International Fertilizer Industry Association

IFA Technical Conference

Chennai, India
24-27 September 2002

International Fertilizer Industry Association - Secretariat: 28 rue Marbeuf - 75008 Paris - France
Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

ENVIRONMENT MANAGEMENT ISSUES IN INDIAN FERTILISER PLANTS (a)

M.P. Sukumaran Nair, The Fertilisers And Chemicals Travancore Ltd, Cochin, India

1. Introduction

India is primarily an agrarian country. In the past over two decades considerable growth have taken place in the country's agriculture front and the food grain production increased to an all time record level of 209 million tonnes during 2001-'02. This success is contributed by a number of factors, of which the support of mineral fertilizers is the most important one. Indian fertilizer industry, with a total capacity of 11.7 million tonnes of N and 4.7 million tonnes of P2O5, is the third largest in the world after China and the US.

Table-1.Fertilizer Capacities, Production and Consumption in India (million MT)

Year	Capacity		Production		Consumption	
	N	P	N	P	N	P
1995-'96	8.998	2.924	8.769	2.593	9.882	2.897
1996-'97	9.332	2.948	8.593	2.578	10.301	2.976
1997-'98	9.987	3.165	10.083	3.058	10.901	3.913
1998-'99	10.571	3.206	10.477	3.181	11.353	4.112
1999-'00	11.068	3.748	10.873	3.407	11.592	4.798
2000-'01	11.719	4.717	11.004	3.748	10.92	4.214

Capacity additions are stalled for the time being in the nitrogenous (N) sector but the phosphatic sector (P) is still expanding. There are 72 operating plants, 54 in the nitrogenous and 18 phosphatic sector, that use a variety of feedstocks, employ different technologies, have different vintages and capacities and are distributed in the public, private and co-operative sectors of the national economy.

Compared to the per hectare fertilizer consumption of China or USA, consumption is low (Table 2) in India and it demand an increase to meet the grain requirement of over one billion people.

Email: mps@factltd.com or mpsn@vsnl.com

Address: The Fertilisers And Chemicals Travancore, Ltd.
Corporate Planning Dept.,
Udyogamandal P.O.
Cochin 683 501
India

Tel: 91 484 545792
Fax: 91 484 545475

(a) received on: 05/07/02

Table-2.Fertiliser Consumption 1999-2000 (per capita) kg/ha	
India	106
US	111
China	271
World	94

Challenges before the industry are indeed complex in nature and include increase in the cost of feedstock and imported raw materials and energy, uncertainty in Government policies and environmental considerations

Environmental issues relating to fertilizer plants have a direct bearing on vintage and technology of the plants, efficiency and operational reliability of available pollution control facilities, prevailing environmental legislations and governmental policies. Of the 72 plants thirty two are of the 1970s vintage, twenty one are built in the 1980s and nineteen plants in the 1990s.As regards technology the new generation plants operate with the latest technology in the field and the old ones have undergone retrofits and revamps to a great extent and substantially upgraded their processes. This paper is intended to have an appraisal of the environmental issues confronting the industry.

2. Pollution Control Efforts

All production units have specific environmental policies and are maintaining the characteristics of the emissions to the atmosphere and effluents discharged to the local streams with in the limits of the stipulations of the regulatory authorities. Though most of the plants follow the end of pipe treatment approach and over the years there has been a gradual improvement in the quality of the environment around the plants.

These units successfully achieve the stipulations of the state and central pollution control authorities and other statutory agencies without much problems trough the support of available technology and current efficiency of operation and management.

Most of the environmental problems in these units are addressed exactly in line of the developed countries and similar results are achieved. New generation plants have been built on modern process technologies where considerable integration has taken place at the inception stage itself to see that pollution prevention is a part of the process design itself. In the case of production facilities that came up in the sixties and early seventies of the last century, pollution control facilities were built and attached later

The stipulations of the pollution control boards (PCB) are within the achievable limits of the available technology at hand. Some times excursions occur in the parameters on account of start up, shut down of plants or may be due to accidental situations.

Table 3.Fertilizer Industry Effluents and their sources.			
Plants	Solid waste	Liquid effluent	Gaseous emissions
Ammonia	Spent catalysts	Process condensate	Ammonia
	Sludge from equipment	CO2 removal solutions	Carbon dioxide
	Insulation debris	Cooling tower blowdown	Furnace flue gas
	Construction debris	Boiler blow down	Vent gases
Urea	Nil	Process condensate	Prilling tower dust
		Gland leakages from pumps	Ammonia
		Floor washings	
Sulphuric Acid	Sulphur sludge	Water treatment effluents	Acid mists
		Acid leaks	SO2 /SO3 in stack
Phosphoric Acid	Gypsum	Plant washings	Fluorine
	Sludge	Gypsum pond water	Particulate matter
		Acid leaks	
Nitric Acid	Spent catalysts	Plant washings	Nitrogen oxides
			Ammonia
Complex	Spillages	Plant washings	Particulate matter
	Slurry from drainage / washing	Plant leakages	Ammonia fumes
Amm Sulphate	Spillages	Plant leakages	Nil
	Chalk slurry	Plant washings	
Power Generation	Oil sludge	Water treatment effluents	SO2 in flue Gas
	Gypsum from FGD	Oil spillage	
Water Treatment	Used resins	Regeneration effluents	Nil
	Sludge from equipment		

In the fertilizer industry key parameters being monitored universally are pH, ammoniacal nitrogen, nitrates, fluorides, phosphates, total suspended solids and chemical and biological oxygen demand in the effluent streams, particulate matter, nitrogen oxides, sulphur oxides and carbon monoxide in exhaust streams.

Table 3 lists the potential sources of pollutants in the effluents from fertilizer plants. It includes plant wise solid, liquid and gaseous pollutants and the streams containing such pollutants. Table 4 gives the minimum national standards (MINAS) for discharge of fertilizer plant effluents and emissions stipulated by the Central Pollution Control Board (CPCB).

Table 4.Fertilizer plant Effluent Characteristics Minimum National Standards (CPCB)

Plant type	Unit	Nitrogenous	Phosphatic	Complex
Total suspended solids	mg/l max	100	100	100
Temperature	Deg C	Recycling water temp + 5		
pH		6.5—8.0	7.0—9.0	6.5—8.0
Oil & grease	mg/l max	10	10	10
Ammoniacal nitrogen as N	mg/l max	50		50
Free ammonia	mg/l max	4		4
Total Kjadhahl nitrogen as N		100		
Nitrate nitrogen	mg/l max	20		20
Phosphates as P	mg/l max		5	5
Fluorides as F	mg/l max		10	10
Cyanides as CN	mg/l max	0.2		0.2
Hexavalent chromium as Cr	mg/l max	0.1	0.1	0.1
Arsenic as As	mg/l max	0.2		0.2
Vanadium as V	mg/l max	0.2		0.2

These are the statutory limits with in which existing operators control pollutants in their streams. In specifying these limits the long-term impact of pollutants in the environment is not given due regard, instead most often it is the level achievable by the use of currently available abatement technologies.

3. Approach to Environmental Management

The approach to environmental management is guided by the twin objectives of meeting the effluent and emission standards as specified by the regulatory authorities and improving the efficiency of the process by recovering valuable material lost to the effluents as far as possible.

Much of the pollution prevention methods implemented by the units follow a prescriptive approach in which a standardized procedure using checklists is often used. A more descriptive approach in which process operators take up pollution problems as a challenge and devise their own ways of solving them is desirable. All environmental issues and pollution prevention opportunities known from past experience are incorporated into the operating philosophy of the plants.

Attempts to reduce the effluent generation at source are more a question of the chosen technologies in these plants. The specific consumption of raw material and energy in these plants show a continuous trend of improvement over these years (Fig 1&2).During the past two decades the water consumed per tonne of fertilizer product manufactured has come down by 30 percent in the nitrogenous and 60 percent in the phosphatic sectors.

Fig 1.Ammonia Energy ConsumptionTrends

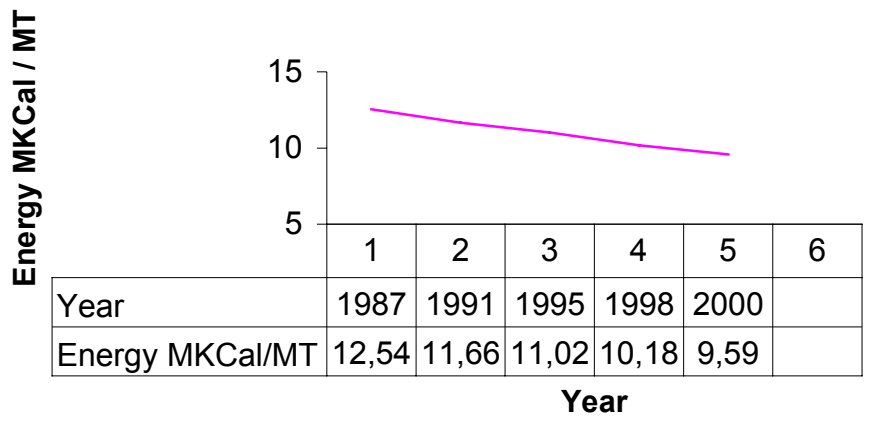
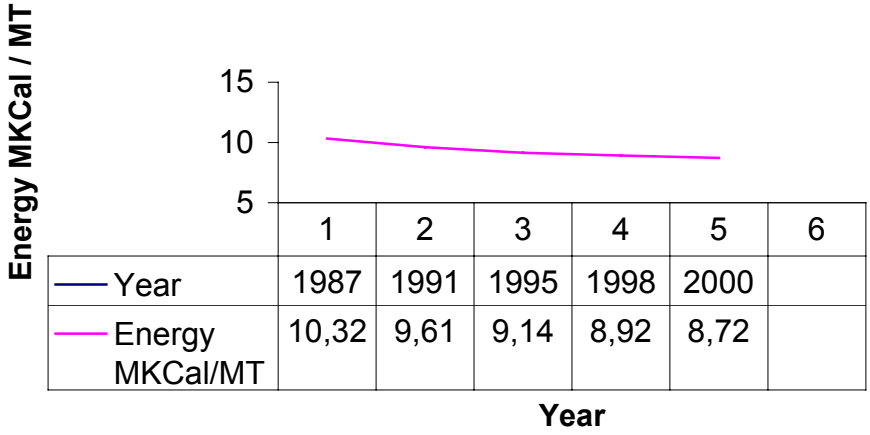


Fig 2.Urea Energy Consumption Trends



This invariably contribute to achieving better environmental standards as material and energy savings invariably result in the gradual reduction in emissions, effluents and solid waste per tonne of product manufactured. Major design changes will be required for further improvements and hence efforts in this line are limited unless it brings about economic incentive by way of increased productivity, lowering of energy consumption, etc.

Still in certain plants as a means of controlling pollution from liquid effluents simple air stripping is done which result in air contamination. Reuse of treated effluents is limited in most plants though they claim that water conservation is achieved. This is mostly due to certain apprehension in the minds of the operators that some upsets in the waste water purification systems may lead to severe damages in other costly equipment.

During start up and shut down of plants effluent generation is high and provision is made in the pollution control systems of most plants to take care of such situations. Still excursions take place which often cause public outcry and invite punitive action from statutory authorities.

4. Environment Management Systems

Environmental management systems are (EMS) used to establish, implement and keep track of its environmental objectives and policies of organizations. They are also intended for continuous improvement of existing operations through regular monitoring and control thereby contributing to reduction in the pollution effects below the limits prescribed by the statutory agencies. EMS in fertilizer manufacturing also aim at bringing sustainability in the industry i.e., conservation of raw materials and energy, elimination of handling and storage of toxic materials and reducing the quantity and toxicity of emissions, effluents and wastes, reducing negative impacts all along the life cycle of a product till ultimate use and final disposal.

Most of the units have established ISO 14000 Environment Management Systems and there are corporate environmental setup for regular monitoring and control. These standards provide tools to:

- monitor and improve organization's impact on the environment and assure customers of commitment to environmental management;
- improve cost control;
- reduce incidents that result in liability; reduce consumption of materials and energy;
- obtain permits and authorizations;
- reduce the cost of complying with environmental regulations;
- maintain good public relations;
- enhance public image and improve industry-government relations.

Some plants have adopted a concept of zero effluent approach incorporating total recycle and reuse of effluents back to the process. But in actual practice this remains more a concept than its fruitful implementation to a reasonable degree of reliability.

5. Greenhouse Gas Emissions

Fertilizer plants emit carbon dioxide (CO_2) and smaller quantities of methane (CH_4) and nitrogen oxides (NO_x) which are major green house gases to the atmosphere. The fertilizer industry worldwide consumed 1.2% of energy and emits 1.4 % of the total greenhouse gases in 1998. Unlike ammonia exporting countries Indian ammonia plants are built around urea plants where bulk of the CO_2 produced during synthesis gas making is consumed. There are no emission standards for CO_2 as prescribed by the statutory bodies. Attempt to reduce green house gas emissions all over the globe to tackle climate change will bring in specific limits for CO_2 emissions and to maintain a level close to what can be achieved practically by the application of BATs.

Green belt and vegetation around process plants act as sink for carbon oxides and reduce the impact of global warming effects through carbon sequestration. Green belt development around fertilizer units is an important step in the direction of sustainable environmental control. All the units have undertaken substantive efforts towards green belt development around these the processing facilities by planting of saplings and protecting vegetation around.

6. Gypsum disposal

Options available for use of gypsum from phosphoric acid plants such as manufacture of plasterboards, gypsum blocks, Stucco plaster and as cement retardant in construction industry are limited when compared to the large scale production. It is either made to slurry and pumped to ponds or stacked in pre determined sites. Gypsum ponds and stacks, though lined with impervious material (HDPE liner, usually 1.5 mm thick) cause leaching of pollutants to the water streams and ground water sources due to imperfections in the linings. In these plants heavy metals are not removed from the phosphoric acid produced. Phosphate rock being consumed in Indian plants mostly come from Asia and Africa and unlike the Florida rock they have a lower content of radioactive impurities. Monitoring of radioactivity level of phosphogypsum stacks is not being done.

7. Environmental Monitoring

From the management angle it is desirable that the environmental friendliness of the industry shall improve year by year. This necessitates quantification of the extent of this improvement. The Environmental burden (EB) approach developed by ICI is quite useful in this matter. The method of EB was developed as a part of the 'SHE Challenge 2000', a voluntary programme developed to promote continuous improvement in safety, health and environmental performance, to assess the potential harm to people and the environment from chemical emissions. It provides a meaningful picture of the emissions from operations, help to identify most harmful emissions and reduce them first and give the public a better understanding of the problems and steps taken to reduce them.

First a set of recognized global environment impact categories are identified such as acidity, global warming, human health effects, ozone depletion, photochemical smog, aquatic oxygen demand, ecotoxicity to aquatic life, etc., on which the emissions and effluents exert an effect .

Second a factor is assigned to each individual emission which reflects the potential of its possible impact.

The next step is to calculate the EB by multiplying the weight of each substance emitted by its potency factor.
EB = (Wa X P Fa) + (Wb X P Fb) + (Wc X P Fc) +……where W is the weight in tonnes for each substance of emission (a,b,c,…..) and PF is the specific potency factor based on the known or estimated environmental risk posed by an individual substance to the specific category under consideration .

EB can be used to compare performance with that of the previous years, compare emissions with other similar technologies and processes and set targets for improvement The environmental burden imposed by the units have to be quantified by considering suitable indices for every environmental aspects.

8. Hazard and Risk Management

All manufacturing facilities have environment management plans incorporating disaster management and control based on reasonable estimates of hazards that can arise out of these installations and their risk potential. These plans are frequently tested to ensure their workability during emergency situations and are capable of mitigating the risk from most expected crisis situations, but not all. Though not widely publicized all the units maintain a safe work environment around the installations in the interests of the employees and the local community. It is also necessary that units have to be very effective in promoting and defending their environmental concerns, if not the environmental movements can do a great deal of damage. At the same time, industry operators shall keep on upgrading their environment management systems and must be cautious of the stringent future regulatory action by governments.

Information to the public regarding the environmental consequences of these plants are meagre and little effort is made from the part of the companies to explain the environmental impacts and risk of the installation to them. No environmental report is published by the companies annually. In this matter the Responsible Care –Environmental Reporting of the European Chemical Industry Council (CEFIC) may be considered as a useful model for compliance. The communities living around these units have a right to know the environmental risk they are subjected to. These issues need to be addressed at the national level itself. Provisions like the Superfund Amendments and Reauthorization Act (SARA) of the US to cope with Community Right To Know requirements have to be enacted and the concerned professionals shall do whatever necessary to allay the fear of the public and enhance the public image of the industry.

9. Nutrient Pricing Implications

Efficient use of fertilizer in agriculture has a direct bearing on the environment. In India, the nitrogen use efficiency is 50 %, phosphate 20-25 % and potash 70-80% only. A major contributory factor to this situation is the inadequate pricing policies, which lead imbalance in the application of fertilizer nutrients. This is because of the fact that the farmers prefer to buy the cheaply available fertilizer material without sufficient thinking of the plant nutrient demand. Soil nutrient ratio gets upset on account of this and leads to environmental problems. There shall be a clear-cut nutrient pricing policy, which will promote balanced application of fertilizers.

10. Environmental Legislation

With the 42nd amendment to the constitution, environment protection has become a constitutional objective in India. There is a host of legislations in the country that are applicable to fertilizer production and its environmental control. Under the Water (Pollution Prevention and Control) Act , 1974, the Central and State Pollution Control Boards (PCB) were established as statutory agencies to lay down standards for effluents, emissions, etc., from different sources and enforce its strict compliance. The control of water and air pollution through legal provisions is achieved through the consent mechanism which specifies the quality and quantity of the effluents and emissions discharged from the units. The Environment (Protection) Act, 1986 is an umbrella Act and provide for the protection and improvement of environment and prevention of hazards to humans, other living beings, plants, property etc. Under the act the Central Government has the authority to prescribe environmental protection standards that are statutory and applicable throughout the country. Other enactments specifically address the various issues in environmental protection and provide for their statutory and legal enforcement. The industry has been successful in complying with the requirements of the above legislations and also in keeping pace with the developments in technology and practice in their efforts to maintain a clean environment around the plants as responsible corporate citizens.

Environmental Legislations
The Water (Pollution Prevention and Control) Act , 1974
Air (Pollution Prevention and Control) Act, 1981
The Environment (Protection) Act, 1986
Notification of Rules Under the Environment (Protection) Act, 1986
The Environment (Protection) Rules, 1986 and Subsequent Amendments
Hazardous Waste (Management and Handling) Rules, 1989
Manufacture , Storage and Import of Hazardous Chemicals Rules, 1989
The Environment (Protection) Second Amendment Rules, 1992-Environmental Audit
Public Liability Insurance Act, 1991, As Amended
The Environment (Protection) (Second Amendment) Rules, 1998
Policy Statement for Siting of Industry, 1980
The National Environment Tribunal Act, 1995
The National Environment Appellate Authority Ordinance, 1997
The Prevention and Control of Pollution (Uniform Consent Procedure) Rules, 1999

11. Future Outlook

Existing operations and continued growth of the fertilizer industry in the country is an essential requirement for increasing agricultural productivity especially because of the developing nature of the economy. At the same time the industry is confronted by major environmental impacts and safety concerns. Environmental regulations continue to become increasingly restrictive all over the industry. Thus, in order to facilitate the above growth perspective, a conducive Environment, Health and Safety (EH&S) policy support for the industry is needed at the enterprise level and at the Government level.

The first and foremost guiding principle of an environmental policy facilitating growth of the industry is the unstinted commitment, involvement and action oriented approach of the

top management of the organization in achieving the set environmental goals. Such a commitment will ensure maintaining and enhancing a company-wide organizational structure and culture that recognizes and encourages the full and active participation of all employees in the systematic management of health, safety, and environmental issues. Binding rules regarding the organization and management of any task being related to health, safety and environmental matters shall be established at the top management level.

Every company shall formulate an EH & S vision and policy statement depending upon the nature and scale of its operation and specifying its current thinking and aspirations of the future. They shall adopt a national pollution prevention policy that encourages source reduction and environmentally sound recycling as a first option, but that also recognizes safe treatment, storage and disposal practices as important components of an overall environment protection strategy. The company shall implement, and continuously improve effective HSE management systems and develop standards that reflect best industry practices to minimize the risk of disturbances in consequence of its operations as well as reduce consumption of raw materials and energy.

Units shall clearly define their environmental targets i.e., the qualitative and quantitative changes that are to be brought about to bring in more environment friendliness in the industry and acceptance to the community around. Steps that are envisaged for minimizing environmental impacts, reducing emissions of toxic gases and those causing global warming and improving the current levels of employee health, safety and pollution prevention are to be specified. Attempts for improving energy efficiency, resource productivity and use of renewable source of energy and raw material need special mention in the policy. The target must also address achieving zero accidents at work places, reducing incidents of work related diseases and overall reduction of the risk exposure to the employees as well as the community around. The target shall focus achieving sustainable development and eco-efficiency as a new business perspective for the industry through production and innovation integrated environmental protection, responsible product stewardship and aiming total quality improvements.

Formulation of country specific best available techniques (BATs) for diligent operation and management of the fertilizer industry may be attempted. Implementation of technically and economically feasible regulatory as well as non-regulatory measures can also improve environmental management in fertilizer production. Providing fiscal incentives also encourage facility operators to adopt newer technologies that reduce pollution to replace existing ones.

The policy shall provide for the use of legal, financial and social instruments which influence the behavior of companies, citizens, public bodies and authorities for achieving the objectives of the policy. Existing and innovative control mechanisms such as statutory provisions, stipulations of the various regulatory bodies may be strengthened. The industry may be advised to go for the currently best available technology for pollution abatement. During the interim phase current strategy of monitoring comparison with set standards and penal action wherever required shall continue. Plants shall be operated to standards that will comply with the requirements of appropriate national and international legislation and codes of practice

Necessary and state of art training may be given to the concerned people responsible for environmental management. This should include keeping them abreast of the new developments, technologies and practical tools ,accident investigation, environmental impact prediction, selecting appropriate protective equipment, implementing emergency response plans as and when necessary and so on. They may be trained to learn from previous incidents and similar experiences and made conversant in the corporate environmental management systems and the proposed action plan for its implementation .In short total capabilities must be available in-house with all organizations to tackle probable emergency situations that are likely to arise.

The policy shall call for regular and meticulous environmental performance monitoring to keep track of the environmental burden imposed by the company and watch the direction of its progressing trends .Quantitative as well as qualitative approaches may be used for this purpose. Emissions, waste streams, hazardous waste, disturbance, resource depletion etc., shall be addressed accordingly.

The current operations should be regularly and systematically assessed for the purpose both of identifying and correcting any element which may put human beings, property or the natural environment at risk or damage.
The policy shall provide for involvement of the community and working with active environmental groups in the region in bettering the environmental situation and thereby enhancing public perception of the industry. Necessary provision may be made for sharing information on EH &S with the public is to be incorporated in the policy

Public should be made acquainted with the operations of the company, it's as such, related benefits and risks as well as the measures taken to minimize those risks. Uncertainty and anxiety among them should be addressed attentively. Care for the safety and health of the employees and the general public should be given priority. The policy shall also call for annual environmental status reports along with the financial performance reports. The feedbacks on these reports from the concerned stakeholders may be used for continued improvement of existing systems.

A result-oriented and forward thinking environmental management perspective adequately supported by an effective action plan at the enterprise level can bring innovative changes to add business value to the fertilizer industry.