EDITORIAL
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GPIC (BAHRAIN)

FOCUS ON:
FINANCIAL STATEMENT ANALYSIS & INVESTMENT
APPRAISAL TECHNIQUES - TRAINING WORKSHOP

24 AFA INT’L. TECHNICAL CONFERENCE “HSE SUMMIT”

2012
18TH AFA INT’L. ANNUAL FERTILIZERS FORUM & EXHIBITION
Cairo: 7 – 9/2/2012
After 90 years’ continuous innovation, Casale today is a world leader in designing, updating and implementing nitrogen fertilizer and methanol plants. Our passionate dedication to our clients, along with our technology, our processes and our know-how, developed and nurtured for so many years, are what makes Casale able to provide you with exactly what you need to stay ahead of the competition. Four dynamic companies in one, united in our aim to provide a complete range of services for the syngas-based chemical makers.
Commitment to Safety, Health and Environment (SHE) in the Fertiliser Industry, should always be a constant and visible demonstration of proactive measures that involve a Top-Down Leadership of the whole management structure, which glides down as a line responsibility with active participation at every level of execution. Fuelled by modern communication systems, not only can incidents that occur within a fertiliser complex be immediately identified; but also incidents that occur globally can be tracked live, minute by minute.

With recent environmental catastrophes such as the BP oil spill in the Gulf of Mexico making worldwide headlines, companies and the oil and gas industry as a whole have been under scrutiny for their SHE policies. The Middle East has recently started to crack down harder on environmental legislations with more public awareness towards safety, health and environmental security, to make it more stringent and streamlined.

Engineering and Technology are very important, but it is good safety practices that organisations must ensure so that hazards and risks are identified and routinely assessed. Active involvement of management should work as a motivational force and build towards a company supported SHE culture, which is consistently practiced by both management and employees. Commitment should be translated into the necessary resources required to develop and harness the correct controls and accountability, so that they can provide constant feedback and modify issues and close gaps.

Fatal incidents around the world have showed convincingly that lives are lost, families and communities ruined, not because of technical failures within an organisation but because of a culture of sloppiness and corner cuttings. Health and safety leadership at the most senior levels in organisations does set the tone and communicates board level expectations. But lack of it can be like a virus hidden within an organisation, waiting with the potential to kill, maim and impose truly massive costs.

The UK and the USA release annual statistics of their work related injuries, work related ill health and lost-time accident records. The Middle East, where no concrete statistics have been available so far, should learn by these examples so that they impact positively on our Safety,
Health and Environmental practices. SHE failure can cost a great deal not only to the company, but also to the country as a whole. To the company, higher insurance premiums; substantial fines; low workforce morale and accident costs, including lost production time, can destroy an otherwise good productivity performance. In serious cases in certain countries, it has lead to corporate manslaughter prosecutions, involving directors and senior managers and with it the threat to corporate and personal reputations.

The country we live in too can pay a heavy price. For example, in the United Kingdom alone each year there are about a third of a million reportable injuries and one million injuries of all severities. Over 12,000 deaths due to work related health damage and some 2 million cases of work related ill health. The result is about 26 million working days lost, costing an estimated 2-3 percent of the UK’s gross domestic product. These statistics are, in graphic terms, the equivalent of two Boeing 747s crashing every month and killing everyone on board and twenty Boeings landing in the UK every day full of sick and injured people. These statistics have been released by the Royal Society for the Prevention of Accidents (RoSPA), UK.

To the high performing companies, safety, health and environmental issues are not just about minimal legal compliance, but about operational integrity and reliability; not just technicalities, but about people; not just individual errors, but about unsafe systems. It is about managing risks, not just reducing liability. In this very volatile world economy that we live in, business education in the sphere of SHE should be made compulsory to the leadership heading these high risk fertiliser industries.

The need of the hour is to send out a powerful message that will reverberate and lift reluctant Middle East leaders towards a much more positive engagement towards Safety, Health and Environment. They must realise that SHE is an integral part of corporate governance; one which tells directors that it is their top level commitment to be emotionally bonded to SHE and that speaks volumes about their company’s values, professionalism and performance. As we witness live, global catastrophes as they occur time and again, it is a question every organisation and its leadership must ask…. Is it worth risking people’s lives to death or injury?

Measures necessary to safeguard personnel in emergencies can have adverse environmental effects sometimes. However, joint consideration of Safety, Health and Environmental issues must be discussed, in order to build a solid framework and maintain a constructive network with line management and supervisory staff. It is the leaders who must ensure that strict measures are in place, through training and auditing and compliance to SHE international standards. For if you can harness the knowledge and help of the workforce, then you will unleash a force for SHE like no other.

Attitude to Safety, Health and Environment is determined by the Senior Executives and not by the size of the organisation.
Arab Fertilizers
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Workshop:
Financial Statement Analysis & Investment Appraisal Techniques

With Member Companies
Jordan National Shipping Lines Co. (JNSL)

Press Release

INTERNATIONAL CONFERENCE «CIS FERTILIZERS»

The Near East Region Multi Stakeholder Workshop on Food Security

STAMICARBON UREA TECHNOLOGY LICENSED TO HENGANG HUAHE COAL CHEMICAL INDUSTRY, CHINA

Carbon Holdings Signs US$ 454 million deal

New Publications at IPI

AFA is a non-profit, non-gov. Arab Int’l. Organization established on 1975. AFA is operating under the umbrella of Council of Arab Economic Unity/ Arab League. AFA comprises all companies are producing fertilizer in Arab world in 14 Arab countries.

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The Journal is providing the chance for publishing adverts for the companies involved in manufacturing and trade of fertilizer and other

"Arab Fertilizers” Journal is published by the General Secretariate of Arab Fertilizers Association (AFA).
The contributions of researchers, students, and experts in the field of fertilizer industry and trade are highly welcomed for free publication provided that they have not been published before. The General Secretariat is not obliged to return the articles which are not published.
Financial Statement Analysis & Investment Appraisal Techniques


The 3 days training workshop aimed to present the basic principles and concepts of financial and management accounting to enable participants from both financial departments and other supporting departments, to understand various components of a set of financial accounts and how to use them to manage and control a business efficiently and effectively.

This program was designed for both employees who work on financial and investment departments; employees working in jobs related to finance and financial analysis. The program is also beneficial for experienced officers and financial manager who wish to update their knowledge and skills about the latest techniques in the various financial functions.

The workshop was implemented by expert from Ernest and Young Association which has presented various courses in accountancy, Finance and other fields to many organizations in the Middle East region. One of the professional service provided by Ernest and Young is business community by providing high quality training programs to enable organizations to improve the skills and enhance the performs of their employees.

65 delegates attended the training workshop which the program outlined the following topics:

- Accounting Concepts (Framework)
- Financial Statements
- Financial Statements Analysis (Ratio Analysis)
- Capital Investment Appraisal
- Budgeting and Cash flow Projections
- Costing and Breakeven
- Decision Making
- Working Capital Management
- Performance Measurement

Beyond excellence
Since its establishment, JNSL has carried out most of the Jordanian government transport shipments of imports and exports in international markets. As the Jordanian Flag Carrier, JNSL expanded beyond ship ownership to manage shipping activities including ship operation, ship management, chartering, brokerage, ship agency, transshipment, break bulk, on-carriage, and specialised maritime training and other services; new accomplishments and expansion to new business areas as well as innovative ideas.

The major focus of JNSL business continues to provide first class shipping services. With a progressive vision for the shipping industry in Jordan, poised to take on the evolution of this industry, both locally and internationally, while serving the regional and international transport needs.

JNSL prides its partnerships with Jordan Potash Company, Jordan Phosphate Mines Company, Arab Bridge Maritime, the Social Security Corporation Jordan, and the Arab Bank. As well as the alliance with Clarksons UK, one of the largest and most prestigious ship broking companies of the world which greatly enhanced and modernized the operational and technical procedures; as well as a 15 year Concession for the Marine Services at the Port of Aqaba in Partnership with Lamnalco Group and the Aqaba Development Corporation (ADC).

Pleased to have entered the field of property development, carrying out projects of expansion to its own building in Aqaba, a 5* deluxe hotel at the business and tourist area of Aqaba.

**JNSL Services**

**Chartering:**
The chartering arm, Jordan International Chartering Company (JICC) was incorporated in 1992 from the chartering division in JNSL formulated back in 1983. Partnered with Jordan Phosphate Mines Company and Arab Potash Company and recently welcomed a new strategic partner, Messrs. Clarksons UK, registered and headquartered in London since 1852 www.clarksons.co.uk to add value and expertise to JICC and allow extended exposure to the local and regional markets.

Through JICC, JNSL maintains close contact with the industry trends and market movements to find suitable vessels in the Red Sea area and worldwide. Its extensive and solid network of contacts puts JNSL at the top of the ranks in this service regionally. www.jicc.jo

**Ship Management:**

At JNSL, safety is our highest priority. We are committed to total quality management of all vessel operations. Arab Ship Management (ASM), the technical ship management company has been successful in attracting the majority of the local ship owners by enhanced performance in agency representation, port agency, brokerage, surveying, transhipments, husbandry, bunkering, finding suitable alternative solutions, and marketing services. With the services provided by this entity, JNSL managed to maintain substantial presence in the market, extensive local on-site experience in ship forwarding and all aspects of interstate and commerce, sales as well as distribution methods and practices. www.jgsa.com.jo

**Ship Agency:**

Jordan Group Shipping Agency (JGSA) became an independent entity in 1995, developing from a department of JNSL since 1976. JGSA managed to increase profits during the past 3 years and
abiding by the highest technical standards and the common international standards and requirements. The services of the company include crewing, technical insurance, sales and purchase of vessels, as well as other consultancy related services. www.asm.com.jo

Education and Training:
We take it as our mission to care for the human factor, developing skills and providing continuous education and training. Our staff are of great importance to us and therefore the establishment of Jordan Institute of Maritime Studies (JIMS) came initially as a consequence to the need of a specialized maritime training center in the region. JIMS cares to the educational and training needs of mariners and technical staff, and is open to the training of such personnel from the public sector and neighboring countries; developing specialized training programs and up to date seminars. www.asm.com.jo

Ship Operations:
A partnership between SITTCO and JNSL to carry out the shipping activities and operation of the group fleet. In addition to that, JNLSO is in the market to charter in vessels to perform contracts of afreightment (COA) from local and international markets, covering vessels ranging from Ro-Ro, Bulk carriers, multi purpose and tankers regionally and internationally. JNLSO is technically armed with an experienced team, updated with the latest techniques in the market, and the company has created substantial and noticeable presence since its establishment in 2004. www.jnlsom.com.

Real Estate Investments:
A new service added to JNSL Group by the establishment of Jordan Maritime Complex Real Estate Investment Company LTD (JMCREI), a partnership with JNSL main shareholder Messrs. Salam International Transport and Trading Co PLC. The company was established in 2004 for the purpose of carrying out real estate development and adding up a stable type of investment to guarantee a low risk partial profit growth to the shareholders investment. JMCREI is considering several projects; some have already completed work, such as JNSL head offices in Aqaba, and a hotel and shopping center at on one of the most prestigious lands at the tourist area of Aqaba, operated by Double Tree - Hilton International.

Main Shareholders
JNSL was privatized in 2002, with the majority shareholding in the hands of Salam International Transport and Trading Co PLC (SITTCO), www.sittcogroup.com. At the same time JNSL maintained the representation of public sector and industrial companies in Jordan, such as the Jordan Phosphate Mines Company (JPMC), Arab Potash Company (APC), which are partners with JNSL in various shipping activities; the Social Security Corporation, the Arab Bank and Arab Bridge Maritime. JNSL has maintained strong ties with the Ministry of Energy and Mineral Resources, managing transportation of crude oil demand to Jordan on board tankers M/V Jerash and M/V Star Hero, and operating storage facility of crude oil at the port of Aqaba. Since its privatization, JNSL Group has been progressively growing and harnessing its strong presence from its legacy of tradition and continuous innovation. Over the years, the Group developed an expansion strategy to diversify its markets and expand its customer base. JNSL has been active in all shipping related activities, running different liner services between the North continent and Far East to the Red Sea in addition to chartering and operating oil tankers on behalf of the Jordanian government.

- Salam International Transport and Trading Co PLC www.sittcogroup.com
- Arab Bank PLC www.arabbank.com
- Jordan Phosphate Mines Company http://jordanphosphate.com
- Arab Potash Company www.arabpotash.com
- Social Security Corporation www.ssc.gov.jo
- Petra Navigation and International Trading www.petra.jo

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JNSL Building, Level 3, Naser Bin Jamil Street, Amman, Jordan Tel.: +962 6 5511500 , Fax: +962 6 5515119 P. O. Box: 5406, Amman 11183, Jordan Tlx: 23067 JOMAR Email:management@jnslgroup.com www.jnslgroup.com
CIS major specialized Fertilizer event «CIS Fertilizers 2011» will focus on:
• World fertilizer market – major trends and market factors
• Fertilizer industry leaders – strategies at key markets
• Agricultural production in the CIS countries
• CIS fertilizers and raw materials – external markets and domestic trade

PLUS: Special session «Fertilizer transportation: railway – port – freight at export routes»

PLUS – Open round-table discussions:
• Discussion of topical questions and peculiarities of 2011 season with major CIS fertilizer suppliers
• Markets and prices in 2012

NEW!: Raw materials markets – ammonia, potash, sulphur

The simultaneous translation into English and Russian will be provided during working sessions!

Among confirmed speakers

• Ben Muirheid, Director, Technical Service, IFA
• Oliver Hatfield, Director, Integer Research
• Mark Evans, Editor - Fertilizer Int’l, BCInsight
• Peter Hellmuth, Member of the Board, K+S Kali GmbH
• Evgenia Apostolopoulou, Consultant - Fertilizers, CRU Group
• Antonella Harrison, Head of Fertilizers, ICIS
• Mikhail Penkov, Head of Market Conditions & Forecasts Department, URALCHEM
• Georgy Eliseev, Head of Strategy Department, SIBUR Fertilizers
• Vasily Gnedov, Director - Purchasing and Logistics, Razgulay
• Alexander Gladunov, Marketing Director, Ukrmilinkvest
• Spartak Kilat, Director - Purchasing and Export, Trans-Oil Group of Companies
• Asad Lapsh, Director of Ukrainian Branch, Agro-Generation
• Darya Kashintseva, Senior Analyst, ID-Marketing
• Svetlana Ivanova, Vice-President, Eastern Europe and Central Asia, International Plant Nutrition Institute (IPNI)

Special session - Interactive discussion with URALCHEM representatives:
• Elizaveta Polotnyanshikova, Marketing Director

Special session - Interactive discussion with SIBUR-Fertilizers representatives:
• Pavel Buslakov, Head of marketing and Ammonia Business Segment
• Andrey Barbashin, Expert of Strategy Department

Preliminary Programme
Wednesday, 16 November 2011
14:00 – 17:00 - field-trip to Odessa Port Plant
19:00 - preliminary registration, joint networking cocktail for conference delegates and participants of the ICIS Ammonia Handling and Shipping Safety Workshop

Thursday, 17 November 2011
1st conference working day
Topic of the day – International Markets and Sea-Borne Trade
Session 1 «World Fertilizer Markets: Major Trends and Market Factors»
Session 2 «CIS Fertilizers and Raw Materials at External Markets»
Special session «Transportation»
Session 3 Open round-table discussion «Markets and Prices in 2012»

Friday, 18 November 2011
2d conference working day
Topic of the day – Domestic CIS Markets
Session 4 «Agricultural Production in the CIS countries»
Session 5 «Domestic Trade»
Session 6 Discussion of topical market challenges and peculiarities of 2011 season with key CIS fertilizer suppliers
The simultaneous translation into English and Russian will be provided during working sessions!

Companies attending our events
North-West Phosphor Company, OCP Group, Odessa Port Plant, Ostchem Ukraine \ Crimea TITAN, Phosagro, Phosporit, RovnoAzot, Salavatnefteorgsintez JSC, Severodonetsk Azot Association, SIBUR Fertilizers, Silvinit, Sinochem, Sumychemprom, SZFK, Tessenderlo Group, TogliattiAzot Corporation, Uralchem, Uralkaliy, Voskresenskiye Fertilizers.


Ports: Ilyichevsk SCP, Kherson SCP, MAMAS FOR PORTS SERVICES CO. LTD, Mariupol SCP, Novorossiysk SCP, Odessa SCP, Port of Tallinn, Port of Sillamae, Reni SCP, Rostov SCP, TIS, Universal Stevedoring Company, VARA, Yuzhniy SCP.


Venue
Odessa Hotel
«Odessa Hotel»**** - modern business-class hotel in the center of Odessa city(near sea passenger terminal).
www.odessa-hotel.com.ua/en

HOTEL BOOKING: «Business-Forum» offers special discounted rates at «Odessa Hotel» (Primorskaya 6a, Odessa, Ukraine) for all registered delegates attending «CIS Fertilizers 2011».

To make reservations please contact the hotel Reservations Department at hotel@odessa-hotel.com.ua or tel.: +38 048 729-48-08, 729-46-23

Rates are including breakfast and VAT. Please, make reservation as soon as possible as room availability is limited.

The Near East Region Multi Stakeholder Workshop on Food Security

Cairo: 3-4 October, 2011

The Near East Region Multi Stakeholder Workshop on Food Security took place in Cairo during the period: 3-4 October, 2011 in which AFA General Secretariat participated and presented a paper on plant nutrition.

The workshop was organized by the FAO Regional Office for the Near East in close collaboration with the Committee on World Food Security (CFS) to discuss regional food insecurity and malnutrition challenges and identify actionable policy recommendations.

The workshop gathered around 70 participants; 36 representatives from 19 countries as well as UN agencies, NGOs, farmers organizations, representatives of international financial institutions, regional institutions, agricultural research institutions, private sector and philanthropic foundations.

In view of the above, three policy round tables was held to discuss the following topics:
- Food Price Volatility
- How to increase Food Security and Smallholder-Sensitive Investment in Agriculture
- Gender, Food Security and Nutrition

The Workshop contributed to a more effective food security and nutrition governance mechanism through which countries and other participants provide policy inputs to CFS through a multi-stakeholder consultation process.

A panellists represented a range of stakeholders: governments, international organizations, grassroots and civil society organisations as well as the private sector.

The key outcame from the round table discussions are:
- The identification of policies that address food security and nutrition challenges;
- Ways to promote policy convergence, coherence and joint action;
- Guidance to relevant institutions on how to play a facilitating role;
- Global, regional and national implications.
Press Release

STAMICARBON UREA TECHNOLOGY LICENSED TO HENGANG HUAHE COAL CHEMICAL INDUSTRY, CHINA

Sittard, July 12, 2011 – Stamicarbon, the licensing and IP Center of Maire Tecnimont S.p.A., has signed a license agreement with Hengang Huahe Coal Chemical Industry, Ltd. in the Peoples’ Republic of China for a urea granulation plant with a capacity of 1860 mtpd. The plant will be built in Hegang City, Heilongjiang Province, PRC.

The Urea plant will use Stamicarbon Urea2000Plus™ Technology, which features a Pool reactor, minimum equipment and minimum plant height. By using Safurex® stainless steel for the high-pressure synthesis section low oxygen intake can be obtained.

Stamicarbon will deliver the PDP (“Process Design Package”), related services and all proprietary high pressure equipment, pool reactor and piping. The high pressure equipment and the pool reactor will be manufactured by SBN. The high pressure equipment, Pool reactor and Piping will be alloyed with Safurex®. Start up is planned in 2014.

Over the last 15 years Stamicarbon has licensed a total of 15 grass roots and revamps in the PRC with capacities up to 3520 mtpd. The future remains very bright for business in the Peoples’ Republic of China, as the growth trend in the fertilizer sector is expected to continue.

Carbon Holdings Signs US$ 454 million deal

In Cairo, Egypt, on 31 July 2011, at the General Authority for Free zones and Investment, Carbon Holdings signed the shareholders agreement for Egyptian Hydrocarbon Company (“EHC”).

The shareholders agreement was also signed by the other investors in EHC; Egypt Kuwait Holdings, Hayel Saeed Anam Group, Saudi Economic and Development Company and Tri Ocean Energy.

EHC will be located on the northwest bank of the Gulf of Suez and produce 1.060 mtpd of low density ammonium nitrate using both nitric acid and anhydrous ammonia as feedstock. EHC have already signed an Engineering, Procurement and Construction Agreement and License Agreement with Uhde GmbH a wholly owned subsidiary of Thyssenkrupp AG. Startup is scheduled for 2014.

The total investment in EHC will reach US$ 454 million with a project finance facility already having been signed with Initial mandated Lead Arrangers Ahli United Bank S.A.E., Banque Misr S.A.E. and Commercial international Bank (Egypt) S.A.E..

Establishing the project will bring 3.000 job opportunities during the construction phase and about 500 sustainable job opportunities during operation. Mr Basil El-Baz, CEO and Chairman of Carbon Holdings said “my company is determined to invest in the Egyptian market because we have confidence that the Egyptian economy will be able to overcome the current circumstances and show significant growth over time”.

About Carbon Holdings

Carbon Holdings (“CH”) is implementing new downstream oil and gas infrastructure in Egypt. In addition to the EHC Ammonium Nitrate Complex CH5 projects include a greenfield Olefins Project and a greenfield Methanol and Ammonia Project.

Media enquiries to: Mohamed A. Helmy
Director - Investor Relations
Email: Helmy@CarbonHoldings.net

Stamicarbon B.V.

Stamicarbon, the licensing and IP Center of Maire Tecnimont, is the global market leader in licensing of urea technology and services with more than 50% market share in synthesis and 35% market share in urea granulation technology. Stamicarbon has over 60 years’ experience in licensing its urea technology, delivering optimum environmental performance, safety, reliability and productivity at the lowest investment level. Over 250 urea plants are using its technology. Furthermore it has completed over 90 revamp projects in Stamicarbon and non-Stamicarbon plants. Since 1947, Stamicarbon has been the world’s leading authority and innovator in the field of urea in close cooperation with research institutes, suppliers and customers.

Stamicarbon has offices in Sittard (The Netherlands), Beijing (China) and Moscow (Russia). More information: www.stamicarbon.com

Maire Tecnimont SpA

Maire Tecnimont S.p.A. is the parent company of an Engineering, Main Contracting and Licensing group, which operates in three sectors: Oil, Gas & Petrochemicals, Power and Infrastructure & Civil Engineering. The Group, quoted on the Milan Bourse, is present in over 30 countries, controls over 50 operating companies and can rely on a workforce of about 5,200 employees, of which more than half are located internationally. At 31 December 2010, the Group reported Revenues of €2,536 million and Net income, after minorities, of €62 million. For further information: www.mairetecnimont.it

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New Publications at IPI

Available for download on IPI website.

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The first edition of the IPI Crop Bulletin on Soya, written by Dr. Fauconnier, was published in 1986. Since this time, the area and productivity of soybean has dramatically increased, with Latin America producers playing a much more important role than before. The authors of this latest IPI publication in Spanish, Dr. R. Melgar (Argentina) and Drs. Vitti and de Melo Benites (Brazil), are well connected to this remarkable growth in their countries, and are well placed to outline soybean development in Latin America.

The publication includes four chapters, conclusions and color photos. In the opening chapter, the authors describe the economic importance of Soya in Latin America, including the development of the biofuel industry that uses soybean oil. The second chapter describes the general conditions required for the crop, climate, soils and potential across the Latin American region. In the third chapter, the role of each nutrient on the development and quality of the crop is outlined, and in the fourth chapter the various fertilization practices used in soybean production are discussed in detail, with a special focus on those applied in no-till systems.

Each chapter is accompanied by tables and figures, as well as color photos describing typical nutrient deficiencies which appear as an appendix. The book will be a useful resource for those involved in Soya research and production, including academia, agribusiness and agronomy communities in Spanish-speaking countries. For copies of the bulletin, please contact Dr. R. Melgar at rjrmelgar@gmail.com or rmelgar@pergamino.inta.gov.ar

Önemli Kültür Bitkilerinin Gübrelenmesi Fertilization of Selected Crops in Turkey
Available for download on IPI website.

A requirement for higher yielding crops due to population growth has led to a greater use of inputs, which are often used in excess, to increase agricultural production. Precautions to control the excess use of fertilizers are very important not only for agricultural production, but for the environment as well as for the economy. Therefore, optimization in the nutrition of crops is essential in producing high quality healthy crops in efforts to obtain higher yields per unit of agricultural land.

Optimal and efficient use of fertilizers can only be achieved by understanding factors such as climate, soil properties, cropping period and the timing, amount and type of fertilizers used. Otherwise, soil fertility and yield quality may decrease, and the environment negatively affected.

This publication includes eleven chapters each focusing on the growth requirements of a different crop: apricots, cherries, citrus, cotton, figs, maize, olives, thyme, greenhouse tomato, vineyards, and wheat, with an emphasis on climate, soil properties, nutrition as well as fertilization practices and recommendations. The authors of the chapters are all leading researchers from Ege University, Bornova; Celal Bayar University, Manisa; and the West Mediterranean Agricultural Research Institute, Antalya.

The publication will be useful for researchers, extension and agribusiness technicians working in Turkey. For copies, please contact Prof. Dr. Dilek Anaç, Ege University, Faculty of Agriculture, Soil Sciences Dept., 35100 Bornova, Izmir, Turkey, dilek.anac@ege.edu.tr.

Fertigation. A Tool for Efficient Water and Nutrient Management
Available for download on IPI website and IFA website. Sound water management has the potential to improve fertilizer/nutrient use efficiency. The introduction of well-tested, efficient fertilizer application through irrigation water or «fertigation» techniques could help turn vast areas of arid and semi-arid land in many parts of the world into farmland, as well as preventing water from being wasted in conventional irrigation systems.

This book is a joint project of IFA and the International Potash Institute (IPI). It presents information relevant to soil-water-fertilizer interactions during fertigation.

The authors have brought together various types of expertise on plant physiology, plant nutrition and irrigation, which are synthesized into practical knowledge related to fertigation in commercial field and greenhouse operations.

Readers will find advice on selecting appropriate fertilizer products for fertigation of a number of field and horticultural crops. The suitability of some fertilizers for fertigation is explained from the point of view of the plant’s physiological demand at different growth stages, the type of soil or growing medium, climatic conditions and irrigation water quality.

For more information, please contact:
Mr. Hillel Magen, IPI Director, at ipi@ipipotash.org.
Nutrient Balance in Arable Lands ... a Global Challenge for the Fertilizer Industry

Paul E. Fixen, Sr. Vice President, International Plant Nutrition Institute

Abstract
Nutrient balance, defined as nutrient removal by crops compared to fertilizer and manure use, is one of many critical performance indicators of the sustainability of cropping systems employing 4R nutrient stewardship. Negative balances lead to declining soil fertility and eventually to reduced productivity once nutrient supplies drop below critical levels. Positive balances are usually associated with increasing soil fertility and may eventually lead to elevated loss of nutrients to the environment. Nutrient balance varies greatly among countries, regions within countries, and farms within regions. It also varies over time as changes occur in both nutrient use and nutrient removal by crop production. A primary challenge for the fertilizer industry is to target its emphasis: use its marketing and delivery strength to increase nutrient balances where they are inappropriately low while also delivering the technology, service and educational programs to reduce balances where they are inappropriately high. Nutrient balance data indicate that nutrient relationships on the farms of the world are changing, and one can infer that they need to continue to change, with the magnitude and direction needed being farm and field dependent. 4R nutrient stewardship offers a useful framework to guide those changes toward more sustainable systems.

Nutrient Balance and 4R Nutrient Stewardship
4R nutrient stewardship is an innovative approach to best management practices (BMPs) for fertilizers. It ensures that the right source (or product) is applied at the right rate, in the right place, and at the right time (Roberts, 2007; IFA, 2009). In the lead article of a 5-part series on 4R Nutrient Stewardship in the American Society of Agronomy’s Crops and Soils magazine, Bruulsema et al. (2009) wrote “This simple concept can help farmers and the public understand how the right management practices for fertilizer contribute to sustainability for agriculture. Getting practices “right” depends on important roles played by many partners including farmers, crop advisers, scientists, policymakers, consumers, and the general public.” The concept of 4R stewardship not only provides structural stability to management decisions, but also offers a simple and effective means of communicating to those outside agriculture about how management contributes to sustainability. To truly be “right”, practices must be site-specific for the crop, field, and for a particular zone within the field. Yet, the scientific foundation upon which 4R nutrient stewardship is built, and that leads us to BMPs, is universal.

Figure 1 is a schematic representation of the 4R nutrient stewardship framework (Bruulsema et al., 2008).

At its core are the 4Rs – application of the right nutrient source at the right rate, right time, and right place. BMPs are the in-field manifestation of these 4Rs. The 4Rs are shown within a cropping system circle because they integrate with agronomic BMPs selected to achieve crop management objectives. Those farm-level crop management objectives contribute toward the larger economic, social and environmental goals of sustainable development. Around the outer circle of the 4R framework are examples of performance indicators. A balanced complement of these indicators can reflect the influence of nutrient BMPs on accomplishment of the goals of sustainable development. Nutrient balance is one of the performance indicators in the framework and is highly relevant in assessing the “rate” component of the 4Rs. In this context, nutrient balance refers to nutrient removal by crop harvest compared to nutrient inputs. Negative balances, where removal exceeds use, lead to declining soil fertility and eventually to reduced productivity once nutrient supplies drop below critical levels. Positive balances are usually associated with increasing soil fertility and may eventually lead to an elevated risk of nutrient loss to the environment. A primary function of nutrient management is to facilitate the balancing of nutrient removals and nutrient inputs at levels supporting optimum crop growth and minimal nutrient losses to the environment. Though assessment of whether nutrient use rates are “right” must clearly be done at a field or farm level, aggregate data at the regional or country scale can reflect general tendencies and trends useful in targeting educational programs, marketing efforts, and policy.

Nutrient Balance for OECD Countries
The Organization for Economic Co-operation and Development (OECD) has published gross nutrient balances for OECD countries calculated as “the dif-
ference between the total quantity of nutrient inputs entering an agricultural system, and the quantity of nutrient outputs leaving the system” (OECD, 2008). The resulting surplus or deficit was expressed as kg of nutrient per ha of agricultural land per year.

Average N balances for 2002-2004 are shown in Figure 2, sorted from highest to lowest balance. The red and green numbers on each bar indicate the change from the 1990-1992 period. The range varies from over 200 kg N/ha to less than 10, with the OECD average estimated at 74. Important to note is that for the 16 countries having the largest surpluses, all but two (Korea and Ireland) showed reductions from the 1990-1992 period and the OECD balance as a whole declined 14 kg N/ha. Average P balances are shown similarly in Figure 3. As with N, the range is extreme, from highs of over 100 kg P2O5/ha for Japan and Korea to a low of a -2 for Hungary with an OECD average of 23. Of the 30 countries reported, four had higher balances than in 1990-1992, four showed no change, and 22 had lower balances. The OECD average P balance declined 14 kg P2O5/ha from 1990-1992. If similar declines occur in each country over the next decade, 13 would have zero or negative balances.

Nutrient Balance for China, India, Brazil and Russia

OECD average balances for N and P are compared to those for China, India, Brazil, Russia and the US in Table 1 along with K balances. Balances are reported as published by the original sources, so estimation methods and assumptions may not be consistent across all countries. Also, the time periods for the estimations vary among countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Gross balance expression</th>
<th>N</th>
<th>P2O5</th>
<th>K2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD1, 02-04</td>
<td>Kg/ha</td>
<td>74</td>
<td>23</td>
<td>--</td>
</tr>
<tr>
<td>India*, 2009</td>
<td>Kg/ha</td>
<td>7</td>
<td>3</td>
<td>-53</td>
</tr>
<tr>
<td>Removal/use</td>
<td></td>
<td>0.88</td>
<td>0.88</td>
<td>8.04</td>
</tr>
<tr>
<td>China*, 2005</td>
<td>Kg/ha</td>
<td>-100</td>
<td>-19</td>
<td>-24</td>
</tr>
<tr>
<td>Brazil*, 2008</td>
<td>Kg/ha</td>
<td>13</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Removal/use</td>
<td></td>
<td>0.69 (0.72)</td>
<td>0.54</td>
<td>0.77</td>
</tr>
<tr>
<td>Russia*, 06-07</td>
<td>Kg/ha</td>
<td>-22</td>
<td>-6</td>
<td>-23</td>
</tr>
<tr>
<td>US*, 2007</td>
<td>Kg/ha</td>
<td>43</td>
<td>4</td>
<td>-14</td>
</tr>
<tr>
<td>Removal/use</td>
<td></td>
<td>0.74</td>
<td>0.92</td>
<td>1.26</td>
</tr>
</tbody>
</table>

Nitrogen and P balances for these countries fall within the range of the OECD countries, with the exception of Russia which has negative balances for N, P and K. India, China and the US also have negative K balances.

China has a high P balance of 79 kg P2O5/ha. However, the results of P analyses performed by the CAAS-IPNI Soil Testing Laboratory on samples collected from 1995-2000 and from 2001-2006 show that 45% and 44%, respectively, of soils tested were deficient in P, testing very low or low (Liu, 2008). Such soil levels suggest that P balances should be positive for the fields they represent to improve soil P fertility. But since 55 to 56% of the samples were not deficient, it is likely that the national P balance is higher than would be optimum. Tremendous within-country variability among geographic areas and cropping systems makes interpretation of national averages for China difficult.

Nutrient Balance Variability within a Country – U.S. Example

Appropriate use of country nutrient balance data requires an appreciation for the variability in nutrient balance that can occur within a country. Some of this variability is farm-specific but some is region-specific and associated with regional soil properties, cropping systems or livestock density. Two projects by IPNI in the U.S. can serve to illustrate these regional differences and their implications for soil fertility. One project, named NuGIS, uses a partial nutrient balance model that is still being refined. It utilizes data from multiple sources to create a nutrient use GIS for the U.S. (IPNI, 2010a). NuGIS currently covers a 20-year period but because Agriculture Census data are used in some balance determinations, most results are at 5-
year intervals. NuGIS is currently only being used in the U.S., but IPNI plans to apply the approach in other countries in the future. The second project is the 2010 North American soil test summary, one in a series of summaries that IPNI periodically conducts with the cooperation of private and public soil testing laboratories (IPNI, 2010b).

The NuGIS maps in Figure 4 show nutrient removal to use ratios by hydrologic region. The ratio of nutrients removed by harvested crops to nutrients applied or biologically fixed (in the case of legume N) is another means of expressing nutrient balance. A ratio of 1.0 occurs when crop harvest removal and nutrient use are equal. Ratios less than one indicate that use exceeds removal (nutrient balance is positive) while ratios greater than one indicate that crop harvest removal exceeds use (nutrient balance is negative). The maps show major regional differences for all three nutrients.

**N and P:** The highest ratios are found in the Midwest Corn Belt and Northern Great Plains with lower ratios occurring in California, the Southeast and the Northeast. The lower ratios are usually associated with production of high cash value vegetable or fruit crops or high livestock populations per unit of arable land. Phosphorus ratios greater than one for the Corn Belt show that crop “mining” of soil P is prevalent in this region.

**K:** Ratios are very high in the West and lowest in the Southeast. The high ratios of the West are related to very high indigenous soil K levels. Even after many decades of cropping, most of these soils continue to supply ample K to crops. However, soil test summaries do show soil K reductions and suggest that with time, K use in the region will need to continue to increase. In contrast, the soils of the Southeast have low cation exchange capacities and do not effectively store applied K. This area also grows high cash value crops with high K needs.

Much of our interest in nutrient balance is due to its connection with soil fertility impacts as discussed earlier in this paper. For example, are the greater than one P ratios of the U.S. Corn Belt resulting in declining soil P levels? The intensity of soil sampling and relatively uncomplicated nutrient budgets of the U.S. Corn Belt provide an opportunity to answer that question with actual data. Figure 5 shows the 2010 median soil P levels and the change from the 2005 for states of the Corn Belt and province of Ontario. Two states showed no change while all others show reductions in soil P levels across this 5-year period. Regression of nutrient balance on change in soil test levels shows that 62% of the variation in change in state median soil test P level is explained by state P balance (Figure 6). The resulting regression line essentially passes through the origin indicating that when P use is equal to P removal by crops, over the last 5 years no change in soil test P level occurred. Since most current levels are near or below what university research indicates are critical levels for crop response, these reductions are agronomically very meaningful.

**The Challenge for the Fertilizer Industry**

Nutrient balance is a critical performance indicator of the sustainability of cropping systems because it indicates the future direction of soil fertility levels under existing practices and can provide an indication of nutrient use efficiency. Nutrient balance varies greatly among countries, regions within countries, and farms within regions. It also varies over time as changes occur in both nutrient use and nutrient removal by...
crop production. Growth in the need for agriculture’s products, and in the expectation or expanding requirements that those needs will be met without negatively impacting the environment, increases the importance of appropriate industry response to nutrient balance indicators.

Defining an appropriate response to existing nutrient balance requires consideration of other performance indicators in the 4R framework (Figure 1) such as soil productivity. If soil nutrient levels are below those considered critical for optimum crop growth, positive balances are usually appropriate until critical levels are achieved. If soil nutrient levels are above the range considered optimum, negative balances may be appropriate until the optimum range is approached. Additional factors that can influence response to nutrient balance levels include access to technology enabling adjustments in source, timing, or placement of nutrients, the needs of livestock enterprises, health and economic risks associated with nutrient insufficiency, labor supply, and site-specific environmental impacts.

A primary challenge for the fertilizer industry is to target its emphasis by using its marketing and delivery strength to increase nutrient balances where they are inappropriately low while also delivering the technology, service and educational programs to reduce balances where they are inappropriately high. Part of the challenge is to identify which is which; a process that can be facilitated by science-based evaluation of nutrient use. That is the objective of the NuGIS project discussed earlier.

Improper (sub-optimal and supra-optimal) nutrient balances can impair optimal crop nutrient recovery efficiency and effectiveness. For example, inadequate P, K, sulfur (S) and micronutrients can reduce crop N recovery and may potentially raise the risk of N discharge to freshwater resources and to coastal oceans, a growing environmental concern (Seitzinger et al., 2010, 2005; Galloway et al., 2008).

In the practical world, sustainable agriculture is less of a condition than it is a direction. None of us can see far enough into the future to know what is sustainable. What we can do is strive to create systems that are more sustainable than those of the past. Continuous improvement is an essential ingredient for sustainability and 4R nutrient stewardship can serve as the foundation for the continuous improvement of nutrient management. The nutrient balance data discussed here indicate that nutrient relationships on the farms of the world are changing, and one can infer that they need to continue to change with the direction needed being farm and field dependent. 4R nutrient stewardship offers a useful framework to guide those changes towards more sustainable systems.

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**GPIC experience in changing The Hydraulic to Electronic Governor**

**Introduction:**

GPIC started to produce Ammonia and Methanol in 1985 with name plate capacities of 1000 MTPD each. Both plants have undergone a debottlenecking project to increase their production by 20% each in 1989. In 1998, Urea plant was commissioned utilizing ammonia product and CO2 side product from Ammonia Plant with a nameplate capacity of 1700 MTPD.

Methanol Plant was built with UHDE technology and ICI technology for the Synthesis unit. The operating pressure for ICI reactor is 80 barg which could be achieved by a steam turbine driven centrifugal compressor. The steam turbine is a condensing/extraction type turbine with a maximum governor speed of 10410 rpm. The speed was controlled by a Woodward PGPL hydromechanical governor with linear output and pneumatic speed setting.

This governor was in service since 1985 till 2007 and has given the best of its performance over that period of time which is evident from the uninterrupted Methanol Plant running records that has reached to 931 days of continuous running. However, the new turbines are fitted with electronic governors due to their technical superiority to achieve finer controls compared to mechanical governors. Moreover, the compressor control can also be embedded with the electronic governor control to achieve higher efficiency from such a high speed rotating compressor by running them closer to surge curve as will be detailed later. In addition, it is a known fact that the specialist to overhaul and calibrate the Woodward governors are few only and hard to get them whenever required. From that angle, GPIC decided to replace the hydraulic governor to Electronic Governor in 2007.

**Electronic Governor Configuration – fig (1):**

The Woodward 505E is standardized extraction –turbine controller, fixed hardware and application that can be configured to suit different turbine setups and characteristics. The design of Electronic Governor meets the requirements of API 612 for installation in Petroleum and Chemical Industries. Data based on the turbine specification, included steam map, and starts up sequence information supplied to the manufacturer are configured in the Electronic Governor software.

The Electronic Governor Cabinet is installed in the Local Control Room and a Local Operator Panel (LOP) was mounted near the turbine. An operator station was provided at the central control room for remote operation with an interface with 505E via Modbus. To interface the 505E controller with the two hydraulic actuators on the turbine Voith I/H convertors. These convert the mA valve demand signals from the 505E into a 1.5-4.5 bar oil pressure. This controlled pressure will be the position demand signal for valve servo which, together with the feedback lever, will position the steam valves (HP speed control& LP extraction control).

The Voith redundant I/H consist of one skid, a manifold block with max-selected valve and two Voith I/H convertors with manual override.

The extraction pressure controller was modified as manual loader and the same analog output serves as remote extraction pressure feedback from DCS and wired to the Electronic Governor Cabinet.
The new system was provided with comprehensive self diagnostics such that all permanent and transient faults are identified, alarmed, reported and retained by the system till acknowledged by the user. GPIC planned to retained the existing emergency trip device, stop valves and HP/LP actuators of the steam turbine.

**Improved Safety in the Electronic Governor:**

- HP valve opening is limited to 30% in case of speed not detected until 505E trips.

- HP valve maximum opening was limited to 93.75%, to avoid disturbances to turbine on account of opening of the 5th nozzle’s plug (the turbine is manufactured with five steam inlet nozzles).

- LP valve minimum opening set at 35% during start-up, to ensure better loading on LP during Start-up – Refer to Fig (2).

**Improved Extraction Pressure Control**

- Originally Extraction feedback was kept in manual, to avoid disturbances to turbine operation in case of fluctuation in extraction pressure. After the upgrade the extraction pressure feedback is enabled, and 5% droop characteristics is introduced to minimize the disturbance. And turbine efficiency was improved by introducing extraction pressure feedback which was not possible by manual control.

During the said job, some challenges were faced that have been resolved internally in consultation with the vendor. Those challenges can be categorized with respect to their nature to either mechanical/fabrication or instrument/electrical.

**Mechanical/Fabrication**

1. The control oil lines had to be modified to install the Voith converters (I•H).
   a. The oil lines had to be properly flushed free from welding particles to avoid damage to vulnerable hydraulic components.
   b. Identification and Installation of blinds for control oil system as it is linked to main oil console.

**Instrumentation / Electrical aspect**

- Selection of the model; to go for simplex or TMR. Then decided to go for simplex as space is limited and it is cost effective. However, redundancy is not available. GPIC came up with a custom design to improve the availability of the system by providing another 505E as hot spare.

- Start up limits of the HP/LP lifts changed to new settings. (full open to limited setting to enhance safety)

- The need to extrapolate the steam map of the turbine due to higher output requirements as shown in the characteristics curve.

- Laying of control/signal cables from main control room to the LCR and installing an HMI in the methanol DCS. This is a pre turnaround activity that needs a lot of attention to avoid disturbing the live system.

- Modifying DCS emergency shutdown signals and I/O signals for analogue and digital signals.

- Installation of redundant MPU speed pick-ups. For this the speed gear detector had to be modified along with the housing for installation of the probes.

Innovation and implementing the best practices is one of our pillars in GPIC towards the continuous improvement. That’s why we have moved strongly toward implementing this change regardless the biggest challenge we have faced which was the fear from change and the people resistance.

**Benefits of Electronic Governor:**

- Highly reliable system at reasonably low cost and limited space requirements.

- Perceived benefits such as:
  - Easy calibration and tuning,
  - Fast/smooth start-up,
  - Advance diagnostics features.

- More safety features, valve limiters.

- Automatic more reliable extraction pressure control than before and adjusts automatically at different variation of speed also absorbs pressure fluctuations.

- The new electronic governor has enhanced the reliability of turbine.

- Accurate control of speed at all operating conditions.

- In case of failure in the signals coming from DCS, the command signal will be frozen at the last valid value and speed & extraction set point can be controlled through OS in MCR or 505E front panel in LCR.

- The machine can be started from either Local control room, Local Operating Panel or from Main control. With the predefined start up curves.

- New governing system calculates the time of shut down and defines the start up as hot or cold start up.

- Speed detection system is dual magnetic pick ups (MPU) in case of one MPU failure the other will be used for controlling the speed automatically.

The Governor replacement project was implemented in 2007 during the annual turnaround, and it was adapted to the turbine controls and commissioned very smoothly without any major problem. This is mainly due to having a clear scope of work and job assignments prior to the implementation phase.
Planning and Implementing EMS according to ISO: 14001:2004
At ARAB POTASH COMPANY

Abstract:
Arab Potash Company (hereinafter “APC”), being a facility with wide spread of operations and Services, faced challenges to apply and introduce an effective Management System (EMS) according to ISO: 14001:2004 standards

These environmental challenges could generally be narrowed down to:

1- Identify, evaluate and document the environmental aspects generated from APC operations and services, APC has 370 Environmental Aspect, 265 out of them are significant.

2- Establish a process of evaluating compliance with Environmental laws and regulations. 3- Establish, implement, and maintain the proper operational controls for the significant environmental aspects.

4- Involving the employees in the environmental responsibilities of the company generally, and in their workplace specifically by designing the best practice training and awareness programs based on the employees’ field experience and the standard procedures (SOPs).

5- Reduce the Environmental pollution generated from APC in a cost effective way.

This Paper will Explain the approach taken by APC team to identify and evaluate the Environmental aspects and how to overcome the challenges of applying an effective EMS, taking into consideration the following:

• The large percentage of Significant Environmental Aspect against the total number of aspects which reaches to (72%).

• The high frequency rate of new environmental regulations.

• The communcation of the new environmental management principles to the employees and contractors and instill the environmental culture within the work places.

• The Improvements in the Environmental performance APC has achieved in the field of natural resources consumptions, Hazardouse Waste manage-
ments and industrial waste water quality.

Recommendation: To achieve a comprehensive result and to get support to solve the shared obstacles we are facing, I recommend sharing the APC experience in the field of Environmental Management system with all AFA Members.

Arab Potash Ecosystem:

The Arab Potash Company (APC) was founded in 1956 by the Jordanian Government to utilize the Dead Sea minerals. APC plants are located at the southern shore of the Dead Sea; the general area is the lowest point on the surface of the earth, with the Dead Sea the dominant natural feature, providing the raw brine for the production of potash.

The APC site currently occupies an area of 262Km², including the concession area and other lands leased or owned by APC or its subsidiaries. The main components of the APC site include:

• 95 Km² in Solar Evaporating Ponds.

• 40 Km² in the undeveloped Southern Concession Area;

• 62 Km² in other land leased or owned by APC;

• 29 Km² of other land exposed by the recession of the Dead Sea.

Safi Site (Solar Pans and Plants)
The Potash Product is Transported to APC Site at Aqaba by 80 Haulage Truck specially designed to Transport Potash.

Other activities related in to APC’s operations include, Jetties for brine intake, and sites for major utilities such as the Sewage Treatment Units, main Generators and substations, and the solid waste (Salt Tails area) landfill sites.

Introduction
Arab Potash Company Environmental Management System was certified according to ISO: 14001:2004 Standard since July 2001, and continually improve and update its EMS.

To keep an effective EMS, the system should be reviewed to cope with new standards requirements, scope changes and new legal requirements, at APC the EMS was fully reviewed 3 times since 2001; the last review was on 2008, in this paper we will discuss the challenges we faced in the Planning and Implementation stages, how we overcome and build an effective EMS which acts as monitoring tool for environmental performance at APC.

What is Environmental Management (EMS) System??
According to ISO: 14001:2004 standards its part of an Organization's management System to develop and implement its Environmental Policy and manage its Environmental Aspects

Planning Environmental Management System/EMS
Planning EMS consists of three major points:

1. Identification and Evaluation of Environmental Aspects.

2. Identification of Legal and other Requirements those are applicable to Environmental Aspects.

3. Set the Objectives, Targets and Programs.

1- Identification and Evaluation of Environmental Aspects

Planning and Implementing EMS
At Arabian Potash Company

Abstract:
At ARAB POTASH COMPANY, Planning and Implementing EMS according to ISO: 14001:2004 standards its part of an Organization's management System to develop and implement its Environmental Policy and manage its Environmental Aspects.

Environmental aspects generated from APC operations and services, APC has 370 Environmental Aspect, 265 out of them are significant.

At the southern part of the country, the Dead Sea, with an area of 10,083 km², is the lowest point on the earth’s surface. It is the lowest point on the surface of the earth, with the Dead Sea the dominant feature of the area. The general area is the lowest point on the surface of the earth, with the Dead Sea the dominant feature of the area.

The APC site currently occupies an area of 262Km², includes Families and bachelor Housing units for approximately 2,200 residents, commercial and community facilities. Additional housing for bachelors is provided at the Al-Hussein bachelor accommodation area opposite the main entrance to the Potash plant.

Potash City, which is approximately 20 km North of the Potash plant, is APC’s main residential area and includes Families and bachelor Housing units for approximately 2,200 residents, commercial and community facilities. Additional housing for bachelors is provided at the Al-Hussein bachelor accommodation area opposite the main entrance to the Potash plant.

The Arab Potash Company (APC) was founded in 1956 by the Jordanian Government to utilize the Aqaba Site Jetty by 80 Haulage Truck specially designed to Transport Potash.

Aqaba Site Jetty
Potash City

Aqaba Site, Storage and Export site for APC, covers an area of 239,000 m² within the southern industrial area, is located 22 kilometers from the Aqaba City and 220 Km from Safi Site, Storage Capacity 260,000 M/ton KCl
mental Aspects:
ISO 14001-2004 4.3.1 Environmental Aspects:
The Organization shall establish, implement and maintain a procedure(s) To identify the environmental aspects of its activities, products and services within the defined scope of the environmental management system that it can control and those it can influence
• APC Continually Reviews its Environmental Aspects, last review was on 2008.
• The Review was conducted by a Multidisciplinary Team from all Concerned Departments.
• The result of 2008 Review is explained in this paper.

1.1. Approach:
The task of the multidisciplinary team was to identify and evaluate all the environmental aspects according to ISO: 14001:2004, article 4.3.1, the approach was to divide APC into Departments, each department was divided into Areas, Each Area was divided into main activities, and each activity was evaluated and identifies the associated environmental aspects.
The below example explains the approach taken:

1.2. Results:
2008 Result of analysis for all APC departments was:

<table>
<thead>
<tr>
<th>Number of Departments</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Of Areas</td>
<td>89</td>
</tr>
<tr>
<td>Number of Activities</td>
<td>188</td>
</tr>
<tr>
<td>Number of Environmental Aspects</td>
<td>335</td>
</tr>
<tr>
<td>Number of Significant Env. Aspects</td>
<td>249</td>
</tr>
</tbody>
</table>

1.2.1. Number of Aspects:
In 2008 round the number of environmental aspects increased compared to 2005, fig. (1) Shows comparison between 2008 and 2005 number of aspects.

1.2.2. Type of Aspects:
Environmental Aspects related to Potash Industry Distribution by aspect Type Fig (2)

1.2.3. Environmental Aspects Distribution per Departments:
The departmental Environmental aspects distribution shows that Production and Maintenance departments have the highest numbers of aspects which is logic as most of the core operations are conducted within two departments.
2. Identification of Legal and other Requirements those are applicable to Environmental Aspects.

In Jordan, the frequency of legal requirement increased during the period 2003-2010, APC / EMS relevant Regulations is periodically reviewed and updated and documented in a special form “ Environmental Legal and other requirement Matrix”, appendix(2)

APC / EMS relevant Regulations

- Jordanian Standards.
- Civil Defense Law # 18/1999.
- Montréal Protocol.
- Regulations #1/2001 for the protection of Environment in the Aqaba Special Economic Zone

Number of legal requirement according to its type:

<table>
<thead>
<tr>
<th>Regulation Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Law</td>
<td>6</td>
</tr>
<tr>
<td>By-Law</td>
<td>10</td>
</tr>
<tr>
<td>Instructions</td>
<td>10</td>
</tr>
<tr>
<td>Jordanian Standard</td>
<td>6</td>
</tr>
<tr>
<td>International</td>
<td>2</td>
</tr>
</tbody>
</table>

3. Set the Objectives, Targets and Programs

Clause 4.3.3 of ISO 14001 states:

- The organization shall establish and maintain documented environmental objectives and targets, at each relevant function and level within the organization.
- When establishing and reviewing its objectives, an organization shall consider the legal and other requirements, its significant environmental aspects, its technological options and its financial, operational, and business requirements, and the views of interested parties.

- The objectives and targets shall be consistent with the environmental policy, including the commitment to prevention of pollution.

3.1. APC considers its significant environmental aspects when establishing its objectives, and targets, Proper environmental performance indicators were adopted for the critical operations, we will discuss below four sample cases at APC.

3.1.1. Natural Resources Objectives and Targets:

In Fig (2), Aspects Type distribution, a category related to Natural Resources consumption was identified, number of aspect is 67 aspect, we conducted a further downstream analysis for this category to determine the type of resources consumed, the result are in Fig.(5):

Using the above chart, we build our objectives and targets, we will take an example on how to set the objective and target and how to monitor the actual performance on achieving these targets; Production directorate adopted the objective of “Minimize Resources Depletion”, 6 associated targets were set to achieve this objective, those Targets covers Water, Power and Fuel Consumptions, those values are reviewed by the technical and operation staff and approved by the technical management, it’s also reviewable and subject to continual improvement.
3.1.2. Natural Resources Monitoring Programs:
The performance in achieving the Target values is monitored on monthly basis, and it’s reviewed quarterly by the management during the Management Review Meeting, the below sample chart explains the monitoring program for water and Power consumptions at Cold Crystallization refinery at APC.

Consumptions values are calculated as specific consumptions based on Ton Potash Produced.

3.2. Liquid Wastes (Industrial Waste Water) / Objectives and Targets
Definition: Industrial Waste Water: It’s the water generated from Operational and Maintenance activities.

Back again to Fig (2), aspect type (Liquid Waste), total number of aspects is 77; conducting downstream analysis for pollutant type in liquid streams, the result is in Fig. (8)

3.2.1. Environmental Objective and Monitoring Program
Maintenance Directorate adopted the Objective “Reduce the Oil and Grease Content on the industrial waste Water below 8 mg/Lit, according to JS: 202/2007”.

This target value is monitored on monthly basis by measuring the Oil and Grease content in the industrial waste water, Fig. (9) Shows the history of monitoring since 2003.

3.3. Solid Wastes / Salt Deposition at Tails Management area, Objectives

3.3.2. Monitoring Program:
• Barrier Dike is built around the TMA.
• 13 Monitoring boreholes at the Tails Area boundaries were established.
• Periodical Monitoring program for the Tails Area Boreholes.
• No signs of brine migration to the nearby agriculture areas.

Since 2006 APC introduced a new controls measure (Engineering Control), to reduce the amount of Oil and Grease at Industrial Waste Water.

• Oil Separators was designed by Eng. Jafar Tarawneh / Maintenance Directorate, and fabricated at APC Mechanical Workshop.

• Using Oil Separators at Maintenance washing ponds both in Garages and maintenance workshops is mandatory.

Chemicals are neutralized at the point of use, the main concern here is the Oil, Diesel and Fuel Oil discharged to Dead Sea.

Oil and Other organic compounds are controlled and monitored according to the below requirements:


• Oil and Grease (FOG) Maximum allowable limit is 8 mg/Lit.

3.4. Hazardous Solid Wastes
3.4.1. Objective: Apply Effective Hazardous Solid Waste Management Procedures according to Environmental Regulation

3.4.3. Hazardous Solid Wastes Management and Control:
• APC produces annually about 15 ton of used Liquid Batteries
• Used Liquid batteries and Spent sulfuric acid are regulated by a special instructions issued by MOE.
• Used liquid Batteries are sold to a licensed recycler by MOE.
3.3.2. Monitoring Program:
- Barrier Dike is built around the TMA.
- 13 Monitoring boreholes at the Tails Area boundaries were established.
- Periodical Monitoring program for the Tails Area Boreholes.
- No signs of brine migration to the nearby agriculture areas.

3.4. Hazardous Solid Wastes

3.4.1. Objective: Apply Effective Hazardous Solid Waste Management Procedures according to Environmental Regulation

3.4.2. Hazardous solid waste category also was analyzed, the result is in Fig. (10)

3.4.3. Hazardous Solid Wastes Management and Control:
- APC produces annually about 15 ton of used Liquid Batteries
- Used Liquid batteries and Spent sulfuric acid are regulated by a special instructions issued by MOE.
- Used liquid Batteries are sold to a licensed recycler by MOE.

3.3. Solid Wastes /Salt Deposition at Tails Management area, Objectives

3.3.1. APC Objective: Developing an Environmental Monitoring Plan for any Eventual Brine Migration from the Tails Area to the Surrounding Agricultural Land.
Spent sulfuric acid is collected and sent to MOE Hazardous Wastes temporary landfill at SWAQA against financial charge.

Used batteries ready for Sale/Scrap Area

Implementation EMS/Communication of Environment Management System

Roots of Communications:

- APC Portal (Intranet), EMS is published on APC intranet site, accessible for all EMS concerned employees at all departments and levels.
- Employee Training and Awareness Programs, task specific training programs are tailored to all APC employees, both technical and administrative staff.
- Local Community Training and Awareness Programs, which includes schools students and sponsoring environmental activities for the local community.

Conclusion:

- Applying EMS according to ISO: 14001:2004 is an effective tool to control and monitor the environmental performance at any facility.
- EMS is not one man show, it’s a team work.
- From APC Experience, Challenges to apply an efficient EMS are:
  - Wide range of areas, activities and large number of significant environmental Aspects.
  - Communicating the Environmental Management Principles to the employees and contractors, and install the environmental culture within the work place
  - Complying with the legal requirements.

Acknowledgments:

- Thank you, to all my colleagues who make this
success with me. • Thank you, to my Management who provide support, advice and resources. • Thank you, for Listening and sharing us our Experience.

References:

Appendices:
Appendices (1), APC Environmental Policy
Appendices (2), Sample of APC Environmental Legal and Other requirements
Appendices (2), Sample of APC Environmental Legal and Other requirements

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<td>Use of Freon 12 &amp; Use of Halon gas</td>
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Abstract

Ammonia and Urea Casale are companies well known for their activity in the field of ammonia and urea plants. In the last decade the two companies have designed and built grass-roots ammonia and urea units that are now on stream.

During the design of these plants many aspects has been taken into considerations, in addition to process performances. The aspects relevant to process safety and reliability have been taken care with special consideration.

This paper describes the design choices made by Casale in order to reach, in its plants, the highest standard of process safety and reliability.

FOREWORD

Safety in the design of petrochemical process plants, primarily relies on the application of various codes of practice or design, which are based upon the wide experience and knowledge of professional experts and specialists in the industry. Such application is backed up by the experience of local plant managers, engineers and operators who have direct experience in the relevant plant operation.

The aspects relevant to process plant safety and reliability have to be taken with special consideration since the beginning of the project and should be developed in each step of the project life covering all plant equipment, units, instrumentation, process control, emergency shut down system and safety relief system.

Plant safety and reliability do not end with the start up of the plant but continues during the entire life of the plant operation involving mainly the routine maintenance with the scope to keep in good order any equipment, units, instrumentation, process control, emergency shut down system and safety relief system avoiding any possible degradation of their reliability and as consequence compromising the safety operation of the entire plant.

This paper describes the choices made by Casale during design and engineering stages of its plants in order to reach the highest standard of process safety and reliability.

The important steps followed, during the design and engineering of a new grass root plant, are listed here after.

-Definition of the most appropriate flow scheme and operative parameters of each equipment / unit according to the “state of the art” of the available proven technology.
-Definition of the most appropriate design condition and material selection for all equipment / units of the whole plant.
-Analysis and definition of the required instrumentation for monitoring and also control the plant operation within the defined operative parameters along the plant.

-Analysis and definition of the required instrumentation and emergency shut down system for preventing operation outside the defined operative parameters that may offset the reliability and safety operation of any equipment, units or plant sections.
-Analysis and definition of the safety relief system able to manage any possible overpressure that may be caused by plant mal-operations, utility failure of failure of process control and emergency interlock system.

-HAZOP study -SIL analysis -Selection of the most appropriate supplier of any equipment, with particular care for the critical items, which can assure not only the best performance but also the most proven design from a reliability and safety point of view.

1. PROCESS FLOW SCHEME

A new Ammonia or Urea plant start with the definition of the most suitable process flow scheme.

Ammonia and Urea Casale has developed advanced technologies for the design of grass-root ammonia and urea plants, according to which new plants have been built or are under construction.

1.1 GRASS-ROOTS AMMONIA PLANTS

Ammonia Casale can offer very efficient designs for the construction of grass-roots ammonia plants.

For plant capacities up to 2500-3000 MTD, Casale proposes its Standard process, while if a capacity higher than 3000 MTD is required Casale can design the plant according to the Megammonia® process.

1.1.1 The Standard Ammonia process

The Casale Standard process for natural gas based ammonia plants is based on the classical steam reforming route.

The main process steps are, as shown in fig.1:

- Desulphurization
- Primary and Secondary Reforming
- HT and LT Shift Conversion
- CO2 removal
- Methanation
- Syngas drying
- Compression
- Ammonia Synthesis
- Hydrogen Recovery
As illustrated in fig 2 the Megammonia® process comprises the following main steps:

- Air Separation (ASU)
- Desulphurization
- Autothermal Reforming (ATR)
- HT Shift Conversion
- CO2 removal
- Nitrogen wash
- Compression
- Ammonia Synthesis

1.2 GRASS-ROOTS

UREA PLANTS

Urea Casale is the company in the Casale group that is active in the urea field and that has developed a novel process to design grass-roots urea plant.

The main concept of the Split Flow Loop® process is to split the total amount of inert present in the CO2 feedstock so that only a minority portion is sent to the reactor, which is operating with the lowest possible amount of inerts. In addition, high condensation efficiency is reached in the HP carbamate condensation using a submerged condenser. This is achieved with the following steps:
The main elements characterizing the HP loop of the Split Flow Loop® process are:

- the Casale Full Condenser
- the Casale-Dente high efficiency trays
- the Casale High Efficiency Hydrolyser used in the process condensate treatment unit.

2. MATERIAL SELECTION AND DESIGN CONDITIONS

Definition of the most appropriate design condition and material selection for all equipment / units of the whole plant is one of the most important activity of the Basic Engineering phase.

Depending on the process plant, different conditions, related to the particular combination of gas composition, temperature and pressure govern the most appropriate material and design conditions selection.

All plant sections are analyzed in details and a final “Material Selection Diagram and Design Condition” is issue by Casale summarizing in congruent and easy way the choice made in terms of equipment material and design condition as well as piping material, corrosion allowance, rating and design conditions (see figure 4).

2.1 AMMONIA PLANT MATERIAL SELECTION

The material selection for the front end of ammonia plant is basically governed by the fact that the process gas is practically a hydrogen rich gas at high temperature and moderate pressure. The front section of the ammonia plant fall therefore in what is called hydrogen service and the material selection must respect the minimum requirement stated by the API standard 941. The material selection takes moreover in consideration any possible chemical corrosion and the use of stainless steel is adopted wherever required in order to increase plant safety and reliability assuring trouble free plant run.

The material selection for the synthesis loop of an ammonia plant is mainly governed by the fact that process gas is practically a hydrogen rich gas with considerable quantity of gaseous ammonia at high pressure and temperature. These two components and their combination at the typical operating condition of Ammonia loop require a specific material selection and equipment design, to avoid problems related to two specific phenomena: hydrogen attack and nitriding. Again the material selection must respect the requirement stated by the API standard 941 while the design of the relevant equipment requires deep knowledge of the problems and specific experience (see also chapter 8).
The main steps of the Split Flow Loop process are the elements characterizing the HP loop of the process condensate treatment unit.

The solution from the reactor is first treated in a condenser where, using steam and CO₂ as stripping agent, the uncondensed stream of inerts is split. The vapours, containing NH₃, CO₂, H₂O and inerts, obtained from the HP stripper are split so that most of the unreacted NH₃ and CO₂ are recovered. The rest is recycled back to the reactor through a condensation stage where practically all the reacting NH₃ and CO₂ in form of carbamate, are recovered.

The process condensate, obtained from the vacuum condenser is purified with two columns and one hydrolyser in order to eliminate all NH₃, CO₂ and Urea. The carbamate solution obtained in the LP section of the reactor is first treated in a carbamate condenser. While the majority portion is sent directly to the reactor, a minority portion is sent to the LP hydratation section where, using steam and CO₂ as stripping agent, the urea-water solution, containing only small quantities of NH₃ and CO₂, is then further treated in the Casale Full Condenser. The urea solution, still containing a minority portion of unreacted NH₃ and CO₂ recovered in form of carbamate, is then further treated in the Casale High Efficiency Hydrolyser used in the process condensate treatment unit. Part of the unreacted NH₃ and CO₂ recovered in form of carbamate condensers is purified with two columns and one hydrolyser in order to eliminate all NH₃, CO₂ and Urea. The carbamate solution obtained in the LP section of the reactor is first treated in a carbamate condenser. While the majority portion is sent directly to the reactor, a minority portion is sent to the LP hydratation section where, using steam and CO₂ as stripping agent, the urea-water solution, containing only small quantities of NH₃ and CO₂, is then further treated in the Casale Full Condenser. The urea solution, still containing a minority portion of unreacted NH₃ and CO₂ recovered in form of carbamate, is then further treated in the Casale High Efficiency Hydrolyser used in the process condensate treatment unit. Part of the unreacted NH₃ and CO₂ recovered in form of carbamate condensers is purified with two columns and one hydrolyser in order to eliminate all NH₃, CO₂ and Urea.

More details relevant to synthesis loop material are provided under para 8.2.

3. PROCESS CONTROL

Analysis and definition of the required instrumentation for control and also monitoring the plant operation is not only matter of plant operation and performance optimization but represent also the “first plant protection layer” since it has also the scope to “keep” the plant within the defined operative parameters avoiding to reach abnormal condition that cannot be tolerated by equipment or plant sections.

Moreover Casale implement, in their new Ammonia grass root plant, what is called “advanced process control system” improving the safety and reliability of the plant applying a strictly control of the most important parameters of ammonia plant front end.

The control of ammonia plant front end can be considered as having two major control areas:

• Steam / carbon and air / feed ratio control.
• Primary Reformer combustion control.

With reference to the steam/carbon and air/feed ratio control, strict control is applied to maintain the steam/carbon and air/feed ratio within design limits as the plant capacity is raised or lowered. Nevertheless steam / carbon must be controlled in ratio to each other in order to ensure that, the steam ratio should be never below a certain minimum value since carbon formation can occur. There is indeed a critical level of steam to carbon ratio, depending on operating conditions, below which carbon is formed in the catalyst pores installed in the reformer catalyst tubes. The carbon deposit in the catalyst causes physical breakdown, and shutdown where a catalyst change will be necessary.

At the secondary reformer inlet, process air is added to the reformed gas. This flow must be controlled in ratio with the feed in order to ensure the right hydrogen / nitrogen ratio at the ammonia synthesis loop. Moreover the air / feed ratio should be never higher than a certain value to avoid undesired secondary reforming temperature rise above its design limits and / or unbalanced hydrogen to nitrogen ratio.

The steam/carbon and air / feed ratio control scheme are configured according to a lead-lag control strategy.

On increasing capacity the increase of steam will lead the increase of feed gas and in succession the increase of feed will lead the increase of process air. On decreasing capacity the process air decrease is followed by the feed decrease and in succession by the steam decrease.

With reference to the combustion control, strict control is applied to maintain the reforming temperature within design limits whilst achieving efficient combustion with a controlled excess of air within the reformer box. Also the air to fuel ratio control scheme is configured to maintain the correct excess of combustion air when the firing demand is changing due to change in plant capacity or ambient conditions. For a load increase, combustion air increases first, then fuel gas will follow. For a load decrease, fuel gas reduces first, then combustion air will follow.

Dedicated instrumentation for detection of all operating parameters is
extensively adopted in Casale new grass root plants allowing continuous monitoring of plant operation as well as alarms for all critical parameters in order to have a prompt operator action in case of need.

4. INTERLOCK SYSTEM

The purpose of the interlock system is to maintain a safe and reliable environment in the plant area protecting personnel, equipment and catalyst against malfunctioning of the control system and/or human mistakes.

Speaking about causes and effects of each interlock logics, Casale usually group them as follow:

I. Main Interlocks Logic (E)
II. Partial Interlocks Logic (I)

The first set includes all interlocks that lead to entire unit shutdown and/or main machines shutdown up to the general plant shutdown.

Apart from general and section shut-down situation, above mentioned, we will have partial shut-down, limited to the operating conditions of individual equipment or to the feeding of some streams to section of the plant (i.e. single cause single action logics). We call them as Partial Interlocks.

A dedicated Emergency Shutdown System (ESD) shall manage the Main interlock logic, while the Partial Interlock Logic could be managed directly by DCS or by ESD if required by Client.

It is important to highlight that dedicated instrumentation and process control, is provided for the Emergency Shutdown System improving the reliability of the entire system.

Moreover for the more critical interlock logics the 2 out of 3 logic is also adopted.

Casale always perform a systematic analysis of the entire plant interlock system providing a full set of documentation for their correct development and implementation during the detail engineering phase like: “Emergency Shut Down System Description”, “Interlock Logic Diagram” and “Cause & Effect Diagram”.

As standard procedure the above final documentation including the “Piping and Instrumentation Diagram” are always subject to the HAZOP and SIL studies (see chapter 6 and 7) with the target to analyze all hazard and operability issues as well as the reliability that each individual Shutdown Interlock Logic must have.

5. SAFETY RELIEF SYSTEM

Analysis and definition of the safety relief system able to manage any possible overpressure that may be caused by plant mal-operations, utility failure of failure of process control and emergency interlock system as well as fire contingency is of the most importance during the design of a new grass-root plant.

The sizing, selection and installation of pressure relieving devices in a process plant are subject to the minimum requirement set by API standard 520 and 521.

As the result of the above analysis a complete “Relief System Summary” is issued by Casale summarizing the quantity of gas to be relived for any possible overpressure contingency of any equipment or plant section. The above summary is then used for the sizing of the individual Pressure Safety Valves considering the worst relieving scenario.

Nowadays, in order to overcome all the correlated environmental issues, process plants are always equipped with a flare system.

The flare system has the duty to collect all source of gaseous emission (basically safety valves and vents) and send them to a common Flare Stack where the harmful gases will be burned and then safely discharged to the atmosphere.

In new ammonia plant usually two flares system are provided, one for the emission from the front end, the second for the emission from the back end (compressor, synthesis and refrigeration section). The two systems are kept separated because the emissions from the back end are contaminated with ammonia, while the emissions from the front end contain carbon dioxide. The mix of streams containing ammonia and carbon dioxide is avoided since they can produce carbamate causing problem of plugging. In urea plants all process discharge points are conveyed in a blow down system that collects all the potential ammonia emissions at safe location thus preventing issues to the plant environment. In addition, all the process drains are collected in a closed drain system, thus limiting process spillages on the floor and consequently to the rain water system.

It is important to highlight that as per Casale philosophy the plants are always equipped with process control vents in order to prevent the relieving through Pressure Safety Valves improving in such way their reliability. Pressure safety valves usually need in fact a general overhaul after relieving.

In particular, for Urea plants design special care shall be taken when designing safety valves for urea or carbamate service especially at high pressure. In fact, such fluids are highly corrosive and prone to crystallize even at high temperature. Urea Casale has developed its own internal standard for designing and manufacturing this type of safety valves (urea service valves). This standard is being adopted by a certain number of selected manufacturers that are having experience with such kind of design and with the manufacturing of the utilized materials.

In particular, all high pressure safety valves for Urea Service shall be provided of:

- Steam jacket on nozzle.
- Low pressure steam nozzle for disk and seat washing.
No dead space is allowed between body valve and process line.
The valve shall be installed directly on process line without any adjusting spool.

6. HAZOP STUDY

A Hazard and Operability (HAZOP) study is carried out to check the Piping & Instrument Diagrams of relevant Plant Project. The study covers normal continuous operation and, when necessary, start-up, shut-down and maintenance operations are also analyzed.

The main aims of the HAZOP study are:

• To identify possible deviations from the intended operation conditions that can cause harm or operational disruption (accidental events);
• To verify the compliance with good engineering practice;
• To propose some actions, where necessary, in order to improve the safety level or the operability of the systems to be installed.

Essentially the examination procedure takes a full description of the process, schematically questions every part of it to discover how credible deviations from the design can occur and decides whether these deviations can give rise to hazards.

The technique adopted is to divide the P&IDs into nodes capturing a significant design intention, and to review the operation of the plant and equipment within the node, while focusing on major hazards and operability issues.

The questioning is focused in turn on every part of the design. Each part is subjected to a number of questions formulated around a number of “guide words” exploring every conceivable way in which that design could deviate from the design intention.

This usually produces a number of theoretical deviations and each deviation is then considered to decide how it could be caused and what would be the consequences.

Some of the causes may be unrealistic and so the derived consequences will be rejected as not meaningful. Some of the consequences may be trivial and would be considered no further.

However, there may be some deviations with both causes that are conceivable and consequences that are potentially hazardous.

These potential hazard are then noted for remedial action.

Any recommendation regarding safety issues normally comes out as a result of a trade-off between the expected frequency of an accident and the expected consequences of it. It is important to apply the same philosophy to all the Units of a plant.

The plant is therefore analysed identifying systems and study nodes for easy reference on the related P&Id’s. Each node shall be reviewed using the relevant guide words and parameters, identifying deviations, causes, consequences, safeguards and actions if any.

Hazard study is normally carried out by multi-disciplinary team. There are two types of team member, namely those who will make a technical contribution and those who play a supporting and structuring role.

The examination requires the team to have a detailed knowledge of the way the plant is intend to work. This means a blend of those concerned with design of the plant and those concerned with its operation. The technique of using guidewords generates a very large number of questions. For most purpose it is essential that the team contain enough people with sufficient knowledge and experience to answer the majority of those questions without recourse to further expertise.

Because examination sections are highly structured and very systematic, it is necessary to have someone to control the discussion. We will call this person the “study leader” or “hazop chairman”. In addition to the study leader it is desirable to have a further supporting member of the team to make a note of the hazards as they are detected. This person is known as the “hazop secretary”.

As a result the HAZOP study highlight a list of recommendations to be included or considered in reviewing P&I diagrams before their final issue.

7. SIL ANALYSIS

7.1. SCOPE AND PURPOSE

The scope of the Safety Integrity Level (SIL) Classification analysis is to provide a route whereby safety-related systems can be implemented using electrical or electronic or programmable electronic technology (E/E/PE) in such a way an acceptable level of functional safety is achieved;

this aim is reached applying the international standards IEC 61508: 2001 and IEC 61511: 2003.

Conceptually, the objectives of the SIL analysis is first to derive the safety requirements of the

| Connection high pressure side | Lenticular flanges according to CASALE std. |
| Nozzle material               | HVD-1                                      |
| Disc material                 | HVD-1                                      |
| Other internal parts material | AISI 316L UG                                |
safety-related systems from a hazard / risk analysis (such HAZOP, for example, or any qualitative process analysis) and then to design the safety-related systems to meet those safety requirements taking into account all possible causes of failure including random hardware faults, systematic faults in both hardware / software and human factors.

In the following paragraphs is outlined the procedure Ammonia Casale follow for the SIL Classification analysis of an Ammonia Process Plant during basic design; this activity can be designated as “SIL Allocation”.

During the detailed engineering phase, this SIL allocation could be reviewed or confirmed according to the customer / engineering company special requirements (safety, reliability, economics, etc.).

7.2. METHODOLOGY

The Standard IEC 61508 provides the guidelines to design and verify the Safety Instrumented Systems (SIS) that use Electrical and/or Electronic and/or Programmable Electronic technology (E/E/PE); these SIS provide safety control functions of processes and typically are composed of sensors, logic solver and final element (one or more).

Essentially, a safety function is an action on demand which is required to ensure that the risk associated with a particular hazard is tolerable and this function is defined in two terms: a) its functionality on demand, i.e. the safety requirements, and b) its safety integrity, that is the required probability that the specified action / function will be performed correctly in order to achieve the required risk reduction.

IEC 61508 specifies the levels of safety performance for a safety function, which are called Safety Integrity Levels (SIL), classifying them into four levels: the Safety Integrity Level 1 (SIL 1) is the lowest level of safety integrity while the Safety Integrity Level 4 (SIL 4) is the highest level. This means that the higher the SIL is, the more reliable or effective the system SIS is; in this way, the SIL levels are correlated to the probability of failure on demand (PFD) which is equivalent to the unavailability of the safety system at the time of a process demand.

The used technique for assigning the target SIL is generally the RISK GRAPH, as described in Annex D of IEC 61508 – Part 5 or IEC 61511 – Part 3;

For this technique, the procedure is based on the following equation:

\[ R = f \cdot C \]

where

- \( R \) is the risk with no safety-related system in place;
- \( f \) is the frequency of the hazardous event with no safety-related system in place;
- \( C \) is the consequence of the event and should be related to the safety / health of people on/off-site or environmental damage or loss of production (economical loss)

In the next pages is described how to evaluate the parameter \( f \) and \( C \) and are defined the values assigned to each parameters in order to follow the right path on Risk Graph for reaching the SIL numeric index and allocate this SIL value to SIS under analysis.

7.2.2 Determination of Frequency Hazard Parameter – \( F \)

The frequency “\( f \)” is determined via others three parameters:

- \( F \) : Frequency of, and exposure time in, the hazardous zone
- \( P \) : Possibility of failing to avoid the hazardous event
- \( W \) : Probability of the unwanted occurrence

For these parameters, the qualitative determination is made with the Tables 2, 3 and 4, where the descriptions are derived from Table D.1 of IEC 61508 – Part 5, Annex D, and Table D.2 of IEC 61511 – Part 3, Annex D
7.2.3 Determination of Consequences Parameter – C

This parameter represents three different consequences:

1. effects on people: the number of fatalities and / or serious injuries likely to result from occurrence of hazardous event;
2. effects on environment: the potential extension of hazardous event (on-site / off-site), considering the degree and typography of release;
3. effects on production: the degree of equipment damages and/or the extent of limited production non-availability due to occurred hazard

The consequence factor C is determined by means of Table 5 for safety / health of people, Table 6 for environment, and Table 7 for production damage, (the determination of production losses has been put in relation to cost of damaged equipment and repair-time necessary to restart the process).

7.3. SIL Allocation Report

The above procedure to determine consequences of failure on demand are recorded for each loop (SIS). If failure on demand has multiple consequences, all consequences are analysed, and the most conservative SIL is used for that function.

The overall SIL required to the each function is the higher among those defined by applying the matrices in Figures 7, 8 and 9.

During the detail engineering phase is task of the engineering company to verify and apply the target SIL level assigned to each SIS function by both installing enough reliable instrumentation (sensor, logic solver and final element) or duplicating it if necessary.

It is finally duty of plant operative people to keep the installed SIS functions operative at the required SIL level performing the required maintenance to avoid degradation of their function by both installing enough reliable instrumentation (sensor, logic solver and final element) or duplicating it if necessary.

7.2. METHODOLOGY

1. SIL assessment examination flow to the unavailability of the safety system at the time of ability of failure on demand (PFD) which is equivalent in this way, the SIL levels are correlated to the probability of occurrence of hazardous event.
2. SIL is, the more reliable or effective the system SIS is; 4) is the highest level. This means that the higher the Safety Integrity Level 1 (SIL 1) is the lowest level of failure prevention.
3. Classification analysis of an Ammonia Process Plant Ammonia Casale follow for the SIL allocation.

In the following paragraphs is outlined the procedure used to determine the SIL required for the safety-related systems from a hazard / risk analysis (process analysis) and then to design the safety-related system in place; during basic design; this activity can be designated as "SIL Allocation".

The Standard IEC 61508 provides the guidelines to design and verify the Safety Instrumented Systems (SIS) that use Electrical and/or Electronic and/or Programmable Electronic technology (E/E/PE); these standards (SIS) are high integrity systems and automatic safety systems that use software to control the application of the process and which is required to ensure that the risk associated with a particular hazard is tolerable and this function is defined in two terms: a) its functionality on demand, i.e. the safety requirements, and b) its safety integrity, which is required to ensure that the risk associated with a particular hazard is tolerable and this function.

SIS provide safety control functions of processes and systems to meet those safety requirements. These functions are generally the automatic monitoring of process parameters (sensor, logic solver and final element) or duplication of the performed function.

Table 1 – Relationships of SIL And Frequency of Unwanted Occurrence Parameter

<table>
<thead>
<tr>
<th>CONSEQUENCES FOR PERSONS PARAMETER (C)</th>
<th>CONSEQUENCE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Minor injury</td>
<td>Affects work performance e.g. restricted duties or requiring maximum one week to fully recover (includes Lost Time Injury and Restricted Work Case). Minor health effects that are reversible e.g. skin irritation, food poisoning etc.</td>
</tr>
<tr>
<td>C2</td>
<td>Serious permanent injury to one or more persons; death to one person</td>
<td>Affects work performance in the long term e.g. prolonged absence from work (includes Serious Permanent Partial Disability). Irreversible Health damage without loss of life e.g. noise induced hearing loss or chronic back injury. Death to only one person.</td>
</tr>
<tr>
<td>C3</td>
<td>Death to several people</td>
<td>Permanent Total Disability. Multiple fatalities (up to ten) in close succession as a result of the incident (e.g. an explosion) or occupational illness.</td>
</tr>
<tr>
<td>C4</td>
<td>Very many people killed</td>
<td>Ten or more fatalities as a result of the incident or occupational illness.</td>
</tr>
</tbody>
</table>

Table 2 – Exposure Parameters

<table>
<thead>
<tr>
<th>HAZARD AVOIDANCE PARAMETER (P)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Possible under certain conditions (possible to avoid danger)</td>
</tr>
<tr>
<td>P2</td>
<td>Almost impossible (no reasonable possibility to avoid the hazard)</td>
</tr>
</tbody>
</table>

Table 3 – Avoidance Parameters

<table>
<thead>
<tr>
<th>PROBABILITY OF UNWANTED OCCURRENCE PARAMETER (W)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>A very slight probability that the unwanted occurrence will come to pass and only a few unwanted occurrences are likely. (Approximately once every 10–100 years)</td>
</tr>
<tr>
<td>W2</td>
<td>A slight probability that the unwanted occurrence will come to pass and a few unwanted occurrences are likely. (Approximately once every 1–10 years)</td>
</tr>
<tr>
<td>W3</td>
<td>A relatively high probability that the unwanted occurrence will come to pass and frequent unwanted occurrences are likely. (More than once every year)</td>
</tr>
</tbody>
</table>

Table 4 – Frequency of Unwanted Occurrence Parameter

<table>
<thead>
<tr>
<th>CONSEQUENCES</th>
<th>CONSEQUENCE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Rare to more often exposure in the hazardous zone. Presence of persons in the hazardous zone smaller than 10% of the time (over a 24-hours period)</td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>Frequent to permanent exposure in the hazardous zone. Presence of persons in the hazardous zone higher than 10% of the time (over a 24-hours period)</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 – Consequence Risk Parameters (For People)
reliability that leads to declassing the SIL level from the target figure.

8. CASALE PROPRIETARY EQUIPMENT

Ammonia and Urea plants incorporate a certain number of critical items.

Such critical items are of the most importance both for the performance, safety and reliability plant point of views.

Ammonia and Urea Casale directly supply a certain number of proprietary items and can also supply the critical equipment that characterize and define its ammonia and urea plants in the world.

Ammonia Casale proprietary items are:

- Ammonia synthesis converter.
- Synloop waste heat boiler / BFW pre-heater.
- Axial radial Shift converters.
- Secondary reformer burner.
- Make up gas wash ejector.

Urea Casale proprietary items are:

- Urea reactor High Efficiency Trays
- Urea hydrolizer High Efficiency Trays
- High Efficiency internals for HP Full Condenser
- HP Ejector for Split Flow Loop Process

and critical items are:

- Urea reactor - Urea Stripper
- HP Full Condenser
- HP Scrubber

8.1 Safety and Reliability in Ammonia Synthesis Converter and Downstream Exchanger

Ammonia synthesis converter and downstream heat exchanger are key items in ammonia plants.

Their reliability is essential, as a plant cannot run without them. In addition, the ammonia synthesis converter is the reactor with the longest run between catalyst changes, since it must run for 10-15 years. Ammonia catalyst, once reduced, should not come in contact with oxygen since is highly pyrophoric. Therefore converters should operate between catalyst changes without repairs or inspections.

To achieve this result without any impact on the safety and reliability of plants, several aspects
have to be considered as converters are subject to different metallurgical deterioration phenomena, and, as they have a complicated mechanical design with multiple catalyst beds.

From a safety point of view, the catalyst re-placements and inspections are critical as well.

### 8.1.1 Ammonia Converter

Due to the aggressive environment created by the combination of high pressure, high temperature and peculiar gas composition, in which the converter operates, the first aspect to be considered in the design of the Ammonia synthesis converters, to ensure a high reliability, is the materials selection.

The concurrence of Hydrogen related damages (High Temperature Hydrogen Attack / Hydrogen Debonding) and Nitriding is typical of the Ammonia synthesis loop, particularly of the ammonia converter, where the highest temperatures and pressures are combined with high content of hydrogen and ammonia. Since the detrimental effects of the environment on the materials increases by increasing the temperature the latter needs to be kept as low as possible. Casale philosophy consists in a suitable material selection and generally keeping the materials at a lower temperature through a suitable thermal insulation and/or gas flush. This concept allows intrinsically increasing the safety of high-pressure parts.

The Ammonia converter pressure vessel has much lower operating temperature than the internals since is fluxed with the low temperature inlet gas, while is protected from the high temperature sections by the internal cartridge. Therefore ferritic materials such Carbon steel or Chrome-Moly steels are generally used, selected according to the API standard 941. In any case Casale selects 1 1/4 Cr 1/2 Mo steel as minimum requirement, even if not mandatory according to API standard, due to its superior reliability in the hydrogen service compared to Carbon and Moly steels. Since the ferritic components of hot pressure parts (typically outlet nozzle and start-up nozzle) suffer from nitriding, a designer can consider welding overlay the parts with austenitic materials or high nickel alloys. However this solution does not protect against Hydrogen debonding. For this reason, Casale design considers to thermally insulate the hot vessel regions rather than cladding them. The insulation consists of an Inconel liner filled with insulating materials (e.g. ceramic fiber). The insulation is easily accessible, easy to inspect and simply replaceable.

Ammonia converter internals are exposed to the highest temperature and therefore the element where the combined effect of Hydrogen and ammonia is strongest. The use of AISI 321 stainless steel for the internals of ammonia converters is preferable compared to other stainless steels since is stabilized with Titanium. In this way there is no risk of carbides precipitation (causing embrittlement of the materials in hydrogen service) that, on the contrary, is possible for grades 304 or 316. For thin elements, where also the use of stainless steel is subject to failure since the thickness of the component is comparable to the nitrided layer, it is necessary to adopt Inconel alloy 600 which is not susceptible to the problem. Also for the interchanger tubes working above a critical temperature (450 °C) selection of Inconel 600 is advised. All the expansion joints bellows (also the ‘cold’ ones – in order to avoid possible mistakes) should be in Inconel alloy 600.

### 8.1.2 Heat Exchanger Downstream the Ammonia Converter

The equipment downstream the converter is usually either a boiler or a boiler feed water pre-heater, to utilize the high converter gas outlet temperature.

Casale standard design provides the equipment directly connected to the converter, avoiding the high-pressure high temperature piping, source of trouble and leakage, and saving material and pressure drop.

With reference to the downstream equipment specific solutions have been adopted by Casale depending on the plant configuration.

The gas can be placed either shell side or gas side.

The gas tube side is used for kettle type boiler or natural circulation boiler.

Some Boiler/Heat exchanger Manufacturer has developed its own specific design for this type of exchanger, which has been used by Casale in the past and still used when considered beneficial.

Casale has also developed its own design, which is based on the adoption of fountain type U-tubes.

In this type of exchanger the gas from the converter enters the head that is equipped with an internal gas inlet/outlet channel. The hot gas coming from converter enters the internal part of the channel, then enters the “U" tubes where is cooled and flows outside this internal chamber, cooling down the pressure retaining wall of the channel. This gas path is permitted by the fountain type distribution of the U tubes having the inlet on the centre of the tube sheet and the outlet on its periphery. Insulated ferrules protect inlet tubes keeping the temperature difference between hot and cold side of the tubesheet lower. Thanks to this flow pattern the thermal stresses on the tube sheet are minimized. In particular, thanks to the full axial symmetry (the cold zone is the external annulus and the hot zone is the central core), the thermal gradient makes the tubesheet subject to compression but not to shear.

The fountain U-tube design overcome to the disadvantage of the fixed tubesheet design that is subject to failure in case of water upset and anyway more vulnerable to shut-down and start-up cycles as well as the disadvantage of standard U tube design where half of tubesheet / inlet channel is at the gas inlet temperature whereas the other part is at the outlet gas temperature. Depending on the tubesheet thickness and dimension this abrupt change in temperature will induce high thermal stresses that could lead to tubesheet failure on the long period.
In addition to the advantages above described of this type of exchanger, hot box, false tubesheet, specially designed ferrules and the use of internal bore welding IBW contribute keeping well below the nitriding temperature tubes, tubesheet and tube to tubesheet weld. An Inconel layer on the tubesheet is anyway provided to permit an easy tubes plugging. It should be noted that tube plugging in U-tubes exchanger does not affect other tubes as in fixed heads type.

When a steam superheater is installed downstream the ammonia converter a different design shall be selected. In this case the steam is not able to keep the tube temperature below the nitriding range, therefore austenitic tubes shall be used. These materials are susceptible to stress corrosion cracking in high temperature steam atmosphere. For this reason special nickel alloys such as Inconel 690 are used. Also specific shell side design shall be provided to avoid dead zone, homogeneous shell flow and water drops impingement on tubes.

8.2 SAFETY AND RELIABILITY IN CRITICAL ITEMS OF UREA SYNTESES LOOP

The pieces of Urea synthesis equipment are key items in Urea plants. Their reliability is essential, as a plant cannot run without them and repairs are generally expensive and time consuming. In addition, they operate at high pressure, generally about 140 bar, and therefore, catastrophic failure is possible, threatening the safety of the plant and its operators. The risk is increased, compared to common high pressure equipments, by the process fluid high corrosion characteristic.

In this equipment safety and reliability are, therefore, strictly connected. An adequate level of both aspects is achieved through several steps:

- Accurate material selection
- Proper design
- Well controlled construction
- Accurate maintenance and inspection.

In all these phases, Casale’s long experience and innovative design guarantees specific solution to achieve the best results.

Material selection

For the synthesis equipment, it should be noted that the activities in the revamping field have brought to Casale a wide experience in all type of process and materials, experience that has been transferred to the new plant design. Specifically, all types of materials used in contact with the process fluid, such as urea grade stainless steel, duplex stainless steel, titanium as well as zirconium, are well known to Casale. Casale has selected 25-22-2 Cr-Ni-Mo type stainless steel, as construction material for these pieces of equipment. Casale has developed detailed specifications to cover the material production, testing and welding, in order to assure the highest quality and resistance. These specifications are continuously updated.
on the basis of the improved experience and the technical progress. In addition, Casale has selected a restricted number of manufacturers that have been qualified for the construction of this equipment.

In any case, the material selection is never separate from the process design. A typical example is the specific features to guarantee in each spot the correct amount of oxygen required to the corrosion resistance of material.

**Design**

Even an accurate material selection could not guarantee by itself alone the reliability and safety of the equipment, since the corrosion, even if under control, is always present. Moreover, construction defects or incorrect operation could damage the equipment and threaten its safety.

For this reason the corrosion resistant material is applied as a loose lining separated by the pressure resistant shell. A leak detection system is foreseen to advise of any damage to the corrosion resistant lining, before the fluid could spoil the pressure components.

Casale’s design provides a specific leaking path that avoids any contact between the process fluid and the pressure resistant carbon steel components in case of leakage.

The leak detection can be further improved providing an automatic leak detection system, which continuously monitor the integrity of the equipments.

A typical scheme of automatic leak detection system is illustrated in the following figure 14.

**Construction**

The equipment construction is one of the most sensitive phases, because all the advantages of a good design can be lost in an inaccurate construction.

Defects, mistakes or incorrect procedures during construction are the first cause of equipment failure. The Casale philosophy is to utilize only few selected manufacturers with a long experience in high pressure Urea equipment. These manufacturers, which continuously work with Casale, are familiar with Casale’s specifications and designs. In any Event, well-defined procedures are supplied to the manufacturers and all the critical construction phases are monitored by experienced inspectors accustomed with this specific type of construction. Accurate tests, well beyond code requirements, are foreseen to certify the accurateness of each specific construction.

**Maintenance and inspection**

These pieces of equipment shall undergo a continuous monitoring and testing all along their life to guarantee a trouble-free operation.

Casale equipment is typically designed keeping in mind plant overhauling every three years, considering that all the required maintenance and inspection activities are adequately be performed as scheduled.

To closely monitor all the equipment along their life, Casale has put in place a specific program, the proactive maintenance system (PAMS).

PAMS is part of the Casale know-how and summarizes the continuous effort applied in up-grading of Casale designs and construction solutions, materials investigations and properties’ assurance, quality controls, and last but not least, the inspection feed-back on operating equipment.
Studies & Researches

Africa's Green Revolution: Supporting regional and national initiatives to increase fertilizer use

Richard Jones and Amit Roy, IFDC

Abstract
In 2006 African leaders declared fertilizer, from both inorganic and organic sources, “a strategic commodity without borders.” The Abuja Declaration on Fertilizer for an African Green Revolution, issued at the end of the summit, agreed on an action plan that included development of agro-dealer networks across rural Africa, the use of “smart” subsidies to ensure that poor smallholders have access to fertilizer and removal of trade barriers and promotion of local fertilizer production.

This paper will describe:1) the agro-dealer development component of the Common Market for Eastern and Southern Africa’s (COMESA) Regional Agro Input Program (COMRAP) being implemented by the Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA), a specialized agency of COMESA; and 2) the use of smart subsidies by the Malawi Government. These examples are then used to develop a roadmap for countries such as Sudan that want to capitalize on their agricultural potential, but need to rapidly increase use of improved seed and fertilizers if they are to sustainably increase agricultural productivity.

Introduction
In 2006 the Africa Fertilizer Summit was held in Abuja, Nigeria to develop a roadmap for achieving the African Green Revolution that resulted in the Abuja Declaration on Fertilizer for an African Green Revolution(IFDC, 2007). In this declaration, African Union Member States resolved to increase the level of fertilizer use from the then current average of eight kilograms per hectare to an average of at least 50 kilograms per hectare by 2015. Two specific items were included in the declaration:

1. By mid-2007, the African Governments must take concrete measures to improve farmers’ access to fertilizers by developing and scaling up input dealers’ and community–based networks across rural areas.
2. With immediate effect, the African Union Member States must improve farmers’ access to fertilizer, by granting, with the support of Africa’s Development Partners, targeted subsidies in favor of the fertilizer sector, with special attention to poor farmers.

This paper will describe the strategy adopted by COMESA in developing a sustainable input delivery system under COMRAP, and how the Government of the Republic of Malawi is using the agro-dealer network and smart subsidies to increase crop productivity. Complementary investments by IFDC to develop an input market information system will also be touched upon as they help improve the efficiency of input markets.

COMESA
In 2008 COMESA launched ACTESA which was designated by the COMESA Heads of State as a specialized agency of COMESA in 2009 to integrate small farmers into national, regional and international markets (see http://www.actesacomesa.org).

In 2010 the European Union signed an agreement with COMESA for the implementation of COMRAP by ACTESA. The overall objective of COMRAP is to contribute to improving rural food security and livelihoods in the COMESA region through training and capacity building of national and regional input providers and regulation of related regional legal frameworks. COMRAP also includes the training of nearly 6,000 agro-dealers and 2,000 agents in eight landlocked COMESA countries.

In June 2010 IFDC was contracted to implement the agro-dealer/agent training component of the program with a deadline of August 2011 to complete all the training. The implementation of such an ambitious program in 15 months necessitated the development of an innovative approach that could draw upon the already established organizational expertise in several of the target countries. IFDC signed a sub-contract agreement with the Kenya-based Agricultural Market Development Trust (AGMARK) that has a well-established track record in training agro-dealers, especially in aspects of business management, while IFDC took on the responsibility for technical training.
شركة الدلتا للأسفدة والصناعات الكيماوية

هي أول شركة في جمهورية مصر العربية تقوم بإنتاج الأسفدة المركبة (الصلبة - السائلة - الورقية والخلبية) وتعهد الشركة بالمحافظة على رياضتها في مجال صناعة الأسفدة بدعم التقدم الصناعي لخدمة الزراعة في مصر بأن تستمر في تقديم مجموعة الأسفدة المفردة والمركبة عالية الجودة مع استمرارها في تقديم الخدمات المميزة لعملائها.

وشريكة الدلتا تتطلع دائماً للتميز في تحقيق الأهداف الجديدة لتطوير وتحديث ما تقدمه من منتجات كما يسرا أن تنوه عن خدماتها لتحقيق الأمن الغذائي من أجل مصر.

• خبراء متميزون في المجال الزراعي لبحث ودراسة أي مشاكل قد تتواجد في الزراعة.
• تحليل التربة والبيئة والنمو الخضري مجاناً خدمة لأرض مصر.
• برامج تسويق متكاملة على ضوء التحاليل والتشخيص لحالة كل مزرعة على حدة.
• حقول إرشادية في كافة أنحاء الجمهورية لتقنيات الأسفدة قبل إنتاجها على المستوى الصناعي.
• ندوات توعية متخصصة للمزارعين في المركز المصري لتطوير الأسفدة.

شركة الدلتا للأسفدة والصناعات الكيماوية-طلخا-دقيه

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المركز المصري لتطوير الأسفدة

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فؤاكس: Delta-efdc@yahoo.com
البريد الإلكتروني: Delta-efdc@yahoo.com
Being located in the north part of Italy, in the area where the culture and know-how of manufacturing critical items for chemical plants blend with experience and willingness to satisfy the Client’s requests, O.V.S. (Officine Valle Seriana) represents today a valid contribution to enhance all the features and characteristics to mark a solid path and commitments towards the Business Community all around the world.

Founded in the 1973 on the platform of consolidated experiences of few Pioneers that believed in the outcomes based on hard work and valuable views, O.V.S. has become more and more well integrated in the demanding scenarios where excellence was, is and will be the basic ground and the paramount attitude for getting superior results.

As a private Company, O.V.S. reflects the Vision and the Mission that the Founders still put in the activities with particular references to the performances and the product qualities.

To come out in good shape even through big waves and turbulent market, it has given to O.V.S. the clear indication that the philosophy and the values that are at the basis of the work platform are genuine, consistent and resistant to the erosion of time and flexible to the challenges that mark every human activities.

What can O.V.S offer to the market? Broadly speaking all the items that are the core of chemical plants such as Heat Exchangers, Reactors, Columns and Pressure Vessels.

This list of items does no differ from what many Companies all around the world can offer.

What, then, can O.V.S. be different from others?

O.V.S. is very proud to carve out strategy and policy that are tailor made to the single Client, considering its own peculiarity and paying attention to the details that matter more.

Quality, Reliability, Accountability, Delivery on Time and Friendly Environment are factors and values that form the O.V.S.’s essence and the O.V.S.’s commitment.

Efforts on matching the technological breakthroughs are daily put into practice to find a common ground of understanding and the developments are seen as dynamic issues that make O.V.S. more active and more in contact with the needs that are to be matched.

If a saying has to be found to qualify the O.V.S.’s spirit and philosophy no better than this: “Enthusiasm + Dedication = Innovation”.

Innovation mindedness led to acquire all the capabilities to deal with the standard and reactive materials and to find technological and innovative approaches to match requirements that are becoming more and more stringent and severe.

The consolidated relationships with the more important Contractors as well as End-Users all around the world have increased the level of challenges and make the confrontation a moment of improvement based on the acquisition of cultures and understandings for mutual benefit.

Flexible organisation and tailor made work force to cope with the variable economic scenario lead to think the relationship with the employees in a dynamic mood and this has contributed to make O.V.S. well associated with the local territory and well appreciated from the concerned Entities.

Satellite units that can deal with specific requirements have been implemented and operative, linked to the main workshop through dedicated networks, to segregate peculiarities in order to offer high quality standards without any contamination that could jeopardize the final product.

Till now, O.V.S. has been able to be present in the developed and developing markets and considers this worldwide experience something that increases day by day knowledge and attitude that in our Organisation are valuable issues.

In the variety of products that O.V.S. is capable to provide to the market, special attention in the recent years has been given to the items for the Fertilizer Industry that, due to the aggressive process environments, requires the use of sophisticated materials as well as special manufacturing Procedures and Certifications.

Internal researches and developments have contributed to develop dedicated Know-How that O.V.S. is very proud to share with Clients.

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**Studies & Researches**

**OFFICINE VALLE SERIANA – O.V.S. (ITALY)**

**A CONSOLIDATED MANUFACTURER WITH POSITIVE THINKINGS**
and End-Users during the execution of new Projects as well as for the revamps of existing plants. To be proactive in the Markets means to forecast the future paths according to the inputs from different Agencies and to pay credit to the relationship with Clients, End-Users and Contractors. O.V.S. is very keen to develop and to establish future contacts with new Clients and O.V.S. assures to be beside the Clients to cope with their needs and requirements spanning from low to high pressure equipment, from carbon steel to titanium materials.

**Items supplied by O.V.S. (Italy)**
- Shell & Tube Heat Exchangers
- Double Pipe Heat Exchangers
- Multi Tube Heat Exchangers
- Columns/Towers
- Reactors
- Autoclaves
- Pressure Vessels
- Scrubbers
- Dampeners
- Filters
- Condensers for Vacuum Units
- Separators

**Materials processed by O.V.S. (Italy)**
- Carbon Steel
- Cladded Carbon Steel
- Austenitic
- Super Austenitic
- Copper Alloys
- Nickel Alloys
- Duplex
- Super Duplex
- Titanium

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### 2011 & 2012 Calendar

**AFA events**

- **22 - 24 November 2011, Amman, Jordan**
  24 AFA Int’l. Technical Conference & Exhibition

- **7 - 9 February 2012, Cairo Egypt**
  18th AFA Int’l. Annual Fertilizers Forum & Exhibition
  Cairo Semira-is Intercontinental Hotel

**Non-AFA events**

- **7 - 10 November 2011, Houston, Texas, USA**
  Sulphur 2011 Conference and Exhibition
  CRU Events

- **15 - 16 November 2011, Odessa**
  Ammonia handling and shipping safety workshop ICIS

- **15 - 17 November 2011, St. Petersburg, Florida, USA**
  Fertilizer Outlook and Technology Conference
  The Fertilizer Institute (TFI) and the Fertilizer Industry Round Table (FIRT)

- **22 - 23 November 2011, Kent, Uk**
  Pneumatic Conveying of Bulk Solids
  The Wolfson Centre for Bulk Solids Handling Technology

- **24 - 25 November 2011, Nairobi, Kenya**
  Fertilizer Trade Africa 2011
  TLG Conferences

- **18 - 20 January 2012, Buenos Aires, Argentina**
  2012 Fertilizer Latino Americano Conference & Exhibition
  FMB Consultants Ltd.

- **7 - 9 February 2012, Warsaw-Poland**
  EuroKarma 2012 Human, Animal & Plant Nutrition International Trade Fair
  EuroKarma

- **20 - 23 February 2012, Athens, Greece**
  Nitrogen & Syngas Conference and Exhibition
  CRU Events

- **1 - 4 March 2012, Mersin, Turkey**
  MERSIN 7th International Agriculture & Horticulture Fair
  Forza Fairs & Organization Services Co. Inc.

- **6 - 8 March 2012, Shanghai Everbright Convention Center, China**
  3rd China International Fertilizer Show
  CCPIT Sub-council of Chemical Industry

- **14 - 16 March 2012, Beijing, China**
  2012 FMB Asia Fertilizer Conference & Exhibition
  FMB Consultants Ltd.

- **19 - 21 March 2012, El-Jadida, Morocco**
  Phosphates 2012 Conference and Exhibition
  CRU Events
Abstract
In 2006 African leaders declared fertilizer, from both inorganic and organic sources, “a strategic commodity without borders.” The Abuja Declaration on Fertilizer for an African Green Revolution, issued at the end of the summit, agreed on an action plan that included development of agro-dealer networks across rural Africa, the use of “smart” subsidies to ensure that poor smallholders have access to fertilizer and removal of trade barriers and promotion of local fertilizer production.

This paper will describe: 1) the agro-dealer development component of the Common Market for Eastern and Southern Africa’s (COMESA) Regional Agro Input Program (COMRAP) being implemented by the Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA), a specialized agency of COMESA; and 2) the use of smart subsidies by the Malawi Government. These examples are then used to develop a roadmap for countries such as Sudan that want to capitalize on their agricultural potential, but need to rapidly increase use of improved seed and fertilizers if they are to sustainably increase agricultural productivity.

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This paper will describe the strategy adopted by COMESA in developing a sustainable input delivery system under COMRAP, and how the Government of the Republic of Malawi is using the agro-dealer network and smart subsidies to increase crop productivity. Complementary investments by IFDC to develop an input market information system will also be touched upon as they help improve the efficiency of input markets.

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In June 2010 IFDC was contracted to implement the agro-dealer/agent training component of the program with a deadline of August 2011 to complete all the training. The implementation of such an ambitious program in 15 months necessitated the development of an innovative approach that could draw upon the already established organizational expertise in several of the target countries. IFDC signed a sub-contract agreement with the Kenya-based Agricultural Market Development Trust (AGMARK) that has a well-established track record in training agro-dealers, especially in aspects of business management, while IFDC took on the responsibility for technical training.
Before starting the training a baseline survey was carried out in each of the eight countries. The survey included the identification of a local host institution that the IFDC-AGMARK partnership could work with. This strategy was presented at the inception workshop organized by ACTESA in Lusaka, Zambia and a preliminary work plan developed and presented to the other implementing partners contracted by COMESA. The most important of these are the Eastern Africa Farmers Federation (EAFF – see http://www.eaffu.org), and selected national farmers’ unions affiliated to the Southern African Confederation of Agricultural Unions (SACAU – see http://www.sacau.org) that are assisting COMRAP in identifying agro-dealers and agents for training and in communicating COMRAP to farmers.

Following the inception workshop, a detailed training curriculum was developed and presented to selected trainers from each of the eight countries in a training of trainers workshop. The training included several sessions on facilitation techniques, as the way in which trainers conduct the training of agro-dealers has been found to be an important determinant of knowledge transfer.

The technical training included a specific module on manures and fertilizers as it is essential that agro-dealers and agents can advise their farmer clients on how purchased inputs can be profitably used without risk to human health and the environment. Publicly funded extension services in many African countries are just not able to meet the demand for extension advice from farmers, and increasingly the private sector is fulfilling this role and in many cases collaborating with government extension to mobilize farmers and assist in farmer training.

The trained trainers are now being mobilized in all eight countries to train agro-dealers and agents identified by the selected national host institutions in consultation with EAFF and SACAU. All trainees are required to complete a simple questionnaire before embarking on the training, which is being used as a baseline to monitor the performance of the trainees and their agro-dealer businesses. An accreditation scheme endorsed by the national governments but implemented by the national host institutions will be started in the coming months. The objective of accreditation is to ensure that agro-dealers and agents adhere to ethical business practices and to control the sale of adulterated, fake and/or expired products. A “carrot and stick” approach will be used to implement the accreditation scheme with access to further training, credit guarantees and participation in government subsidy schemes being restricted to accredited agro-dealers and agents. Accreditation fees paid by the agro-dealers and agents to the national host institution implementing the accreditation scheme will be used to sustain the scheme over time.

To further support input market development and assist farmers in price discovery, IFDC has established the Regional Agricultural Input Market Information System (AMITSA) in eight countries of east and southern Africa (see http://www.amitsa.org). Special trained agro-dealers voluntarily collect retail prices of selected inputs on a monthly basis. This information is relayed by e-mail or telephone to the IFDC database manager who then collates and processes the information into a report that is posted on the AMITSA website and disseminated to multiple organizations including the agro-dealers themselves. Mobile telephone technology will be deployed in 2011 to enable customized price collection and dissemination across the region. With this technology, the agro-dealers will be able to use a tailor-made mobile phone application, short message service (SMS) and a dedicated Internet site to collect and directly upload data onto the AMITSA server.

By August 2011 there will be a cadre of nearly 6,000 trained agro-dealers and 2,000 agents in the eight countries being targeted by COMRAP. This commendable initiative directly addresses one of the 12 resolutions made by African Union Member States in the Abuja Declaration. More importantly, the professionalization of agro-dealers and agents on such a large scale provides commercial input suppliers, including fertilizer manufacturers and distributors, a viable mechanism to reach millions of potential customers wanting to purchase their products.

**Smart subsidies**

The resolution by African Union Member States “…to improve farmers’ access to fertilizer, by granting, with the support of Africa’s Development Partners, targeted subsidies in favor of the fertilizer sector, with special attention to poor farmers” deserves special attention.

Smallholder farmers without formal agricultural training have a poor understanding of mineral fertilizers, which reduces fertilizer use efficiency and profitability. This poor understanding extends to
policy makers and development investors who recognize the need for and benefits from increased use of mineral fertilizers, but underestimate the investments needed to develop appropriate fertilizer recommendations and then empower farmers with the knowledge about which fertilizers to use, how much to apply, when and how they should be applied.

The Government of the Republic of Malawi (GoM) has a long history of promoting the use of hybrid maize and mineral fertilizers. In the post-independence period until 1992 this was done through a vertically coordinated system that provided farmers with credit through the government-owned smallholder agricultural credit authority (SACA) to purchase seed and fertilizer from the Agricultural Development and Marketing Corporation (ADMARC), a government parastatal that had a monopoly on both input supply and output marketing. Under this system loans were easily recovered from farmers who could only market their surplus produce through ADMARC that was linked to SACA. Seed and fertilizer were both subsidized, the former through the government parastatal National Seed Company of Malawi, and the latter through free fertilizer donations.

In 1992 structural readjustment led to the liberalization of input and output marketing and the withdrawal of subsidies, but by the early 2000s the country was experiencing regular food deficits and various intervention including the ‘Starter Pack’ and ‘Targeted Inputs Program’ were introduced in an attempt to boost productivity through increased use of improved seed and mineral fertilizers. In 2006/2007 the GoM implemented the Agricultural Inputs Subsidy Program to promote access to and use of fertilizers in both maize and tobacco production to increase agricultural productivity and food security. The subsidy was implemented by means of a coupon system, which could be redeemed by recipients for selected fertilizer types at approximately one-third of the normal cash price. In a review of the 2006/2007 program, Dorward et al (2008) reported that the subsidy by coupon (voucher) system could be an effective way of rationing and targeting subsidy access to maximize production and economic and social gains, but stated that many practical and political challenges remain in the program design and implementation required to increase efficiency, control costs and limit patronage and fraud. As a result of these experiences the program has continued to evolve to one where vouchers are distributed to targeted farmers, which can be redeemed through agro-dealers for both improved seed and fertilizer.

The Malawi subsidy program has attracted a great deal of attention because it has succeeded in achieving both national food security and improving the livelihoods of millions of smallholder farmers. The cost of the subsidy program has to be measured against two things; the macroeconomic benefits of the subsidy, and the costs to government and the macro-economy of the alternatives. The cost to the Malawi government of the subsidy has been around 9 percent of government spending, or 3.5 percent of GDP. This is not a trivial amount but was not unsustainable until 2008/9 when this increased dramatically to 16 percent of GDP due to the global spike in fertilizer prices. Although fertilizer prices have fallen from their all-time highs in April 2008, there is renewed concern over rising oil and food prices, which is reflected in the upward trend in fertilizer prices (see Figure 1).

Dorward and Chirwa (2011) are in no doubt that the subsidy has been a significant success, which has contributed to “increased food availability, higher real wages, wider economic growth and poverty reduction.” However, this paper is not intended to support or condemn the use of subsidies in Malawi or elsewhere, but rather to focus on the apolitical issue of increasing fertilizer use efficiency, which should translate into increased profitability. Morris
et al (2007) in the book Fertilizer Use in African Agriculture: Lessons Learned and Good Agricultural Practices give a detailed analysis of the technical response to fertilizer use, and conclude that there has been an overall downward trend in the profitability of fertilizer. They conclude that unless progress can be made in reducing fertilizer prices in a sustainable way, the profitability of fertilizer use will depend on tailoring the dosage, composition and timing of application to specific field and seasonal conditions. Figure 2 shows the maize and nitrogen value cost ratios (VCRs) in Malawi over the period 1997-2007. VCRs of two or more are generally recognized as the minimum for profitable investment in fertilizers, but figure 2 shows that VCRs over the last 10 years have been highly variable, particularly when maize is valued at pre-harvest prices (the value of maize to deficit, buying households) and almost always below two when maize is valued at post-harvest prices (the value of maize households with a surplus to sell) (Dorward et al 2008).

Poor transport infrastructure significantly increases the farm gate fertilizer price, and to partially address this issue there has been a shift inprocurement from low to high analysis fertilizers, with Diammonium Phosphate (DAP) and Urea becoming ubiquitous on maize, which is the major food crop grown by smallholders in Eastern and Southern Africa on which mineral fertilizers are used. However, this shift has been made based on the economics of logistics, and has ignored socio-economic constraints faced by smallholder growers in utilizing mineral fertilizers, and the need for balanced nutrition that not only includes primary (Nitrogen, Phosphorous and Potassium) and secondary (Calcium, Sulfur and Magnesium) nutrients, but also micronutrients (Iron, Copper, Zinc, Boron, Manganese, Chlorine and Molybdenum).

In Malawi the shift from compound basal dressing fertilizer and Sulfate of Ammonia top-dressing to DAP and Urea had two unintended consequences. The relatively low N content of DAP led to maize being starved of nitrogen in the early stages of growth as there was insufficient labor available to both weed and hand apply the Urea top-dressing, and the elimination of Sulfur led to Sulfur deficiencies. Participatory research with smallholder farmers combined with soil and leaf analysis and agronomic trials led to a change in procurement policy with DAP being replaced by 23:21:0+4%S but Urea continuing to be used as a top-dressing.

Despite addressing the Sulfur deficiency, several other nutrient deficiencies have been identified including Zinc and Boron. Such deficiencies are increasingly prevalent across Sub-Saharan Africa where the already highly weathered soils have been cultivated continuously without applied nutrients, which has further depleted the already low soil organic matter.

IFDC’s experience would expand this list to include the need for integrated soil fertility management (ISFM) defined as “a set of soil fertility management practices adapted to local conditions, aiming at maximizing the agronomic use efficiency of nutrients and improving crop productivity. Practices involved include the use of mineral fertilizer, soil amendments (lime, rock phosphate), organic inputs, improved germplasm, and the use of rotations or intercropping with legumes.” A good example of ISFM is given by Jones et al (1997) who reported that combining leguminous leaf residues with Nitrogen fertilizer increased fertilizer use efficiency.

The lesson from this is that increased mineral fertilizer demand from farmers will only be sustained if fertilizer use is profitable, and fertilizer companies wanting to expand their market will need to be proactive in understanding what the nutrient requirements of different crops are, and in developing sound recommendations that will lead to increased fertilizer use efficiency and hence profitability. In the Malawi context it is urgent that greater attention is
given to increasing fertilizer use efficiency, and using mechanisms such as the Agricultural Input Subsidy Program as a catalyst for change. Unless these fundamentals are addressed, repeated subsidies will remain a palliative rather than earning the accolade of ‘smart.’

**Conclusions**

This paper has examined two of the resolutions agreed upon at the Abuja Summit that are being implemented, and have attracted attention from policymakers. Apart from Malawi, several other countries in Eastern and Southern Africa have already introduced fertilizer subsidies, and are using established agro-dealer networks in their implementation, which is a positive development being assisted by complementary public sector investments by COMESA. There is a real opportunity for the private sector to pool its resources through industry associations such as the Arab Fertilizer Association (AFA) to assist with these efforts, as increased fertilizer use efficiency will lead to increased fertilizer demand. In Mozambique the International Fertilizer Association (IFA), the International Plant Nutrition Institute (IPNI), and the International Potash Institute are supporting IFDC in the implementation of the Maize Intensification in Mozambique project to help Mozambican smallholder farmers improve their livelihoods through intensifying maize production. IFDC is actively exploring opportunities to pursue a similar approach in Sudan where there is enormous untapped irrigated and rain-fed agricultural potential that is attracting the interest of commercial investors from the Arab World who are looking to safeguard their own food supplies against the threat of global warming. The success of such initiatives will be dependent on enhanced understanding and collaboration between regional economic communities, national governments, public international organizations such as IFDC which understand and support the commercial world without any vested interest, and commercial companies that are driven by profit. In more developed markets it is common for fertilizer companies to offer a service to farmers that includes soil sampling and testing, and the formulation of crop- and soil-specific fertilizers that address identified nutrient deficiencies. However, providing such services to large numbers of poorly organized smallholder farmers is a challenge that most commercial input suppliers shy away from. However, the rapidly expanding markets in China and India are excellent examples of such collaboration, and it is now time to see these types of partnerships being expanded to Sub-Saharan Africa.

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