International Fertilizer Industry Association

IFA Technical Conference

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IFA TECHNICAL CONFERENCE 2004

DISCUSSIONS

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EDITOR'S NOTE

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

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China National Chemical Construction Corporation, CNCCC

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International Fertilizer Industry Association, IFA

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With the support of:

China National Agricultural Means of Production Group Corporation

China National Offshore Oil Corporation

China National Petroleum Co., Ltd

China Petrochemical Co., Ltd

Huaken International Trade Co., Ltd.

Sino-Arab Chemical Fertilizers Co., Ltd

In cooperation with:

China Chemical Mining Association

China Nitrogen Fertilizer Industry Association

China Phosphate Fertilizer Industry Association

China Sulfuric Acid Industry Association

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Saif Ahmed Al Ghafli, Chairman of the IFA Technical Committee

Ladies and gentlemen,

On behalf of the Technical Committee, it is with great pleasure that I welcome you to the 2004 IFA Technical Conference in the capital of the People's Republic of China. We are very honoured to have been invited here for this important event in our Association's calendar.

From a historical perspective, this conference represents the oldest continuing series of industry gatherings dating back to 1947. Over the years, the production engineers of this Association have met, every other year, in 28 different cities in 22 countries. This is a testimony of how broad our global coverage is. Of course, the question arises: why does it take so long for such an important conference to finally find its way to the largest producer and consumer of fertilizers to be the host? A partial answer lies in the fact that the Chinese producers, until now, were largely under-represented in this forum. In the past, very few Chinese engineers attended this conference and virtually no paper was offered by them. Perhaps another valid reason is that past meetings tended to be organized in regions where cutting edge technology for our industry was developed and ideas were freely exchanged. This is true for West Europe, which has been the venue of the majority of these gatherings.

I am indeed delighted to be in Beijing and I am particularly happy to note a good turnout by the hosts. For over half a century, the Technical Conferences have provided the fertilizer industry leadership in technological advances. During this period, the direction of change was dictated from within the industry itself but it is now increasingly shifted to the stakeholders or the society at large.

In the early stages, the industry was primarily concerned with meeting product specifications and physical quality. Laws were enacted on product specifications wherever fertilizers were produced or sold.

The environmental movement, which started in the sixties, did not establish firm rooting until a couple of decades later. Many countries still do not attach high priority to strong environmental rules and enforcement.

The oil crisis of 1973/74 had probably the most profound impact on our industry. Globally, this industry accounts for between 2 and 3 percent of total energy consumption. A modern ammonia plant, for instance, consumes as much energy as a power plant for a standard medium-sized city of half a million people and there are some 400 such ammonia plants around the world today.

The Technical Committee of the Association strives to meet the expectations of its members and stakeholders. Its work revolves around three objectives: to be cleaner, more efficient and safer. During my tenure as Chairman, the Committee has formed three Task Forces and a Working Group to provide in-depth focus to meet these objectives. For

example, the former Task Force on Emissions, carried out an emission survey every two years. In this way, members were having an internal audit of their performance. Similarly, we conduct an annual survey on safety performance, representing an internal audit for each participant, which will foster consciousness in the workplace. We award Certificates of the Principles of Safety to all companies who participate in these surveys and pledge to uphold these principles. And to help to spread the understanding at all levels, these certificates are available in 25 languages. As for energy efficiency, the Task Force concerned has, at the beginning of this month, embarked on a global benchmarking survey of Energy Efficiency for Ammonia Production. I am very happy to report that some 80 ammonia plants will be involved, including ammonia producers from China.

As the industry matures, technological advances become increasingly difficult to attain. This does not imply that the industry will not continue to build bigger and more efficient plants or safer working conditions. Five thousand tons per day urea plants will become common. In this conference you will hear of a new standard for ammonia production: 3500 tons per day.

Parallel with the technological progress, there is now active movement towards creating more rules that will affect our industry. The Nitrate Directive in West Europe was one of the earliest. Cadmium regulations are being formulated or re-formulated. Rules on ammonium nitrate are being overhauled in many countries. Shipping regulations, impurities in fertilizers, emission allowances and the monitoring of the fertilizer product from cradle to grave are in the midst of examination or in various stages of implementation. A number of papers relating to these issues will be presented at this conference.

I trust our presence here will provide Chinese members and potential members, a window to the range of activities that this long standing international Association provides. We earnestly hope that they will participate in the initiatives the Committee carries out. You will be happy to note the sizable contribution of papers from China in this conference. By way of mutual exchange, we hope that we will create a more homogeneous entity with common benefits to be shared by all.

Before I conclude, I would like to thank the host members for their kind invitation to come to Beijing. In particular, I would like to thank Mr. Lihua Chen, of CNCCC, also the IFA Regional Vice President of China, for providing the local co-ordination and for hosting tomorrow's reception; Mr. Sihai Wu of SACF, IFA Senior Vice President, for hosting the technical visit next Friday, Ms. Qiao Hong for her tireless efforts in co-ordinating Beijing and Paris and the rest of the world. And on behalf of the participants, I would like to thank Cargill Crop Nutrition, KBR (stands for Kellogg Brown and Root) and Stamicarbon for supporting the lunches.

I would also like to thank all the authors of papers for their long hours of hard work and their generosity in sharing their information for the benefit of all, the Chairmen of sessions and their rapporteurs for their willingness to guide us through many interesting documents.

This conference marks my penultimate duty in my tenure as Chairman of the Technical Committee. I have the rare privilege of guiding two Technical Conferences.

My work was made much lighter by the tireless efforts of our Vice Chairman, Mr. Bjarne Christensen of Kemira GrowHow; Bjarne: Thank you. I would also like to thank our

Convenors, Mr. Tore Jenssen, Mr. Ozzie Morris, Mr. Fadhel Al Ansari and Mr. Vaughn Astley for their time to organize the many fora and providing bright ideas, as well as our Committee members who have responded to our initiatives. Lastly, I am grateful to the Secretariat, for the assistance in facilitating and implementing these initiatives.

May I wish you every success in your deliberations and enjoy the warm and generous hospitality of our hosts.

Thank you.

TO ENHANCE THE INTERNATIONAL COOPERATION AND IMPROVE THE LEVEL OF FERTILIZER PRODUCTION TECHNOLOGY BY THE CHAIRMAN OF THE CHINA PETROLEUM AND CHEMICAL INDUSTRY ASSOCIATION, MR. TAN ZHUZHOU

Honorable Mr. Zeng Peiyan Mr. Chairman, Distinguished guests, Ladies and Gentlemen,

Good Afternoon!

In this blooming warm season of spring, our friends from different parts of the world gather here in Beijing to exchange and discuss the technology of fertilizer production. First of all, Please allow me, on behalf of the China Petroleum and Chemical Industry Association and the host of the Conference to extend my warmest welcome to all of the guests and friends present.

The 2004 International Fertilizer Production Technology Conference is the 30th gathering since 1947. It is also the first time for IFA to hold this conference in China. It is an importance topic of our common concern to improve the progress of agriculture. Fertilizer, as the food of agriculture, enjoys the same concern as agriculture from all the governments. I believe that the opening of this conference will play a positive role in enhancing the development of the global fertilizer industry and fertilizer production in China.

China, as an agricultural and most populated nation, has always been attaching great importance to the development of the chemical industry. Since the 1970s, China has imported large quantities of advanced technologies and equipments from abroad and achieved a huge progress in fertilizer production. Especially when it comes to the 1990s, China further intensified and adjusted the structure of the fertilizer production, making it better for Chinese fertilizer to fill the needs of agriculture. At present, China has become the largest producer and consumer of fertilizer in the world. In 2003, the total output of Chinese fertilizer amounted to 39.246 million tons. Among them, nitrogen fertilizer reached 28.796 million tons, phosphate fertilizer, 8.806 million tons and potassium fertilizer 1.645 million tons; we also imported totally 6.291 million tons of fertilizers from abroad, among them, nitrogen fertilizer amounted to 993 thousand tons, phosphate Fertilizer, 1.582 million tons and potassium fertilizer 3.716 million tons. But we still lag quite behind on fertilizer production technology and company scale, with a lot of problems left unresolved. I am convinced that this conference will bring new opportunities to the cooperation between China and the rest of the world in the field of fertilizers, and will further accelerate the development of the Chinese fertilizer industry and that of the world as a whole. The China

Petroleum and Chemical Industry Association, along with the China Nitrogen Fertilizer Association and the China Phosphate Fertilizer Association and other associations would like to collectively strengthen the communication between China and the International Fertilizer Industry Association and other organizations in different parts of the world, and make our contribution to the development of the world fertilizer industry.

To ensure a smooth opening of this conference, the International Fertilizer Industry Association and the China National Chemical Construction Corporation have jointly a solid and careful preparatory work. I strongly believe that with our concerted efforts, this conference is bound to be a truly grand and fruitful one.

At last, I wish the conference a great success. And I wish everyone here good health, and have a good time in Beijing.

Thank you all!

Strengthening Communication, Deepening Cooperation and Exploring Mutual Development by Mr. Sihai Wu, The Senior Vice President of IFA and The General Manager of Sino-Arab Fertilizer Company Limited

In this blooming warm season of spring, Beijing, the capital of China, witnesses the grand opening of the IFA Conference that is held every other year globally. It is also the first time for IFA to host this conference in China since its foundation more than 70 years ago. The opening of the conference will certainly provide all the experts scholars and entrepreneurs both home and abroad with a sound stage for our cooperation in communication and learning from each other. The conference is bound to promote the development of China's fertilizer production technology with great and lasting significance. I wish the conference a great success and hope all of you have a fruitful conference.

With the rapid advance of globalization and information technology, the world fertilizer technology is accelerating day by day. Especially in recent years, we have achieved numerous and various technology innovations and research performances in the field of basic fertilizer theory research, production processes and fertilizer plant technology. Many new technologies, new ways and new patents have been promoted and applied. As an international organization, IFA has always been committed to promoting international communication and cooperation in fertilizer technology, managing to have the fruits of up-to–date fertilizer technology innovation shared by the public, thus upgrading the world fertilizer technology. The IFA conference held every other year promotes the communication among the experts in the industry to a large extent and achieves the goal of promoting the understanding, helping each other and developing side by side. The IFA conference in Beijing should be a unique opportunity for learning and communicating for all the experts in the chemical industry.

China is the largest consumer and producer of fertilizers. With an annual production capacity of 40 million tons, we rank first in terms of output. But we still lag behind technically in the chemical industry as a whole. A large number of small-sized fertilizer plants are less competitive in production cost and the product quality still remains poor. In recent years though, we have experienced a series of technical innovations and reforms,

both managerial and systematic, but there is still a gap between China and the developed countries. Therefore, we should make full use of this opportunity to strengthen the cooperation and communication and better promote our technology advancement.

In the meantime, objectively we have seen a large improvement in terms of chemical production technology, the scale of manufacturing and resource use. Many technology and research patents have been promoted and applied, creating obvious economic profits. We would take this opportunity to offer everyone a solid stage for presenting, promoting and deepening cooperation.

As an agricultural country, we still have a long way to go for the development of the chemical industry. The developing momentum of globalization requires us to face up to the world, constantly enhance our own level of development and our capacity of competition in the course of cooperation and communication and accept the challenges of global market competition. To host the conference in China is strong evidence that the international fertilizer industry is attaching great importance to the Chinese fertilizer industry and China's market. With the further development and upgrade of China's fertilizer industry, China will be playing a great role in enhancing the development of the world fertilizer industry, ensuring the grain production for 1.3 billion Chinese people, in helping to solve the problems incurred by farmers, counties and the agricultural industry. I am strongly convinced that China's fertilizer industry is bound to have a bright future.

Once again, I wish the conference a great success!

INTERVENTION BY MR. LIHUA CHEN, THE PRESIDENT OF THE CHINA NATIONAL CHEMICAL CONSTRUCTION CORPORATION DURING 2004 INTERNATIONAL FERTILIZER PRODUCTION TECHNOLOGY CONFERENCE

Honorable Chairman Mr. Maene, Vice-Premier Zeng Peiyan, and Chairman Mr. Tan Zhuzhou, Distinguished guests and Dear friends,

At this blooming sunny season of spring, we gather here for the "2004 International Fertilizer Production Technology Conference". As the Executive Chairman of the conference and on behalf of the China National Chemical Construction Corporation, I would like to extend my warm welcome and sincere thanks to the leaders from relevant government branches and dear friends from both home and abroad! Sincere thanks are also reserved for all the branches and units that have offered their valuable support to the conference.

Four years ago, the China National Chemical Construction Corporation and the International Fertilizer Industry Association held a successful "2000 International Fertilizer Trade Conference", which had a deep influence in the field of fertilizer production and trade. This conference is the 30th since the foundation of the International Fertilizer Industry Association. It is also the first time for China to host such a large-scale international fertilizer production technology conference, with 270 delegates from 30 countries. The conference will present us with more than 30 lectures and will introduce advanced fertilizer production technologies and renovation programmes. We strongly believe that the conference will establish a brand new platform to link China with the international fertilizer industry.

I take this opportunity to make a brief introduction about the China National Chemical Construction Corporation, which is also known as CNCCC. CNCCC is one of the large-scale state-owned enterprises, which is directly under the management of the State Assets Administration and Supervision Committee. Our business mainly involves import and export trade, R&D, fine chemical products and fertilizers. As for technology and equipment introduction, we imported more than one hundred units of bulk technology production equipment and more than one thousand units of key technology equipment for Chinese companies by way of international tenders, for billions of US dollars and covering many national economic fields, such as environmental protection, industry, agriculture, transportation, energy, etc. With regard to the import and export of chemical products, through many years of client, product and market research and development, fine chemical products with high added value and high technology content have emerged as our signature business. Our products mainly involve pesticides, paints, pharmaceuticals and their intermediates. With an annual export value of more than 200 million US dollars, we are now playing a very important role in the national chemical industry. International engineering contract business is our traditional business. We have completed more than 60 projects in more than 10 countries and exported more than 50 complete sets of equipment. With that, we have gathered a rich experience and gained a good reputation in Asian and Eastern European markets. We are now committing ourselves to develop the African as well as the South and Central American markets, trying to complete domestic and overseas engineering contracts, with equipment manufacturing being one of our signature businesses and new profit sources.

The Tianjin Chemical Industry Research and Design Institute, as one of our own institutes, has always taken the lead in fields such as industry water treatment, inorganics, catalysts and their carriers, etc. The China National Industry Water Treatment Engineering Technology Research Center is located in this institute. The Changzhou Coatings and Chemical Industry Research Institute is the leading research institution in the fields of domestic construction, civil service, industry, environmental protection, national defense, aviation coatings and pigments. The National Coatings Engineering Technology Research Center is now under construction in this institute. The Shandong Chemical Industry Planning and Design Institute is involved in the fields of chemical industry, energy and construction. It strengthens our competitive capacity in the market of domestic and overseas engineering projects. Each year, the above 2 institutes undertake many national science and research projects. Over the years, they have made a great contribution to Chinese science and technology development in their fields.

As regards the industry, CNCCC has the Huayu Chemical plant, the largest DSD producer in Asia with an annual output of 15,000 tons; the Sino-Arab Fertilizer Co., Ltd is a key joint venture company in which CNCCC invested. Its capacity for complex fertilizers has reached 1.2 million tons, making it the largest complex fertilizer plant in Asia. In 2002, CNCCC was allowed by The State Council to start the Hubei Dayukou Mining Fertilizer Combination Project. By the time that this project will restart its production, the annual production capacity of NPK complex fertilizers is expected to reach 500, 000 tons. In order to bring our clients and market advantages into full play, maintain our supply channels and retain our position as the largest pesticides and intermediates exporting corporation, we joined the Jiangsu Pesticides and Chemical Industry Group Company by way of holding shares,

making it our reliable pesticides and their intermediates production base and new products pilot and processing base. This established a solid foundation for us to maintain our signature business and further develop international markets.

CNCCC is willing to build and develop all kinds of cooperative relations with companies both at home and abroad in economy and trade, production, research and any other field, especially in fertilizer production, trade and technology innovation, etc.

I wish the conference a great success!

2004 IFA TECHNICAL CONFERENCE, VICE PREMIER ZENG PEIYAN'S INTERVENTION

Mr. Chairman, Ladies and Gentlemen,

The 2004 IFA Technical Conference is solemnly opened today. It is the 30th IFA Technical Conference, but the first time for such an internationally grand gathering of the fertilizer industry to be held in China. On behalf of the Chinese Government, I would like to express my congratulations on the successful opening of the conference, and to extend my warm welcome to all the entrepreneurs and specialists here, coming from the world over.

This conference will be a display of the latest achievements of the international fertilizer industry, as well as a place for discussing the significant points on its sustainable development. Extensive communications and consultations will be carried out among the delegates from different countries, and from different fields as well, such as fertilizer manufacturers, transportation, development and research, and management. I am strongly convinced that this conference will exert a great influence on the technical progress of the global fertilizer industry.

China is a great nation of agriculture, and the production and consumer of fertilizer, too. Rationally applying fertilizer is not only the essential material base for increasing the agricultural production, but also the potential for reducing its cost and raising its economic benefits. By dozens of years of good efforts, the unceasing progress of Chinese fertilizer technology and greatly improved manufacture efficiency has played a positive role in providing the adequate food and clothing to 1.3 billion people, and in the course of fulfilling the magnificent undertaking of comprehensive construction of a well-to-do society.

Currently, in order to promote greatly agricultural development and to protect the ecologic environment, according to the demands of scientific development, the Chinese Government takes into account the urban and rural areas' development, and gives top priority to solve the problem of agriculture, rural areas, and farmers. The Government takes strong measures and vigorous action to provide the peasants safe and efficient means of production, encourage the fertilizer technical improvements, adjust its manufacturing structure, decrease the enterprises' functioning cost, lighten the burden on the peasants in order to increase the agricultural production, develop the rural areas and raise farmers' incomes. Meanwhile, it strengthens the ecologic construction and protection of the rural areas, guides the peasants to use fertilizer rationally, develops ecologic agriculture, reduces water pollution, and protects drinking water resources. For the further improvement of quality and efficiency of the manufacture of Chinese fertilizers, China is willing to import

advanced experience, and strengthen the external economic and technical exchange and cooperation, in order to bring about domestic fertilizer production onto a new stage.

The International Fertilizer Industry Association is the institution for development and research of fertilizer, and a global trade organization of manufacturers and consumers as well. It has conducted a large amount of effective work for its members' technical advancement, and provided a broad platform for communication in the global fertilizer industry. We hope that Chinese fertilizer enterprises, some related associations and development and research institutions are able to strengthen the connections with their counterparts abroad, act in close coordination, with the development of agriculture, make greater contribution to the progress of the fertilizer technical improvements at home and abroad.

In conclusion, I wish the conference a complete success!

Thank you very much.

PAPER 1: CURRENT SITUATION AND TECHNICAL PROGRESS OF THE PHOSPHATE FERTILIZER INDUSTRY IN CHINA. LIN LE, CHINA PHOSPHATE INDUSTRY ASSOCIATION

Viren Kaushik, Fertiliser Association of India (FAI), India:

Q. What is the specification of low-grade rock, which is used for slurry process MAP production?

A. It is 28% P_2O_5. It has also magnesium with a ratio of: MgO: P_2O_5: 8~10.

Arthur van Brempt, Kemira GrowHow S.A./V.N., Belgium:

Q. What is the Cd content in Chinese rocks? (lowest & highest)

A. The cadmium content of Chinese rocks is low. In general it is around 10ppm.

Anonymous:

Q. How is the phosphogypsum used in the production of sulphuric acid and cement? What is the normal capacity of the plant? Can you provide us with a brief process description?

A. There are two types of processes used. One requires pre-heating. This can produce up to 400,000 tons sulphuric acid per year. There is only one plant located in southern Shandong.

The other process uses a long oven to deposit the rocks but without pre-heating. More energy is required. The plant capacity is only about 60,000 tons.

Ozzie Morris, Cargill Crop Nutrition, USA:

Q. What is the energy source for roasting gypsum?

A. Coal.

Tore K. Jenssen, Yara International, Norway:

Q. What is the availability of phosphate rock resources in China? Is that sufficient for future needs?

A. The current resources are sufficient for current and foreseeable future needs.

Q. Do you have to import phosphate raw material in order to satisfy domestic demands?

A. No phosphate rock was imported.

C. Santosh, Indian Farmers Fertiliser Cooperative Ltd. (IFFCO), India:

Q. China uses mainly three processes for manufacture of phosphoric acid. What is the percentage distribution among the above three processes?

A. 98 % are produced by DH process. Only one plant uses HH method with the capacity of 110 tons P2O5/day, HDH 210 tons P2O5/day.

Q. What is the maximum capacity per day for single stream for each process?

A. DH 1000 tons P2O5/day, HH 110 tons P2O5/day, HDH 210 tons P2O5/day.

Q. Can you provide the detailed quality of rock used for each process and give your experience on suitability of the rock for each process?

A. The quality requirements for phosphate are less strict for the DH process, which is best suited for domestic rocks.

Q. Is there any major difference between Hydro Agri and Krebs process for manufacture of GTSP? Which process is best suited?

A. They are not comparable.

Q. Which are the different pipe reactor technologies used for manufacture of DAP and give their comparison?

A. No data is available.

Q. Can you provide capital cost for roasting and decomposition of phosphogypsum plant?

A. The total plant investment for producing the 400 ktons/year sulphuric acid and 600 ktons/year cement using $ 103 million.

Q. Can you provide process details for manufacture of aluminium tri fluoride?

A. Please check with the patent holders such as: ALCOA of USA, Chemie Linz of Austria, Buss of Germany and Aluminium Pechiney of France.

PAPER 2: OVERVIEW OF THE DEVELOPMENT OF CHINA'S NITROGENOUS FERTILIZER INDUSTRY: SOME BASIC EXPERIENCES. WANG WENSHAN, CHINA NNFF ASSOCIATION

Hans van Baal, Stamicarbon, The Netherlands:

Q. In order to meet increasing demand of fertilizer, is China also investigating possibility to invest in new projects outside China where cheap gas is available?

A. This is being considered but there are many obstacles to overcome.

Anonymous:

Q. Please specify lowest to highest energy levels used per ton of NH3 production (in terms M Kcal)?

A. 7 to 15 million kcal per ton.

Tore K. Jenssen, Yara International, Norway:

Q. What is the future demand for the different types of fertilizers in China?

Urea and urea based fertilizer?

Ammonium nitrate and AN-based fertilizers?

NPK: urea or AN-based?

A. Currently, urea-based fertilizers account for some 60 % of the demand. It is increasing. Over the longer term, the trend is towards NPK complex fertilizers.

S. Nand, FAI, India:

Q. What is the plan to construction of natural gas and ammonia plants?

A. *No answer.*

Q. What is the availability of natural gas for new plants and the price of natural gas delivered to the fertilizer plant? ($ per mm BTU)

A. China is rich in coal. For new plants we are moving to the sources of raw materials, namely, coal and natural gas. However, there will only be few large natural gas based plants but continue to rely on coal.

PAPER 3: PROSPECTIVE EU CADMIUM REGULATION FOR FERTILIZERS. J.A.M. VAN BALKEN, EFMA, BELGIUM

Doudou Fam, Industries Chimiques du Sénégal (ICS), Senegal:

Q. Since 1990 we have been talking about a regulation of cadmium content in phosphate fertilizer. There is up to now no economic technology to remove cadmium. As the European union will no longer postpone the regulations, what are the measures taken to assist or help companies which are concerned to continue research in order to implement an appropriate technology?

A. The European Commission supplied money to some North African countries to develop decadmiation technology in the late eighties and early nineties. Decadmiation technologies were developed on laboratory scale but further developments on pilot scale have ceased.

In recent discussions with the EU Commission, the European producers together with IFDC (USA) offered to start a consortium to investigate what would be the most promising technology for an economically feasible decadmiation process. It became clear that the Commission has no funds and feels that the money necessary to develop this decadmiation technology should primarily come form those who are directly concerned (i.e. phosphate rock suppliers).

Q. We know that the contribution in soil cadmium content is only 6%. Will a regulation on fertilizer be efficient if there is no action on the remaining 94%?

A. Proposed EU regulation concerns EC Fertilizers. In our discussions with the Commission it became clear that the issue of non-EC fertilizers and imported fertilizers is not properly thought through. It is however, to be expected that once the EU legislation is enforced in the national laws of the Member States, these States will take additional measures to tackle this problem.

F. Kabbaj, Groupe Office Chérifien des Phosphates (OCP), Morocco:

Q. What is the progress being achieved by EFMA to avoid the need for labeling for cadmium in the fertilizers?

A. So for EFMA has maintained a good dialogue with the European Commission on labeling. By requiring the fertilizers with 20 mg Cd per kg P_2O_5 that is sold in the market, it could create a wrong impression on the quality of the fertilizers, especially when there is no direct correlation between cadmium content and yields. Should labeling be necessary, we will find ways to avoid any misleading message that could be attached to it. The debates with the EC continue.

Arthur van Brempt, Kemira Growhow S.A./N.V., Belgium:

Q. I have noted that in some countries farmers are requesting for fertilizers with less than 20 mg Cd per kg P_2O_5. Everyone seems to be afraid of cadmium.

A. Cadmium discussion is all over Europe. It's political, not scientific. However, in regions where the level of cadmium is already high, it does not mean measures should not be taken. There is no need for a harmonized legislation to cover all regions.

Tore K. Jenssen, Yara International ASA, Norway:

Q. Do you foresee the EU expanding its reach to regulate other impurities?

A. There are already signs that after cadmium, other impurities could be included in future. It is apparent from the Water Act that both arsenic and lead could be the likely candidates on the target list.

Jinming Wang, Sino-Arab Chemical Fertilizer Co. Ltd. (SACF), China:

Q. Apart from the source of cadmium from the air, the human body also absorbs cadmium through crops, while the most of cadmium from crops is from fertilizer. Are there any scientific measurements in the EU of the cadmium concentration in crops with that of the soils as well as the relation between cadmium in food with that in human bodies?

A. Human bodies absorb cadmium both through food as well through inhalation. There are much more sources of cadmium to the soils such as wastes, sludge, but it is easier to regulate the industry. That's way fertilizers received the attention. However, the mechanism of up-take is not well understood and there is a substantial difference in plant up-take between different plant species. For instance, tobacco plants absorb unusually large quantities of cadmium. The maximum Cd content in food in Europe is well regulated by EC Directive EC 446/2001. In the meantime the scientific world is trying to understand more on the up-take mechanism of Cd from soil by the crops. In 2000 and 2003 this was topic of the workshop organized by SCOPE in Brussels and Ghent.

PAPER 4: IMPLEMENTING SO2 EMISSION TRADING IN CHINA. YANG JINTIAN, CHINESE ACADEMY FOR ENVIRONMENT PLANNING

S. Nand, FAI, India:

Q. What are the SO2 emission standards (national and local) for the sulphuric acid and power plants (volumetric ppm and weight – kg/MT H2SO4)?

A. We have emission standards for the power sector. There are different numbers for generators built at different stages.

Q. Does China plan to desulphurise high sulphur content coals?

A. No, but the Government encourages the use of low sulphur-containing coals.

Jinming Wang, SACF, China:

Q. Concerning the establishment of the sulphur absorption systems. Is there a deadline given by the government?

A. Yes, with the new emission standards for the power plants, most of the plants will have to install FGD to meet the requirements.

Q. If all power stations are equipped with sulphur absorption systems, how much of the SO2 can then be absorbed? What would be the amount, if the SO2 is turned into H2SO4? What is the present H2SO4 production capacity, and what is the real situation at present?

A. The SO2 absorption normally reaches 85-90% but the SO2 absorption systems will not produce H2SO4.

Leif Kjaergaard Rasmussen, Kemira GrowHow, Denmark:

Q. Have you tried to estimate the potential savings by the implementation of the Emission Trading system on the 2005 reduction target of 10%?

A. No, we have not made this estimate, we are still in the pilot phase.

PAPER 5: EFFORTS TOWARDS ACHIEVING ZERO LOST TIME INJURY IN P.T. PETROKIMIA GRESIK. H.M. DJUMHARTO AND EDIMAN HOTMAN, P.T. PETROKIMIA GRESIK, INDONESIA

Anonymous:

Q. How do you address Accident Investigation Methodology and Behavioral Safety (Attitude)?

A. The company has a system and procedure for the investigation of an accident. The investigation details where and why the accident happened and who were involved. Regarding the behavioral safety, every employee has to pass a psychological test, which contains one's behavior concerning safety. The test is conducted during recruitment and is periodical every 2 or 3 years. Besides this, all managers have the duty to encourage workers in having safety manners and in working safely. It is not easy to measure one's safety behavior, but however we try our best from time to time to find the best way in measuring one's safety attitude in relation with the safety record.

Q. If the number of employees are 3600, what about contract employees? Do you count them?

A. Yes, we count any accident on contract employees. The record is put separately from the permanent employees. You cannot see the contract employee accident record in my paper, because I did not take this into account, when preparing the paper.

Q. Have you measured any impact on the productivity to see whether it is reduced or improved after 2001?

A. We have not measured productivity in relation with the number of accidents or safety performance. We have the opinion that productivity cannot be improved by means of safety, but we realized that safety may provide a condition or climate to improve productivity.

Saif Ahmed Al Ghafli, FERTIL – Ruwais Fertilizer Industries, UAE:

Comment: Excellent approach to safety, LTI analysis based on a mathematical form.

A. Thanks for your comments.

Q. The 8 dominant factors are valid but not enough. Very soon the efforts will be exhausted in how far you could improve?

It is the staff attitude towards safety, which will make the difference in sustaining low LTI´s. It is not enough for the employee to know what to do and how to do it, but he/she should have enough motivation and drive to answer why he/she should do the safety practice. It is the attitude, the safety attitude, which should also be addressed, improved and sustained.

A. Have realized that the approach we took to reduce the accident rate is far from perfect yet. It is our expectation to reach sustainable low LTI´s perhaps after we have made a comprehensive evaluation of our safety management system. We still have to make a corrective action plan in a different approach, meaning that attitude should be put into the main consideration. Anyway, thanks for your advice.

Mohammed Al Khaldi, Saudi Arabian Fertilizer Company (SAFCO), Saudi Arabia:

Q. Did you quantify your safety culture among employees by carrying out another audit?

A. Up to now we have never been quantifying the safety culture among the employees. What we do in the company, is to make employees keep in their mind, that there is no other alternative to safety, and that safety belongs to everybody, and that safety is everyone's responsibility, besides safety promotion, safety training, safety contests, etc. Those 8 dominant factors affected 88.4% of the accident frequency rate simultaneously. Therefore in overcoming any obstruction within the safety management system, we focused on those 8 factors. Even though, it is possible to conduct another safety audit in order to measure those 8 factors individually.

Comment: Please make sure, that your safety practice is a pro-active mode rather than a reactive one.

A. Thank you for your comment. We always expect to have a pro-active safety culture/manners. I believe that it is a never ending effort will gain a condition, where a pro-active behavior belongs to every employee, not only in the safety aspect, but also in all aspects within the company.

Zheng Xiu Xing, China National Chemical Construction Corp. (CNCCC), China:

Q. It is a very big achievement that the number of accidents has been reduced from 80 to 5-7 cases per year. I like to know your definition of an accident. Does it mean only an injury to a person or are also an equipment or a process failure included?

A. The number of accidents, which are taken into account, is only the number of injuries to people/employees. And the lost time injury refers to the man-hours lost due to absence of an employee, who had an accident.

Li Xin Hua, Sino-Petrol South West Fertilizer of Talimu, China:

Q. Since 2001 the accident rate has decreased at high speed. Are the main 8 factors still the same? Have you looked at this statistically?

A. I believe that the 8 dominant factors are still related to the accident rate so far. We have to see after 5 years from 2001 whether those factors still have an important role for management in reducing the accident rate. It could be changed after 5 years and the records may show the change later.

Leif Kjaergaard Rasmussen, Kemira GrowHow, Denmark:

Q. Your paper indicates 84 to 71 accidents from 1996 to 2000. From 2001 to 2003 there are only 6, 5 and 7 accidents respectively. How do you explain this dramatic drop? I have never seen any new safety system with such an immediate impact.

A. At the beginning, when we approached to focus on the 8 dominant factors, we did not know, that this would lead to such a reduction so drastically. However, in fact, the approach was working very well. Therefore we believe that this approach is the best way for our company to reduce the accident rate at this moment. The approach may be changed later after that we have made a comprehensive evaluation.

Q. Are people involved in an accident with a minor injury, but still capable of doing other another job, excluded from your safety statistic?

A. If one is having an accident, an evaluation must be carried out. It is possible to send him/her to another job, which he/she still might be able to do. The plant manager together with the personal and safety manager have to evaluate the person's capability after he/she has experienced an accident.

PAPER 6: PRODUCT STEWARDSHIP. TORE K. JENSSEN, YARA INTERNATIONAL ASA, NORWAY

Arthur van Brempt, Kemira GrowHow S.A./N.V., Belgium:

Q. Could you describe Yara's actual and future policy regarding the production and sales of NPK B class fertilizers?

A. We have for a long time produced only the C type NPK, except in France, where we have a low production of B type NPK in response to market demands. We have raised the issue of only C type also in France with other manufacturers, so that all NPK´s satisfy the lowest possible decomposition properties (non–cigar–burning effects in case of being heated, e. g. in a fire).

To achieve a common policy, we request the authorities in France to distinguish between the B and C types in their requirements to storage and handling.

PAPER 7: FLUORINE RECYCLING: A NEW APPROACH TO EFFLUENT MANAGEMENT IN PHOSPHORIC ACID PLANTS. ARJUN CHARI AND S. SUBBIAH, INDO JORDAN CHEMICALS CO. LTD., JORDAN

No written questions were submitted.

PAPER 8: REVERSE OSMOSIS OF PHOSPHATE PLANT POND WATER BY THE USE OF NOVEL PRE-TREATMENT TECHNOLOGY. VAUGHN V. ASTLEY, IMC GLOBAL INC., USA

Bjarne Christensen, Kemira GrowHow, Denmark:

Q. What is limiting the concentration in the reject?

A. The practical limit for the reject concentration for any given pre-treatment process is the point just before solids start to precipitate. Higher feed pressures to the RO unit will produce higher recoveries and consequently a higher concentration of dissolved solids in the reject. However, regardless of the pressure, a point will be reached where dissolved solids start precipitating at the RO membrane surface. We expect to achieve 5-8% P2O5 in the reject and essentially saturated in calcium sulphate.

Q. Is the membrane in use of special nature?

A. The membranes uses are commercial "off the shelf" membranes produced by DOW, Hydranautics or others. Typically, brackish water membranes will be used for operating pressures up to 600 psi (41 bar) and seawater membranes will be used for higher pressures up to about 1000 psi (61 bar).

Janne Laukkanen, Kemira GrowHow, Finland:

Q. What is the energy consumption rate in kw/m^3 water?

A. We estimate our electricity usage is about 7.5 kw/m^3. In the demonstration facility we do not meter power use, but estimate about 22,800 kwh/day for 800,000 gallons/day.

PAPER 9: WATER MANAGEMENT IN THE AQABA INDUSTRIAL COMPLEX. KARIM HALASEH, JPMC, JORDAN

No written questions were submitted.

PAPER 10: PHOSPHOGYPSUM STACK SYSTEMS, CLOSED AND LINED REPLACEMENTS AT CARGILL CROP NUTRITION. OZZIE MORRIS, CARGILL CROP NUTRITION, USA

Bjarne Christensen, Kemira GrowHow, Denmark:

Q. What is typical cost for closing a gypsum stack?

A. Cost of closure of stack depends of many things like location, shape of stack and how it was build. Typically cost of closure is about USD 7 - 20 million.

PAPER 11: GYPSUM STACKING WITHOUT IMPERVIOUS LINING AND CAPPING: PRAYON'S EXPERIENCE. TIBAUT THEYS, PRAYON TECHNOLOGIES, BELGIUM

Arthur van Brempt, Kemira GrowHow S.A./N.V., Belgium:

Q. You neutralize gypsum by lime up to pH 10. Is the free CaO in some cases limiting the reuse of gypsum, especially in building industry?

A. In gypsum we are actually in window 7-10 pH. Plaster and cement industry require gypsum above pH 7. Most important thing for plaster industry is constancy in pH and slow movement in pH.

Q. You mentioned that gypsum stacking costs are about € 4,5 /t gypsum. Are parts of liming cost included?

A. Actually we don't consider liming costs as stacking cost. Figure for liming costs are about 30 kg CaO/t gypsum.

Jiangping Wang, Guizhou Hongfu Phosphate Co. Ltd., China:

Q. What is the filter surface ratio between DH and HH?

A. First filter (DH) is much smaller than second filter (HH). Relative surface for DH filter is about 15 t P_2O_5/m^2d and relative surface for HH filter is about 6-7 15 t P_2O_5/m^2d.

Darwish Armara, Saudi Arabian Mining Company, Saudi Arabia:

Q. Is radioactivity in the produced phosphogypsum in acceptable level?

A. In our case radioactivity is not a problem because we avoid radioactivity by choosing rocks of low level in torium and uranium. Kola rock is mainly used. In past we have used also Phalphos and Kovdor rocks which have also low content of radioactivity.

Cement industry can utilize higher radioactivity gypsum because gypsum is diluted to 4-5 % into cement. Product in plaster industry contains almost 100 % gypsum where radioactivity is more critical. We produce gypsum for plaster industry where gypsum radioactivity requirement is less or equal than radioactivity in natural gypsum. That causes limitations for raw material.

If all of gypsum would be used in cement industry almost all of rocks could be used, for example, all Chinese rocks.

Wang Cheng, Shandong Redsun Akon Co., China:

Q. How much fresh water is used per added t P_2O_5 in CPP-process?

A. A1: In HH-processes water consumption is about 1,5 m^3/t P_2O_5 less than in DH-process. Water consumption in CPP-process is about 4 m^3/t P2O5.

Q. Do you use water recycling from gypsum stack?

A. There is a water collection system that runs almost all the time empty. To ensure that water coming from the stack causes no environmental damage, quality of surface and ground water around the stack are regularly monitored.

Peter C.C. Leung, CK Life Sciences International (Holdings) Inc., China:

Q. Are you selling gypsum at good price or do you just give it away?

A. We do have two prices for gypsum. Actually prices are not good. In our case it's question of survival. Price covers only transportation cost and plus a small benefit in case of plaster industry. We are making money on it but the price is much lower than price of natural gypsum.

Q. Is natural gypsum 100 % replaceable by phosphogypsum? In cement industry there are huge potential for phosphogypsum.

A. It's question of economy. In European cement industry the price of gypsum is negative. European cement industry receives money for consuming gypsum from downstream industry, for example, from citric acid production and from coal plant SO_2 gas cleaning.

In other countries like countries in Asia the price of natural gypsum is about USD 20 /t and markets there are very interesting for phosphogypsum.

In USA it is used wet stacking system and it needs huge investment to change it into dry stacking system. There is need for economical evaluation. Florida rock contains also quite high level of radioactivity, which also causes difficulties for utilization.

Q. You have 19 % crystal water in your gypsum. How many molecules of water there are in gypsum?

A. It's question of mass ratio. In hemihydrate gypsum there are ½ molecule of water in one gypsum molecule and in dihydrate gypsum there are 2 molecules of water in

one gypsum molecule. Theoretically in DH molecule there are almost 20 % crystal water. In our gypsum there are about 19 % crystal water because there are also other impurities in gypsum.

PAPER 12: EXPERIENCES OF IMPLEMENTING A GRASS ROOT INVESTMENT PROJECT IN AQABA, JORDAN. PEKKA SUPPANEN, KEMIRA GROWHOW OY, FINLAND

No written questions were submitted.

PAPER 13: EXPERIENCES IN THE PRODUCTION OF NP, NK AND NPK GRANULAR FERTILIZERS USING UREA WITH AMMONIUM PHOSPHATES AND/OR SUPERPHOSPHATES. JOHN SINDEN, FOSFERTIL FERTILIZANTES, BRAZIL

K. Cagmuggen, Kemira Growhow:

Q. What are the requirements concerning water content and temperature of Urea based NP or NPK to be sure of having a free free-flowing product?

A. To avoid caking of the product, the temperature has to be kept at 45 - 50° C.

a) Allowable moisture content depends on the urea content in the product.

O ~ 130 kg/t	Urea	Maximum	H_2O	1.2%
130 ~ 250 kg/t	Urea	Maximum	H_2O	0.8%
250 +hg/t	Urea	Maximum	H_2O	0.5%

b) Use coating agent talc + amine-oil anticaking for free flow.

solid coating	1.0 – 1.5%
Liquid amine oil	0.3 – 0.4 with 30% amine

Li Tianwen, Lutianhua Group Inc., China:

Q. What about the tendency of your product when TSP was used as the basic material?

A. Urea + TSP behaves the same as the UREA + SSP – pH is critical – at least 4.9 – 5.2.

Q. What about the decomposition of Urea when the product was tried at 100 ~ 120° C?

A. Urea – NPKs – the maximum allowable temperature exit dryer is 80 – 85°C. At 100 – 120° C – there is decomposition with NH_3 release and biuret formation.

Q. Can this process be used to produce high-nitrogen content product?

A. Yes. Industrially done with maximum NP – 27:27:0

NPK – 18:18:18

(+400 kg of Urea/MT)

Pilot plant tests have been done for the product 36 – 13 – 0

PAPER 14: TECHNICAL DESICIONS AND PROBLEMS OF COMPLEX FERTILIZER PRODUCTION BASED ON AMMONIUM NITRATE. BORIS V. LEVIN AND A.N. SOKOLOV. – PHOSAGRO, V. ILYIN – JSC CHEREPOVETSKY AZOT, RUSSIAN FEDERATION

ANONYMOUS:

Q. NP solution purification process reduces which impurities?

A. The producer does not disclose technical aspects for NP production based on NP solution after phosphate rock – nitric acid attack. However, we may assume that the main removable impurities are calcium phosphates.

Q. In CHERERVETZ KOCA, phosphate is used to produce phosphoric acid. KOCA produces an acid with low organics. If an acid with higher organics were used, would it affect the reduction effect on the detonation properties?

A. With the use of any type of phosphoric acid, the content of organics should not exceed 0.2% in final NP product. In case it exceeds the above-mentioned value, it may enhance detonation properties.

Zhou Qingyi, Yunnan Three Circles Chemicals Co. Ltd., China:

Q. How much is the MgO content in the P-containing liquid additive?

A. MgO content in APP is 0.2%.

Q. To eliminate Mg residue, how much lilamine is added? How much is the cost? Are the results good?

A. Magnesium nitrate is used at production of pure AN (N-34.5%). When producing NP fertilizer, the availability of magnesium results in the formation of insoluble residues, which is why Mg content should be minimized.

The coating agent is used according to the producer's recommendations.

In case of lilamine, 0.70 – 1.20 Kg/T of NP is added.

ANONYMOUS:

Q. In producing NP, when the additive is phosphate acid, there are more residues on the surface of equipment. What is the composition of the residues?

A. The main component of residues is mono ammonium phosphate and also magnesium, aluminium, iron phosphates.

Q. In producing NP, when the additive is phosphate acid, how fast is the loss of productivity? Can you explain why to us?

A. The decrease of production efficiency is caused by a considerable amount of impurities in wet process phosphoric acid.

Leif Kjaergaard Rasmussen, Kemira GrowHow, Denmark:

Q. A 32:5:0 NPK might show improved performance in the EU detonation test compared to Ammonium Nitrate 34.5 after 5 thermo cycles. But how does a 32:5:0 behaves after repeated cycling compared to a AN 34.5 stabilized with Magnesium Nitrate?

A. The detonation test of AN and NP were carried out in accordance with the directive 80/876 of EC commission which provides for only 5 thermo cycles.

Q. Is there any major difference in the behavior compared to AN 34.5, if the product is misused? E.g. The product is ground and mixed with fuel oil and detonated.

A. We are planning to carry out this test. As soon as the test results are known, we shall inform you about them.

Heikki Hero, Kemira GrowHow, Finland:

Q. What is the pH of the final product?

A. pH of final product is more than 4.50.

Q. Stability in thermal cycles when water is increased? – T + 10 ↔ + 50°

A. The test revealed that at the increase of water content of up to 0.5% the stabilization in thermocycles does not change.

Arthur van Brempt, Kemira GrowHow S.A./N.V., Belgium:

Q. Is the water content in NP production (32-5) higher compared to pure AN (34.5)?

A. AN 34.5 N = typical Max. 0.1%.

NP = ? % H_2O.

The water content in AN and NP is the same and it amounts to 0.3%.

Q. Is this higher water content the reason that you need a coating on NP (No coating needed on pure AN)?

A. The water content is not the reason for coating.

Flow sheet options for the production of urea based NPK fertilizers.

Heikki Hero, Kemira GrowHow, Finland:

Q. Can you guarantee the maximum biuret content?

A. By controlling the temperature throughout the process cycle, the biuret content is kept under control. Even though I do not remember the exact number, the maximum biuret content can be kept under reasonable level – below 1.2%.

Q. Can this process tolerate any nitrates in the process or in storages? Are there any other critical impurities to be avoided totally?

A. We should not granulate urea based NPK fertilizers in the same plant where you granulate ammonium nitrate based fertilizers.

Arthur van Brempt, Kemira GrowHow S.A./N.V., Belgium:

Q. Any experiences or recommendations related to bulk flow cooler on Urea based NPK?

A. I will not use bulk flow cooler in this application at all because these material have extremely low critical relative humidity. The problem is during cooling operation, the drying continues as it cools and you get condensation in the cooler resulting in blockage of material.

Q. Practicable/acceptable granulation window related to the granulator temperature? (Higher temp less water needed but temperature window becomes smaller)

A. On the granulation curve, the region is very close together at high temperature and is wider apart at low temperature. At higher temperature, it is more difficult to control the granulation. At the plant in Iraq, it is very critical. At less than 80°C, there was no granulation. At more than 82°C, it is over granulation. So 2°C window is available. This is specific to the product 27:27:0 with only solids route (i.e.,) Urea and Ammonium phosphate supplied in solid form. It is seen from my experience, in slurry route, the mixture content for granulation is somewhat greater than through solid route and it appears to be less sensitive to temperature than total solid route.

Jiangping Wang, Guizhou Hongfu Phosphate Co. Ltd., China:

Q. The processes are similar between DAP and NPK. If we convert a DAP Plant to NPK Plant, what is the capacities difference between the two plants?

A. It depends on who designed the DAP plant. There are some DAP plants designed with high residence time. In such cases, the conversion to NPK plant may not affect the capacity. But typically for a DAP plant, the residence time in the Dryer is 6 ~ 7 minutes and for a Urea based NPK plant, the residence time required is around 15 minutes. I guess you loose half the production. This is without taking into account, the recycle ratio available. We need double the residence time.

Dai Zhiqian, Lutianhua Group Inc., China:

Q. Would you tell us the contents of nitrogen phosphorous potassium in your typical products?

A. *No answer.*

Q. Are there any problems to produce high nitrogen (urea) content product?

A. *No answer.*

Q. How much is the nitrogen content of your products?

A. *No answer.*

PAPER 15. FLOWSHEET OPTIONS FOR THE PRODUCTION OF UREA-BASED NPK' FERTILIZERS. DAVID IVELL, JACOBS ENGINEERING, USA

Jinming Wang, SACF, China:

Q. It is mentioned that the granulator and dryer for urea-based fertilizer are different from MOP/DAP. The diameter and L/D ratio are longer. What is the designation principle of diameter and L/D ratio for granulator and dryer with urea base fertilizer?

A. The typical L/D ratio for granulator for DAP Plants might be 2.0. For the typical urea based NPK plants, the L/D ratio might be in the range of 2.0 to 2.2.

Q. For urea-based fertilizer, dust is mixed with coating oil as coating agent. If it means that no amine is used in anti-caking agent for urea base? If there is physical difference between urea base oil and nitrate base oil? i.e., flashing point, viscosity etc?

A. *No answer.*

Q. In producing of urea based NPK, the water balance is a challenge. What special technique is used in your process to treat the tail gas from granulator and dryer?

A. *No answer.*

PAPER 16. PHOSPHORIC ACID EXPANSION IN BRAZIL. PAUL SMITH AND ASSOCIATES, BUNGE FERTILIZANTES, BRAZIL

Arafat Ghosheh, Ma'aden (Saudi Arabian Mining Company), Saudi Arabia:

Q. In your presentation, you specify 1.6 – 1.7 M3/P2O5. Is this figure only for Igneous rock. What would be specific volume of reactor for sedimentary rock?

A. The specific volume of Plants is very variable. Some of the plants are designed recently with large specific volume. Some of them have boosted the volume and in some plants the specific volume was reduced. The specific volume in plant is 1.4m3/T P2O5. The coopper brass plant has specific volume of 2m3/T P2O5. With 2.0 m3/T P2O5 specific volume and with good igneous rock, about 97% efficiency is achievable in single stage dihydrate process with two washes. There has been general policy to reduce the specific volumes to reduce the investment cost because many of the plants in the world are built on fixed price turnkey. But the operating cost is important for phosphoric acid producers. If we design with big reactors, we start with high cost, but the cost reduces day by day during the rest of the life of the plant. If you want to boost up the capacity later, you can do that without changing the reactor.

Q. You mentioned filtration rate of 18 TPD P2O5/M2. Is that achievable?

A. The filtration rate of hemihydrate plant is principally due to very small 30m2 belt, which has a cycle time of 40 sec if the rock is pure, no much of impurities, the crystallization is very very good. Most of the advantages come from small belt.

Janne Lunkkanen, Kemira Growhow, Finland:

Q. You have used clay to inhibit corrosion in HH-Process. What is used consumption rate (kg / T P2O5)?

A. The amount added normally is to supplement the aluminium level in phosphate. The aluminium level is relatively low in phosphate. Kaolin is principally added to protect the agitators from corrosion at 100oC in second stage. It does improve crystallization. For dehydrate plants, the normal aluminium level is 0.2 to 0.25% for good filtration and for good passivation of fluorine. It improves granulation in granulation plants as well.

PAPER 17. ASSIMILATION AND DEVELOPMENT OF IMPORTED PHOSPHATE TECHNOLOGY. JIANGPING WANG AND HE HAOMING, GUIZHOU HONGFU PHOSPHATE CO. LTD., CHINA

Bjarne Christensen, Kemira GrowHow, Denmark:

Q. What type of crystal modifier is used to improve the gypsum filtration in the PA Plant?

A. It is secret. Except that we also have layered in equipment, which is also equipped to improve filtration.

Q. How do you anticipate keeping the gas side clean in the heat recovery system during operation?

A. The lean / first lean is what we consider. That is why we do some laboratory work in laboratory and we also do some bench scale test / pilot study. The results of the tests are satisfactory.

Arafat Ghosheh, Ma'aden, Saudi Arabia:

Q. What is the maximum content of MgO handled in your plant without serious effect on Phosphates Acid operation?

A. According to the design, the maximum oxide should be lower than 1.2%, but in actual we run the plant at a level of 1.5 to 1.6%.

Name in Chinese, SACF, China:

Four questions – All in Chinese.

Jinming Wang, SACF, China:

Q. How much price is MICA? How much unit cost is increased compared with mineral oil? MICA is efficient for nitrate nitrogen based compound fertilizer. If is it efficient still in urea based fertilizer according to your experience?

A. Mineral oil must be used as coating agent and it is only 1 kg/MT. MICA more or less acts as internal descicant. That is the way it is acting and replacing magnesium sulphate, as quality improvement.

We have no experience in urea-based plants. We have only experience in Ammonium Nitrate and Nitric acid plants.

Q. MICA is added in process. Is it only coated on the surface of article or mixed with other raw material?

A. *No answer.*

PAPER 18. MICA – THE KEY TO BETTER QUALITY IN GRANULAR FERTILIZERS. HEIKKI HERO AND HARRI KIISKI, KEMIRA GROWHOW, FINLAND

Darwish Amara, Saudi Arabian Mining Company, Saudi Arabia:

Q. Is the flotation for calcite and silicate done in one process or separate?

A. *No answer.*

Q. What reagent is used for calcite flotation?

A. *No answer.*

Jean-Bernard Peudpiece, Grande Paroisse, France:

Q. Has mica an effect on moisture pick up properties of the fertilizer grade?

A. *No answer.*

PAPER 19: AZF AMMONIUM NITRATE SOLUTION BY PIPE REACTOR: A SAFE AND ENVIRONMENT-FRIENDLY PROCESS. J.B. PEUDPIECE AND J.F. GRANGER, GRANDE PAROISSE, FRANCE

Leif Kjaergaard Rasmussen, Kemira GrowHow, Denmark:

Q. Is it possible to add sulphuric acid to AN pipe reactor?

A. Because of safety concern, sulphuric acid cannot be fed directly to the AN pipe reactor. There will also be a problem of pH control in the reactor. What we have done in one of our plants is that if sulphur content in the AN solution is not high, a special pipe reactor is installed in AN solution buffer tank.

Chandra P. Chhabra, Tata Chemicals Ltd., India:

Q. What is the average on-stream time of the plant? What is the frequency of failures?

A. It is difficult to say but if all the accessories are available, there is no reason for plant to stop. Unlike granulation plants which are designed for 20-22 hours operation, these plants are designed for 24 hours a day operation.

Arun Kumar, National Fertilizers Ltd., India:

Q. What are the on stream days of the plant?

A. In our plants, AN solution through pipe reactor has to cope up with nitric acid plant.

Unidentified:

Q. What is the temperature of nitric acid in nitric acid exchanger and what is the material of construction of exchanger?

A. It can be operated continuously at temperature 65^{o}C. Beyond this temperature there will be problem of corrosion. The material of construction of nitric acid exchanger is a stainless steel grade and it is not a very special material.

Leif Kjaergaard Rasmussen, Kemira GrowHow, Denmark:

Q. What is the turndown ratio of pipe reactor?

A. If the throughput is reduced, pressure drop through pipe reactor goes down and mixing of ammonia and nitric acid is not good. This reduces the efficiency of reaction in the pipe reactor. Generally, there is a range of 1 to 3 but for one of our plants we were able to achieve a range of 1 to 4 with the installation of two different pipe reactors in the same separator.

Unidentified:

Q. For a 2000 TPD plant, what is the temperature at the outlet of the reactor before the separator? Which are the countries where such reactors are in operation?

A. Such pipe reactors are operating in US, Europe, Australia and India. Whatever is the size of the plant, the temperature of the outlet of the reactor depends on the AN concentration and pressure. The pressure in separator is atmospheric, and therefore the temperature at the outlet of the reactor is same as in separator.

V.K. Bali, IFFCO, India:

Q. What is the cost of production and energy consumption per tonne? Has there been any accident with this process?

A. There has been no accident with this process. It does not require any energy input. The yields in the process are very good and the use efficiencies of nitric acid and ammonia are higher than 99%.

PAPER 20: LOW N2O EMISSION NITRIC ACID PROCESS. LUIS M. MARZO, ESPINDESA, SPAIN

Unidentified:

Q. It is said that no ammonia producing HNO3 process is on stream. It uses air to produce HNO3. The project cost is only 50% less than ammonia exchange process. Can you give me some comment about this news?

A. If I understand well your question, relates to the manufacture of nitric acid without using ammonia. The only raw material is air. As far as I know there is no such process being used by the industry. In the past NO was produced in some cheap energy countries by using electric arch techniques but this process is not in use nowadays. At first glance it seems that even if NH3 consumption can be avoided, the cost of energy would be less excessive.

Bjarne Christensen, Kemira GrowHow, Denmark:

Q. How is full oxidation achieved before the absorption tower? Is it only the combination of temperature and time or do you have some other design features?

A. Espindesa achieves the full oxidation of NO to NO2 simply by combination of temperature and time. We pay attention to the length and diameter of duets upstream of the absorber to achieve full oxidation and no other designer figure is considered.

Jean-Bernard Peudpiece, Grande Paroisse, France:

Q. Explosion of reactor has to be considered during hazard study, so in order to limit effect zone, NOX quantity has to be limited. Here for residence time of reactor is limited. On the other hand for N2O decomposition residence time has to be increased. What is your philosophy to deal with?

A. *No answer.*

PAPER 21: OPERATING EXPERIENCE OF THE BENFIELD CARBON DIOXIDE REMOVAL SYSTEM AT RUWAIS FERTILIZER INDUSTRIES (FERTIL). MOHAMED R. AL RASHID AND BOUSMAHA BELMAMOUN, FERTIL, UAE

Sri Chandra, Ministry of Chemicals & Fertilizers, India:

Q. In this process, you are facing lot of problems in spite of repeated modifications. Even after modifications, solution carry over is there i.e. up to 60ppm & iron content problem as well in there? I feel these may be another problem of Arsenic disposal in due course of time as it is carcinogenic.

A. There is no arsenic disposal problem as the corrosion inhibitor used is vanadium.

Q. In view of above problems, why not choose some other CO2 removal process like “GV” etc.?

A. Instead of going for another process, which will be very costly and not required, we are studying the alternatives recommended by UOP.

- Replacement of the actual distributor which is not the usual used by IP¨= tangential entry and Norton 898 distributor.
- Integrate a rich solution flashing tank.

Chandra P. Chhabra, Tata Chemicals Ltd., India:

Q. What about other plants like NFL Ltd. (India). Had you compared the courses?

A. Other plants have different designs and some of them are having T/A/ each year or each two years. We are studying the possibility to have a small shut down between major T/A (each 3 years). Also we are in the process of analyzing the root cause of the carry-over for final corrective action.

Q. What in your opinion is the comprehensive system for the Benfield system?

A. Our problem of carry-over is specific to our plant as:

- Running at a capacity much higher then the rated capacity.
- Design of the inermals of the regenerator as done by chiyoda is not the one used commonly by UOP Benfield. We have investigated considerably the problem of carry-over. We are now studying further some alternatives proposed by UOP with the objective to run the plant continuously without regenerator internal cleaning and with a minimum deposits on the trays from T/A during 3 years.

Fadhel Al Ansari, Gulf Petrochemical Industries Co. (GPIC), Bahrain:

Q. What is the effect of potassium carbonate carry over at 60 ppm on urea plant? You had a carry over problem and had solved it through a number of solutions / actions. What is the single solution that had the major effect?

A. At this level, it is not affecting the performance of the CO2 compressor. Earlier with heavy carry over, there was a significant deteriorating effect on the performance of the CO2 compressor leading to urea plant load limitation. The progressive accumulation of fouling deposits on the aerodynamic components and flow path circuit and inside of the seal chamber was resulting in reduction of efficiency and loss in capacity through put of the machine. As contermeasure and to minimize the deposits a coating was applied on the aerodynamic components. This was done using sermalon coating of 50-60 microns thickness.

Bernard Laurent, Kemira GrowHow, Belgium:

Q. You have mentioned one of the corrective measures was to install an activated carbon filter. What is the yearly consumption of activated carbon? Are you regenerating activated carbon and if yes, how many times?

A. Activity carbon filter was used only with DEA activator and during the transition period of introduction of Act I. It was regenerated once per week. Now with Act I we are no more using activated carbon filters since 2001.

V.K. Bali, IFFCO, India:

Q. Must congratulate you for your good paper and effort you made in solving your problem. Fe of 120 ppm has been reduced to 75 ppm, which is still high.

A. This value over 75 ppm is after one to two years of continuous run.

Further we are optimizing our circulation rate.

Further all the elbows reducers and piping with higher velocity will be replaced to stainless steel.

Lian MingChu, CNOOC Chemicals Co. Ltd., China:

Q. How much is the Act I consumption in a year?

A. Act I consumption was high during the first year of introduction. Now it is around 5000 to 6000 kg per year.

Q. How much content is the Act I in solution?

A. Act I content in the solution = 0.5%.

PAPER 22: COAL-BASED AMMONIA PLANTS, NEW TECHNOLOGY AND TRENDS IN AMMONIA PRODUCTION IN CHINA. LI ZHIJIAN, NATIONAL PETROLEUM AND CHEMICAL PLANNING INSTITUTE, CHINA

Viren Kaushik, FAI, India:

Q. How many new coal based plants planned for setting up in next few years – their size and gasification technology proposed?

A. Very few grass-roots coal based plants will be built. Focus in the modernization of existing plants (increasing capacity, improve technology).

Zhong Xuliang, Huaken International, China:

Q. Please compare the production cost of ammonia with 3 different raw materials such as: coal, gas and oil.

A. Coal is roughly 1000 ~ 1300 RMB/t.

NG plants are not comparable.

Oil is about 1500 ~ 2000 RMB/t.

Q. If the oil is the most expensive raw material for ammonia production, when this kind of production will be finished?

A. Before 2007.

Sri Chandra, Ministry of Chemicals & Fertilizers, India:

Q. What is the ash content in the coal used in coal gasification plant?

A. 10 ~ 30% depends on places.

Q. What is energy consumption per T of ammonia?

A. 40 ~ 55 GJ / per ton.

Q. Where coal has more than 30% ash do you use it directly in gassifier (any wasting process for this)?

A. We do not wash coal in ammonia plants, but in coal mines, we do not know the process.

S. Nand, FAI, India:

Q. What is the energy consumption GJ/MT ammonia for medium and large size ammonia plants? On low calonfic value basis.

A. 40 ~ 55 GJ/t ammonia.

Arun Kumar, National Fertilizers Ltd., India:

Q. What is energy consumption (preferably in unit for per metric ton of ammonia) for coal gasification?

A. 40 ~ 55 GJ/t ammonia.

Hans van Balken, European Fertilizer Manufacturers Association (EFMA), Belgium:

Q. Could you give us the figure for energy efficiency in ammonia preferably in Gt?

A. ~ 40% output / input.

Q. Could you give us the figure for the around of CO2 per tonne NH3?

A. ~ 4 ton CO2/t ammonia. Some will be used for urea and Ammonium bicarbonate.

Amiad Alexandron, Haifa Chemicals Ltd., Israël:

Q. What is the current ammonia price in China?

A. USD 220 ~ 225/t.

Q. What will be the fixed cost of ammonia produced by coal-based technology?

A. Fixed cost is about 30% of the total.

Chandra P. Chhabra, Tata Chemicals Ltd., India:

Q. How about gas base domestic technology?

A. For small and medium-sized plants the domestic technology and equipment are supplied totally by China. For large-scale plants, there are technologies available but he clients are reluctant to use it. In near term, the technology for large-scale plants is also imported.

PAPER 23: ENERGY SAVING AND CAPACITY INCREASE RETROFIT FOR A LARGE-SCALE AMMONIA PLANT. TAO JIGANG, GUIZHOU CHITIANHUA GROUP CO. LTD., CHINA

CNOOC Chemicals Co. Ltd., China:

Q. Have you changed the burners for rich oxygen? Who developed the axial radial flow technology?

A. We have not changed the burners, we plan to do that. We commissioned a Swiss Company to develop the axial radial flow technology and we were the first one to use this technology.

Unidentified:

Q. Is it possible to increase the capacity by 50%? Do you have any plan to increase capacity by 50%?

A. Our retrofit was planned in 1990 and implemented in 1996. There was no example at that time of 50% increase in capacity but in future we will continue to increase the capacity. Further increase in capacity of our plant is limited by the compressors and other equipments. We cannot increase the capacity by 50% but we do have plans to increase it further by 10%.

Viren Kaushik, FAI, India:

The extent of increase in capacity is determined not only by technology but also the condition of existing plant. The design margin in the plant determines the extent of capacity increase. Therefore, the increase in capacity depends both on method or technology and design margin of the plant.

Avinash Malhotra, Kellogg Brown & Root (KBR), USA:

For plants of that generation, according to our experience there are more than 20 plants, which have been debottlenecked to produce 50% more. These plants have also achieved energy consumption as low as 7.5 Gcal. That is what you get when you use new technology.

Arun Kumar, National Fertilizers Ltd., India:

Q. I appreciate the in-house efforts for increasing the capacity. You have renovated the rotor of compressors only for capacity increase or have you achieved energy savings?

A. Yes, we have combined capacity increase and energy savings with imported technology.

V.K. Bali, IFFCO, India:

Q. You have mentioned major items of renovation as addition of inlet ammonia cooler to feed gas compressor to meet the requirement of capacity increase and inlet ammonia cooler for ammonia synthesis compressor. Are these items same?

A. There are two different coolers. One is for NG compressor and the other cooler is for syn gas compressor.

PAPER 24: DIAMONDS, PEARLS AND STAMICARBON GRANULES: A LATEST UPDATE. HANS VAN BAAL AND JO MEESSEN, STAMICARBON, THE NETHERLANDS

Dai Zhiquan, Litianhua Group Inc., China:

Q. Would you tell us the weight ratio between air and molten urea of the sprayers?

A. Not to be disclosed.

Q. What is the pressure of the atomizing air?

A. Stamicarbon doesn't use atomizing air but air transportation of nuclei trough? The film cone of urea melt.

Fadhel Al Ansari, GPIC, Bahrain:

Q. What are the ammonia and dust emissions design / actual from granulator?

A. Design: NH3 ~ 120-130 mg/Nm3 with 500 ppm in the melt and no abatement system. However, individual ammonia content in melt is 185 ppm so actual NH3 emission will be lower.

Urea dust: Depending on dust scrubber design. For Egypt plant design is at 15mg/Nm3 from granulation exhaust stack. Urea dust from granulator before urea dust scrubber is max; 1%.

Zhang Tongfu, China National Chemical Engineering Corp. (CNCEC), China:

Q. 1970's Stamicarbon company got most of 13 set plants in China but from 1988 to middle 1990's Snaproggeti (Italy) Co. occupied Chinese urea technology market; In 1994 your vice president led a group of experts to introduce new technology in China. My question is that after loose period, your company reoccupied big market rate in China if attribute to:

1. Urea process technology improvement?
2. Using new materials for key equipment and piping?
3. Your market policy and competed price?

What are the ammonia and dust emissions design / actual from granulator?

A. Stamicarbon's strategy aimed for long standing position urea licensor through indeed innovative technology and through thorough research. This resulted in:

1. Urea 2000 plus technology with pool condensor / pool reactor which is standard today.

   In China e.g.: - Zepu Project

   - CNOOC Hainan project

   - Ningxia revamp

   World wide all mega units in Qatar, Saudi Arabia and Iran are with pool condensor.

2. Safurex: Material developed for urea application. Now standard material allocating also to reduce oxygen content in melt with reduction of equipment (H2 reactor / scrubber).

   Applied in China for Nigxia poolcondensor and stipper and synthesis units in SAFCO and Iran.

3. Granulation as presented.

More to be announced in our May seminar.

Urea dust: Depending on dust scrubber design. For Egypt use design at 15mg/Nm3 from granulation exhaust stack. Urea dust from granulator before urea dust scrubber is max; 1%.

PAPER 25: FIRST APPLICATION OF THE UHDE DUAL PRESSURE AMMONIA PROCESS FOR THE 3300 MTPD AMMONIA PLANT FOR SAFCO IN SAUDI ARABIA. NORBERT FRISSE AND D. LIPPMANN, UHDE GMBH, GERMANY

Bousmaha Belmamoun, FERTIL, UAE:

Q. Could you tell us what is the rated capacity of the synthesis turbine?

What is the system pressure and flow to this turbine?

Is the large capacity Uhde Ammonia Unit self-supporting in terms of steam or does it require to import steam from utilities plant?

A. Synthesis gas compressor turbine will be an extraction – condensing – turbine normal operation. 28.6 M/u.

Live steam at inlet turbine	112 bar / 530°C	332.5 ~4
MP steam extraction	54 bar / 425°C	271.1 ~4
Condensation	0.18 bar (a)	57.4 ~4

Ammonia Plant is still self supporting energy export exists in form of either MP steam or electricity. No utility steam required except for start up.

Q. What is the S/C ratio at the inlet of primary reformer?

A. Total steam to carbon ratio: 3.0.

Arafat Ghosheh, Saudi Arabian Mining Company, Saudi Arabia:

Q. Do we understand that site location for ammonia preferably next to shore (sea) to enable traryoff of CO2 removal columns? (mega size)

A. Close to sea is preferred, however, also other solutions are possible, eg. Supply of LP flashe vessel in form of plates and final manufacturing at site.

PAPER 26: STAMICARBON REVAMPING STRATEGY IN CHINA. MARK BROUWER AND JAN MENNEN, STAMICARBON, THE NETHERLANDS

No written questions were submitted.

PAPER 27: BLUE PRINT OF CNOOC ORIENTAL CHEMICAL PARK: CONSTRUCTION OF CNOOC FERTILIZERS COMPLEX. YANG YEXIN, CNOOC CHEM. CO. LTD., CHENGDA ENGINEERING CORP. OF CHINA

King Hu Liang, CNOOC, China:

Q. How much does Hingxia revamping urea plant?

A. *No answer.*

Q. What does the changes of Hingxia urea plant process per meter?

A. *No answer.*

Chandra P. Chhabra, Tata Chemicals Ltd., India:

Q. Where the two phases benchmarked?

A. Phase I was not benchmarked but phase II is benchmarked with phase I.

Q. What is overall energy consumption?

A. Over energy consumption is 4.6 G cal/ MT of urea.

Fadhel Al Ansari, GPIC, Bahrain:

Q. Have you ever revamped a snam project: urea plant?

A. *No answer.*

Q. What is the cost of natural gas?

A. *No answer.*

PAPER 28: AMMONIUM NITRATE: DEVELOPMENTS IN REGULATORY CONTROLS AND INDUSTRY RESPONSE. KISH SHAH, EFMA, BELGIUM

Fadhel Al Ansari, GPIC, Bahrain:

Q. What is the cost of natural gas?

A. *No answer.*

Arthur van Brempt, Kemira GrowHow S.A./N.V., Belgium:

Q. In the Oppau (and Tessenderlo) exploitations ANS sulpho-nitrate was involved. Suppose that the product would have been AN 33.5 instead of ANS would the energy released by the detonation have been lower or higher? Note that the ANQ with an AN content below 45% is classified as non-hazardous.

A. *No answer.*

Dong Ancheng, Phosphate Fertilizer Plant of NCIC of Sinopec, China:

Q. To produce NPK fertilizer, we need to use AN, how to break AN to pieces safely?

A. *No answer.*

PAPER 29: THE HIDDEN FACTS OF PROCESS SAFETY VALVE RELIABILITY. MUHAMMAD M. ALKHALDI, SAUDI ARABIAN FERTILIZER CO. (SAFCO), SAUDI ARABIA

Chandra P. Chhabra, Tata Chemicals, India:

Q. Have you carried out risk assessment of "heavy lost itself?"

A. *No answer.*

Q. What process has been followed in your survey for safety v/v? Was it on line?

A. *No answer.*

PAPER 30: FALL IN EFFICIENCY IN THE SYNTHESIS GAS COMPRESSOR DUE TO "O" RING EXTRUSION. ARUN KUMAR, NATIONAL FERTILIZERS LTD., INDIA

Chandra P. Chhabra, Tata Chemicals, India:

Q. Operating hours before failure in presentation?

A. *No answer.*

Q. Is your picture of fixing "Tetlon back up swing needs ok"?

A. *No answer.*

Q. How could you accurately measure such large diameter?

A. *No answer.*

STANDBY PAPER: POSSIBILITIES FOR USING THERMOGRAPHY IN IMPROVING SAFETY IN THE NPK FERTILIZER INDUSTRY, MIKA PERÄLÄ, KEMIRA GROWHOW, FINLAND

Chandra P. Chhabra, Tata Chemicals, India:

Q. How do you select emissivity in thermography?

A. *No answer.*

NOTES