



2006 IFA Technical Symposium

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Discussions



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EDITOR'S NOTE

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PAPER 1: GLOBAL CHALLENGES FOR FERTILIZER PRODUCTION TECHNOLOGIES. HEIKKI SIRVIÖ, KEMIRA GROWHOW OYJ, FINLAND

Johan Horn, Foskor Ltd., South Africa:

- Q.** Does the COP's referred to also integrate health and environment issues or are the system not integrated with SHE?
- A.** Yes, safety, health and environmental issues are integrated in the Code of Practices. In addition to correct selection and operation of the plant and equipment quality wise, they also include aspects related to operational rules, like use of process safeguards, proper process and personnel safety equipment or emergency procedures and training, among other things.
- Q.** Where is the health of employees and environmental impacts addressed and regulated?
- A.** The health and environmental legislation is to a large extent European Union based legislation, which is implemented locally in every member country. There are small differences in the implementation, and some variation may occur. Competent authorities are nominated in every country. In individual companies, like Kemira GrowHow, health and safety impacts are addressed, evaluated and best practices implemented in every business unit and production site as a part of the site's or BU's management. Activities are supported and coordinated by the Kemira GrowHow Risk Management team.
- Q.** Does Kemira GrowHow subscribe to OSHAS 18000, ISO 14000 systems? If not, which systems are used?
- A.** Kemira GrowHow uses ISO 9001, ISO 14001 and DNV's ISRS (International Safety Rating System) as main guidelines for quality, safety and environmental management. In addition, the EFMA Product Stewardship program and the CEFIC Responsible Care –program give focused requirements and guidelines that are taken into account.



PAPER 4: CODE OF PRACTICE AS A TOOL TO IMPROVE SAFETY. TEIJA KANKAANPÄÄ, KEMIRA GROWHOW OYJ, FINLAND

Alsayed Abo Alhawa, E.F.I.C. – Egyptian Financial and Industrial Company, Egypt:

- Q.** What are the bases of fertilizers classification (A & B)?
- A.**
- Class A Fertilizers: Fertilizers classified as oxidising material. UN Class 5.1 Oxidising Substance UN2067.
 - Class B Fertilizers: NP, NK or NPK Fertilizers with <70% AN which show self-sustaining decomposition. UN Class 9 UN2071.
 - Class C Fertilizers: Fertilizers not classified in Class A or B. UN Class Non-hazardous.
- Q.** Is there only one code of practice for the sale production, storage, handling, transport and sale mandatory used for the three classes (A, B and C) or is there a special code of practice for each class? If there is more than one code, what is the difference?
- A.** Yes, there is only a code of practice for the safe production, storage, handling, transport and sale of AN-containing fertilizers.

Bernd Serr, European IPPC Bureau, Spain:

- Q.** Does the code address or do you know examples where safety priorities interfere (negatively) with efficiency or environmental targets?
- A.** Kemira GrowHow has not recognized cases where codes of the practice for safety have interfered with environmental targets. Changes, whether related to products, technology or working methods, are done in a controlled manner, which naturally takes more time and sometimes also money when compared to an uncontrolled way of handling changes.

Fadhel Al-Ansari, GPIC – Gulf Petrochemical Industries Co., Bahrain:

- Q.** Do you have standard operating procedures and codes of practice as two separate documentations?
- A.** Codes of practice for safety give the guidelines for operations, and operating instructions exist separately for each production line.

T.N.V. Satyanarayana, Indo-Jordan Chemicals Co. Ltd., Jordan:

- Q.** The first part is to design and implement code of practice for safety. The second part is to ensure the compliance to the code of practice by all the employees.
Does your company adopt punitive measures to ensure that codes of practice are complied with by all the employees?
- A.** It is the obligation of everyone to stop an unsafe act, and e.g. contractors have been changed when they have not complied with the rules. In an individual level the consequence of non-compliance is a talking-to given by the superior.

PAPER 5: AMMONIUM NITRATE BASED FERTILIZERS IN SC "ACHEMA". JUOZAS TUNAITIS, AICHEM STOCK COMPANY, LITHUANIA

Tore K. Jenssen, Yara International ASA, Norway:

- Q.** What is the dust emission from the AN prilling tower in mg/m³?
- A.** The dust emission from the prilling tower is in range of 50-70 mg/m³.
- Q.** What is the loose bulk density of the straight AN?
- A.** The density of straight AN is around 1.

Jean-François Granger, Grande Paroisse S.A., France:

- Q.** The prill size distribution is given as 88% between 2 and 4 mm.
Could you give us the value of the D₅₀ of the said prills?
- A.** D₅₀ value is 2.5 mm.



PAPER 8: PHILOSOPHY OF IMPLEMENTING DIGESTION SYSTEM IN DIHYDRATE PA TECHNOLOGY. KARIM HALASEH, JPMC – JORDAN PHOSPHATE MINES CO., JORDAN

Paul Anthony Smith, Bunge Fertilizantes S.A., Brazil:

- Q.** Excellent presentation, converting from RLCS (Rubber Lines Carbon Steel) tanks to concrete tanks. Why did you maintain the overflows from A to B and from B to C, and not use underflows which can be easily and safely provided in a rectangular concrete tank?
- A.** I agree with you that it requires less power, easily as well as more safety when using underflow connection between compartments, but overflow connection is easy to bypass any compartment of the digester in case of mechanical, electrical problems with agitators. Whereas underflow connection, digester is to be completely bypassed.

Marten Walters, Jacobs, United States:

- Q.** You attributed the reduction in washing efficiency from 98.9% to 98.2% P_2O_5 after the digesters had failed to increase scale formation on the filter. Did you measure the gypsum size to see if this change with and without digesters in operation?
- A.** From previous technical papers, it has been proved that gypsum crystals produced from reactors and digesters have lower specific surface area by 10-15% than the crystals produced only from reactors.



Parallel Session 1: Safety, Health and Environment

PAPER 9: WORKPLACE SAFETY MANAGEMENT AT GPIC: A CASE STUDY APPROACH. FADHEL AL-ANSARI, GPIC – GULF PETROCHEMICAL INDUSTRIES Co., BAHRAIN

Gerhart Arnold, DuPont Safety Resources, Germany:

- Q.** How did your safety programs and your culture change influence other business parameters like productivity, profitability, yield, up time, health?
- A.** In GPIC we believe that a healthy and safe working environment has direct impact on all other business aspects and to determine the exact correlation of how this relationship is maintained is somewhat a difficult process. However, if we correlate GPIC's Profitability, Performance Indicators, and Safety Statistics, one can safely say that the relationship is directly proportional. However, regardless of these relations, Safety, Health and Environment issues must be the objective of any organisation. Profitability can not be the only objective.
- GPIC Average Return on Investment for the past 5 years is 42.7%.
 - GPIC Average on stream factor for the past 5 years:
 - Ammonia Plant: 93.8%;
 - Urea Plant: 94.4%;
 - Methanol Plant: 96.6%.
 - GPIC Average Utilisation Factor for the past 5 years:
 - Ammonia Plant: 100.6%;
 - Urea Plant: 98.2%;
 - Methanol Plant: 102.6%.

Inamullah Naveed Khan, Engro Chemical Pakistan Ltd., Pakistan:

- Q.** What is the TRIR (Total Recordable Injury Rate) of 2005 at GPIC?
- A.** Zero.
- Q.** Can you share safety statistics of your plant (i.e. million man-hours achieved without lost workday injury, etc.)?
- A.** GPIC achieved 4,697,408 person-hours or 1,440 days of continuous work without a Lost Time Accident (LTA) by the end of April 2006. GPIC's contracted workforce achieved 2,482,639 person-hours or 978 days of continuous work without LTA by the end of April 2006. The combined total as of the end of April 2006 is 7,180,047 person-hours without LTA.

Magdalena Aleksandrowicz, DuPont Poland S.p. z.o.o., Poland:

- Q.** What are the next steps of development of SHE and other aspects of operations, such as environment, operational excellence, cost reduction?
- A.** Among the SHE programmes being implemented by GPIC the following:
- Conducting a company-wide Behavioural Based Safety (BBS) program. The program was started in 2005 and to date more than 330 of the employees plus all the main contracting companies that work for GPIC have been provided with a 2-day BBS program presented by RoSPA (Royal Society for the Prevention of Accidents). And, by end of June 2006, another 100 employees will be further trained by RoSPA to be qualified as BBS Observers. The remaining part of 2006 will be actual evaluation of the observation and the BBS program. In 2007, the BBS will be established as GPIC's main SHE driver;
 - Conducting a company-wide ergonomic survey program by the reputable Canadian society IAPA. And based on the survey (which will take 2 months to be concluded May/June), GPIC comprehensive Ergonomic system will be established;
 - Investigating to establish a work-life balance program in GPIC and to proactively address issues of work-related stress.

PAPER 10: OPERATION OF AN AMMONIA PLANT ON A START-UP / SHUT-DOWN CYCLE. PAN ORPHANIDES, ORPHANCO, GREECE

Salem Saidi, CPG / GCT, Tunisia:

- Q.** How much STPP (super triple polyphosphate) do you use by operation for washing and what is the concentration?
- A.** Unfortunately I don't have this detail available. Please contact the PFI Plant Manager Mr Basil Parnassos at vparn@pfi.gr to give all the details.



Parallel Session 2: Production Technologies

PAPER 11: WASHING OF METHANATOR CATALYST (AMMONIA PLANT III). YASSER ABDELMONEM, ABU QIR FERTILIZERS COMPANY, EGYPT

John Brightling, Johnson Matthey Catalysts, United Kingdom:

- Q.** The root cause of the carryover of benfield solution was foaming in the solution due to organic matter present.
What was the organic material present (presumably by product MeOH from the LTs)?
- A.** The organic matter which was present in the benfield solution was from the by-product of LT catalyst reactor (new catalyst).
- Q.** Have changes been made to eliminate the source of benfield contamination?
- A.** We change the solution and the same kind of LT catalyst.

Chandra Shekhar Prasad, Tata Chemicals Ltd., India:

- Q.** Efficiency of methanator before and after washing the catalyst?
- A.** Efficiency of methanator reactor increased after washing.
- Q.** Life assessment of catalyst after water wash?
- A.** The same methanator catalyst in operation until now without problems.

PAPER 12: TECHNOLOGICAL DEVELOPMENTS AT FOSFERTIL BRAZIL. PAUL ANTHONY SMITH, BUNGE FERTILIZANTES S.A., BRAZIL

Antoine Hoxha, Prayon Technologies S.A., Belgium:

- Q.** What is the reason the evaporators not being used for concentrating from 25% to 34.5% all the acid?
- A.** There are two possible methods for operation. All 4 evaporators always produce 52% acid to minimise corrosion and scaling.
- Case 1: All 4 evaporators operate from 25% to 52% P₂O₅ in parallel;
 - Case 2: The two new shell and tube evaporators operate from 25% to 50% P₂O₅ the concentrated acid being mixed with the balance of weak acid producing 34.5% acid. The older two units with carbon blocks, which are more susceptible to scaling, operate from 34.5% to 52% P₂O₅ to increase their operational factor.

Q. What was the recycle ratio in the pilot plant tests?

A. The recycle ratio was selected in function of the capacity of the present axial-flow flash-cooler recirculation pump. In fact the effective recycle ratio was about 20:1 compared to the filter feed flow. Note that the phosphate is of an igneous origin and this ratio is normally sufficient for the good processing of igneous phosphates.



PAPER 13: EMISSIONS FROM UREA PLANT FINISHING SECTIONS. JO MEESEN, STAMICARBON B.V., THE NETHERLANDS

Bernd Serr, European IPPC Bureau, Spain:

- Q.** Concerning acidic scrubbing of NH_3 containing gases and treating the liquor by electrolysis, does your lower NH_3 emissions justify entering the electrolysis business, including higher electricity and steam consumption (a typical “cross-media” effect)?
- A.** The driver is not necessarily of economical nature as the question suggests, the driver would rather be environmental. The abatement system may be considered when environmental restrictions require lower emission figures than before.

Severino Cortón, Fertiberia S.A., Spain:

- Q.** Can you give us an estimate of the operating cost of the “Residue free NH_3 -abatement”?
- A.** Is it too early to quantify, however the costs are minor. The desorber that makes part of the abatement system will be small, both in size and in terms of steam consumption. Besides, the type of steam required is produced in the plant itself and is usually available in excess. Electricity consumption should not be excessive either, after all we are talking relatively small amounts of ammonia to be recovered.

Pan Orphanides, Orphanco, Greece:

- Q.** Are the results you reported about quantity/size of dust formed in yours and other FB granulation process, confirmed by the results in the Agrium plant in Canada (which was a Yara FB granulation transformed in Stamicarbon’s granulation)?
- A.** The results of the Agrium plant in Canada are in line with the results reported in the paper.

Marcial Pérez, Profertil S.A., Argentina:

- Q.** In the granule growing model proposed in your technology, how does the layering mechanism affect the mechanical strength of the granules against the accretion model in the classical technology?
- A.** Strength is determined by a number of parameters, only one of which is the layering mechanism. Formaldehyde plays an important role too. Question here is how much strength one needs to establish versus how much formaldehyde one wants to save. Results from Stamicarbon’s FB granulation technology have shown that good and marketable strength can be achieved with lower formaldehyde content than what is needed in other type of FB processes.

PAPER 14: GRANULATOR'S OPTIMIZATION BY AN OPTICAL ONLINE PARTICLE ANALYSER: RHEWUM'S SIZECHECKER 100, PRESENT SITUATION AND FUTURE OUTLOOK. SIGURD SCHUETZ, RHEWUM GMBH, GERMANY

Alsayed Abo Alhawa, E.F.I.C. – Egyptian Financial and Industrial Company, Egypt:

- Q.** What is the maximum capacity of one screening unit work under the observation of this type of size control, without overflow of materials and without observation?
- A.** The maximum feed rate to the screens is approximately 200 t/h (in 2 units).

Paul Niehues, Uhde Fertilizer Technology B.V., Norway:

- Q.** As crushed product contains lots of dust and the visibility is not the best, how does the system work with crushed product?
- A.** It has been tested with roll crushed urea. The results have been excellent. The system measured particles smaller than 0.5 mm perfectly. However, the software has foreseen that a certain quantity is continuously bypassing. The final result shall be evaluated by a test in our laboratory facility. A dedusting by a screen prior to the SizeChecker will solve this problem.

Marcial Pérez, Profertil S.A., Argentina:

- Q.** How can we overcome the problem of getting a wrong granules size measure that occurs when two or more than two granules are falling down overlapped (but not stuck to each other) showing a bigger shadow?
- A.** Since the system is evaluating besides the size also the shape of the particles, abnormal particles such as the described twins will not be counted in the statistic evaluation. Only particles with a shape in a certain range of the determined form factors are counted. Moreover, the sample dosing will be controlled automatically by the camera, means in case that the percentage of similar falling particles is too large, the conveying speed will be reduced in order to avoid that two or more particles are falling at the same time at the same position.



PAPER 15: NEW DEVELOPMENT IN THE TILTING PAN FILTER TECHNOLOGY ALLOWING TO REDUCE INVESTMENT, MAINTENANCE AND ENERGY COSTS. MARC COLLIN, PRAYON TECHNOLOGIES S.A., BELGIUM

Martin Modise, Omnia Fertilizer Ltd., South Africa:

- Q.** Weekly maintenance -8 hours- lost time as opposed to minimal lost time for belt filter.
- A.** Weekly maintenance of filters: there are two applied philosophies for weekly maintenance: either you allow production to stop for a minimum time, generally eight hours per week, or you do not allow it and you need a spare filter. The second philosophy is sometimes applied with belt filters with an increased investment cost. Indeed, where the capacity of the plant would require for example 3 filters, 4 identical belt filters need to be bought. We, at Prayon, we have adopted the first philosophy which has the advantage of reducing the initial investment.
- Q.** Is there cake thickness limitations?
- A.** The cake thickness is limited as follows:
- To 5-6 cm on belt filters and table filters due to the curbs;
 - To 7-8 cm on classical tilting pan filters to limit the loss of filtration area between 2 cells;
 - Not really limited on TDI filters, so that thickness of 10 cm can be contemplated with the associated advantages (washing efficiency).
- Q.** "The increase in cake thickness implies increased washing efficiency", how thick?
- A.** The washing efficiency increases with the cake thickness (see figure 10 shown in the paper). Why? Because the amount of washing liquid crossing 1 cm³ of cake increases with the cake thickness.

Giora Aviram, Rotem-Amfert-Negev, Israel:

- Q.** We have a tilting pan filter since the eighty's. Is it possible to do some change and improvement in existing filters?
- A.** As far as we know, in your case, Rotem plant, the surface of the existing filter can be increased by about 15% by implementing new fast drain cells.

PAPER 16: USE OF CARBON FIBER REINFORCED DIABON GRAPHITES TUBES IN SHELL AND TUBE PHOSPHORIC ACID EVAPORATORS. LOÏC BERNARD, SGL CARBON GMBH, GERMANY

Antoine Hoxha, Prayon Technologies S.A., Belgium:

- Q.** You mentioned an influence of the acid impurities on the maximum acid velocity in the tubes. Could you please give more details?
- A.** The type of impurities present in the green acid influences the shape and hardness of the gypsum crystals. The maximum allowable velocity in the tubes depends on the solid content, the hardness and the shape of the crystals. It is usually recommended not to exceed 3 m/s. However, some rocks allow higher velocities whereas some rocks do not permit to exceed 2.5 m/s. Usually igneous rock allow higher velocities in the evaporator than sedimentary rocks.
- Q.** Is it related to the solids content?
- A.** The solid content has a direct influence on the maximum allowable velocity in the tubes.
- Q.** What would be the problems with Tunisian acid for example?
- A.** The Tunisian phosphate rock contains quite some silica which renders the green acid potentially erosive. It is recommended then that the acid velocity doesn't exceed 2.7 m/s in the evaporator.

Karim Halaseh, JPMC – Jordan Phosphate Mines Co., Jordan:

- Q.** What is the cost of one heat exchanger shell-tubes graphite (one with 600 m² surface area)?
- A.** The answer to this question was somewhat vague since the cost of such equipment depends heavily on the process conditions. A very rough estimate would be US \$ 500000 ± 25%.



PAPER 19: BEST AVAILABLE TECHNIQUES FOR INTEGRATED POLLUTION PREVENTION AND CONTROL FOR THE FERTILIZER INDUSTRY. BERND SERR, EUROPEAN IPPC BUREAU, SPAIN

Amiad Alexandron, Haifa Chemicals Ltd., Israel:

- Q.** 384 mtpd nitric acid plant 6 bar-g monopressure was built in 1974, just after the energy crisis and with a prominent heat recovery as tail gas temperature is 36°-40°C. In 1985, we added one more absorption tower to reduce the NO_x to 500 ppmv. Installing SCR to meet new criteria of 350 mg/Nm³ is not feasible due to low temperature of the tail gas, where below 85°C there is precipitation of ammonium nitrate/nitrite. Heating the tail gas upstream or downstream is not economic (calculated by Uhde) and also will cause increase NO_x emission to somewhere else (heating by burning fuel). The result is not BAT. No credit on energy saving from 1976. What can be done?
- A.** If our working group supports that, the future BAT reference document will contain a section relating to the issue on SCR/low tail gas temperature/alternative measures for NO_x abatement. There are reference plants applying H₂O₂ to the last absorption stage, which might be the viable alternative to SCR, if applied efficiently with keeping the costs at bay and still achieving a comparable NO_x emission level.

Zlatko Babić, Petrokemija d.d., Croatia:

- Q.** Could you give us some information about issued IPPC permits for existing ammonia, acid and fertilizers production plants in EU? Are they available on the web or as hard copy?
- A.** Unfortunately, we have never been provided with such documents for fertilizer plants, so we do not have such information. However, issued permits should be available directly from companies (if necessary after removal of confidential parts) or from competent authorities (if necessary after removal of confidential parts, there are rules about free access to environmental information/data).
- Q.** Does air emission limit values will be proposed for existing and new ammonia, acid and fertilizers production plants in EU?
- A.** The BAT reference documents do not propose limit values. The levels given are the emission or consumption levels which can be generally expected when applying BAT. This, of course, is intended to have a direct impact on the limit values which will be written in national legislation or permits. In this state of the work, it can be foreseen that the future BAT reference document will present numerous BAT levels for the manufacture of various products. Sometimes, the levels will differentiate between existing and new plants. However, the BAT levels will usually be a range, and where no separate conclusions for new/existing plants are drawn, in most cases the challenging end of the range will apply for new and the more relaxed end of the range will apply for existing plants.

PAPER 20: GASEOUS EMISSIONS IN THE FERTILIZER INDUSTRY AND THEIR IMPACT ON SPECIFIC ENERGY CONSUMPTION PER TONNE OF PRODUCT. SRI CHANDRA, MINISTRY OF CHEMICALS & FERTILIZERS, INDIA

Zlatko Babić, Petrokemija d.d., Croatia:

Q. Could you give us more details about methods or pollution abatement that you applied to reduce ammonia and SPM (Suspended Particulate Matter), emission from urea prilling tower (e.g. from 150 mg/m³ to 50 mg/m³ urea dust emission)?

A. Methods/measures adopted to reduce SPM/Ammonia Emission from prilling tower from 150 mg/Nm³ to 50 mg/Nm³ are as under:

- Lower velocity of air in prilling tower, helps in lesser carry-over of urea dust. Therefore, prilling towers are designed presently based on natural draft instead of forced draft;
- Dust formation is favoured by higher prill temperature. With rise in temperature of urea prills at prilling tower bottom, more fines are formed. In the present day design, prilling tower height is increased to reduce prill temperature available at tower bottom. Lower prill temperature reduces formation of fine dust particles at the bottom, which otherwise would have been carried over by air, resulting in emission with higher urea, dust content;
- Prilling towers with spray heads of the older design are being gradually replaced by prill buckets. Prill buckets are very convenient and produce prills of uniform / shape and size, and, more importantly with reduced fines formation. This method has largely contributed towards less dust carryover with exhaust air from prilling tower;
- As per the most recent trend, old prill buckets are being replaced with new spinning buckets of advanced design. Spinning buckets help in generation of much lesser amount of fines compared to the conventional buckets;
- Installation of de-dusting system at the top of prilling tower of older generation urea plants, have helped in reducing dust emission. However, the de-dusting system, which envisages washing of the dust laden air coming out from prilling tower before it is released to atmosphere, is by itself a very cumbersome system. Therefore, the methods employed in present day design, and as discussed above, are much superior and effective.

Q. What are the quantities of emission of ammonia from the process vents of urea plants? Are they in compliance with proscribed levels?

A. The quantities of emission of Ammonia from Process Vents (High Pressure Loop, Low Pressure Loop, Process Condensate Treatment, Top of Prilling Tower, Seal and Gland leakage of Liquid Ammonia Pumps etc) varies from plant to plant in the range of 50-177 mg/Nm³ and they are in compliance with the prescribed levels/norms of Pollution Control Authorities in India.

Salem Saidi, CPG / GCT, Tunisia:

Q. How do you extract reinforced tubes broken from the exchanger?

A. Extraction of broken reinforced tubes in Heat Exchanger depends on the suitable pulling-tools. In case we do not have any approach with the pulling-tools from tube-sheet ends, then there is no alternative except to leave it like that and plug from both the openings.

PAPER 21: MODERN REGIONAL GRANULATION IN EASTERN EUROPE. CHARLES FORMISANI, A.J. SACKETT & SONS COMPANY, UNITED STATES

Pan Orphanides, Orphanco, Greece:

- Q.** Is your concept suitable to produce formulations high in nitrogen (25-10-10) (20-20-0) (30-10-5 or 26-13-0) and rather low in potash?
- A.** This type of plant is not suitable for producing grades with very high nitrogen content. Typically 20% N is about the maximum.

PAPER 22: THE LOGIC AND INSIGHT OF CONTINGENCY IN PROJECTS BUDGET AND TIMETABLE. MENACHEM ZINN, DEAD SEA WORKS LTD., ISRAEL

Bjarne Christensen, Kemira GrowHow, Denmark:

- Q.** Professional project management measures continuous expenditure and aim according to original budget. Observed deviations shall be handled and informed (approved) by the Project Approving Body.
How is this handled in Dead Sea Works?
- A.** More or less in the same manner: any deviation from the approved budget (overrun), has to be approved by the "internal client" (= the budget owner). Even using any part of the contingency, before overrunning the budget, requires the approval of the SVP responsible for the budget. Upon consumption of the contingency, we apply with budget increase demand to the required authority level for the extra budget needs (CEO or Board of Directors, depending on the scope of the increase).
- C.** A major factor nowadays are unforeseen events and happenings that are beyond project managers view: overheated market, overloaded EPC contractors-equipment manufactures causing price hikes of 20-30%, no EPC contractors willing to bid for major projects on a LSTK basis unless validity is short and risks for overrun for investor!
- A.** I totally agree. Upon estimating the investment, the market situation, overloaded EPC contractors etc., should be taken into consideration (although this task is not trivial!).

Magdalena Aleksandrowicz, DuPont Poland S.p. z.o.o., Poland:

- Q.** How do you integrate the BBS system throughout the organization/supporting departments?
- A.** The Behavioral Accident Prevention Process® (BAPP®) is applicable to all individuals/departments in our organization. Just as you would integrate the process into the operations and maintenance groups, it is implemented in the same manner into other support groups. For example, it is equally as critical for an individual from the engineering or purchasing group to maintain one hand on a staircase handrail as it is for someone from operations or maintenance. At PotashCorp, these groups were typically incorporated into the implementation of BAPP® at the site along with the operations and maintenance groups. This is a decision that is made during the planning for the implementation.
- Q.** What leading indicators are used?
- A.** Once the implementation has begun, there are many leading indicators that can be used to inform the user of the current health of their implementation. The following is a partial list of the common indicators that PotashCorp uses:
- Employee contact rate (observation rate per employee) is established and meeting the goal;
 - Steering team member attend scheduled steering team meetings;
 - Scheduled events such as training or informational sessions taking place as scheduled;
 - Steering team and management group accomplishing the items on their to-do list for the implementation;
 - Health of the communication process (how many employees can explain, in basic terms, the fundamentals of the BAPP and why the site is implementing the BAPP);
 - Roles and responsibilities are developed and followed up on for managers, supervisors, facilitator, steering team, observers and workers;
 - Employees believe that the critical behaviors are important;
 - Supervisors and managers support the observation process;
 - Tangible incentives are not used to stimulate observations;
 - Comment quality from observations is of high quality;
 - Gathered data are used to remove barriers.
- Q.** Is safety a part of performance management system and motivational system in your organization?
- A.** Safety is one of the seven measurement areas in the PotashCorp performance management system. In addition to the yearly review, Managers and Supervisors have safety performance development plans that are monitored on a frequent basis. Accomplishment of these action plans directly impacts the individual's level of participation in short term incentive plans.

Amiad Alexandron, Haifa Chemicals Ltd., Israel:

- Q.** Do you use the observation statistics in case of incident/accident if something wrong with the specific shift, area, etc, and as leading information which could present the incident?
- A.** Observation data can be sorted by work group (shift), department, and plant area. Supervisors have access to this data. This data is a leading indicator of what is working well and what areas need more attention in their work group. Supervisors use this data regularly. The steering team reviews any incidents that occur to extract critical behaviors and identify if a correlation exists between the observation data and the behaviors involved in incidents. This can be an indication of the quality of the observation data.
- Q.** Do you encounter reduction of cooperation with the employees with time due to routine "book-keeping"?
- A.** People naturally resist any changes to their routine. The BAPP® introduces changes to the organization, some of which are additional paperwork that must be completed and entered into the computer software program. Like any change, employees must understand and see real value in performing in a different manner. In this case, they need to see the value in gathering and working with the behavioral data. Once they see the value, the resistance is minimized. At PotashCorp, we have had little reduction in cooperation which we attribute to the educational efforts that we have undertaken.

Johan Horn, Foskor Ltd., South Africa:

- Q.** Can/is this system extended to also include health of employees and environmental incidents or behaviour of employees towards health and environment?
- A.** The process is very adaptable to any situation where behavior is performed. Behavior is the observable act that is measured to determine the amount of risk exposure in the working interface. Where those behaviors involve health issues, they are included on the plant critical behavior inventory and observed for. An example would be the use of hearing protection in a noisy environment which if not done correctly, would create an illness in the employee (hearing loss).
Some of our sites have developed critical behaviors associated with environmental exposure. An example would be to use a drip pan or catch can when transferring fuel. This is a clearly observable act and has a direct impact on the environment.
- Q.** How long before you saw this becoming part of your companies' culture?
- A.** Culture and climate change are two important changes that occur in an organization. Climate change occurs much more quickly than culture change. You can have an almost immediate impact on climate simply by people changing the things that they pay attention to. For example, if a supervisor begins to routinely checks with their crew on safety preparation for the job, the climate would immediately be impacted in that crew towards safety preparation for jobs. Over time, if the supervisor continues to perform this behavior of checking on safety preparations, it will become a part of the natural way that the crew prepares for the job. At this point we would say that it was part of the culture. We find that this culture change can take more than a year to become part of the normal way that things are done.

Kees Langeveld, Amsterdam Fertilizers Europe, The Netherlands:

Q. In 1995, the LTIR was 2.5. What is it at the moment?

A. Year to date in 2006, the Lost Time Incident Rate at PotashCorp is 0.12.

Q. What were the criteria on which you selected the vendor for introducing the system?

A. PotashCorp looked at six criteria when selecting a vendor for their BBS system.

- We evaluated the recommendations for overall process organization and management. We wanted a vendor that could lay out the big picture of process organization that showed how every level at the facility had a role and what those roles were. We wanted clearly defined roles for senior management, supervisors, a process facilitator and the steering team. We thought it would be important to have a steering team, made up of primarily wage role employees, to guide implementation;
- We wanted the development of site specific critical behaviors (specific to the risk present, not someone else's generic list) and operational definitions. The behaviors and exposure that our observers were looking for had to be specific to the site where the observations were taking place. The operational definitions had to act as a guide so that different observers would record an observed work scene in the same manner;
- We wanted to gather exposure data related to site specific critical behaviors. It was important to us that the data gathered be broken down along the lines of enabled, difficult, and non-enabled behaviors. The process had to incorporate an understanding that injuries were not a result of employee misbehavior, which is an insulting and blame oriented term to employees. This was a critical point for us. We wanted a mechanism to train wage role employees to be highly skilled at gathering workplace exposure data. A strategy for achieving this high skill level is important;
- We wanted a process that would provide a comprehensive feedback system. It was important to us that the feedback system incorporate an understanding of enabled, difficult, and non-enabled behaviors. Feedback delivered had to be meaningful to employees to encourage behavioral change for enabled behaviors and detailed enough to identify the barriers present for difficult and non-enabled behaviors. We wanted a mechanism to provide feedback to the entire organization about process status and current activities;
- We wanted a process that uses the data gathered to remove barriers to safe work. Barrier removal should utilize the hierarchy of control to guide action plan development. Ongoing measurement should take place to ensure barriers are actually removed;
- We wanted a vendor that could show statistically significant long term results from their interventions.

Jahangir Piracha, Engro Chemical Pakistan Ltd., Pakistan:

Q. What is the involvement of supervisors and managers in the observation program?

A. While some of our sites train supervisors and managers to conduct observations, the majority of sites place these levels of employees in support roles. For example, managers and supervisors set the climate and culture for what is important to the organization by what they pay attention to.

Some of the ways that supervisors support the process is by ensuring that they have an adequate number of observers trained on their shift to capture the data necessary for action planning, ensuring that each employee on their shift is observed at the appropriate frequency, ensuring that the data gathered is shared with the work crew at safety meetings, ensuring that action plans are developed and implemented to remove exposure to their crew, ensuring that employees are cooperating with the observers, ensuring that barriers to observations are removed and that their observers are coached to improve their observation skills. Managers ensure that supervisors are meeting their responsibilities in setting the correct climate on their crews for the process to prosper. They work with supervisors to help them increase their skill level at creating the correct climate for the employee led initiative to succeed. This includes ensuring that data is gathered, employees receive feedback, and action plans are developed. Where money must be spent to change a physical hazard in the plant, they generally authorize this expenditure.

Q. What is the observation program frequency?

A. An observation strategy is developed based on risk exposure in the workplace. This means that areas with higher exposure are observed more frequently than low exposure areas. In general, each employee is observed and provided feedback at least once per month.

Marcial Pérez, Profertil S.A., Argentina:

Q. What kind of short term indicators could we use to be sure that BBS program is being applied appropriately?

A. See answer to question 2 raised by Magdalena Aleksandrowicz.

Anonymous:

Q. Who is the vendor for your BBS process and who can I contact for more information?

A. Behavioral Science Technology, based in Ojai California USA is the vendor that PotashCorp uses. You may contact Mr. Don Groover, Vice President and Executive Relationship Manager, at 1-805-646-0166 or at: don.groover@bstsolutions.com.



PAPER 25: THE UHDE PUGMILL GRANULATION: THE PROCESS FOR SAFE AND RELIABLE PRODUCTION OF CAN AND OTHER AN BASED FERTILIZERS. PETER KAMERMANN, UHDE GMBH, GERMANY

Bjarne Christensen, Kemira GrowHow, Denmark:

- Q.** You emphasized the safety aspect of AN+ carbonate filter. In paper 6 (Ronald Kersten, TNO), the detonation ability of AN+ carbonate and AN+ gypsum was reported equal. Have you made studies as a basis for only highlighting AN+ carbonate as a safe (class C) product?
- A.** The results of TNO are correct and comprehensible. We (Uhde) consider Ammonium Nitrate + Gypsum not less safe than AN + Calcium Carbonate. But there is the difference that Gypsum is not able to buffer the pH of the Ammonium Nitrate as Calcium Carbonate does ($\text{CaCO}_3 + \text{HNO}_3 \rightarrow \text{CaNO}_3 + \text{H}_2\text{O} + \text{CO}_2$). According to the EU classification AN + CaCO_3 is a C-class fertilizer and AN + Gypsum is an A-class fertilizer (see Annexe 1).

PAPER 26: GRANULATION OF NP AND NPK PRODUCTS BASED ON SUPERPHOSPHATES PRODUCED FROM IGNEOUS PHOSPHATE ROCKS. JOHN SINDEN, JSA LTDA, BRAZIL

Thanh Phong Nguyen, SCPA c/o Baconco Vietnam, Vietnam:

- Q.** Why can't we use the igneous phosphate for USP process?
- A.** Despite the comments of Mr Granger from Grande Paroisse, none of the Brazilian companies have been able to achieve a satisfactory rate of reaction between the igneous phosphate and the "acidulation agent" –the urea– sulphuric acid. We have carried out many tests with igneous phosphates and none of them produced material with satisfactory physical properties and always with low conversions.

Charles Formisani, A.J. Sackett & Sons Company, United States

- Q.** When neutralizing the free acid in SSP, what are the main differences in using NH_3 versus limestone?
- A.** The main difference between the reactions of Ammonia X Limestone in the neutralization of the free acidity of the SSP-TSP is in the speed of the neutralization. The effect of Ammonia is basically instantaneous and is completed in the Granulator and as such since the principal objective is to raise the pH above 4.2/4.3 it is possible to add excess which reduces the granulation efficiency. The reaction time is much slower and is completed in the dryer or even latter. As such it is possible to still have a residual free acidity ex granulator which maintains a higher granulation efficiency.



PAPER 27: SAFE AMMONIA STORAGE. KJETIL BAKLI, YARA INTERNATIONAL ASA, NORWAY

Amiad Alexandron, Haifa Chemicals Ltd., Israel:

- Q.** Do you have the report available for the Rostock incident?
- A.** See presentation on Annexe 2 (Rostock 4 jan 2005).
- Q.** Are you familiar with the ASTM RBI system (1925?)?
- A.** I don't know it in detail.
- Q.** Is this procedure compatible for single wall tank?
- A.** I don't know it in detail.
- Q.** Does it required to take off part of the insulation for the US electrodes?
- A.** UT inspection will require taking off parts of the insulation.
- Q.** And how does it affect the future integrity of the wall tank?
- A.** It does not affect the integrity; however, good workmanship is important to maintain the level of insulation.
- Q.** Does this test have a breakthrough also for ammonia spheres, where the wall thickness is 25 mm (e.g.) and there are sometimes tiny cracks?
- A.** This UT test that we are developing can also be applicable for ammonia spheres. A wall thickness of 25mm is not a problem.
- Q.** How do you measure or eradicate the corrosion under the insulation?
- A.** Basically, corrosion under insulation is not a problem for low temperatures, which we experience for refrigerated ammonia tanks. For pipelines, there are x-ray methods available.

Zlatko Babić, Petrokemija d.d., Croatia:

- Q.** As we have ammonia storage single wall with external insulation and external concrete wall, does implementing outside ultrasonic testing means to prolong inter-storage inspection?
- A.** The intention is to avoid oxygen ingress by not opening the tank. Hence, the tank will not be opened.
- Q.** If it is not, what can be done outside ultrasonic testing?
- A.** Because oxygen ingress is avoided by doing outside inspection. SCC is contingent on the availability of oxygen.

I.C. Jha, IFFCO – Indian Farmers Fertiliser Cooperative Ltd., India:

Q. What are the special techniques of ultrasonic testing while tanks are filled with ammonia?

A. Traditional UD technic.

The research project on NH₃ SCC crack detection in welds of Ammonia storage tanks from the outside is aiming for an inspection technique which is usable with the tank in service and still reliable in detecting the possible indications independent from the orientation of the crack.

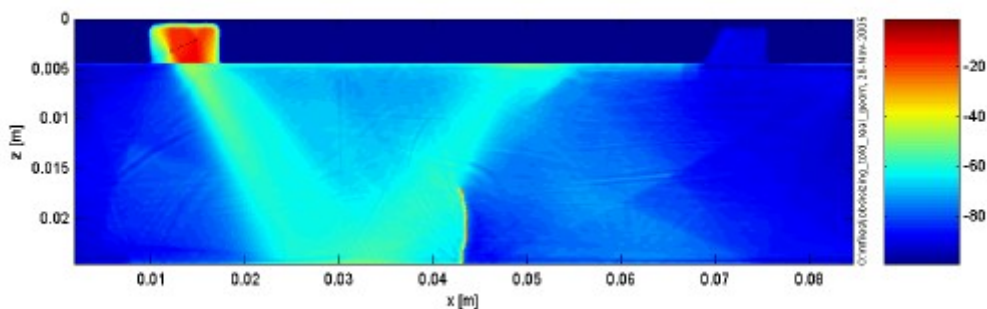
The UT technique used until now seems to be sensitive to real crack geometries.

The direction we are now working in is, instead of a UT techniques based on reflection of the signal (Puls - Echo), a technique which is measuring the transmission of the signal, or the lack of transmission in case of a crack-like indication in or next to the weld.

This means as long as there is no crack-like indication in or close to the weld, the energy sent in the material will be received, with a little dampening. In case of a crack-like indication the energy sent in will be reflected at the indication and will not reach the receiving transducer.

Until now we only have done computer based simulations with promising results. At the moment we are about to start testing on real material with real cracks in. We will have to wait for the results of these tests to know if this technique is suitable for in - service inspection of NH₃ storage tanks.

Below can be found a picture of the simulation of the shading effect of an indication:



Q. UT is being done only for weld joints or for parent material as well?

A. Basically, only for welds and welded joints. However, the parent material close to the weld will also be covered to a certain extent.

Inamullah Naveed Khan, Engro Chemical Pakistan Ltd., Pakistan:

Q. What is the frequency of internal inspection of single walled storage tanks at Yara sites?

A. The intention is to follow the recommendations given by EFMA.

Q. Is there any experience worldwide where a single walled sphere has been converted to double walled on site?

A. Yara has no experience with such conversions.



**Parallel Session 5:
Production Technologies**

PAPER 29: USE OF SUB-COMMERCIAL ROCK PHOSPHATE (60-65 TCP) IN HEMI PHOSPHORIC ACID PLANT: CHALLENGES AND OPPORTUNITIES. S.R. SUBBIAH, INDO-JORDAN CHEMICALS CO. LTD., JORDAN

Marc Collin, Prayon Technologies S.A., Belgium:

- Q.** Can you give us an idea of the evolution of the P₂O₅ recovery of the plant, before and after the use of sub-commercial rock phosphate?
- A.** Sub-commercial rock is being used since 2001, and the overall yearly average P₂O₅ recovery is indicated below:

Year	1998	1999	2000	2001	2002	2003	2004	2005
P ₂ O ₅ recovery (%)	92.7	91.8	92.2	92.6	93.0	92.4	92.0	90.9
% Sub-commercial rock used	2	5	9	38	67	74	69	69

Johan Horn, Foskor Ltd., South Africa:

- Q.** What happened to the rock/ton P₂O₅ usage ratio (what was the impact on efficiency)?
- A.** As the blend ratio of sub commercial rock was increased, the specific consumption (rock/ton P₂O₅) got increased due to lower TCP content in sub commercial rock phosphate. There was no appreciable change in the yearly average P₂O₅ recovery efficiency.
- Q.** What was the capital expansions/projects required in order to achieve?
- A.** It depends on many factors such as the process employed, the plant design / operating capacity, and capacity cushion available in reaction/filtration/ Concentration systems etc. However, for stabilization of IJC's Phosphoric acid plant of 700 MT P₂O₅ / day capacity with sub commercial rock phosphate, around two million USD was spent on capacity augmentation schemes.
- Q.** What happened to total production cost/ton of P₂O₅ (including capital recovery, rock cost, maintenance etc.)?
- A.** There was an increase in chemicals cost and maintenance cost. This was compensated by the low cost of rock phosphate, and there was a net cost advantage.

- Q.** Why did your "on-stream time" get reduced and then again increase in more or less 2000?
- A.** The on stream factor got reduced during 2001 due to marketing problems, and not due to any technical problems of the plant. In the year 2002, marketing was improved and the plant achieved higher on stream factor.
- Q.** Was there any impact on acid quantity specifically the forming of solids and compounds X&Y?
- A.** There was no impact on acid concentration, and suspended solids in product acid, since sludge recycling system was in operation. However, there was an increase in R_2O_3 content in product acid when substantial quantity of sub commercial rock is used.
- Q.** Did your filtration rate reduce? And if so, by how much?
- A.** There was marginal reduction in filtration rate by approximately 6-8%.

PAPER 30: TACKLING CHLORINE CORROSION IN PHOSPHORIC ACID PRODUCTION: PRAYON'S EXPERIENCE. ANTOINE HOXHA, PRAYON TECHNOLOGIES S.A., BELGIUM

Paul Anthony Smith, Bunge Fertilizantes S.A., Brazil:

- Q.** Why was there no mention of cost data?
- A.** Thank you for raising this important point. We did perform a cost analysis for a given situation. However, as materials/labour costs depend on local conditions we did not present it here. Our aim is to give corrosion data based on which any producer can estimate its own costs based on local prices.
- Q.** With the presence of high N prices, isn't 52N+, a duplex alloy, much cheaper?
- A.** Unfortunately it is less now, because the prices of 52N+ have gone up quite recently. The producer of 52N+ now proposes 47N as a cheaper alternative. We are currently testing its corrosion behavior.
- C.** 52 N+ is also more resistant to erosion. The only problem with 52N+ is that it is difficult to get hold of in small quantities and all sizes.
- A.** There are reports (A. Aaka et al. Proc Grado Conference, NACE Italia, 1995) that in erosion/corrosion conditions, the main factor determining the lifetime of the equipment is the corrosion behavior and not hardness. In collaboration with the University of Liège we are testing the relative importance of erosion and corrosion for different alloys. Indeed, availability of 52N+ is a big issue for many phosphoric acid producers. Also, the better mechanical properties of 52N+ do not necessarily mean that less material will be needed for given equipment.



Parallel Session 5: Safety, Health and Environment

PAPER 31: ENVIRONMENTAL FOOTPRINT OF A FERTILIZER PLANT AND ITS REDUCTION TECHNIQUES. JAHANGIR PIRACHA, ENGRO CHEMICAL PAKISTAN LTD., PAKISTAN

Zlatko Babić, Petrokemija d.d., Croatia:

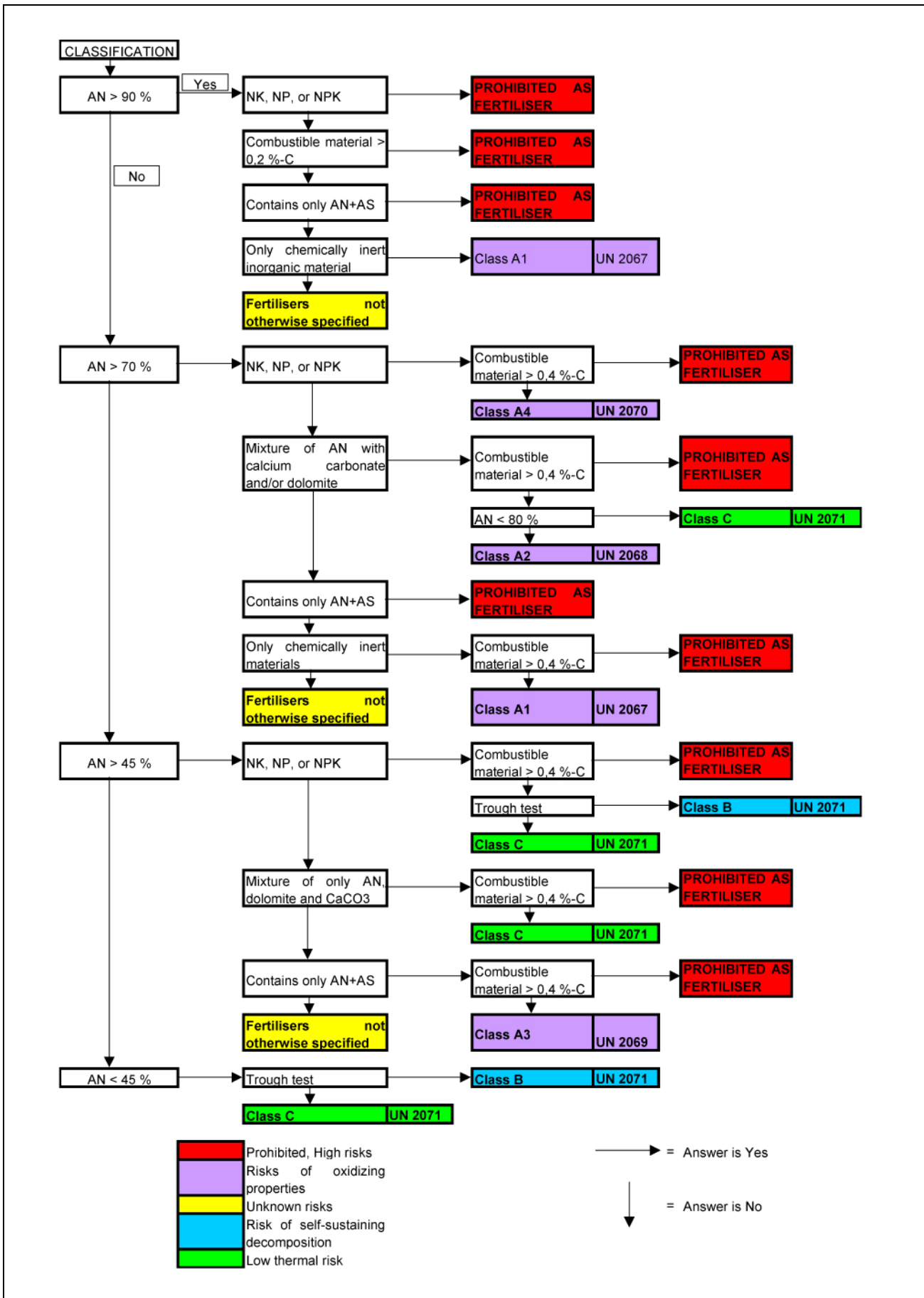
- Q.** What is the production capacity of your company?
- A.** The Urea plant capacity is 950,000 million tons/annum. Further, we have a 150,000 million tons/annum NPK plant but it is located about 600 km from the urea plant site.

PAPER 32: DUST CONTROL IN PHOSPHATIC FERTILIZER PLANTS. ALSAYED ABO ALHAWA, E.F.I.C. – EGYPTIAN FINANCIAL AND INDUSTRIAL COMPANY, EGYPT

Zlatko Babić, Petrokemija d.d., Croatia:

- Q.** How often do you change the filter bag?
- A.** We often change the filter bag by loosen up the retaining nut, removing the retaining clamp, removing the venture, lifting up the bag and replace it with a new one.
- Q.** Do you have a problem with stickiness?
- A.** No problem at all with stickiness because the bag cleaning mechanism (pulse - jet system), briefly forces a burst of compressed air down through the bags, expanding it violently, the fabric reaches its extension limit and the dust separates from bags.
- Q.** Is it possible to regulate pressure in system?
- A.** Pressure in the system is already regulated by guide blade valve.
- Q.** And how do you do that (automatic or manual control)?
- A.** Pressure in the system is automatically controlled via a sensor and actuator.

Annexe 1



Yara Rostock Ammonia release 04.01.2005

- Repair works on an ammonia tank required the tank to be emptied (but not opened). When preparing the tank back into service, a violent reaction occurred inside the tank
- More than 100 tons of ammonia were released (25% immediately, the rest over some 20 hours)
- Professional emergency handling (55 firefighters, 6 rescue teams, and 40 policemen were involved)
- Injury: Two workers injured (*one later died in hospital*), no injury amongst public
- Material loss: Total loss of tank
- Production loss: None



What went wrong

- The cool-down of the tank followed recommended industry practice: First add ammonia-water, then spray cold ammonia droplets on top.
- The ammonia droplets would normally dissolve immediately in the ammonia-water, but a thin oil-layer had settled on top of the ammonia-water, preventing the mixing.
- Opening of a drain valve caused the breaking of the oil-layer, resulting in a violent reaction between ammonia and ammonia-water and a sudden pressure increase. The relief valves are not designed for this, thus the tank swelled and weld seams broke.
- Principal lesson learnt: Ammonia-water should not be used when re-commissioning a tank.

