcal and what was the area that gave the highest energy saving. Why did they choose you when you were not the designer?

Ans. The savings identified were in a number of different categories. The quick fixes that I talked about were done almost straightaway and the savings were about 2% of the energy efficiency. The capital projects have not yet been implemented, those are currently under implementation and the savings from those will be another 3 or 4%. The total we identified in the study as I said was about 12% but not all of those schemes will actually be implemented at least in the short term. So at the moment the client is working through the engineering for implementation of the larger schemes that we identified.

Q – Anonymous

What was the total estimated cost of the scheme which you suggested?

Ans. That's a good question. I am not sure that I have the answer for all of the schemes; some of the schemes down at the bottom of the priority list had quite long pay backs which were not necessarily appropriate so I think the important thing is to go down the priority list and identify the most important things to implement straightaway and that is what the client is doing at the moment. They are implementing the top 3 or 4 from that list and that will be done in the next few months.

Q – Anonymous

So far as I understand there is not much improvement on the energy consumption they had before; not much improvement, more or less the same

Ans. That's right because the process is not finished yet. The auditing process has been done but the implementation of the ideas is still not completed.

Q – Anonymous

Which was the area consuming more energy in that plant?

Ans. The part of the process with the single biggest opportunity is around the synthesis loop and the heat recovery from the synthesis loop was a very significant area.

Q – Tore Jenssen, Norsk Hydro, Norway

Based on your experience from several energy audits, how much of the gains in energy efficiency can be related to changes in operational practices compared to technical modifications (without excessive costs of course)?

Ans. Good question. I think it depends on the organization. I can think of some organizations where there have been a number of relatively quick fixes or just operating practices and parameter adjustment that can be done more or less straightaway and get 2, 3 or 4%. I think the Chambal case is probably more typical when the quick fixes might give 2% in energy consumption. In some plants it will be less than that, it just depends. 2% is not unusual.

PAPER 39 Energy Conservation Measures in Ammonia Plants in IFFCO, Kalol and Phulpur Units
I.J. Ohri, IFFCO, India

Q – E. Madnawidjaja Pupuk Kujang, Cikampek, Indonesia

It is very interesting that IFFCO have 3 plants and 2 plants are already 20 years old. In your company or in India, has there been an investigation into how long ammonia plants can be operated, with of course repeated revamping.

And my second question:

In the second revamp of the first plant you mentioned you replaced the primary reformer tubes after only 7 years. This looks very early. Was there a problem?

The third question. As you mentioned the urea production costs are high because of the naphtha base. Is it the intention to import urea since the international market urea price is relatively low ? And finally, has India already joined WTO? I read in Fertecon publicity that Government of India at present doesn't buy all the urea produced by the urea producers, only a certain percentage was bought by the Government.

Ans. I will try to answer your questions one by one.

The first question was what is the life of the plant if I understood correctly. Normally I think you go on making improvements in the plant. If you happen to visit our plants you won't feel that this plant is 25 years old, the reason being, for example, we have changed all the piping on the plant during the last five years. The original design material of construction of the process gas piping was P1 (carbon half molly) which we have all changed to P11 about 6 or 7 years ago. Most of the critical equipments for example, the reformer and the synthesis converter have either been revamped or changed. All the instrumentation has been changed to the DCS system. So I don't think there is a limit after 15 years of continuous operation. This plant is 25 years old, it has lower energy than the original design, it is operating at 100% or a little more than 100%.

Your second question was about the reformer revamp. Yes the life of the reformer was at an end, the reason being failures of the tubes probably due to the high heat flux. There was also a problem with the burners, because of this there was a failure so we decided to revamp it early.

The third question is about WTO. This question of course is for the Government. It is a big question; the Government has formed a committee to tackle this issue because if India starts importing then most of the naphtha plants will be in trouble. That's why Government has to come up with the policy and probably within 2 or 3 months it will come out. One thing is very sure, that the plants, which have a very high-energy consumption, will not be able to survive in that new situation.

Q – Matt Blackwell, WMC Fertilizers, Australia

I noticed that you changed the material of construction of the reformer tubes each time you revamped the plant, was there a particular reason for that ?

Ans. Definitely. For example, as I had put in the paper, the heat flux was high, we wanted to increase t he life and at about the same cost we were able to get a better material. We could also increase the catalyst volume. We were able to increase the life of the plant, and I think all over the world people are now using HP material.

PAPER 40 Energy Conservation at GNFC
R.T. Bhargava, Gujarat Narmada Valley Fertilizers Company Limited, India
(Presenter : B. Swaminathan, FAI, India)

No question.

PAPER 41 The Abu Qir fertilizer experience in conservation and recycling of the water in two sites: A. Cooling water system
B. The production of demineralized water for stream generation
Fatma Hussien Badawy, Abdel Rahman and S. El-Salahy, Abu Qir Fertilizer and Chemical Industries Company, Egypt

No question.

Current Developments in Antipollution Control in the Fertilizer Industry
Illustrated by a Case Study for an Urea Granulation Plant

Philippe Goossens, Socrematic – Procedair/GFL, France

L'industrie des engrais est actuellement en pleine construction de nouvelles unités respectant les lois restrictives antipollution d'aujourd'hui.

Les unités existantes exploitant des anciens équipements durs ont été requises pour améliorer leurs standards environnementaux qui, à terme, implique un besoin pour des systèmes plus efficaces tout en réduisant, autant que possible, la maintenance.

Nous analyserons l'augmentation des performances environnementales d'une unité d'engrais spécifique pour produire de l'urée et plus spécifiquement une unité utilisant la technologie de la granulation à lit fluide.

Socrematic, qui fait partie du groupe Procedair/Fives-Lille, a commencé à installer des « tampons turbulaires » à la fin des années 70 dans une unité d'urée de granulation à lit fluide, en Hollande.
Depuis, plusieurs systèmes utilisant ce système à anneau unique de type Venturi ont été installés dans le monde dans les unités d'urée utilisant le processus de granulation à lit fluide H.F.T.

Une analyse complète des principaux facteurs techniques observés durant une enquête extensive sur les systèmes de contrôle de pollution installés, nous laisse envisager plusieurs développements afin d'atteindre une meilleure efficacité, une meilleure confiance et une moindre maintenance. Ils ont été réalisés dans différentes unités nouvellement construites durant ces cinq dernières années et quelques-unes unes sont pleinement opérationnelles depuis peu.

Le résultat actuel prouve la validité de ces développements et renforce la volonté d'augmenter de façon régulière leurs performances environnementales.

De même qu'en réduisant l'émission de poussière de l'urée provenant du granulateur et des refroidisseurs à une concentration de moins de 30 mg/Nm^3, Socrematic a récemment étudié et proposé un système antipollution pour réduire les gaz résiduels contenant de l'ammoniac à des valeurs en dessous de 20 ppm dans le tas épuisé.

Le système de réduction de l'ammoniac utilisera une solution d'urée acidifiée par un acide inorganique et sera situé dans le vaisseau tampon existant. Cependant les sels résultants ne contamineront pas le produit final puisqu'ils seront évacués par un réservoir de recyclage séparé. Le premier d'entre eux sera installé dans une nouvelle unité d'engrais en Asie et sera opérationnel en 2001.

ABSTRACT

The fertilizer industry is currently building new plants which comply with the stricter antipollution laws in force today.

Existing plants operating older scrubbing equipment are being required to improve their environmental standards which in turn induces a need for more efficient systems while reducing maintenance whenever possible.

We will analyse the increase in environmental performance of a specific fertilizer plant for producing urea and more specifically one using the fluidized bed granulation technology.

SOCREMATIC, part of the PROCEDAIR/FIVES-LILLE GROUP started to install «TURBULAIRE » scrubbers » at the end of the seventies in a urea fluidized bed granulation plant in Holland.
Since then several systems using this unique Venturi type ring system have been installed worldwide in urea plants using the HFT fluidized bed granulation process.

An in-depth analysis of major technical factors observed during an extensive survey of installed pollution control systems led us to propose several developments in order to achieve higher efficiency, better reliability and lower maintenance. They were implemented in different newly built plants over the last five years and some have been in full operational service for a while.

Current feedback proves the validity of these developments and strengthens the will to even further increase their environmental performance.

As well as reducing the urea dust emission from the granulator and coolers to a concentration of less than 30 mg/Nm^3, SOCREMATIC has recently studied and proposed an antipollution system to lower the residual gaseous ammonia content to values lower than
20 ppm in the exhaust stack.

The ammonia abatement system will use a urea solution acidified by an inorganic acid and will be located in the existing scrubber vessel. The resulting salts however, will not contaminate the final product as they will be evacuated to a separate recycling tank. The first of these will be installed in a new fertilizer plant in Asia and will start operating in 2001.

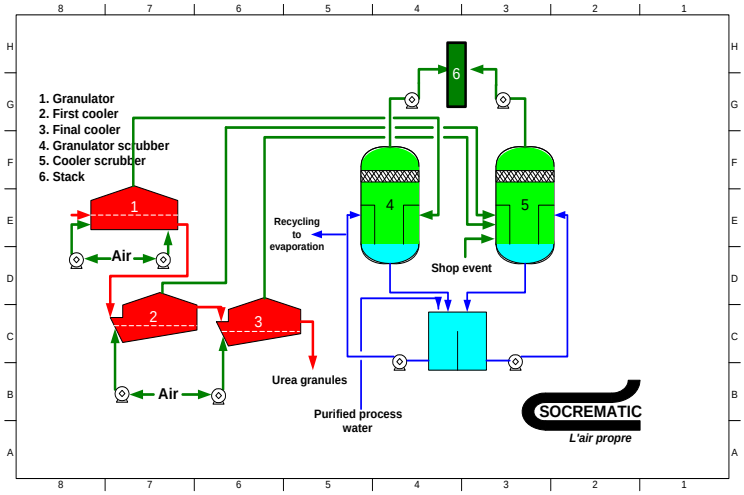
1.- INTRODUCTION

SOCREMATIC/PROCEDAIR has been designing and building specially developed scrubber systems for the fertilizer industry for over 20 years using trade names such as “AIR-MIX”, Turbulaire scrubber.

In the eighties, the urea fertilizer market shifted away from traditional prilling plants using huge air flow but moderate urea dust content towards granulator plants using very moderate air flow with a higher but coarser urea dust content.

Several granulation techniques were proposed such as drum granulation, pan granulation and fluidized beds. The fluidized bed technology however, became very popular and consequently an efficient scrubbing system was required to handle the urea loaded off-gas from the granulator, the first and second cooler and even from the factory

itself in order to meet the customer's wish to comply with the prevailing local emission standards.



TYPICAL SYSTEM LAYOUT IN A UREA GRANULATION PLANT

The «Turbulaire » scrubber installed from the seventies onwards, suited the need for a relatively low cost, sturdy and almost zero maintenance scrubber respecting the required air emission standards.

As recently improved installations have already reached a 30 mg/Nm^3 urea dust emission value well below 0.2 kg per ton of product, the emphasis is now being placed on reducing the gaseous ammonia emission. The introduction of an organic formaldehyde based granulation additive in the urea solution prior to the granulation reduces effectively these emissions by 50%, moreover some governments/companies now wish to aim for a further decrease to 20 ppm.

The first scrubber system complying with this limit has been developed by SOCREMATIC/PROCEDAIR/GFL and will be operational in 2001. It will incorporate a separate chemical scrubbing stage using an inorganic acid namely sulfuric acid as reactant; this absorption stage is installed in the same vessel as the dust scrubbing stage. Proven technology is used to separate the absorption step from the dedusting step since in this way no resulting salts can end up in the recycled urea solution from the dedusting stage. Thus, an up-to-date system responding to the latest air environmental standards has been designed.
This paper will essentially deal with the description of this scrubber system.

2.- SCRUBBER DESIGN

2.1 Description

The «Turbulaire » scrubber consists of a vertical cylindrical shell with conical top and conical hopper at the lower end. It is divided into two chambers : the agglomerator chamber and the eliminator chamber.
The agglomerator chamber is in the lower portion of the scrubber and includes the hopper containing the scrubbing liquid bath, the gas inlet passage with conical throttle and the liquid level regulating assembly.

The eliminator chamber is above the agglomerator chamber and consists of a set of swirl vanes and a sump preceeding the gas outlet.

The gas inlet is located radially on the side of the shell and the gas outlet at the top center. The agglomerator cylinder is surrounded by the gas inlet passage. The shell and the peripheral nozzle of the agglomerator chamber form an annular throttling gap at the bottom of the gas inlet passage. The normal operating level of the scrubbing liquid bath is just below the throttling gap.

Spray nozzles located on top of the peripheral chamber are installed at regular intervals so as to humidify the entire annular volume. Through an external common inlet, the scrubbing liquid is distributed to the nozzles by means of an internal manifold, integrated into the shell. In order to facilitate the control maintenance of the nozzles, they are mutually linked by external flexible connecting hoses.

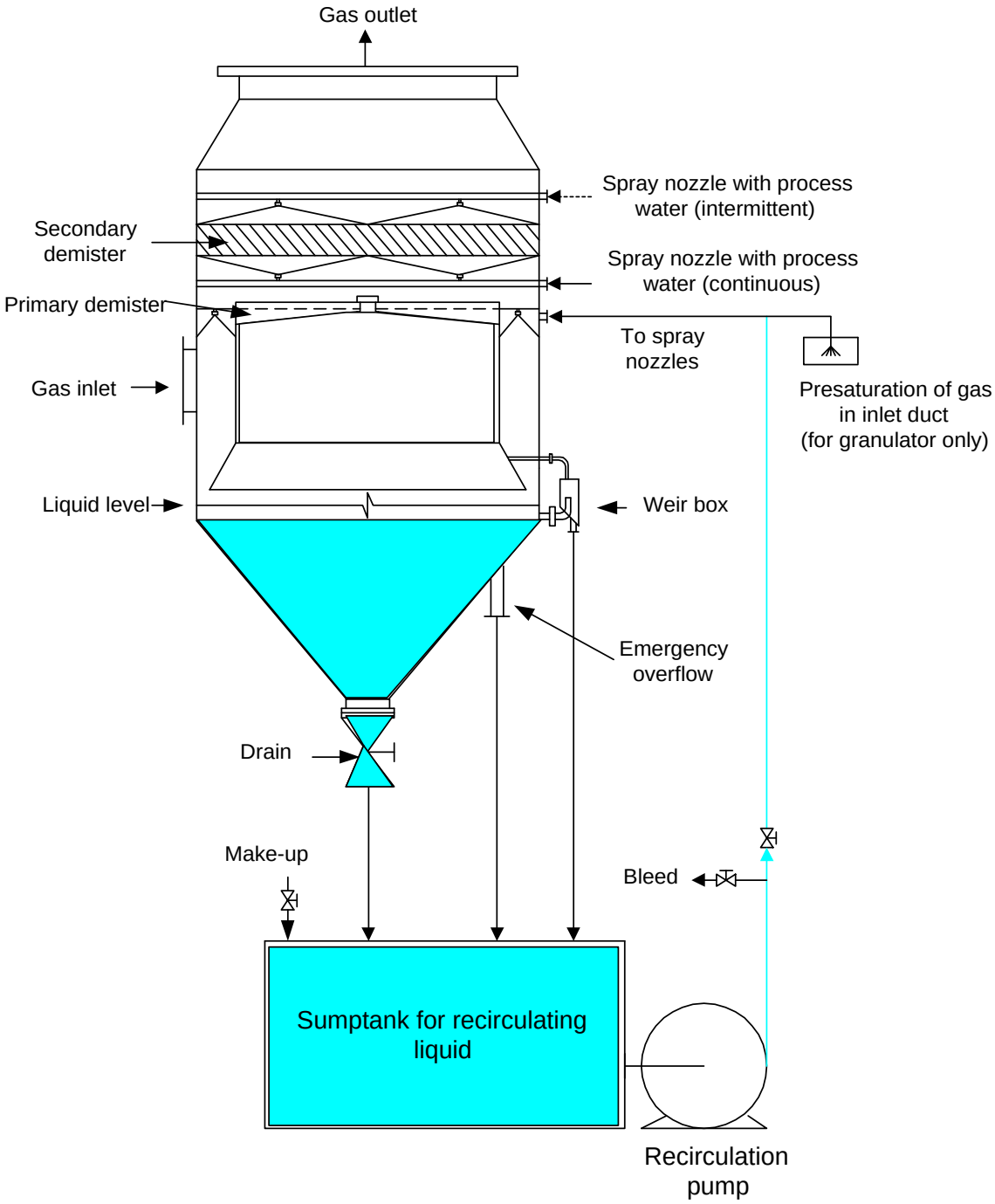
Swirl vanes are mounted at the top of the agglomerator chamber. A horizontal plate joining the agglomerator with the shell forms the eliminator sump. Large pipes drain the liquid from the sump into the scrubbing liquid bath in the hopper.

The current standard scrubber system has a secondary mist eliminator of the metal mesh type installed above the swirl vanes section. Continuous flushing of the mesh pad is recommended and carried out through spray nozzles mounted on an efficient distributor network so as to cover the entire surface of this secondary mist eliminator.

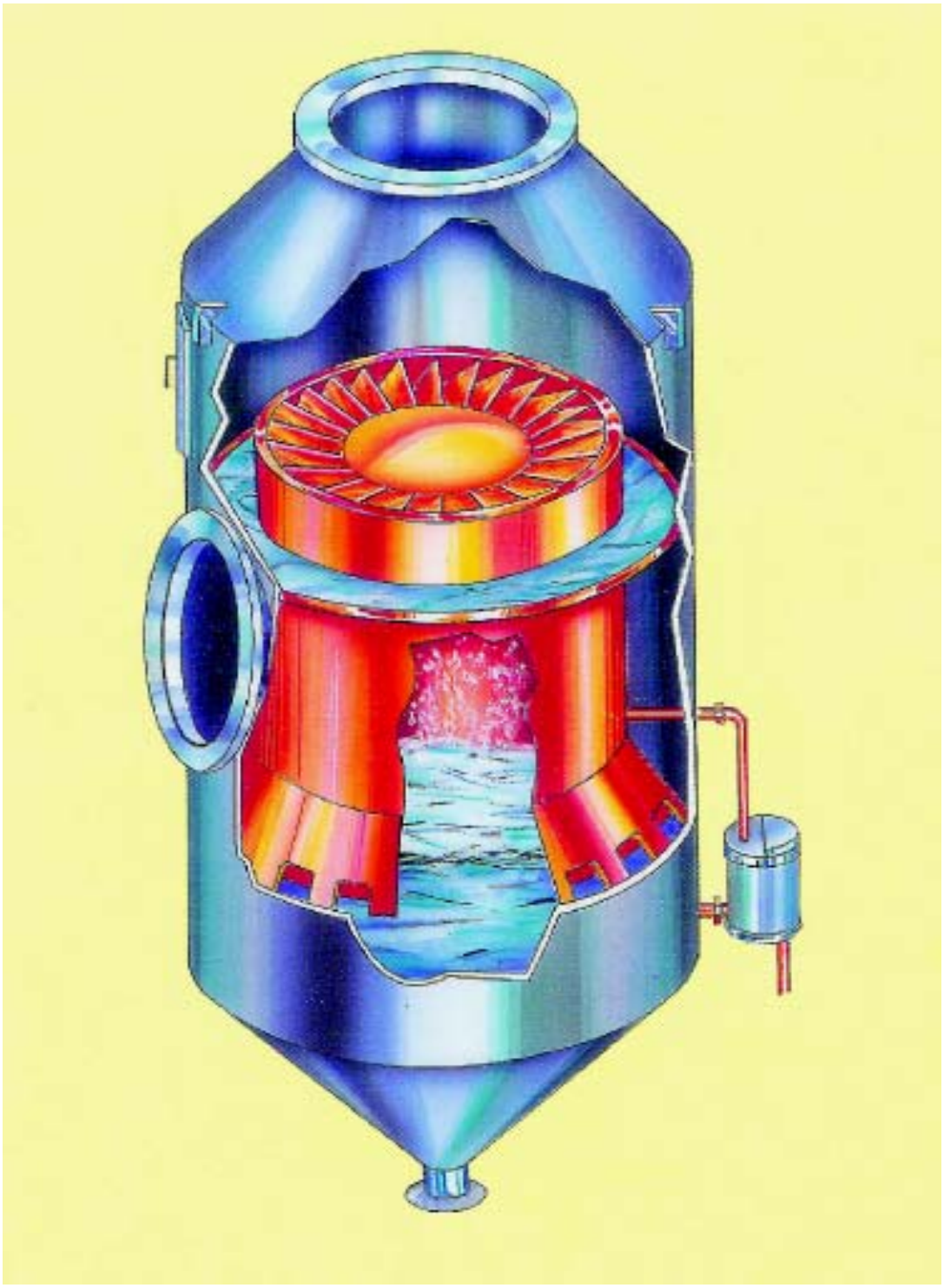
A liquid level regulating device of a weir box type is mounted on the lower exterior region of the shell so as to maintain the water level in the sump at a predetermined level.

Several manholes are provided for inspection. The scrubber is mainly manufactured in AISI 304L or 316L stainless steel.

The following illustrations represent a schematic cut-away view of a «TURBULAIRE » type scrubber with a secondary mist eliminator.



TURBULAIRE SCRUBBER IN UREA GRANULATION PLANT



2.2 Operation

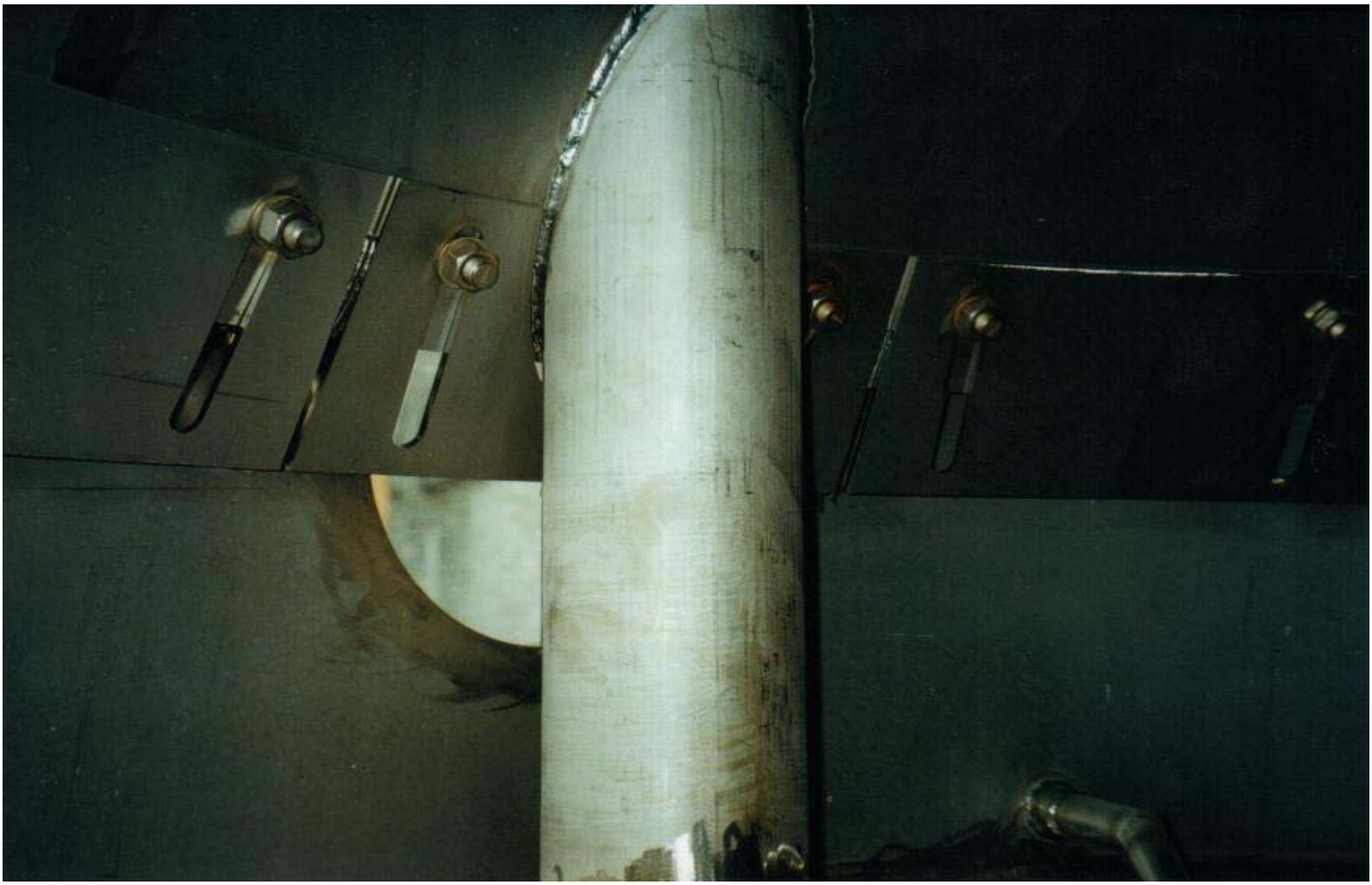
As the flue gas enters the scrubber through the inlet, its speed is increased to the desired operating velocity as it passes through the predefined throttling gap. The dust-laden gas is then discharged at high velocity and penetrates the liquid bath wherein the dust combines with the liquid to form a slurry which is discharged through the hopper outlet valve or continuously through the weir box. The turbulence resulting from the entrance of the high velocity gas into the scrubbing bath is sufficient to produce a dense spray. This spray is removed from the gas by the swirl vanes and the secondary mist eliminator.

The spraying in the peripheral chamber immediately at the gas entrance ensures the pre-saturation of the gas before its impaction with the liquid bath. Particles of moisture are formed around the dust particles, thus building up its particle size and allowing them to be separated more easily from the gas stream.

The efficiency of the scrubber can be raised by means of increasing the pressure drop through the unit by restricting the annular throttling gap.

Following the nominal inlet gas (volume, temperature, moisture content and density), the value of the gap is predefined. For different conditions , other values might be required. This is perfectly possible by adjusting the gap opening.

Indeed, the skirt gap opening can be adjusted by repositionning the slide plates on the annular skirt. The gap opening being controlled with a set of gauges made to correspond to peripheral gap values.



ADJUSTABLE SLIDE PLATES ON THE ANNULAR SKIRT PRIOR TO OPERATING (INSIDE VIEW)

ADJUSTABLE SLIDE PLATES ON THE ANNULAR SKIRT PRIOR TO OPERATING (OUTSIDE VIEW)

3. SPECIFIC FEATURES

3.1 Secondary mist eliminator

Owing to the high solubility of urea, it is of course understandable that dust caught mechanically by impingement and turbulence in the bath will also carry mist escaping from the swirl vane section along with it. Therefore a secondary mist eliminator, a metal knitted meshpad, has been installed at the top of the scrubber. This pad was especially developed by a well-known manufacturer with a superior liquid draining capacity due to an improved internal geometry.

SECONDARY MIST ELIMINATOR WITH ADJACENT SPRAYRAMP

3.2 Spray system

It was noted that the secondary demister was difficult to clean with a simple spray system. As only a limited amount of make-up water can be used to purge a 40 % urea solution, an elaborate sytem using a sequential spraying was installed to provide enough water per surface area.

SWIRL VANE SECTION WITH SPRAY SYSTEM

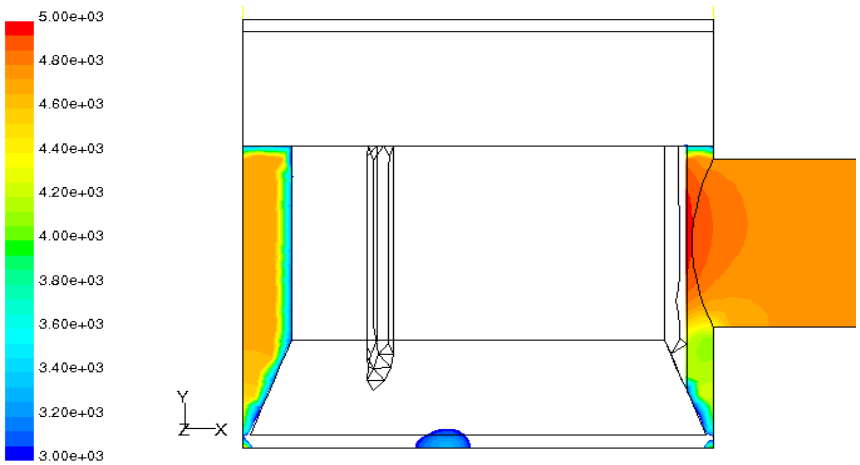
3.3 Pressure drop and control

A special study was carried out in order to trace any «high turbulence area » causing an abnormal increase in energy measured by a pressure drop. You will find below the static pressure simulation chart of the entrance followed by the annular throttling gap, in general and in detail. These simulations resulted in a better positionning of the down-comer tubes from the first demister section and the distribution of the gas over the entry section.

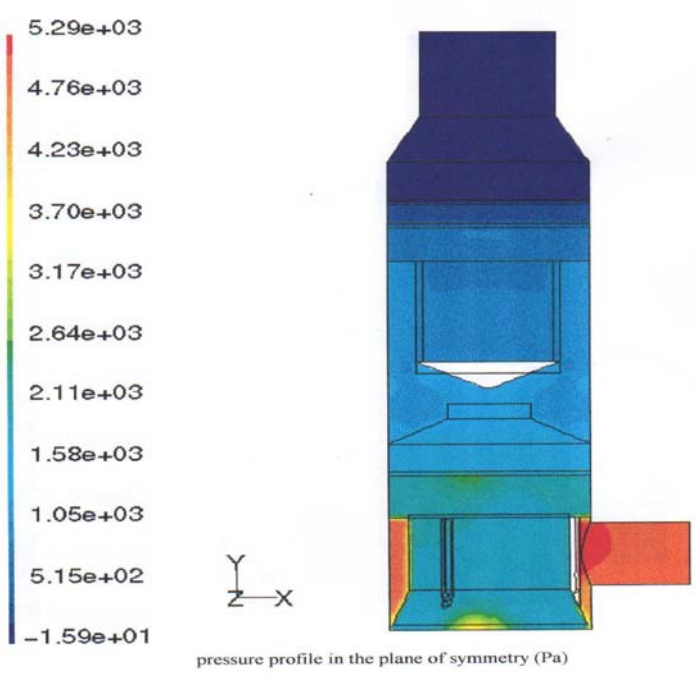
Unfortunately energy is needed to capture the dust particles in the gas. Based on the measurements of several installed systems, following pressure drop values are required to obtain a maximum 30 mg/Nm^3 urea dust emission :

- 400 mmW.C for the granulator scrubber,
- 200 mmW.C. for the cooler scrubber.

The next diagrams illustrate the pressure loss from the gas entrance to the swirl vane section as well as over the total scrubber.



PRESSURE LOSS THROUGH THE SCRUBBER



pressure profile in the plane of symmetry (Pa)

3.4 Multiple gas streams in «cooler » scrubber

This scrubber generally receives several air streams, from one or two coolers in series, from shop ventilation, etc...

Because of different relative humidities and temperatures of those air streams, mixing outside the scrubber could lead to dust build-up in collecting flues upstream. Therefore we have provided multiple inlets to this particular scrubber system.

4.- NEW DEVELOPMENT : 90 % AMMONIA ABATEMENT

Certain companies operating urea granulation plants do already add organic formaldéhyde to the urea melt prior to granulation to reduce the gaseous ammonia emission by more that 50%. Some want to go even further and at urea dust and gaseous ammonia abatement system is currently being built in Asia this has been designed to provide an even greater efficiency.

Careful analysis of all the parameters has encouraged us to propose the urea dust abatement system and the gaseous ammonia absorption system in one large vessel rather than in two separate vessels. Indeed the latter layout would incorporate a longer ductwork and would thus create a much higher energy demand on the blowers and would need a larger implantation area whereas the urea dust abatement system would adopt the classical “Turbulaire” layout.

The absorption section consists of two stages in which an absorption medium is used. Each stage being continuously irrigated with an acidified ammonia sulfate/sulfite solution.

This solution will be kept at predetermined pH value using sulphuric acid. The purge on the recirculation loop will be regulated with a pre-set density. The absorption section will be followed by a final high efficiency demister section, so as to eliminate the nuisance of mist carry-over. The absorption medium has already been installed and has proven to be successful in several plants throughout the world.

CONCLUSION

The new urea granulation plant which will operate the system described in this paper is scheduled to begin operating in May/June 2001.

This plant will be a trend setter using state of the art technology.

SOCREMATIC and its client will monitor the daily operation of the plant closely and hopes to be able to inform you of the figures obtained in a future technical paper.

SOCREMATIC is proud to be able to offer solutions which meet the current anti-pollution laws. It will continue to research and develop in order to serve its customers and the environment.

New Corrosion Resistant Material for better Performance

Gerd L. Meier, SGL Technik GmbH, Germany

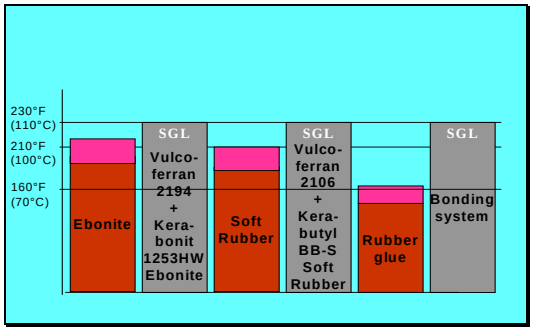
New Developments in Rubber Linings

• New rubber qualities for higher temperature and higher corrosion resistance
• Rubber seams made with hand extruder

Reliable Performance of P_2O_5 Evaporators

• Is graphite still the best solution for evaporators in few of corrosion resistance and life time

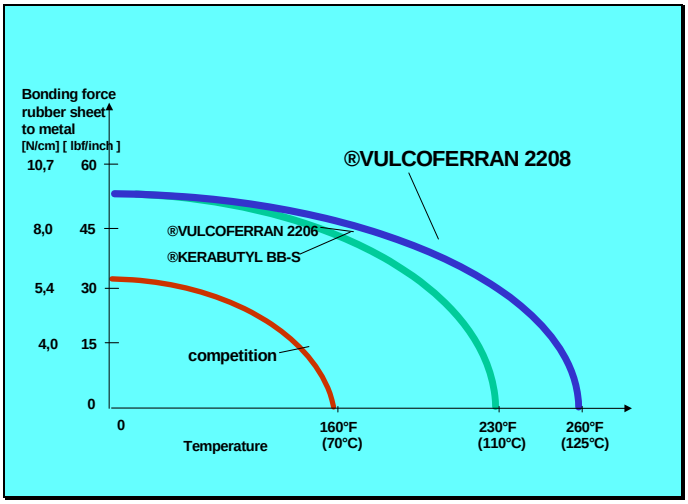
Present Temperature Limits



Objectives of the new material development

•Higher temperature resistance
•Good resistance against organics, nitric acid, hypochlorite
•Soft rubber and Ebonite suitable for site lining
•Bonding system of same material with same features
•Same material cost level as the existing rubber qualities
•Insensitive to temperature variation
•Material with high “Martens Point“ (softening point)

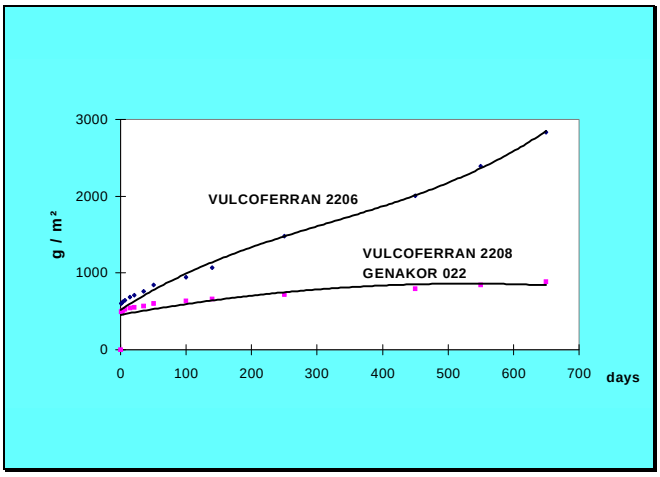
Soft Rubber



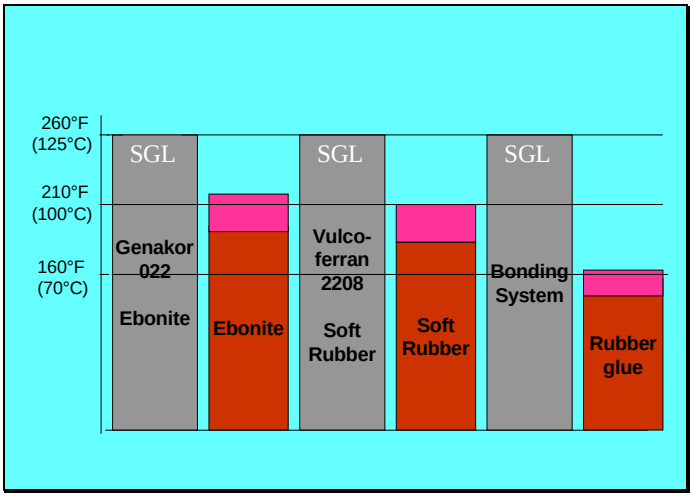
Physical Properties

Properties	Dimension	®Genakor 022 (IR) Ebonite	®Vulcoferran 2208 (BIIR) Soft rubber
Density	g/cc	1,40	1,19
Shore hardness		D 78 ± 5	A 70 ± 5
Tensile strength	psi	> 3.000	> 750
Elongation at brake	%	> 2	> 100
Bonding strength to steel	psi	1700	--
90 ° Stripping test	lbf/inch	--	60
Vulkanization temperature	°F	230	self vulcan./230
E-Modulus	psi	> 130.000	
Spark test (permissible)	kV/inch	No testing	75

Demineralized Water Test at 180 °F
Weight increase (g/m^2) as function of time



New Temperature Limits



Extended corrosion Resistance

•Nitric Acid 20 % at 180 °F
•Hypochlorite up to 600 g per gal active Cl_2
•Organics: 2208: alcohol and organic acids
(no aromatic compounds or chlorinated hydrocarbons)
022: alcohol and organic acids
(traces of aromatic compounds or chlorinated hydrocarbons)
• Defoamers: 022: most of the defoamers resistant
2208: some of the defoamers resistant

Operating Experience

•Reactors for pigments: 022; 2 years (field lining)
(HCl + H_2SO_4 + pigments from 20 to 240 °F)
•Tanks for Uranium waste: 2208; 3 years (field lin.)
(HCl + H_2SO_4 + HNO_3 at 140 °F)
•Duct for waste gas: 2208; 3 years (field lining)
(acid mixture at 260 °F)
•Rail road cars: 2208 (shop lining)
Sodium hypochlorite with 600 g per gal Cl_2;
Hydrochloric acid up to 37 %
Caustic soda up to 50 %

New rubber material
®VULCOFERRRAN 2208 and ® Genakor 022

Advantages and features:
• Improved corrosion and temperature resistance
• Soft rubber and Ebonite suitable for site and shop lining
• Bonding system of same material with same features
• Insensitive to temperature variation
• Extruded rubber sheets from 1/8 to 1/4 inch
• Material with high “Martens Point“ (softening point)

• Same material cost level as the existing rubber qualities

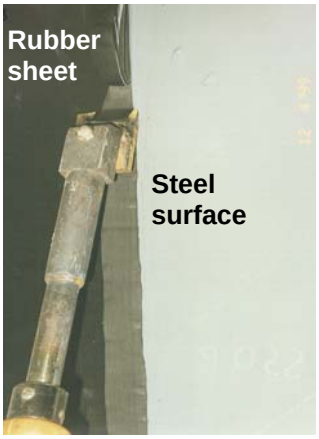
Rubber seam extrusion

(Patent-No. 198 14 376.1)1. Old technology of rubber joints
2. New development by rubber seam extrusion
3. Advantages and Features

Old technology of rubber joints

Fixing the first rubber sheet

Bevel the edge



Design of the seams between the rubber sheets

The pre-vulcanized rubber is sticked to the steel with a polar glue.
This glue absorbs water that weakens the bonding greatly.

0 hours

Original pre-vulcanized **rubber**

1.000 hours

Water penetration starts at the seams

10.000 hours

Water absorption behind the rubber. Bonding force is weakened

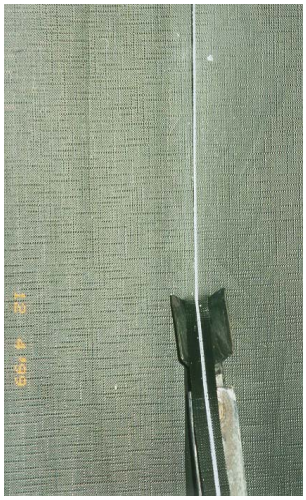
20.000 hours

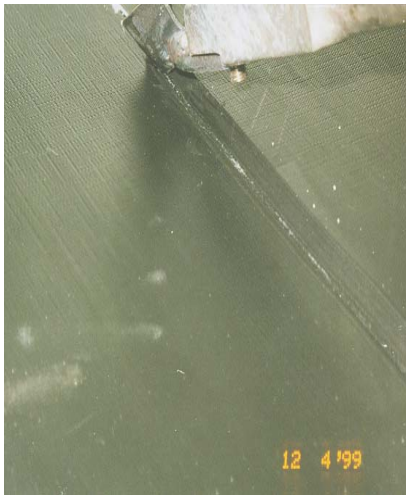
Heavy loss of bonding force Peeling off of the rubber.

Seam extruder
Rubber sheets without seam preparation

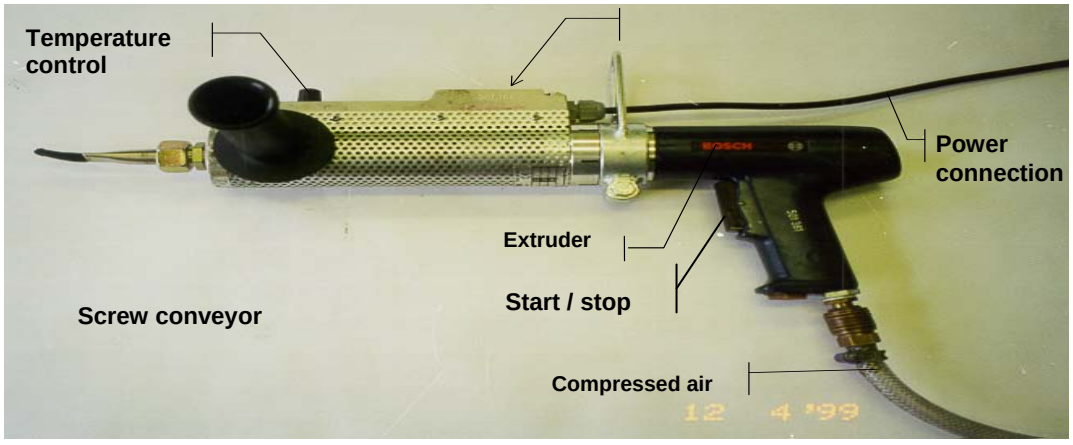
Rubber sheet	Rubber sheet

V-seam cutting

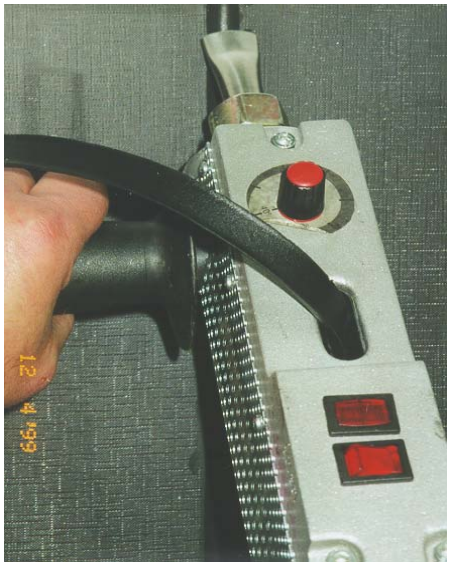




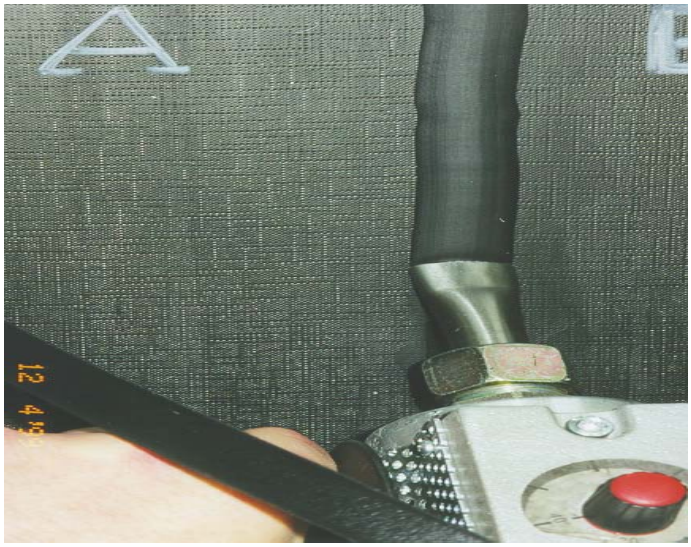
Hand extruder



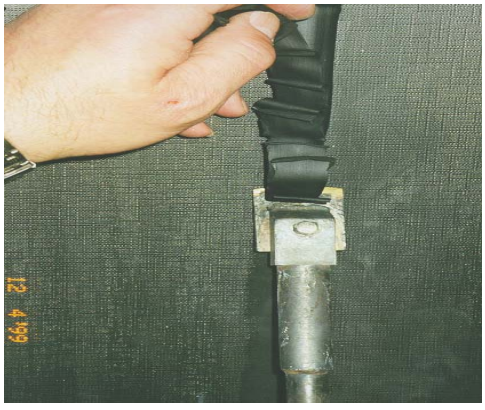
Rubber seam extrusion

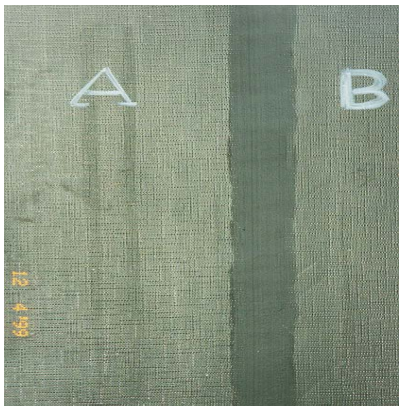


Rubber seam



Option : rubber seam flattened





Seam extruder

Technical description:
•Rubber sheet material and extruded seam exactly the same
•Complete bonding of the seam material to the rubber sheet and the seam root to the steel
•Speed of seam adjustable up to 3 ft per minute
•Sheet material thickness from 1/8 to 1/4 inch
•Spark testing of seams possible

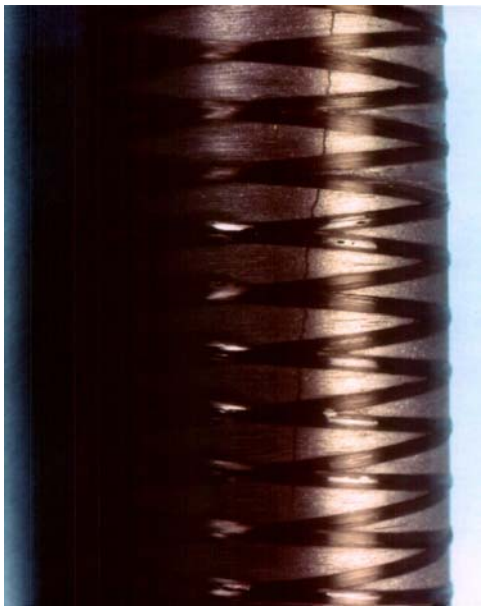
Advantages and Features:
• Rubber sheet material and seam of same quality without glue in between
• Seam can be controlled visually and by spark testing
• Same physical properties after vulcanization
• No liquid absorption of seam
• No cracks or opening in seam region
• Operational reliability
• Time saving in rubber application
• No expensive steel preparations in corners and complicated shapes
• Flattening of the seam possible for further application, like brick lining or assembly of internals
• No flow disturbance or scaling caused by the seam
• Suitable for small repairs of cracks in the lining material
• Economical and reliable technology

P_2O_5 evaporator

• Critical equipment for the concentration of phosphoric acid
• Material must be corrosion resistant
• The scaling in the tubes requires cleaning with chemicals or high water pressure
• The life time of the evaporator is essential for the operating costs
• Repair of the evaporator must be easy and cost effective

What is the better material choice ?
Graphite or Metal

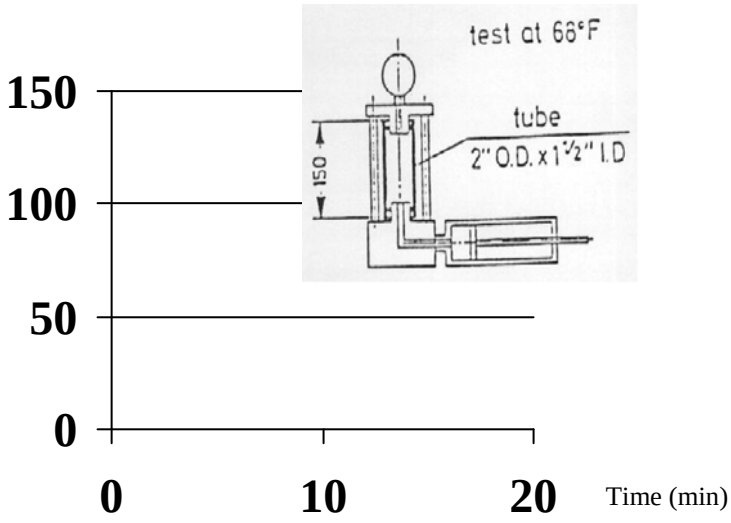
DIABON tubes HF1 – Carbon fiber reinforced



The carbon fibers keep the tube in compression and hold broken tube together, therefore averting catastrophic failure

DIABON HF1 – carbon fiber reinforced

Hydrostatic retention of HF1



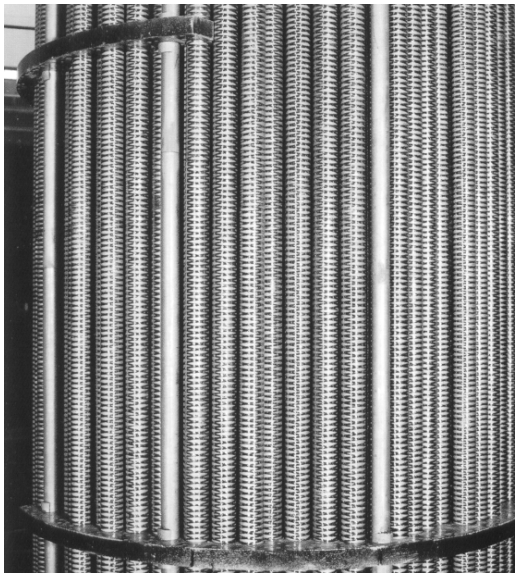
A cracked HF1 tube can hold 40 psig pressure without leakage

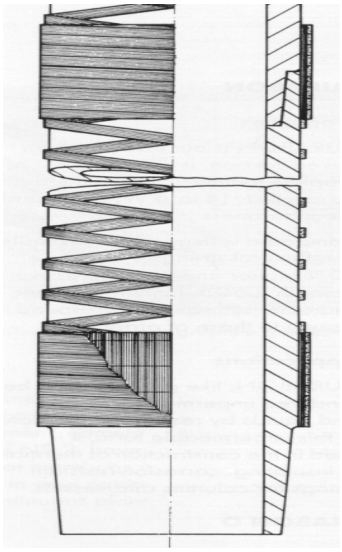
DIABON tubes HF1 – carbon fiber reinforced

Features:
• 60 % higher bursting pressure compared to standard graphite tube
• 2,5 times higher resistance to steam hammer
• Same heat transfer duty as the evaporator with standard graphite tubes
• Same diameter and same pitch, therefore anytime replaceable with standard graphite tubes
• No shutdown of operation because of a cracked tube

Disadvantage:
• 10 to 15% higher investment costs of evaporator with carbon fiber wrapped tubes

® DIABON graphite evaporator for P_2O_5





SUMMARY

• Rubber sheets are a reliable material for corrosion and erosion protection for many decades
• The lining technology of rubber sheets shall be easy to apply for the applicators. The lining work can be tested to guarantee a long lifetime
• Evaporators made of graphite tubes remain a reliable and economical solution, the unique solution with fiber wrapped tubes improve the reliability
• The best corrosion solution of your plant can be offered and guaranteed from one source