



UNITED NATIONS ENVIRONMENT PROGRAMME
INDUSTRY AND THE ENVIRONMENT

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DEVELOPMENT ORGANIZATION

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Mineral Fertilizer Production
and the Environment

Part 2.
Environmental
Management
Systems



In collaboration with the
INTERNATIONAL FERTILIZER INDUSTRY ASSOCIATION

MINERAL FERTILIZER
PRODUCTION
AND THE
ENVIRONMENT

Part 2.
Environmental
Management
Systems



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1. INTRODUCTION

Medium-specific environmental action in resolving air, water and waste problems separately was the norm in most industries and governments until recently. In many countries it is still the main way in which environmental issues are addressed. The traditional approach to environmental policy concentrated on effects rather than causes. While some improvements in environmental quality certainly resulted from this approach, the limits also soon became apparent. The need to look at all the impacts simultaneously and to address the priority areas in a systematic way has now become more or less universally accepted.

A second principle, equally important, has been that of preventive rather than remedial action. This approach forestalls and minimizes the excessive costs involved in treating pollution after it has been produced. In practice, in the fertilizer industry this is difficult to achieve with *existing* plants.

An integrated, systematic approach to all environmental issues can, with considerable benefit, be part of an overall environmental management system, whereby the company establishes a coherent and integrated environmental programme. This goes beyond the need to comply with regulations and official requirements, and even beyond the advantages of accreditation under the ISO standards. A comprehensive environmental management system can, in itself, be of intrinsic value to the company.

The Environmental Management System, EMS, approach is a logical way for the company to improve the organization of its environmental actions, but this does not obviate the need for regulations (nor compliance with such regulations). In fact, it is now seen as desirable that the company and government programmes be made complementary, to allow more efficient operation of each. This presupposes a dialogue and eventually a cooperative approach to environmental control, with both partners taking action on agreed items.

Compliance with (these) regulations, although burdensome, can be achieved with a co-ordinated effort and corporate commitment. The cost of compliance is not always associated with highly technical equipment or costly capital expenditures. Often individual decisions and daily routine practices can have the greatest positive impact. An integrated approach to regulatory compliance achieved the desired goal, with the added benefits of improved and operating efficiencies¹.

¹ Extracted from a paper by M.E. Kenna, IMC Agribusiness, USA, entitled “*Environmental Compliance at the Retail Fertilizer Outlet*”, presented at the meeting of the Fertilizer Industry Round Table, Maryland, October 1998.

2. SOME DEFINITIONS

Agenda 21

The sustainable development programme adopted at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992. The production side of the fertilizer industry is covered by Chapter 30 "Strengthening the role of business and industry". Section 30.13 states that "Industry and business associations should encourage individual companies to undertake programmes for improve environmental awareness and responsibility at all levels to make these enterprises dedicated to the task of improving environmental performance based on internationally accepted management practices".

Benchmarking

Benchmarking involves the comparison, ranking or rating of different business processes, units or companies against standards. The aim: to identify ways of improving the performance of operations, systems, processes.

Best Available Techniques

The most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.

Cleaner Production

The continuous application of an integrated, preventive environmental strategy applied to processes, products and services to increase eco-efficiency and reduce risks to humans and the environment.

Cleaner Production Assessment

A procedure used to examine industries, production processes, raw materials as well as products, in order to evaluate environmental improvements that could be made, and estimate their costs.

Contaminant

A compound which is present in the environment in concentrations higher than the background level, but not necessarily causing a negative impact.

Discharge

A general term for all releases of contaminants into the environment, be they gas, liquid, or solid, or a combination thereof.

Eco-balance

A term used to describe the total environmental impact of a material or product from “cradle to grave”.

Eco-design

The integration of environmental aspects into the product development process, by balancing ecological and economic requirements. Eco-design considers environmental aspects at all stages of the product development process, striving for products which make the lowest possible environmental impact throughout the product life cycle.

Eco-efficiency

Eco-efficiency is the term used to describe the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth’s estimated carrying capacity.

Emission

The direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in the installation into the air, water or land. The term “effluent” may be preferred for releases into surface water.

Emission Limit Values

The mass, expressed in terms of certain specific parameters, concentration and/or level of an emission, which may not be exceeded during one or more periods of time.

End-of-Pipe

The practice of treating polluting substances at the end of the production process when all products and waste products have been made and the waste products are being released (through a pipe, smokestack or other release point); usually used as an adjective to refer to a pollution control strategy.

Energy Audit

Identifies the costs and physical quantities of energy inputs used, the annual and seasonal trends in energy use and cost, and the energy use per unit of output.

Energy Efficiency

The ratio between the consumption of energy and a given quantity, usually refers to the amount of primary or final energy consumed per unit of gross domestic or national product.

Environment

The environment is defined as the surroundings in which the organization operates, including air, water, land, natural resources, flora, fauna, humans, and their inter-relation. Surroundings in this context extend from within an organization to the global system. It comprises the whole complex of living organisms and non-living components surrounding them, and their interrelationships.

Environmental Accounting

An attempt to devise balance sheets to measure economic activity in terms of the cost to the environment.

Environmental Audit

Environmental Auditing is a systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing, with the aim of helping to safeguard the environment. It involves analyses, tests and confirmations of a facility’s procedures and

practices with a goal of verifying whether they comply with legal requirements and internal policies, and evaluating whether they conform with good environmental practices.

Environmental Compliance Audit

Systematic review and testing by professional environmental auditors of the management, production, marketing product development and organizational systems of an enterprise to determine and assess environmental regulations.

Environmental Impact

An assessment and decision process which attempts to determine the impacts of policies, programmes.

Environmental Impact Assessment

Environmental Impact Assessment (EIA) identifies and predicts the impact on the biogeophysical environment and on man's health and well-being of projects and operational procedures, and interprets and communicates information about the impacts. It is carried out before operation commences or when a major change in circumstances is planned.

Environmental Management System

An Environmental Management System (EMS) is that part of the overall management system which includes the organizational structure, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and monitoring the environmental policy. The systems govern how business and industry manage environmental, health and safety compliance and risk. Guidance on the planning and implementation of environmental management systems is given in the ISO 14000 series.

Environmental Management System Audit

The ISO definition of an environmental management system audit is *a systematic and documented verification process of obtaining and evaluating evidence to determine whether an organization's environmental management system conforms to the environmental management system audit criteria set by the organization, and for communication of the results of this process to management.*

Environmental Performance Evaluation

Environmental Performance Evaluation uses standards, methods and environmental performance indicators to measure environmental performance of an enterprise's entire value chain.

Environmental Policy

Environmental Policy is the company's overall aims and principles of action with respect to the environment including compliance with all relevant environmental regulations.

Environmental Reporting

Corporate Environmental Reporting may be destined for an internal audience or for an external audience. It involves the publication of verifiable information on corporate environmental performance, contained either in annual reports or in stand-alone reports. It can be a simple document written for informal, internal education or a detailed document for specific target audiences.

Environmental Technology Assessment (ENTA)

A process where the environmental aspects of a technology are systematically examined. ENTA is a tool used to identify cleaner technologies.

Externality

The cost or benefits occurring to parties other than the supplier and the purchaser of an economic transaction.

Hazop

Operational hazards.

Stakeholders

The entities that will be affected by a particular action or policy.

Sustainability

The definition adopted by the World Commission on Environment and Development is “Development is sustainable where it meets the needs of the present without compromising the ability of future generations to meet their own needs”.

Waste Minimization

The elimination or reduction, to the extent feasible, of a waste that is generated and that would otherwise be subsequently treated, stored or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) reduction of total volume or quantity of the waste or (2) reduction of toxicity of the waste, or both, so long as such reduction is consistent with the goal of minimizing present and future threats to human health and the environment

3.

ENVIRONMENTAL MANAGEMENT SYSTEMS

■ 3.1 SYSTEMATIC ENVIRONMENT PROGRAMMES

The process of establishing a coherent and integrated environmental programme is briefly summarized in this section.

One of the important first steps is to understand the range and diversity of environmental issues to be addressed. The list of issues is longer than many managers at first believe. The relationship between issues is also an important factor, for action on one issue can easily affect the company's performance on another. The preparation of a comprehensive environmental assessment report is thus an important first step.

Some of the specific management elements which contribute to improving environmental performance are shown below.

Some Elements of a Company Environmental Programme

1. Sound policies and clear objectives which define environmental issues and identify the Company approach, e.g. emphasis on prevention rather than treatment;
2. Well-defined operating standards and realistic targets for discharges and site safety;
3. Visible and effective management commitment to environmental protection;
4. Clearly defined line management responsibility and accountability;
5. Adequate resources for the programme;
6. Regular review of environmental performance, e.g. audits;
7. Programmes on training and awareness on environmental risks;
8. Effective incident reporting and investigation;
9. Effective contingency planning for accidents, spills and fires;
10. Reporting systems within the company, and with the public.

While the precise content of a programme has to be determined by each company itself, a number of international organizations, such as the International Chamber of Commerce, have prepared environmental guidelines for their members to follow. The individual management elements may already be included in formal standards for environmental management systems such as ISO 14001.

A further comment concerns financial accounting within the company. Considering the long-term nature of most environmental investments (and avoided liabilities), accounts should consider making more explicit the cost and benefits of environmental protection rather than placing this in the normal operating budget.

Major companies now recognize that a clear statement of their overall environmental policy greatly helps the various initiatives to function in a coherent manner. Such policy is often framed in a simple way to allow easy communication to employees and the public. A more comprehensive implementation document should be available to provide detailed guidance for operational managers.

A policy statement may include principles, objectives, definition of responsibilities, and an outline of the means to accomplish the goals. In addition to reaffirming regulatory compliance, quantitative environmental targets should be given wherever possible. Open reporting and communication is also often included as a policy component.

Major companies also scrutinize the environmental performance of their suppliers and contractors. These in turn, will need to develop their own environmental policies and programmes if they are to keep their larger corporate clients.

The policy and systems will not function without a sound corporate structure that facilitates environmental action in the plant, provides feedback to top management, and responds to issues as they develop. Every company has a different structure and no one reporting and responsibility model can be proposed. Nevertheless some of the common elements are:

- Responsibility for environmental performance at a high level, preferably the chief executive;
- Review of environmental performance by the Board;
- A director with responsibility for environmental coordination;
- An environmental committee to enable input from all levels to be considered;
- Independence at the working level to see that the most appropriate environmental action is taken;
- Good communication up and down;
- Use of environmental specialists for certain tasks;
- Establish technical back-up for some environmental services.

Environmental performance is improved if there is a corporate climate where good operational control is encouraged. Sustaining such a 'culture' is at least as important as maintaining formal systems of reporting and inspection.

■ 3.2 THE ISO 9000 SERIES: QUALITY ASSURANCE

Founded in 1946, the International Organization for Standardization, ISO, has some 111 member national and regional standard-setting bodies. There are currently over 200 technical committees that create and review standards. Once approved, ISO standards may be incorporated into voluntary, national-level technical standards specifications and guidelines. The system seeks equivalence or consistency of product or process testing methods.

In 1987, a number of key nations ratified an agreement recognizing an international quality system standard, the ISO 9000 series. One description of the system reads "ISO 9000 is an international standard for operating a business in a manner that provides quality assurance for goods and services and provides an environment for improvement. It does not guarantee quality. Rather, it provides a system that ensures that corrective action will be taken when an unacceptable event occurs, and that prevention mechanisms are in place to minimize quality problems".

The publication of the ISO 9000 series in 1987, together with the accompanying terminology standard (ISO 8402) has brought harmonization on an international scale. The ISO 9000 series embodies comprehensive quality management concepts and guidance, together with several models for external

quality assurance requirements. The ISO 9000 series standards, in particular those for contractual use (ISO 9001, ISO 9002 and ISO 9003) are being employed by many industries for many different kinds of products and services, in over 70 countries. The choice of the quality system, between ISO 9001, 9002 and 9003 depends on the situation, depending largely on whether development work is required, or not. ISO 9000 is hardly used. ISO 9001 is a model for quality assurance in design, development, production, installation and servicing. ISO 9002 relates to production, installation and servicing and ISO 9003 to the final inspection and test.

The following example concerns the experience of the Fertilizer Division of ICI (UK)¹ (now Terra Nitrogen)

At ICI, design and development activities are effected on a corporate basis. The corporate engineering division therefore sought and obtained certification to ISO 9001. As regards the Fertilizer Division, ISO 9003 was considered too restrictive since it was not just a simple matter of concentrating on the final testing of the product. ISO 9002 could satisfy all the requirements and this was set as the target. There are 18 clauses in ISO 9002. They cover all aspects which are required to demonstrate the supplier's capability to provide Quality Assurance in manufacturing.

The Gulf Petrochemical Industries Co. (GPIC) also chose ISO 9002.

Once a company is certified and registered to an ISO 9000 standard, it receives a certificate and may be listed in a register published by the certification body. The registrar will reinspect the environmental management system on a regular perhaps annual basis. The validity of an ISO 9000 registration certificate is typically from one to three years.

Implementation of the ISO 9000 series is by no means restricted to the developed countries. For example, in India, it has been noted that *"Today, quality management and international trade are among the most important concerns of industry and the government. There is an upsurge of activity in the Indian industry, due to liberalization of the Indian economy and the need to upgrade quality to meet global market requirements. The Import-Export Policy (1992-97) has been tailored to promote the quality of goods and services for boosting exports. This has brought India to the threshold of faster growth and internationally competitive industrial production. (...) If India is to attain and sustain the goals of high quality in its goods and services as an outcome of a liberalized economy, implementation of the ISO 9000 series will go a long way in realizing such goals. The momentum, that has already been generated by a modest beginning to implementation of ISO 9000, must be accelerated to bring under its ambit a large spectrum of the industrial and service activities in this country."* (Source: *Fertiliser News, India, December 1995, Vol. 40 (12), pp. 75-63.*)

■ 3.3 THE ISO 14000 SERIES: ENVIRONMENTAL MANAGEMENT SYSTEMS

Just as it is preferable to catch quality problems at their source, environmental issues are most effectively addressed by a preventative rather than an "end of the pipe" approach. Environmental decision-making becomes an integral part of the management function of the organization. It may not be necessary to set up an independent management system - in certain cases it may be possible to conform with the requirements by adapting elements in the present management system. Each company needs to develop its own approach to EMS, however a number of framework structures have been prepared to guide this process.

¹ "ISO 9002-Four Years of Certification", D.C. Thompson, IFA Technical Conference, Ammam, October 1994.

In 1993, the International Organization for Standardization (ISO) set up a Technical Committee on Environmental Management, TC 207, and a number of sub-committees, to develop standards on a broad range of topics related to environmental management. The standards were to become the “ISO 14000 series of Environmental Management Standards”. Some of the sub-committees relevant to the fertilizer production are:

- SC1. Environmental management systems; Includes ISO14000 and ISO14001.
- SC2. Environmental auditing and related environmental investigations. Includes certification criteria for auditors.
- SC3. Environmental labeling.
- SC4. Environmental performance evaluation.
- SC5. Life cycle assessment. Includes assessments of inputs and outputs through the life cycle, impact assessments for example of residues.
- SC6. Terms and definitions.

In 1996, five standards in the ISO 14000 series were published with the remaining sixteen draft standards scheduled to be published subsequently. The motivation to prepare this group of standards was to introduce uniform requirements for the operation of industrial plants and establish a framework for managing environmental impact. All the standards except ISO 14001 are guidance documents. Companies become registered only to ISO 14001.

The ISO 9001 certificate relates to quality management systems. An ISO 14001 certificate relates to environmental management systems. The objective of the ISO 14000 series is to provide a single worldwide framework for environmental management, in a similar way the ISO 9000 deals with quality. However, while quality management systems concern the customers’ requirements, EMS deal with the requirements of a wide range of interested parties, and with the increasing requirements of society as regards environmental protection.

Companies intending to be certified under ISO 14001 should meet the specific requirements of the standard. The basic activities under the environmental management system, EMS, should be implemented, documented in a special manual, and respective training of all the personnel carried out. The company should apply for registration with an accredited certifying body; the following steps are involved in obtaining the registration:

- Document review
- Assessment/Registration Audit
- Registration
- Surveillance

Many analysts of ISO 14000 and ISO 9000 (the ISO quality system series of standards) believe that the two series of standards will be streamlined in some manner. A joint task force has already been formed by the ISO to study this possibility. Some believe that ISO 14000 will conform to ISO 9000 in theory and structure. It is also possible that the provisions of ISO 14000 might eventually become a portion of the overall ISO 9000 series. Incorporating ISO 14001 into the ISO 9000 series could provide some benefits for companies. In the future, it might be possible to become registered to both standards at once.

Health and safety issues are covered neither by ISO 9000 nor by ISO 14000. Their possible inclusion in the ISO 14000 series is under consideration.

ISO has published a brochure to help organizations choose the combination of ISO 14000 environmental management standards that best meets their needs.

The brochure lists 21 published standards, technical reports, guides and documents under development that make up the ISO 14000 family, as well as other ISO 14000 publications by ISO. The ISO brochure also includes a classification of the ISO 14000 family according to the following applications:

- at the organizational level (implementing EMS, conducting environmental auditing and related investigations, and evaluating environmental performance);
- to products and services (using environmental declarations and claims, conducting life cycle assessment), addressing environmental aspects in product standards, and understanding terms and definitions).

ISO 14000 - Meet the whole family!, 12 pp., is available from ISO's national member institutes and the ISO Central Secretariat, whose address is given at the end of this publication.

**Table of Contents of ISO 14001:
Environmental Management Systems - Specification with Guidance for Use**

1. Scope
2. Normative references
3. Definitions
4. Environmental management system requirements
 - 4.1 General requirements
 - 4.2 Environmental policy
 - 4.3 Planning
 - 4.3.1 Environmental aspects
 - 4.3.2 Legal and other requirements
 - 4.3.3 Objectives and targets
 - 4.3.4 Environmental management programme(s)
 - 4.4 Implementation and operation
 - 4.4.1 Structure and responsibility
 - 4.4.2 Training, awareness and competence
 - 4.4.3 Communication
 - 4.4.4 Environmental management system documentation
 - 4.4.5 Document control
 - 4.4.6 Operational control
 - 4.4.7 Emergency preparedness and response
 - 4.5 Checking and corrective action
 - 4.5.1 Monitoring and measurement
 - 4.5.2 Nonconformance and corrective and preventive action
 - 4.5.3 Records
 - 4.5.4 Environmental management system audit
 - 4.6 Management review

■ 3.4 EUROPEAN ECO-MANAGEMENT AND AUDIT SCHEME, EMAS

EMAS, the Eco-Management and Audit Scheme, was set up by an EU Regulation of 29 June 1993. The purpose is to promote spontaneous, continuous improvements in the environmental performance of the industry. This is to be achieved through the establishment and implementation by the companies themselves of an environmental policy, programmes and management systems in relation to their sites. Participants in the scheme must:

- adopt a company environmental policy
- conduct an environmental review of the site
- introduce an environmental programme on the basis of the review
- carry out environmental audits
- set objectives for the continuous improvement of their environmental performance.

These elements must be verified by an accredited environmental verifier, and the company must draw up an environmental statement to be validated by the verifier. The statement must be designed for and available to the public. Around 700 companies throughout the EU participate in this scheme.

Companies taking part in the European EMAS scheme must have their own environmental management system, carry out regular environmental audits, issue an environmental statement (for example in the form of an annual environmental report) and have this report verified by an independent auditor. Companies that meet these requirements are registered as participants for a maximum period of three years.

The European Commission has launched an Internet site for EMAS (<http://www.emas.lu>). It offers up-to-date lists of EMAS-registered sites and accredited verifiers. It also provides information on the standards and other relevant information.

EMAS and ISO 14000

EMAS is a regulation developed to meet the needs and expectations of governments, citizens and consumers in the EU member States. The ISO 14000 standards, by contrast, rely on voluntary acceptance by all interested parties. EMAS applies only to manufacturing industry. The ISO standards apply to all types of organizations.

There are difference in their origin and purpose. The ISO standards are voluntary instruments, intended for use in countries at all stages of economic development, under a wide range of governmental systems. EMAS is a regulation developed for the EU Member States, to be incorporated in their laws. It can therefore take a more prescriptive approach to environmental issues than ISO 14000, which relies on voluntary acceptance by all interested parties.

The environmental management system in EMAS is in fact very similar to that described in the ISO 14000 series, but there is one fundamental difference: sites that conform to EMAS are obliged to report publicly on the results of regular audits which must be verified externally. Such reporting is not required under the ISO standard.

The EMAS requirements that fall outside the scope of the ISO 14000 standards are:

- the production of an environmental statement
- independent verification of its EMS and environmental statement
- communication of the validated environmental statement to a central registry maintained by the Competent Body

- communication of its environmental statement to the public.

While ISO standards allow self-declaration of EMS compliance, this is not an option under EMAS.

For organizations operating in EU countries which wish to be verified to EMAS, an ISO 14001 registration/certification will cover most of the requirements that relate to its EMS. To facilitate the use of ISO 14001 to achieve EMAS recognition, CEN/PC7 has developed a “bridging document”. EMAS requires that companies make relevant environmental information available to customers, the public and authorities in the form of a published, validated environmental statement. ISO 14001 does not require this. The “bridging document” is intended to incorporate this into the ISO 14001. EMAS also requires that contractors working on the site apply environmental standards equivalent to the company’s own; users of ISO 14001 will need to incorporate this requirement into their system.

The bridging document suggests that users of ISO 14001 ensure that they can demonstrate that they have conducted an environmental review which has addressed the relevant issues in EMAS. Other differences include the place of environmental performance measurement within an environmental audit, the frequency of audits, and the emphasis placed on “economically viable application of best available technology”.

* * * * *

Environmental management systems need to be audited to ensure they are functioning correctly. See section 4.5.

4. ENVIRONMENTAL MANAGEMENT TOOLS

The Environmental Management System (EMS) sets the management framework, the tools help in undertaking various environmental tasks as required by the environmental programme.

■ 4.1 ENVIRONMENTAL IMPACT ASSESSMENT

The role of Environmental Impact Assessment (EIA) is to contribute to the planning of a new operation or major alterations of an existing one. The systematic consideration of environmental impacts, which is the main feature of EIA, often leads to the identification of alternative engineering or siting options and/or mitigating measures. As a result, EIA can have a major positive influence on the project design.

EIA has been neglected as a company management tool - it is helpful in process optimization, to guide the monitoring and auditing and reporting programmes, and so on. The EIA should become one of the basic factors in an EMS.

Often, undertaking an EIA is a legal requirement for a company before it can receive planning permission or a permit to operate a major installation.

A major benefit of a formal EIA is that it provides environmental baseline information and prediction of impacts against which future operations can be periodically audited.

The final planning permit or site license for the plant will usually reflect the results of an EIA. Such a license will specify a number of conditions concerning site preparation, layout, and equipment. Day-to-day management requirements are more likely to be specified in an operating permit.

Carrying out an EIA requires some environmental expertise and insight in addition to technical knowledge concerning the project itself. For major projects a multi-disciplinary team is usually assembled to research further information, evaluate impacts, and propose practical alternative options. Local public authorities are often good sources of information and should be involved in the EIA.

The cost of an EIA depends on its complexity. One of the first steps in the process is a scoping study to see what an EIA should cover. Generally the cost of project delay due to a badly managed EIA is more important than the cost of the study itself.

The following steps should be included, to the extent and at the level of detail appropriate to the size of the project:

- Establish an environmental profile of the site,

- Describe project activities (including discharges, wastes and emissions),
- Assess likely environmental impacts of project activities, and incorporate them in the revised project.

Physical environmental impacts considered in EIA typically include:

- climate and air quality,
- water, including groundwater,
- geology and soils,
- ecologically sensitive areas and habitats,
- land-use and surrounding activities,
- noise, vibration and radiation,
- visual quality.

The socioeconomic factors may include:

- population and demographic impacts,
- land-use and settlement,
- cultural and historical features,
- local economic structure,
- transport aspects.

A review should also examine the environmental services in the area, such as wastewater treatment, safe landfill, competent contractors, etc.

Reports to be used for environmental assessments should be concise, limited to significant environmental issues, and aimed at informing project designers and project decision-makers, including financiers. The level of detail should again be commensurate with potential impacts.

The following text is extracted from the IFDC/UNIDO Fertilizer Manual¹.

“An Environmental Impact Assessment (EIA) and a document entitled “Environmental Impact Statement (EIS)” are the instruments of risk management at the enterprise or regional levels.

Objectives of EIA (EIS)

All chemical installations should be subject to a periodical environmental impact review. The frequency of the evaluation is established either by law or by internal company regulations. The EIA becomes an EIS when it is formally released by the company to the controlling government organizations.

The objectives to be achieved by conducting an EIA are as follows:

1. Determine the achieved level of protection of man and the environment.
2. Identify discrepancies and their sources relative to established legislation and internal rules.
3. Analyze emergency cases and check implementation of the recommendations.
4. Check the implementation of related policies and decisions.
5. Determine necessary adjustments and provide information on justification and the efficiency of their implementation.

¹ *Fertilizer Manual*. IFDC and UNIDO. Kluwer Academic Publishers, Dordrecht, the Netherlands, 1998.

6. Provide a basis for recognizing good and inadequate performance.
7. Demonstrate management's commitment to environmental protection and provide motivation for improvement.
8. Provide information on achievements in environmental protection to public authorities and community shareholders.
9. Provide input into the company's education and training activities.

Methodology

The EIA process is often a real problem for managers who do not understand how to supervise the process, including any public review stage that may be required.

The methodology of the EIA preparation differs from company to company depending on its size and organizational system. The three basic methodological approaches to determine the preparation of the EIA are as follows:

1. In large companies a special safety or environmental department assumes the responsibility for preparing a regular EIS.
2. In medium-size companies a task force is convened; this group is composed of the operational staff, safety staff, and maintenance staff under the responsibility of a technical manager.
3. In small companies a specialized auditing company may be contracted; however, in this case participation of the local staff is crucial for the success of the study and implementation of the recommendations.

In all cases the group should be given access to all technical documentation, environmental reports, and regular water and air analysis results, reports of technical deviations, accident reports, and all legislative background related to factory operations.

Group members during the period of EIA preparation should be freed from their everyday functions and responsibilities.”

Procedure for and Content of EIA (EIS)

A unified, obligatory format of the EIA does not exist. Countries that introduced the regular auditing obligation only recommended general issues that should be reported in the EIA. A format of an Executive Summary also is suggested in the *Fertilizer Manual*. It can be adjusted to local conditions, technical culture, and management rules to comply with the objectives of EIA. The main sections are as follows:

1. Review of the legislation and internal company rules.
2. Review of statistical data.
3. Review of the technological process.
4. Emissions, effluents and disposal - This chapter describes the present situation outside the factory area at the local control points.
5. Economic and financial analysis.

Application of EIA/EIS

The cost of preparing an EIA/EIS is high. Considering that an installation of average complexity includes 60-100 pieces of equipment, thousands of valves and fittings, and processes three to ten substances, the process review may require 3-6 months and cost approximately US\$ 60,000-US\$ 100,000. Therefore, legislation must consider this cost.

Widening the scope of the EIA would involve very little extra time and cost of preparation. In the meantime the costs of the EIA preparation may be considered part of the investment cost of a newly

revamped installation; consequently, every company may easily find the necessary financial resources (own or credit facilities). This is also valid for Eastern and Central European countries with economies in transition when they are looking for strategic investors to change their production strategy. Therefore, the preparation of the EIA study should be combined with the restructuring program of an industrial enterprise.

■ 4.2 RISK ASSESSMENT

The European Commission draws a clear distinction between the concepts of risk assessment and risk management:

- Risk assessment is a scientifically based process consisting of the identification and characterization of hazards, the assessment of exposure and the characterization of the risk.
- Risk management, on the other hand, is the process of weighing policy alternatives in the light of the results of risk assessment and, if required, selecting and implementing appropriate control options, including regulatory measures.

While the task of risk assessment remains the responsibility of the regulatory authorities, the task of risk management remains the responsibility of the regulatory authorities.

In the USA, the US Fertilizer Institute, TFI, organizes seminars on risk management, emergency preparedness, and community outreach. The first seminar was held in late March 1997 in Kansas, attended largely by presidents and environmental heads of multi-outlet companies. Each seminar includes copies of TFI's Risk Management Guidance for Retail Facilities and Operation Outreach manuals. The seminar has 3 parts:

1. Preparation of a site-specific risk management program.
2. Emergency response requirements
3. Operation Outreach guidance, to inform the community.

The US Environment Protection Agency, EPA, also is mounting programs, including workshops on RMP requirements.

The US *The Presidential/Congressional Commission on Risk Assessment and Risk Management*, Final Report. Volume 1. 1997, states: "Risk management is the process of identifying, evaluating, selecting, and implementing actions to reduce risk to human health and to ecosystems. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce or prevent risks while taking into account social, cultural, ethical, political, and legal considerations."

Risk is defined as the probability that a substance or a situation will produce harm under specified conditions. Risk is a combination of two factors:

- The probability that an adverse event will occur (such as a specific disease or type of injury)
- The consequences of the adverse event.

Risk encompasses impacts on public health and on the environment, and arises from exposure and hazard. Risk does not exist if exposure to a harmful substance or situation does not or will not occur. Hazard is determined by whether a particular substance or situation has the potential to cause harmful effects.

In the USA, proponents of risk analysis believe that federal programs should be carefully targeted to address the worst risks to health and the environment first. Others favour regulating to achieve risk

reduction in more cost-effective and flexible ways that minimize overall economic impacts. They argue that regulations are appropriate only when the risk reduction achieved is worth the cost. Proponents also believe that increased use of risk analysis would ensure that agency decisions were rational and based on sound science.

Opponents of risk legislation argue that excessive reliance on risk analysis, especially quantitative analysis, to evaluate problems and solutions ignores other equally important facets of policy decisions. Critics charge that quantitative methods cannot assess very long-term or newly discovered threats. They also believe that quantitative cost-benefit analyses undervalue environmental and health benefits, exaggerate costs, and focus on relatively widespread but individually small costs and risks rather than on much larger costs and risks to smaller, and often more vulnerable, groups.

Many who promote the use of risk analysis acknowledged that it has limitations, but they believe these can be overcome through data collection, research, or the establishment of guidelines for the consistent conduct of analysis and presentation of results.

Under ideal conditions, a risk analysis gathers, organizes, and summarizes all of the important information relevant to hazard management. It includes qualitative as well as quantitative information about the characteristics of the hazard, exposed population, potential effects, and available management strategies. It describes scientific uncertainties. It provides a range of forecasts based on alternative, scientifically plausible assumptions about the relationship between exposure to the hazard and potential health or environmental effects.

A good risk management decision addresses a clearly articulated problem in its public health and ecological context. It emerges from a decision-making process that elicits the views of those affected by the decision, so that differing technical assessments, public values, knowledge, and perceptions are considered. It is based on a careful analysis of the weight of scientific evidence that supports conclusions about a problem's potential risks to human health and the environment. And it is made after examining a range of regulatory and non-regulatory risk management options.

A risk management decision reduces or eliminates risks in ways that:

- Are based on the best available scientific, economic, and other technical information.
- Account for their multi-source, multi-media, multi-chemical, and multi-risk contexts.
- Are feasible, with benefits reasonably related to their costs.
- Give priority to preventing risks, not just controlling them.
- Use alternatives to command-and-control regulation, where applicable.
- Are sensitive to political, social, legal, and cultural considerations.
- Include incentives for innovation, evaluation, and research.
- Can be implemented effectively, expeditiously, flexibly, and with stock-holder support.
- Can be shown to have a significant impact on the risks of concern.
- Can be revised and changed when significant new information becomes available, while avoiding “paralysis by analysis”.

■ 4.3 LIFE-CYCLE ASSESSMENT

Life-Cycle Analysis (LCA) is a method used to quantify the environmental burden of a product process or activity on the basis of an inventory of environmental factors from the extraction of raw materials until their final disposal (or subsequent reuse or recycling as defined within the scope of a given study). Occupational health impacts and environmental factors include the consumption of raw materials and energy and emissions to air and water.

Life-Cycle Assessment is a qualitative interpretation of the results of life-cycle analysis. It is typically derived by undertaking the classification and valuation of a life-cycle analysis inventory. Life-cycle assessment seeks to determine the associated qualitative effect on environmental concerns such as global warming, ozone depletion and acidification.

K. Oren (1997)² reported Norsk Hydro's experience to date of life-cycle analysis. He noted that a fertilizer life-cycle analysis implies an evaluation of the environmental impact from raw material extraction through fertilizer production, packaging, transport, fertilizer application, harvesting and use of harvest, ultimate disposal of wastes, and recycling of nutrients.

In Norsk Hydro there were three phases:

1. Clean up actions and end-of-pipe treatment
2. Cleaner technology and operational excellence.
3. Today applying all our experience to and expertise to the life-cycle aspect of our products.

Life-cycle analysis, or assessment, refers to specific tools and methods used for putting the life-cycle approach in to practical, workable quantities. The European work has to a great extent been on methods. Life-cycle inventory is a way of collecting and systematizing all input and output data relating to emissions, wastes and other categories chosen. Most efforts are related to step three, above - to bring the complex issue of emissions and energy use into a system where some few indicators concentrate the most significant information in a reliable way.

References: *Life-Cycle Assessment: what it is and how to do it*. CP14. UNEP, Paris, 1996.
ISO 14040-43. Life-Cycle Assessment.

■ 4.4 MONITORING AND INCIDENT REPORTING

Monitoring may range from a few simple measurements to comprehensive statistical sampling and analytical programmes. Measurements may be made visually or with manual equipment, or rely on sophisticated instrumentation. The way in which samples are taken is as important as the quality of the measurement itself. The numerical results must be correctly interpreted and presented in an appropriate form.

Monitoring helps the plant manager to optimize the use of raw materials and energy during production. It leads to the generation of smaller amounts of discharges, emissions and wastes, and it is an essential element in the cleaner production approach to environmental management.

Guidance on monitoring is given in the UNEP/UNIDO Technical Report No. 27, "Monitoring Industrial Emissions and Wastes", UNEP, Paris, 1996.

² Oren K. (1997). *Life-cycle analysis: an update of the industry's efforts*. In Plant Nutrition in 2000, IFA, Paris. Another Norsk Hydro paper, by J. Kesters and T. Jennsen, *Selecting the right fertilizer from an environmental life-cycle perspective*, IFA Technical Conference, Marrakech, 1998, also refers.

4.4.1 Monitoring Objectives

Process Optimization

Information from measurements can be used to optimize a process, in order to maximize output of a product, improve or maintain its quality, and minimize waste emissions into the environment. The parameters that are monitored include air emissions, discharges, water and energy use etc.

Auditing

Auditing consists of a short campaign which is more intensive than usual process monitoring. Its purpose is to support a diagnostic study of process efficiency. As it is often carried out to reduce loss of materials to the environment, it tends to focus on input-output parameters.

Compliance with Emission Standards

Routine monitoring is often used to identify and quantify plant emissions, as a check on compliance with emissions standards or discharge consent requirements.

Quality Control

Monitoring of raw materials and inputs to a process is often a prerequisite for efficient operation. Inspection of finished products may also reveal process inefficiencies that lead indirectly to the identification of process losses.

Occupational Health and Safety

It is most important that monitoring should be carried out in work places where there is risk of exposure of personnel to hazardous substances.

Environmental Reporting

Monitoring is necessary to prepare an environmental report which should preferably include emissions to the environment compared over several years. Some governments require regular reporting of discharges and emissions.

4.4.2 What Should be Monitored?

The general, broad areas include the following:

- within a plant
 - the industrial processes,
 - input materials and energy,
 - discharges of residues;
- outside the plant
 - releases to the environment,
 - environmental quality and ecological impact.

4.4.3 Incident Reporting

Both EFMA and IFA have “Incident Reporting Schemes”. The main objective of these schemes is to learn from significant incidents and to share this information in order to prevent future incidents and improve safety.

The term “incident” covers accidents and deliberate acts, giving rise to hazardous situations. The term “significant” is used to mean major, potentially major, incidents from which important conclusions can be drawn, or incidents which significantly affect members of the public or with medical consequences.

■ 4.5 ENVIRONMENTAL AUDITING - THE MANAGEMENT SYSTEM

□ 4.5.1 Environmental System Audit

The environmental system itself should be reviewed, or audited, on a regular basis. An environmental audit is a systematic, documented, periodic and objective evaluation of how well the environmental organization, management and equipment are performing. Audits are one of the key elements of an EMS, and they can be considered as management tools to collect and analyze information on operating plants, which could be compared over several years and measure environmental performance.

An audit is not an attempt to lay blame for failures, it is an examination of the system to determine why failures occur, and then encourage participation to improve the system. Most companies keep the results confidential and for internal usage.

Many audit procedures have been developed by companies, consultants and national authorities. At the international level, the ISO 14000 series provides guidelines on environmental auditing. ISO 14010 provides the general principles of environmental auditing, applicable to all types of environmental audit. ISO 14011 establishes audit procedures. ISO 14012 provides guidance on qualification criteria for environmental audits. It is applicable to both internal and external auditors.

Audits are helpful in:

- facilitating management control of environmental practices;
- assessing compliance with company policies, including meeting regulatory requirements.

Benefits of an Audit

Experience shows that environmental audits can also have a number of other benefits, including:

- increasing employees’ awareness of environmental policies and responsibilities,
- identifying potential cost savings, including those resulting from waste minimization,
- evaluating environmental training programmes,
- providing an information base for use in emergencies and evaluating the effectiveness of emergency response arrangements,
- enabling management to give credit for good environmental performance,
- assisting relations with authorities by making them aware that complete and effective audits are being undertaken, and by informing them of the types of procedures adopted,
- facilitating insurance coverage for environmental impairment liability.

One important reason for an audit is to monitor regulatory compliance. Compliance audits include a comparison of the current operation with applicable laws and regulations (standards). Compliance auditing is sometimes required for amendment of permits and licensing, and it is frequently included in wider environmental audits.

In addition to regulatory compliance and management system auditing, specific technical audits of energy consumption, waste and pollution sources, and site contamination are possible. Each technique has its own application and method which is described in appropriate operations manuals.

□ 4.5.2 Audit Procedures

Audits may be carried out in-house by a company audit team, or by external auditors familiar with environmental issues. External auditors are arguably less able to recommend solutions to operating problems since they do not understand the plant as well as employees. On the other hand, they are often able to bring a fresh approach and additional technical experience to the problem.

A large number of companies already carry out internal audits, and numerous institutes and associations conduct training courses for their members.

Audit activities can be subdivided in the following phases:

- preparing the audit,
- executing the audit,
- reporting.

Preparing the Audit

The audit is conducted under the responsibility of an environmental manager who assigns the tasks to be performed by each audit team member. The manager establish an audit plan for every plant to be checked and which concentrates on the environmental risk areas in the plant.

The plan should include:

- environmental risk areas and high priority items,
- audit scope, objectives and criteria,
- details of units and individuals to be visited and interviewed,
- important reference documents,
- time, duration, places of the audit and meetings,
- language and confidentiality requirements,
- reporting issues and document retention requirements.

Executing the Audit

Experience has shown that it is essential to have a formal opening meeting between the audit team and the plant managers. The meeting offers an occasion to discuss the audit plan and the audit procedures. The plant managers should also provide essential information on improving working conditions and preventing accidents.

Then the audit team collects and compiles data from the company internal documents. The information obtained should be completed and verified by a plant inspection tour. The audit finding are then submitted again to the plant managers to obtain acknowledgment about the factual basis.

Audit Reporting

The environmental manager is responsible for the audit report. The report may include the following subjects:

- the audit team, audit period,
- the scope, objectives, criteria, reference documents,
- the audit plan,
- summary of audit process,
- the period covered,
- confidentiality, distribution list,
- audit conclusions based on the audit findings.

According to the conclusions obtained, existing plans and targets should be revised and adapted. It is up to the plant manager to decide on the follow-up of the audit. The frequency of the audit will depend on the size and complexity of the operations. For example for a high risk operation, one where the management system is new, it would be appropriate to audit the system annually. For a low risk operation, a full audit may be undertaken every three years.

■ 4.6 ENVIRONMENTAL AUDITING - TECHNICAL AUDITS

□ 4.6.1 Objectives of a Technical Audit

Natural resources:

- make a better use of non-renewable natural resources,
- use the least environmentally damaging raw materials.

Energy:

- reduce energy consumption according to the targets defined.

Emissions and solid wastes:

- locate dysfunction (spills, emissions) which occur during the process and prevent new ones,
- minimize emissions to a financially acceptable level, in particular dust, NO_x, SO₂ and CO,
- minimize solid wastes at the source and during operation.

Safety and health:

- analyze the working conditions, improve them and reduce health risks,
- increase employees' awareness of environmental policies and encourage them to participate in their development,
- introduce training programmes for employees at every level of the company,
- establish emergency plans,
- prevent any accident.

Technical audits may also be carried out on other facets, such as;

- site audits,
- health and safety audits, etc.

□ 4.6.2 Waste Audits

A waste audit is a process by which the sources of all emissions and wastes within a plant are identified. This technique is an important way of identifying waste minimization opportunities. Waste minimization can have both economic and environmental benefits. The waste audit steps are listed below, and explained in more detail in the UNEP/UNIDO technical guide entitled "Audit and Reduction Manual for Industrial Emissions and Wastes".

The phases recommended by UNEP/UNIDO (1998) are shown in figure 4.1.

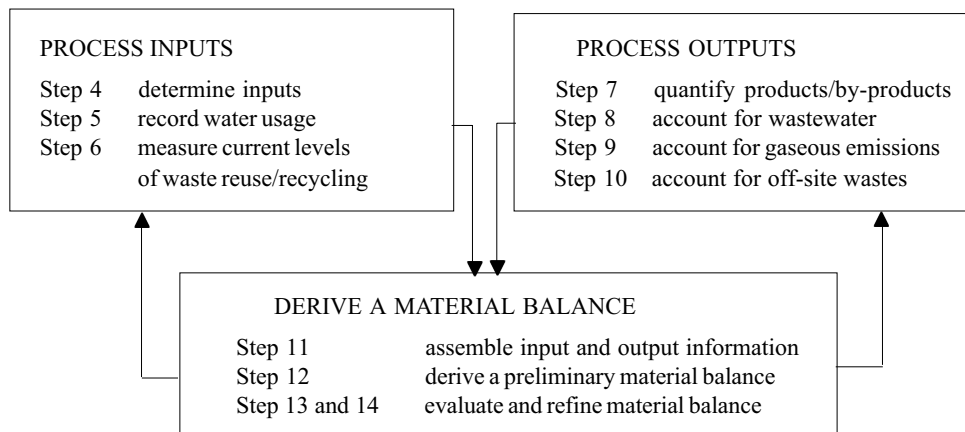
► **Figure 4.1** *Quick reference audit guide*

PHASE 1: PREASSESSMENT

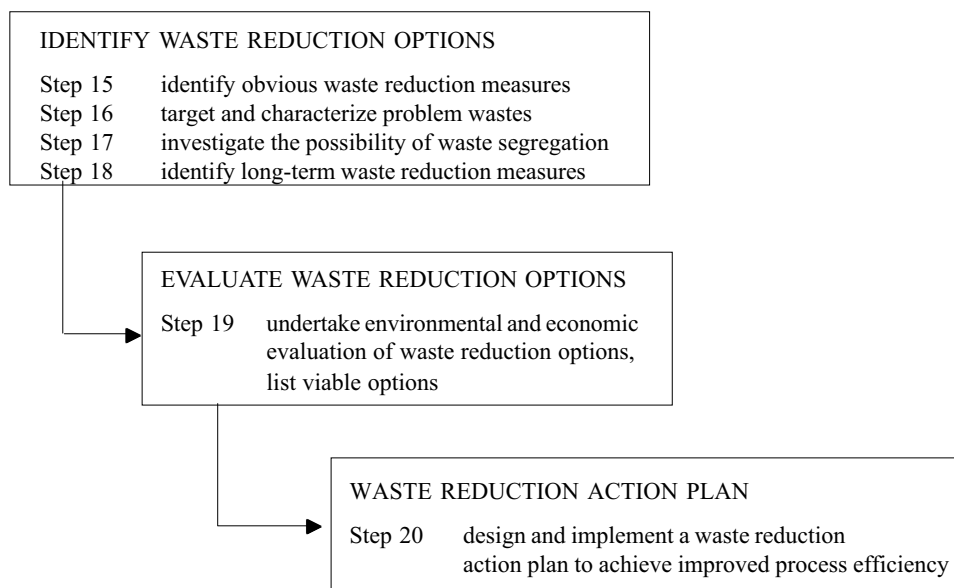
AUDIT PREPARATION

- Step 1 prepare and organize audit team and resources
- Step 2 divide process into unit operations
- Step 3 construct process flow diagrams linking unit operations

PHASE 2: MATERIAL BALANCE



PHASE 3: SYNTHESIS



4.6.3 Energy Audits

A detailed study of energy use can be well worthwhile for many plants. Energy consumption can often be reduced by adopting more efficient operating procedures and equipment.

There is a double benefit to such a study. Not only does it identify major cost-savings to the company, it also reduces a number of indirect environmental impacts from transport of fuel, and CO₂ emissions from fuel use. CO₂ is the major greenhouse gas implicated in global warming, and a number of legislative measures will soon be aimed at reducing such emissions from industry.

Energy audits are similar in concept to other audits. Careful preparation, a rigorous methodology and subsequent follow-up, remain the keys to success. Subsequent to the audit, it is, of course, necessary to identify appropriate conservation measures.

Procedure for energy audits

Phase 1. An audit of historical data

Collect and analyze company records of energy use to determine:

- the cost and physical quantities of energy inputs used,
- annual and seasonal trends in energy use and cost,
- the energy use per unit of output.

Phase 2. The screening survey

Undertake a screening study of energy use in the operation. This will be a fairly quick, low cost preliminary investigation of an operation using existing data to indicate:

- major energy consuming plant and processes,
- obvious energy waste and inefficiencies,
- gaps in the metering and reporting of energy use,
- priority areas for investigation of inefficient or inappropriate energy systems.

Phase 3. Detailed Investigation and analysis

Processes or plant identified by the screening survey as justifying further investigation will have to be examined in order to determine the size of avoidable energy losses and the cost of reducing waste.

Detailed surveys may incur considerable cost and/or time, therefore it is vital to select only those processes, areas or plant which are most likely to yield significant cost-savings for a reasonable effort.

Source: National Energy Conservation Programme, Australia.

4.7 CORPORATE ENVIRONMENTAL REPORTING

4.7.1 Introduction

There is a direct relation between citizen access to information and environmental quality. The Brundtland Report, endorsed by the United Nations General Assembly in 1987, recommends that governments recognize: “the right of individuals to know and have access to current information on the state of the environment and natural resources, the right to be consulted and to participate in decision making on activities likely to have a significant effect upon the environment”

Reporting is the stage at which environmental information is prepared and submitted for review. Reporting closes the management loop by giving the company an overview of how it is performing, outlining areas for improvement, and searching for the solutions to achieve these. Public reporting is becoming an important management instrument in some countries. It communicates to government, investors, and the general public what is happening at the site, and any further action the company needs to undertake. Public reporting often provides a useful focus for dialogue with public groups, and for dealing with lending agencies and insurance companies.

4.7.2 Target Audience and Benefits of Reporting

There is a wide audience which is interested in environmental reporting at different levels and for different reasons. The target audience and their interests are:

- **Directors**
- **Employees**
 - are assured that they are working in an environmentally responsible company
 - are encouraged to participate in the environmental developments
- **The financial community (shareholders, investors, lenders, ...)**
 - considers that environmental reporting is good management from an economic point of view
- **Governments/environmental authorities**
- **Local residents and the media**
 - are paying attention to companies' environmental and safety performances
- **Private and professional customers**
 - increasingly tend to discriminate against environmentally harmful and unsafe products.

4.7.3 The Environmental Report

A variety of communication tools can be used to release information about environmental performances, depending on the type of information to be communicated and on the type of audience. One of the communication tools the company may use, is the external environmental report. An environment report permits the direct communication of the company's activities on the environment, safety and health, to employees and to the outside world, and demonstrates the importance the company attaches to environmental issues.

The company may want to communicate information such as:

- general information on the activity and the products of the company,
- an assessment of the significant environmental issues of relevance to the activities concerned,
- the environmental policy,
- internal environmental management processes,
- description of EMS,
- environmental performance,
 - pollutant emissions (preferably in mass terms rather than pollutant concentrations, which can be misleading),
 - waste generation,
 - resource consumption (raw materials, water, energy),
- compliance aspects,
- targets achieved or not achieved, details of improvements and of lack of improvements,
- medium and long term projects, etc...

As with other aspects of environmental management, top management commitment to communicate and dialogue with interested parties is a pre-requisite for environmental reporting. Responsibility for environmental reporting also needs to be assigned at an appropriate level in the company.

An account of the present situation on environmental reporting is given in the UNEP Technical Report No. 24 “Company Environmental Reporting”.

It is important to recognize that environmental reporting is a long-term commitment. Once an enterprise has published a report, expectations are that this will continue, and credibility may be lost if it is seen as a mere exercise in public relations. It is better to consider a longer period between reports and to communicate this to the target audience than to say nothing.

In future, the consequences for a large company of not reporting may be considerable, taking into account current market thinking and the demands of investors, banks and insurance companies. As well as being an integral part of a well-functioning environmental management system, it seems likely that, over the next years, environmental reporting will become a part of normal annual reporting for most companies.

4.7.4 “Right to know” USA

The following text is extracted from “Emergency Planning and Community Right-to-Know Act” by P.L. Gray and C.S. Leason, in *Environmental Challenges of Fertilizer Production - an Examination of Progress and Pitfalls*, IFDC International Workshop, Atlanta, September 1997.

In 1986 the US Congress enacted the Emergency Planning and Community Right-to Know Act (EPCRA). The two principal components are the emergency planning program and the routine reporting requirements. Almost all facilities that manufacture, use, or store numerous hazardous substances in any significant quantity are subject to some or all EPCRA’s emergency planning and routine reporting obligations. During the past three years, the focus of the U.S. Environmental Protection Agency’s attention regarding EPCRA has been on the toxic release reporting requirements. Under EPCRA, facilities that handle “toxic chemicals” in excess of specified thresholds must estimate the amount released into the environment during a calendar year and report this to EPA or state authorities.

EPCRA has three major planning provisions, intended to enable communities to respond to, and protect its citizens from accidental release of hazardous substances. State and local bodies must establish and publish plans for responding to emergencies involving the release of hazardous substances. These must be reviewed annually. The primary objectives of the emergency plan are to:

- identify facilities that handle extremely hazardous substances
- evaluate methods and procedures to be followed by a facility to respond to a release on an extremely hazardous substance
- designate a community emergency coordinator and facility emergency coordinators to implement the plans
- train emergency response and medical personnel.

The facilities must provide information regarding the nature and amount of substances handled and facilities that exceed or equal a threshold planning quantity of an extremely hazardous substance must report the fact and participate in community emergency planning.

EPCRA requires owners and operators of facilities to report emergency releases of hazardous substances.

In addition, there are three periodic reporting obligations intended to inform the public about the danger

presented by hazardous substances handled by industrial facilities in their communities. Any facility required to have a safety data sheet for a hazardous chemical, pursuant to OSHA (Occupational Safety and Health Administration), must submit a copy to state and local authorities. An annual inventory report must be submitted, and also to the local fire department, by March 1 of the following year. Also facilities in certain designated SIC codes (Standard Industrial Classification) having ten or more employees are required to report annually the amount of certain toxic chemicals that they have manufactured, processed or otherwise used during the previous year.

Releases are recorded in a data base which is available to the public and this has led companies to voluntarily reduce discharges to avoid unwanted media scrutiny, especially since a public interest group lists facilities in descending order of quantity of toxic chemicals released, providing material for a "Top Ten Polluters" list.

In order to list a chemical, EPA must show that it "is known to cause or can reasonably be anticipated to cause significant adverse acute human health effects at concentration levels that are reasonably likely to exist beyond facilities' site boundaries a result of continuous, or frequently recurring, releases, either because of its toxicity or its toxicity and persistence in the environment."

When EPCRA was enacted in 1986, it identified 309 individual chemicals and 20 chemical categories in the initial toxic chemicals list, the TRI (Toxic Release Inventory). In November 1994 a further 286 chemicals were added.

In 1997 EPA expanded EPCRA to include facilities in non-manufacturing industry groups, including mining, waste treatment and wholesale facilities.

EPA also gave advance notice in January 1997 of a new "materials accounting" element to reporting requirements. Thousands of companies which would be subject to this requirement protested, in view of the cost and the potential loss of trade secrets.

The most significant litigation in recent years has involved challenges to EPA's expansion of the list of chemicals.

EPA may seek civil penalties up to \$27500 for each violation and \$27500 for each continuing day of violation. EPCRA also provides for criminal penalties. Also private parties have the authority to bring civil actions.

4.7.5 Corporate Benchmarking

Canada

The Canadian Fertilizer Institute, CFI, an association which represents Canada's fertilizer manufacturers and most major distributors and dealers, publishes the emission reported by its members. In Canada releases of pollutants are reported to Environment Canada, which issues a "National Pollutant Release Inventory".

Europe

In compliance with EU laws regulating information, surveys that are based on confidential information are prepared for the European Fertilizer Manufacturers' Association, EFMA, by a fiduciary company. Members receive aggregated production figures, a production cost survey and a summary of their combined financial performance each year. In addition, the fiduciary company collects monthly delivery figures from the members, compiles the EFMA Environmental Report (a survey of the emissions produced by the members' ammonia, nitric acid and fertilizer plants) and the cadmium statistics, which contain information about the cadmium content of EFMA members' deliveries of P₂O₅ containing fertilizers to

EFMA countries and enable the members to monitor their self-imposed cadmium limit. The latest survey, published for the first time in 1998, is an energy survey which quantifies the energy consumed in the production of intermediates and finished fertilizers, thus providing the members of EFMA with a useful bench-marking tool.

India

The Fertiliser Association of India, FAI, began to assemble information on emissions and discharges in 1998. It is the first group of fertilizer producers outside the developed world to initiate such benchmarking.³

USA

In the USA releases of pollutants into the environment are reported to the states' Departments of Environmental Quality, which publishes an annual "Toxic Release Inventory" (TRI) report (NPRI). Under the Toxic Release Inventory (TRI) regulations in the USA, companies are required by law to report on the quantities of over 300 chemicals that may be emitted during the year. The monitoring report is available to the public. While TRI does not limit the role of pollutants per se (this is done under other regulations) the compilation and publication of such monitoring data strongly influences a company's attitude to its emissions.

³ B. Swaminathan and M. Goswami. *Benchmarking of emissions from nitrogenous fertilizer plants: Indian experience*, IFA Technical Conference, Marrakech, 1998

5. ENVIRONMENTAL APPROACHES

■ 5.1 CLEANER PRODUCTION, ECO-EFFICIENCY, GREEN PRODUCTIVITY AND POLLUTION PREVENTION

The concept of Cleaner Production (CP) was introduced by UNEP in 1989. Cleaner Production is the continuous application of an integrated preventative environmental strategy applied to processes, products and service to increase eco-efficiency and reduce risks for humans and the environment. It applies to:

- production processes: conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity and toxicity of all emissions and wastes,
- products: reducing negative impacts along the life cycle of a product; from raw materials extraction to its ultimate disposal,
- services: incorporating environmental concerns into designing and delivering services.

UNEP's International Declaration on Cleaner Production, which is supported by IFA, is given in Appendix 9.3.

This International Declaration is a statement of commitment to the practice of a specific preventative environmental management strategy, Cleaner Production, to systematically reduce pollution and improve efficiency in resource use. The specific goals of the declaration are :

- To spread the awareness of the urgency of current environmental problems and the concept of a preventative strategy (Cleaner Production) as a preferred solution, in a way that society and community leaders understand exactly how this strategy worked and the relevant benefits it provides.
- To renew and intensify the commitment to actually using Cleaner Production by society and community leaders, to the extent that they acquire ownership and take the initiative for local management of this practice.
- To diversify and broaden the client base for using Cleaner Production, thereby increasing the overall demand.
- To encourage local support for the adaptation of actual Cleaner Production activities as a prudent economic investment, which should motive and facilitate wide scale implementation beyond current demonstration activities.
- To promote further international cooperation and technology transfer that will maximize initiatives around the world for the Cleaner Production strategy.

5.1.1 Cleaner Production Assessment

A Cleaner Production assessment is a procedure which companies, consultants etc. can use to identify sources of environmental concern and catalyze corporate effort to achieve continuous environmental improvement through an on-going programme. It resembles a waste audit in concept but also includes a broader set of steps to search for prevention options.

A central element of a CP assessment is analysis of the material and energy flows entering and leaving a process. Cleaner production options e.g. substitution of raw materials or use of more energy efficient equipment, can be identified using such an analysis.

Cost of inputs and outputs are also an important element of such analysis, e.g. costs of raw materials, disposal charges, maintenance charges, etc.

A CP assessment, however, is only a starting point for a CP programme in companies. By assessing its energy and material flows, a company should be able to identify key environmental, health and quality issues. Following the assessment, companies can use a variety of tools such as monitoring and auditing (waste, energy, health and safety) to address these issues and perhaps provide benchmarks for improvement. These benchmarks can be disseminated in environmental reports.

5.1.2 Cleaner Production and Eco-Efficiency

The concept of eco-efficiency was first coined in 1992 by the Business Council for Sustainable Development (BCSD). The inter-linkages between eco-efficiency and cleaner production are numerous. Like cleaner production, eco-efficiency links the goals of business excellence and environmental excellence, by creating the bridge through which corporate behaviour can support sustainable development, the integration of economic growth and environmental improvement.

Eco-efficiency goes beyond resource use and pollution reduction by emphasizing value creation for business and society at large, while providing for competitive needs. By increasing value for the goods and services it creates, business will maximize resource productivity, gain bottom-line benefits, and reward shareholders, rather than simply minimize wastes or pollution.

Eco-efficiency embraces cleaner production concepts such as efficient use of raw materials, pollution prevention, source reduction, waste minimization, and internal recycling and reuse. It captures the idea of pollution reduction through process change as opposed to the earlier end-of-pipe approaches. It shares characteristics with many environmental management tools such as environmental assessment or design for environment by including them among the technological options for reducing material and energy intensiveness in production, as well as facilitating reuse through re-manufacturing and recycling. Eco-efficiency also features a life cycle perspective which follows products from the raw material through to final disposal stages. It is thus an extension of the total quality management process.

Eco-efficiency is an evolving concept which allows companies to adapt to the changing dynamics of the marketplace. Companies are now faced with new demands from more stakeholders, and those who implement eco-efficient practices will be able to respond more aggressively to competitive pressures and anticipate customer needs, while at the same time protecting the environment and employee health and safety.

■ 5.2 INDUSTRIAL HEALTH AND SAFETY

Unsafe situations and technological accidents are due mostly to poor cooperation between different units, poor inspection, unclear instructions and responsibilities, lack of trained employees etc. The company must identify the major hazard risks, determine how they can be controlled and establish emergency plans to prepare employees to deal with accidents which could be dangerous for themselves, the surrounding population and the environment. Local communities should be informed. Fertilizer associations, local authorities and the government should also be involved.

□ 5.2.1 Safety Legislation and Regulation

Fertilizer production includes the manufacture of toxic chemicals (ammonia), strong mineral acids (sulphuric, nitric and phosphoric) and oxidizing agents (ammonium nitrate) in large quantities. At the various stages of manufacture, distribution and use, several thousands of tonnes of such chemicals are stored and handled.

Health and safety regulations fall into a number of categories, each with its own special requirements. Examples are the control of substances hazardous to health and the control of major accidents. The former deals mainly with the effects on the people handling the chemicals and the latter with the effects on third parties.

Process workers and consumers are protected through various regulations, the aim of which is to ensure that the health risks created during the manufacture, or arising during storage and use, such as dust and toxic fumes, are both understood and kept to a minimum. Thus, most of this type of legislation is concerned with "information". That is, the information which must be given at all stages of the chain from production to end use. Information is given in two ways, through labelling and safety data sheets.

Labelling

One of the most comprehensive publications dealing with classification and labelling is the IMDG Code and the classifications in this Code (Explosive, Toxic, Corrosive, Flammable, Oxidizing etc.) are accepted throughout the world. Classification is generally based on recognized test procedures such as those in the United Nations "Orange Book".

The IMDG Code gives specifications for hazard labels and placards, with full illustrations. These specifications and symbols are used in virtually all national labelling legislation. Many countries have incorporated the provisions of this code into their national legislation.

The Code forms the basis for EC Directives on Classification, Packaging and Labelling of Dangerous Substances (Directive 67/548 EEC and subsequent Amendments).

Safety Data Sheets

Product (or Material) Safety Data Sheets serve two purposes as they inform those concerned in handling chemicals of the hazards involved and they also provide the basis for risk assessments. Safety data sheets should be provided at all stages in the distribution chain and some countries have required their use under legislation.

The European Community has implemented a Directive (91/115 EEC) which sets out in detail the safety information to be given and the way in which it must be set out. To help fertilizer manufacturers some national and international organizations have prepared general data sheets so that the information given for particular fertilizers and intermediates is consistent.

The requirement for the provision of Safety Data Sheets originates from the Classification, Packaging and Labelling Council Directives 67/548/EEC for substances and 88/379/EEC for preparations. Detailed particulars of the specific information to be covered by Safety Data Sheets are described in the Directive 91/155/EEC and its amendment 93/112/EC. In addition to the normal product properties, Safety Data Sheets are required to provide health hazard and eco-toxicological information which is generally difficult to obtain and interpret.

5.2.2 Safety Training

Plant safety involves the development of safe working procedures to protect the work-force, and training of all employees in health and safety procedures. A senior manager is responsible for overseeing the system, and reporting to the board. A health and safety executive may be established to assist the manager, and to give appropriate representation to shop-floor personnel.

Staff training is an important part of the programme. This may, for example, cover:

- staff awareness of workplace hazards,
- health and safety routines and procedures,
- emergency procedures,
- first-aid,
- incident reporting,
- accident prevention and safe conduct.

An example of training in the fertilizer industry.

Norsk Hydro A.S. created in 1991 an independent training centre, Hydro Care Industrial Safety Academy (ISA) in Landskrona, Sweden. The centre offers training courses for chemical industry personnel to deal with emergencies, to prevent accidents and research and develop new tools. It collaborates with the Swedish Rescue Services, the departments of the Environment and Safety in Landskrona and also with the University of Lunds.

The primary focus is on the practical handling of chemicals and the development and marketing of safety programmes and methods. There are basic training courses for:

- operating personnel,
- works management,
- transport personnel,
- municipal and industrial personnel employed in dealing with chemical hazards,
- personnel within state rescue services.

and special courses for:

- corporate management,
- safety managers/expert personnel,
- fire brigade engineers and fire chiefs in municipal contingency planning,
- personnel involved in coordinating activities in state and municipal rescue operations,
- chemical accidents, emergency medical treatment,
- R&D in contingency planning for chemical accidents.

□ 5.2.3 Fertilizer Safety Publications

National and international associations can also establish recommendations for safety practices and help to coordinate a general safety programme used by all the country's manufacturers.

The European Fertilizer Manufacturers' Association (EFMA), has produced a guidance booklet which includes model Safety Data Sheets for 13 fertilizer materials/products, and other relevant information. Only a small number of fertilizer substances are classified as dangerous and therefore require Safety Data Sheets to be produced and provided in accordance with EEC Directives. They are:

- Ammonia, anhydrous,
- Ammonia solution,
- Nitric acid,
- Phosphoric acid,
- Sulphuric acid.

However in the interest of good Responsible Care[®] and to provide basic product information for the user, model Safety Data Sheets (SDSs) were also produced for the common fertilizer materials listed below:

- Ammonium nitrate fertilizer,
- Ammonium nitrate solution,
- Ammonium sulphate,
- Calcium ammonium nitrate,
- Diammonium phosphate (DAP),
- Monoammonium phosphate (MAP),
- NPK fertilizer (ammonium nitrate based),
- Urea.

Associations in other regions of the world have issued comparable information. For example, the *Fertilizer Association of India (FAI)* in collaboration with major fertilizer manufacturers issued a "Safety Manual for Fertilizer Plants" in 1995. The manual provides, among other things, information on:

- General safe practices
- Hazards and their handling
- Fire prevention
- Safety aspects in different plants
- Safety inspections
- Guidelines for a Disaster Management Plan.

The European Fertilizer Manufacturers' Association (EFMA) and the International Fertilizer Industry Association (IFA) started in 1974 to issue a series of safety recommendations. A list of those issued since 1985, still relevant and available, are:

- Safety Recommendations for the Large Scale Storage of Anhydrous Ammonia. 1985
- Safety Recommendations for the Storage of Hot Concentrated Ammonium Nitrate Solutions.
- Safety Recommendations for the Use of Anhydrous Ammonia in Agriculture. 1985
- Summary of Recommendations for the Safe Handling of Fertilizers containing Nitrogen. 1985

- Recommendations Concerning Rubber Hose for Use with Ammonia. 1987
- Recommendations for Safe Storage and Handling of Wet Process Phosphoric Acid. 1990
- Hazardous Properties of Ammonia. 1990
- Selected Tests Concerning the Safety Aspects of Fertilizers. 1992
- Handbook for the Safe Storage of Ammonium Nitrate Based Fertilizers. 1992
- Guidelines for the Transportation of Nitric Acid. 1998.

An example of safety recommendations prepared by a national fertilizer association are the following Product Safety Data Sheets (PSDS) prepared by the UK Fertiliser Manufacturers' Association (FMA):

- Straight ammonium nitrate fertilisers.
- Solid compound fertilisers with between 70% and 90% ammonium nitrate.
- Calcium ammonium nitrate and other solid straight nitrogen fertilisers with less than 70% ammonium nitrate.
- Solid compound fertilisers with less than 70% ammonium nitrate and which are not cigar-burners.
- Solid compound fertilisers containing ammonium nitrate and which are cigar-burners.
- Urea and ammonium sulphate.
- Solid compound fertilisers (NPK, NP or NK) not based on ammonium nitrate.
- Fertilisers (PK, P or K) which do not contain nitrogen.
- Fluid straight nitrogen fertilisers.
- Fluid compound fertilisers (NPK, NP or NK).

The interested reader is also referred to the relevant sections of the IFDC/UNIDO *Fertilizer Manual*, 1998¹. Section 19.3.1 concerns ammonia, 19.3.2. nitric acid, 19.3.3. sulphuric acid, 19.3.4. phosphoric acid. Section 10.2.1 concerns the handling of anhydrous ammonia by the dealer and on the farm in the USA, where 3.3. million tonnes of nitrogen in the form of anhydrous ammonia is applied directly to the soil.

■ 5.3 INDUSTRIAL ACCIDENTS

- **APELL - Awareness and Preparedness for Emergencies at the Local Level**
- **The Seveso Directive**

APELL is an initiative sponsored by the United Nations Environment Programme (UNEP), in co-operation with the United States Chemical Manufacturers Association (CMA) and the European Chemical Industry Council (CEFIC). The Community Awareness and Emergency Response (CAER) Programme developed by CMA, and experiences in its implementation, served as the main background for APELL. APELL also acknowledges specifically the existing responsibilities and roles of the national and international planning communities.

APELL involves two basic aspects:

- To create, and/or increase community awareness of the possible hazards involved in the manufacture, handling and use of hazardous materials and the steps taken by authorities and industry to protect the community from them.

¹ Fertilizer Manual. IFDC and UNIDO. Kluwer Academic Publishers, Dordrecht, the Netherlands, 1998.

- To develop, on the basis of this information, and in co-operation with the local communities, emergency response plans, involving the entire community, should an emergency endangering its safety arise.

Thus APELL consists of two parts:

- Provision of information to the community, “Community Awareness”.
- Formulation of a plan to protect the public, “Emergency Response”.

APELL is basically addressed to in-plant hazards and the related movements of hazardous materials in the local community. The implementation of the APELL process may involve people and communities across local, regional or international boundaries. Territorial boundaries or jurisdictions should not restrict the participation of all interested parties in the APELL process, but instead highlight the need for the APELL Process to develop a coordinated emergency response plan.

In highly developed control systems there may be a consultative or surveillance role for third parties such as community groups and NGOs. This is certainly the case in the Responsible Care[®] programme, and in APELL. Many western regulations now include ‘right to know’ clauses that give the public access to government information. In an attempt to build greater public support, some companies are starting to adopt greater transparency also in their own management systems and monitoring.

The safety programmes addressed under APELL are not the same as traditional health and safety programmes. They involve outside organizations and individuals, and also require a greater degree of information sharing that is usually the case. The old practice of merely pushing hazards from the workplace to the public area should be avoided.

The EC “Seveso” Directive was motivated by a serious incident at Seveso in northern Italy. This accident resulted in close attention being paid to the effects of major accidents involving chemicals at individual sites. The outcome was that in 1982 the European Community issued the first of a number of Directives under the general title of Major-Accident Hazards of Certain Industrial Activities. Subsequent amendments have broadened the scope to include storage sites away from production centres.

Article 1 of Directive 82/501/EEC states:

This Directive is concerned with the prevention of major accidents which might result from certain industrial activities and with the limitation of their consequences for man and the environment. It is directed in particular towards the approximation of the measures to be taken by Member States in this field.

For the purposes of this Directive:

Major accident means;- an occurrence such as a major emission, fire or explosion resulting from uncontrolled developments in the course of an industrial activity, leading to a serious danger to man, immediate or delayed, inside or outside the establishment, and/or to the environment, and involving one or more dangerous substances.

Fertilizer plants which are classified as having the potential to cause a major accident include those for the production of ammonia, nitric acid and ammonium nitrate.

Among the requirements of such legislation are:

- provision of evidence that the risks to the workforce and surrounding population and to the environment have been identified (risk identification and assessment),
- taking adequate precautions to minimize the risk,
- reporting of major incidents to the authorities.

and for “top tier” sites (i.e. those with considerable quantities of dangerous substances):

- preparation of on-site and off-site emergency plans,
- provision of information to persons living or working in the vicinity, on the nature of the hazard and the safety measures and correct action to be taken in the event of an accident.

An *Environmental Impact Assessment*, EIA, may be prepared in respect of potential accidents. This concerns cases where the concentrations of the chemical substances would greatly exceed allowable levels inside the factory site and outside the fences. The duration of this exposure would have an impact on the environment and health of the local population. These cases require preparation of special plans, e.g., contingency plans. For major risk situations. Governments prepare national contingency plans which will mainly be implemented by local civil defense organizations, fire departments, national guards, etc. For preparation of a good contingency plan, the following information is necessary:

- Identification and analysis of hazards and risk assessment
- Definition of the emergency response resources
- Instructions on the emergency actions

Fire-fighting often generates large amounts of polluted water and an important part of the emergency plan is how this can be contained and treated.

6. REGULATORY AND PLANNING FRAMEWORK

■ 6.1 INTRODUCTION

Environmental regulations are found under a variety of Acts dealing with pollution, protection of waterways, environmental measures relevant to the industry health and safety, protected areas and habitats, nuisance and noise, amongst others. Planning regulations may influence siting of activities, and environmental assessments. Different administrative jurisdictions may administer these acts, thus requiring an efficient liaison and communication with multiple governmental bodies. Where a country is party to international conventions and environmental treaties, some further obligations may arise.

Any project has to take account of various environmental objectives and goals as set out under legislation, or in official guidelines and targets. Environmental quality standards for air, water, soil, noise and chemical exposure are among the common standards encountered. There may be more general targets concerning environmental performance of operations and even industry sectors. The targets for the protection of landscape, natural values, and wildlife may be more difficult to interpret in operational terms because they are often phrased in qualitative terms. There may also be government commitments to public involvement in environmental approvals.

The approval process may consist of several stages, with prior environmental impact assessment being among the first. Depending on the nature of the project, hazard and other specialized assessments may form a part of an environmental impact assessment. Land-use and siting approval follow the acceptance of the environmental assessment, with possible further permits on key operations as required under individual legislation. In some countries, permits are increasingly combined into a single approval, but this is not the case everywhere.

Rehabilitation of abandoned operations and sites is now a universal requirement in modern legislation, but the long-term objectives of such rehabilitation vary widely. There is still no universal understanding of what a worked out site has to look like after operations cease.

International treaties and conventions are in principle binding in the first instance on national governments, which are obliged to implement such arrangements through national legislation. However, it is prudent for companies to themselves ensure that the intent of such treaties is fully respected, if only to safeguard against legislative changes later. Important international instruments include the Basel Convention on trans-frontier movement of waste materials (including wastes for recycling), marine dumping conventions, phasing out of ozone depleting substances, occupational health and safety agreements, conventions on the protection of migratory and endangered species. Two major conventions, on climate change and biodiversity respectively, have recently joined the earlier list.

Official baseline surveys, development of environmental framework policies, maintenance of inspection monitoring and enforcement functions require extensive infrastructure and expertise if it is to be well

done. Government services are being reduced in many countries, and some companies will find their government counterparts severely stretched to provide timely response to the many demands made on them. In many cases, local service and technical infrastructure for, for example, specialized waste services, do not exist, laboratories are under-resourced, and consultants hard to find. Companies operating in such situations will need to ensure a higher degree of autonomy and of self regulation than normal.

■ 6.2 OVERVIEW OF THE REGULATORY FRAMEWORK

□ 6.2.1 Development of Regulations

West Europe

Legislation for fertilizers has been on the statute books of some Western European countries for over one hundred years. This legislation has been updated and expanded to give the wide ranging controls now in force. However, the evolution of such legislation has not proceeded at the same rate everywhere in the world and there are still many countries with only rudimentary controls, if any at all. It is clear that the more advanced a country is in terms of the production and use of fertilizers, the more advanced is its legislation. In 1959, 95% of fertilizers were produced in Europe, North America and Japan. In the 1990s well over one hundred countries have fertilizer production capacity but far fewer have corresponding legislation.

It should be recognized that much of the legislation is introduced for sound and socially desirable reasons, no matter what this burden may impose on the industry. For example, the introduction of the Clean Air Act in the UK contributed to the remarkable improvement in air quality and the decline in bronchial illnesses. The various Factory Acts, starting in 1833 and leading up to the Health and Safety at Work Act of 1974 have improved the work place environment and hence the efficiency and well-being of the labour force.

Some legislation also results from international incidents or decisions taken by supra-national organizations such as agencies of the United Nations. For example, the EC Directive on Major Accident Hazards (The Seveso Directive) was adopted as a direct result of the incident at Seveso in Italy in 1976 and the tragedy in Bhopal in India accelerated its first major revision. The fire at the Sandoz warehouse in Basel, Switzerland, was responsible for the second revision.

Protection of the environment as such did not appear in the original EEC Treaty. However, Community lawmakers soon recognized the need to create common standards to protect consumers to ensure the free circulation of goods among the Member States. Amendments to the Treaty of Rome and the subsequent Single European Act recognized the complicated relationship between the environment and commerce.

Goals of Environmental Protection Actions by the Community

- to preserve, protect and improve the quality of the environment,
- to contribute towards protecting human health,
- to ensure a prudent and rational utilization of natural resources.

EC environmental protection actions must become integrated into other EC policies, the most important of which are agriculture, regional development and energy and must be based on three principles:

- preventive action should be taken,
- environmental damage should be rectified at source,
- the polluter should pay.

Council Recommendation 75/436/EURATOM, ECSC, EEC, although not legally binding, describes the application of the “polluter pays” principle and states that: “natural or legal persons governed by public or private law who are responsible for pollution must pay the costs of such measures as are necessary to eliminate that pollution or to reduce it so as to comply with the standards or equivalent measures laid down by the public authorities”.

USA

The first fertilizer control law in the United States was passed in Massachusetts in 1869; since then all state legislatures (except Hawaii) have passed, and revised many times, effective laws to regulate the sale of all fertilizers.

Listed below are the regulatory agencies that are responsible for formulating and enforcing U.S. regulations:

1. Department of Transportation (DOT).
2. National Fire Protection Association (NFPA).
3. Occupational Safety and Health Administration (OSHA).
4. Environmental Protection Agency (EPA).
5. State Fertilizer Control Authorities (administer state fertilizer consumer protection laws and regulations).
6. Bureau of Alcohol, Tobacco and Firearms (BATF).

A discussion of the role of each of these organizations follows.

Department of Transportation (DOT)

The U.S. Department of Transportation (DOT) was created in 1967 to “assure the co-ordinated, effective administration of the transportation programs of the Federal Government” and to “develop national transportation policies and programs conducive to the provisions of fast, safe, efficient, and convenient transportation”. The DOT is responsible for administering and enforcing Title 49 - Transportation - of the Code of Federal Regulations (CFR).

National Fire Protection Association (NFPA)

The NFPA, a society established in 1896, is composed of 68,000 individuals and more than 100 organizations world-wide whose goal remains “to promote the science and improve methods of fire prevention, to obtain and circulate information on these subjects, and to secure the co-operation of its members in establishing proper safeguards against loss of life and property by fire”.

Through the last 100 years the NFPA has evolved into a respected advisory body with many of its standards adopted as law. The *National Fire Codes* are a set of over 300 written standards and recommendations contained in 12 volumes developed by volunteer members of the NFPA. Included in this set of volumes is *NFPA 490 Code for the Storage of Ammonium Nitrate*.

Occupational Safety and Health Administration (OSHA)

The Occupational Safety and Health Act of 1970 was adopted as public law “to assure safe and healthful working conditions for working men and women by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes”. The motivation for this Act and for the subsequent founding of the Occupational Safety and Health Administration was concern over the growing rate of occupational illnesses. “While earlier laws were principally designed to provide compensation for workplace injuries and illnesses, the purpose of the OSHA Act was prevention”.

U.S. Environmental Protection Agency (EPA)

The EPA was created by a reorganization plan in 1970. This plan also transferred to EPA certain activities (such as environmental research, monitoring, standard setting, and enforcement) necessary to achieve its purpose. -The goal of EPA has been, and continues to be, “the protection of the environment by the abatement and control of pollution”.

Title 40 in the Code of Federal Regulations consists of 16 volumes all pertaining to environmental protection. These volumes contain standards divided into three main areas: Clean Air Program, Clean Water Program, and Solid Waste Management. The Clean Air Program contains standards that set limits on emissions and affect a wide variety of industries. Part 50 - National Primary and Secondary Ambient Air Quality Standards restricts emissions of sulphur oxides, particulate matter, carbon monoxide, ozone, and nitrogen dioxide.

One avenue EPA uses to ensure compliance with its emissions and effluent limitations is through state agencies. While the federal agency sets standards, some state agencies have been given jurisdiction over this aspect of environmental compliance. Mississippi’s state agency, the Department of Environmental Quality (DEQ), issues permits required for construction, plant operation, and discharge of wastes. DEQ is also responsible for issuing permits for changes and/or modifications to the process. Neither federal nor state organizations have in their mandate regulatory authority relevant to safety in storage, handling, or shipping of ammonium nitrate fertilizers.

Development of Regulations Impacting Nitrate-Based Fertilizers

The regulations impacting nitrate can generally be traced to the reactions to major accidents that have involved ammonium nitrate or mixtures containing ammonium nitrate. In the United States, the major tragedy that occurred in Texas City, Texas, in April 1947, causing over 500 deaths and millions of dollars in damages, resulted in the many regulations covering storage and transportation of nitrate-based products. In Europe, the events most responsible for the adoption of regulations were two explosions that occurred in Germany in 1921, a detonation in Belgium in 1942, and a shipload of wax-coated product that exploded in France in 1947. All of these events could have been avoided with the information currently known. Regulations stemming from these events were directed to preventing accidents involving ammonium nitrate and other nitrate products.

* * * * *

Legislation and regulations are often enacted in two stages:

- An Act, Law, Ordinance or Decree. This provides the legal basis for enforcement and analytical procedures, legal powers of entry for control officials, the institution of legal action, criminal or civil. These are basic principles which once established rarely require change.
- Regulations (Orders, Standards, Rules) made under the Act etc. by the national executive body, generally the relevant Government department. These are relatively easy to modify as required. They contain detailed information on the individual fertilizers as well as technical instructions on matters such as sampling technique and analytical methods.

The regulatory and planning framework falls naturally into a number of sections. These different sections are based on different legal frameworks, covering for example, consumer protection (fertilizer quality), transport (including packaging and labeling), production (general safety and emission controls) and planning (major hazard considerations).

□ 6.2.2 Consumer Protection Legislation

As in all economic sectors, the consumer, in this case the farmer, must be protected by consumer legislation. Furthermore, farmers have no reliable means of testing the product and once it is applied to the soil it is too late to check for adulteration. The information given on the bag and/or in an accompanying leaflet should include the identity of the product, the weight, the nature and composition, recommendations for storage and recommendations for use. The nutrient content of the product must be what is claimed, within permitted tolerances.

Fertilizer composition may be controlled by:

- Registration of approved individual products (e.g. Denmark, France, India).
- Specifications of products which may be marketed, including permitted tolerances on the declared nutrient contents (e.g. EU) - the “list principle”.
- Conformity with what is stated on the label - “truth in labeling” (e.g. USA).

United States

In 49 states and Puerto Rico, there are fertilizer laws and regulations that are designed to assure consumers that the product purchased meets the standard noted on the label. These laws are administered by the State Department of Agriculture in 43 states and Puerto Rico. They are administered by the Office of State Chemists in two states; land-grant universities in two states; and a State Plant Board, a Department of Environmental Management, and a Fertilizer and Seed Certification Service in the three remaining states. In administering these laws, the state agencies collect a fertilizer tax to finance the service and publish tonnage reports showing distribution of products in the respective state.

Officials charged with administering fertilizer laws have worked toward uniformity of the laws, first under the auspices of AOAC International and since 1946 the Association of American Plant Food Control Officials (AAPFCO). Through the years, the AAPFCO has developed a Uniform State Fertilizer Bill that has been totally or partially adopted by 38 states. The current Uniform Bill contains 12 adopted sections and 13 additional tentative sections. Included in the 12 adopted sections are Definitions, Registrations and Licensing, Labelling, Fees, Reports, Inspection and Analysis, and Misbranding. Some of the tentative sections pertain to Short Weight, Stop Sale, Seizures, Adulteration, Violations, and Constitutionality. In addition to the Uniform Fertilizer Bill, the AAPFCO has developed uniform bills for other topics and has developed rules for primary and secondary containment of fluid fertilizers.

Canada has been an active participant of AAPFCO since its inception and has adopted many of its regulations. It functions as a national organization, however, and not a state or provincial agency.

Major Objectives of AAPFCO (the American Association of Plant Food Control Officials)

- Promote uniform and effective legislation, definitions, rulings and enforcement practices;
- Encourage and sponsor the adoption of the most effective and adequate analytical methods for fertilizer by all member agencies;
- Develop high standards of fertilizer inspection techniques and procedures;
- Promote adequate labelling and safe use of fertilizers;
- Provide facilities and opportunities for the free exchange of information, discussion and cooperative study of problems confronting members of the Association;
- Cooperate with members of industry in order to promote the usefulness and effectiveness of fertilizer products.

The AAPFCO has established guidelines for state fertilizer bills, fertilizer terms and definitions, etc. and has drafted a model “fertilizer bill”.

Extract from the “Summary of State Fertilizer Laws”

UNIFORM STATE FERTILIZER BILL

An act to regulate the sale and distribution of fertilizers in the State of BE IT ENACTED by the legislature of the State of

Section 1 Title

This Act shall be known as the “..... Fertilizer Law of 19..

Section 2 Enforcing Official

This Act shall be administered by the of the State of, hereinafter referred to as the “.....”

Section 3 Definitions of Words and Terms.

When used in this Act:

The term “fertilizer” means any substance containing one or more recognized plant nutrient(s) which is used for its plant nutrient content and which is designed for use or claimed to have value in promoting plant growth. except unmanipulated animal and vegetable manures, marl, limestone, wood ashes and other products exempted by regulation by the
etc.

India

The Indian “Fertiliser Control Order”, the FCO, was promulgated four decades ago. There is compulsory registration of fertilizer manufacturers, importers and dealers, and specifications of all fertilizers manufactured, imported and sold in the country must be given. The FCO also provides for the regulation of the manufacture of fertilizer mixtures, packaging and labeling, appointment of enforcement agencies, establishment of quality control laboratories and prohibition of the manufacture, import and sale of non-standard or adulterated fertilizers. A revised FCO was promulgated in 1985. A number of micronutrient fertilizers were prescribed for the first time in October 1996. Tolerance limits are listed.

European Union

Fertilizers are regulated at EU level by means of “Directives”, which are binding on member states, but the countries themselves must implement them. The first fertilizer directive, issued in 1976, covers straight and compound nitrogen, phosphate and potash fertilizers. Subsequently it has been extended to cover secondary nutrients (calcium, magnesium, sodium and sulphur), trace elements and liquid fertilizers. In the case of straight ammonium nitrate, EU specifications are directed in particular towards product safety, covering granule or prill size, porosity, pH, organic matter content, chloride and copper contamination and detonability. Products which conform to the specifications may be labeled “EU Fertilizers” and may be marketed in any EU country, provide they comply with national laws (e.g. on safety), and are labeled in the language of the country.

In addition to the EU regulations, each member country has its own national legislation. Typically this covers product classification, packaging and labeling, product liability and consumer protection. Some specify the information which must be included on the bag to ensure that the user is provided with adequate information, while other legislation requires, in certain instances, that safety data sheets be provided. These provide information on product properties, health and ecotoxicological hazards.

Some examples of national legislation are as follows.

In *Denmark*, the first Danish Fertilizer (and Feedingstuff) Act dates from 1898. Today, products are registered with the Plant Directorate. A “Fertilizer Catalogue” is issued once a year. The most frequent contraventions are differences between declaration and analytical content, omission of registration and non-legal statements on the label. A direct fine may be imposed or there may be prosecution in more serious cases. However, the results are published and this alone has a positive impact.

The first fertilizer law in *France* dates from 1888. Subsequently, the regulations have been modified as new needs have become apparent. For example the law was modified in 1972 to cover micronutrients and organic amendments. In 1979, a new law was promulgated, according to which, for a fertilizer to be imported or offered for sale in France, it must either conform to the specifications given in the EU directives, or conform to standards which are already established, or registered for the most commonly used products, or otherwise be registered, if it does not fall within the scope of the above-mentioned categories.

In the *United Kingdom* the original “Fertilizer and Feedingstuffs Act” dates from 1893. As elsewhere, developments in agriculture and in the nature of fertilizers have required progressive expansion of the coverage of the Act, and it was followed by new Acts in 1906, 1926 and 1970 (the Agriculture Act). The Act is implemented by means of regulations issued by the relevant Ministry, normally the Ministry of Agriculture, Fisheries and Food; regulations have been issued on more than 20 different occasions since 1897. The Ministry is obliged to discuss proposed regulations with the persons or organizations likely to be affected. The Agriculture Act of 1970 obliges manufacturers, importers or traders to comply with definitions of specific fertilizers laid down in the regulations. Rules for inspection, sampling and analysis are prescribed. Subsequent regulations concern aspects such as labeling, tolerances and packaging.

□ 6.2.3 Transport

Controls on the transport of fertilizers are limited to those products which are classified as hazardous (dangerous) goods. In general terms this means those products classified as “oxidizing” due to the high concentration of ammonium nitrate. (UN classification Group 5.1). Ammonia is classified as 2.3 (toxic gas), phosphoric and sulphuric acid class 8 (corrosion). There is a much smaller group of products which can exhibit self sustaining decomposition, where thermal decomposition, once started, will continue even if the source of heat has been removed. Such products, which include NPK fertilizers based on ammonium nitrate, are known as “cigar burners” (UN classification Group 9 type B if the decomposition continues, type C if it stops).

Probably the most important aspect of all the transport legislation and the one which is common to all modes of transport, is the need for careful labelling of packages so that the type and degree of hazard can be readily identified in any country. In the case of bulk loads, by land or sea, the relevant information must be included in the documentation which must stay with the material and be readily available to the authorities at all times.

Sea Transport

All sea transport is governed by IMO which is supported by all maritime nations in the world. Regular updating of the IMDG Code ensures that new materials and hazards are covered. The Code imposes restrictions on the types of vessel which may be used, the quantities which may be carried and the form in which they may be handled.

Classification is based on a number of properties such as explosive, oxidizing and toxic, with appropriate methods of test to establish the classification. Within the classifications products, such as fertilizers, may be sub-classified according to composition. The IMDG Code is also concerned with other hazards such as cargo stability and provides test methods for properties such as the angle of repose of bulk materials.

Classification of Ammonium Nitrate (AN) Based Fertilizers

The fertilizers described below are classified as oxidizing because they assist the combustion of other materials. Packaged materials will carry the “oxidizing agent” label, with a yellow diamond symbol, UN class 5, division 5.1.

Type	Fertilizer Mixture	AN Content	Combustible Material not more than
A1	AN + added matter (inorganic & chemically inert)	90% or more 70 - 90%	0.2% 0.4%
A2	AN + calcium carbonate and/or dolomite	80 - 90%	0.4%
A3	AN + ammonium sulphate	45 - 70%	0.4%
A4	AN + nitrogen/phosphate/potash sources	70 - 90%	0.4%

Road Transport

Internal transport is normally covered by national regulations which may be based on international agreements such as ADR in Europe. Such regulations not only cover the labelling of the products but also the definitive marking of the vehicles, specification of the documentation required and, in many cases the need for driver training in case of emergencies.

Rail Transport

As with road transport, internal rail movements are normally subject to local regulation, with cross border transport covered by international agreements such as the RID in Europe. These agreements also cover the labelling of packaged goods and transport documentation.

Inland Waterway Transport

Cross-border traffic is covered by international agreements such as the European provisions concerning the international carriage of dangerous goods by inland waterways (ADN) or regional agreements such as the Regulations for the carriage of dangerous substances on the Rhine (ADNR).

Air Transport

Because of the large-scale trade in fertilizer materials, there is virtually no air transport of fertilizers apart from small sample quantities. Such transport is covered by the International Air Transport Association (IATA) rules.

Handling and Storage

The potential for major incidents arising from fires in stores containing large quantities of fertilizers forms the basis for their inclusion in Storage legislation. In some countries such as Germany, Finland and the Netherlands, the maximum quantity of ammonium nitrate which can be stored in individual heaps is 100 tonnes. This makes the marketing of straight ammonium nitrate fertilizer commercially non-viable in those countries.

A more recent development within the UK has been the linking of local planning consents to the presence of stores and other sites where dangerous chemicals are kept, handled or produced. Exclusion zones have been declared around such sites, within which building may be restricted.

6.2.4 Production

The most important regulations concerning fertilizer production are those relating to Major Accident Hazards. However, because some of the materials used in fertilizer production are classified as hazardous, other regulations will apply as well as the general safety regulations which apply to all manufacturing facilities.

Legislation for the control of harmful emissions to atmosphere has existed in the UK for over a century, starting with the Alkali & Works Act of 1863. In the last 30 years or so, such legislation has been absorbed into European legislation which rationalizes the controls in all member states. Most recently these have taken the form of Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC). Previously there was an obligation to use the Best Practicable Means to control pollution but this is being extended to Best Available Techniques Not Entailing Excessive Cost (BATNEEC) under IPPC. It also means that account must be taken of the best ways of reducing *overall* pollution, known as the Best Practicable Environmental Option. For example, there may be better results from releasing gases to atmosphere rather than scrubbing them and releasing the pollutants to water.

6.2.5 Safety Legislation and Regulation

See section 5.2.1 “Safety legislation and regulation”.

■ 6.3 ENFORCEMENT AND SANCTIONS

Each type of legislation requires an equivalent group of enforcement officials, samplers and analysts as well as recognized official methods of sampling and testing, and recommended or approved laboratories. In addition, each production site should have a system of quality control and environment monitoring. The sampling and test procedures for the latter may not necessarily be the same as for enforcement but the results obtained should be equivalent.

In most consumer protection legislation there will be a requirement for the declaration of nutrient content. This means that the actual nutrient content supplied must be that stated on the documentation or label, within a prescribed tolerance. The tolerance may be a single negative tolerance, thus giving an absolute minimum nutrient content, or may be a plus and minus tolerance, thus giving a range of nutrient content. The tolerance is provided to allow for sampling and analytical uncertainty (error) and to some extent, for manufacturing variability.

Environment

Environmental legislation may set out emission limits or guideline values, together with an enforcement system based on official inspection. Such a system should contain details of recognized test methods. In many countries there is a national (federal) authority such as the EPA in USA, policing environmental pollution from all sources, but the states often have requirements which are additional to and separate from the federal regulations. In the USA, in addition to the EPA having policing authority for federal environmental regulation, the EPA also delegates some of this authority to the states. In the UK, the Environment Agency was formed from the amalgamation of Her Majesty’s Inspectorate of Pollution, which covered atmospheric pollution and the National Rivers Authority, which covered the pollution of waterways.

Each Agency has a group of specialist inspectors, often regionally based, who visit production operations and monitor the quality of discharges to atmosphere and/or watercourses, and check general compliance with permit conditions. Recognized methods of test are used but these are not always incorporated into the legislation.

The EFMA Best Available Techniques (BAT) booklets¹, include sections giving details of suitable analytical techniques and recommended frequencies of analysis for the control of both air and water pollution by fertilizer manufacturers.

Emission limits for pollution control are normally absolute i.e. maximum limits with no tolerances allowed.

General Safety

General safety regulations and major accident hazards are normally controlled nationally by central governmental (federal) bodies although enforcement is on a regional or local (state) basis. For example in the UK, safety policy is controlled by the Health and Safety Commission, through a Health and Safety Executive and both of these are part of the government Department of Employment. The Executive is responsible for control and enforcement through local Inspectors, organized regionally, with advice from specialists in some areas such as explosives.

Four Principles of Enforcement (HSC, UK)

- Action taken by enforcement authorities to achieve compliance should be *proportionate* to any risks to health and safety and to the seriousness of any breach. This concept is built into the principle of “so far as is reasonably practicable”. In general, if there is a significant risk, the duty-holder must take measures unless their cost is “clearly excessive” compared with any benefits.
- “*Consistency* of approach does not mean uniformity. It means taking a similar approach in similar circumstances to achieve similar ends”. In practice, consistency is not a simple matter as inspectors are faced with many variables. The decision as to enforcement action is a matter of judgment and all enforcement authorities should have arrangements to promote consistency in the exercise of discretion.
- “*Transparency* means helping duty-holders to understand what is expected of them and what they should expect from the enforcing authorities”. This also includes what they do not have to do, i.e. distinguishing between statutory requirements and advice or guidance. Employers may appeal to industrial tribunals in relation to statutory notices and use a complaints procedure in the case of administrative decisions.
- “*Targeting* means making sure that inspection is targeted primarily on those whose activities give rise to the most serious risks or where the hazards are least well controlled; and that action is focused on the duty-holders who are responsible for the risk and who are best placed to control it - whether employers, manufacturers, suppliers or others.”

Enforcement policy statement, Health and Safety Commission, UK

¹ EFMA. Best Available Techniques (BAT) for Pollution Prevention and Control, Brussels, 1995.

- Production of Ammonia. 40 pp.
- Production of Nitric Acid. 29 pp.
- Production of Sulphuric Acid. 31 pp.
- Production of Phosphoric Acid. 42 pp.
- Production of Urea and Urea-Ammonium Nitrate. 40 pp.
- Production of Ammonium Nitrate and Calcium Ammonium Nitrate. 31 pp.
- Production of NPK Compound Fertilizers by Nitrophosphate Route. 33 pp.
- Production of NPK Compound Fertilizers by Mixed Acid Route. 35 pp.

The legislation may be enforced in a number of different ways through fiscal incentives, taxation, subsidies, environmental liability, civil law and market forces in general. In most developed countries, state and local advisory organizations are fully involved.

Enforcement may be international, national or local, depending on the type of legislation. Sanctions may be under criminal or civil law depending on the offence.

International transport law is upheld through the United Nations and international organizations such as IMO. Sanctions might include the prevention of vessels from entering harbours or preventing lorries or trains from crossing national borders.

Environmental protection is usually in the hands of national government bodies, with regional enforcement. Sanctions include fines and possible closure of polluting plants. In the USA the federal government has direct enforcement authority for its environmental programmes but there are also state and local environmental officials and requirements. Even where the federal government has legislated in a particular area, most of the environmental laws leave the states free to adopt stricter standards. Individual states are also taking the lead in developing controls over packaging, used product disposal, recycling, environmental advertising and related matters. Sanctions range from the serving of “improvement notices” which require action to be taken within a reasonable time limit, through fiscal penalties and imprisonment to temporary or permanent plant closure.

■ 6.4 SITING

As a consequence of legislation on major accidents, some countries are now considering the regulation of building development in close proximity to major accident hazard sites. This recognizes the need to prevent major accidents or more particularly to reduce the consequences of major accidents. By controlling development around major accident sites, the risk of serious injury to persons living in the vicinity is drastically reduced.

The first stage in the development of such legislation is to regulate existing sites through registration. All sites holding more than a specified quantity of hazardous substances are required to register. Such sites are then deemed to have planning consent for a larger quantity (up to a third more) than would be allowed for a new application. Any further increase is treated as a new application and consent can be refused if there is a significant risk to people in the vicinity.

New sites have to apply for consent before any hazardous substances can be stored. In addition, other planning applications for development in the vicinity of major hazard sites must be critically examined and the risks assessed before permission is given.

Although such planning legislation is under the control of planning authorities, it usually contains a provision for statutory consultation with the local Health and Safety authority.

■ 6.5 WASTE DISPOSAL

Within the European Union the management of waste is considered to be the key task in the 1990s. Production of waste is on an upward trend and thus measures are aimed at prevention, recycling and the development of an infra-structure for safe disposal.

The fertilizer industry has three significant waste disposal problems: gypsum from phosphoric acid production, sodium chloride from potash production and the disposal of used bags of whatever size. The industry is directly concerned with the first problem but only indirectly with the second.

The EFMA BAT booklets, give guidance on the safe disposal of the wastes produced in those processes.

Control of waste disposal is by regulations which include charges and levies as well as civil liability for environmental damage. The basic principle of “the polluter pays” is common to all these regulations. In other words the costs must be borne by the producer of the waste.

In many countries fertilizers are distributed in packages rather than in bulk. Plastic sacks made from polyethylene or polypropylene are most commonly used because of the need to maintain the quality of the fertilizer. These bags range in size from 25 kg up to Intermediate Bulk Containers of 500 kg or 1 tonne capacity. Paper and/or hessian sacks can be used but are not suitable for nitrate containing fertilizers.

Used fertilizer sacks can be re-used for many purposes at the farm level but in due time a surplus is likely to accumulate. Legislation requiring the establishment of plastic recycling schemes has been introduced in some countries (for example Germany). In other countries (for example UK) voluntary recycling schemes involving both the producers and the users (fertilizer producers) of the plastic sacks have been introduced.

7. EMISSION STANDARDS AND INTEGRATED POLLUTION CONTROL

■ 7.1 INTEGRATED POLLUTION PREVENTION AND CONTROL (IPPC)

The following text is extracted from “The European Union Environmental Agenda and its Global Impact on Fertilizer Production and Trade, by S. Brockett, in *Environmental Challenges of Fertilizer Production - an Examination of Progress and Pitfalls*, IFDC International Workshop, Atlanta, September 1997.

The West European fertilizer industry has generally aimed to achieve higher environmental standards of production than the law requires. Furthermore, the industry makes every effort to co-operate with the authorities in the formulation of new legislation. For example, in anticipation of the EU Directive on Integrated Pollution prevention and Control (IPPC), adopted in September 1996, the fertilizer manufacturers of the EU assembled their combined knowledge of pollution prevention and control techniques in order to define the “Best Available Techniques” (BATs) for the production of fertilizers. The industry’s assessment of BAT is being used in the process to determine Euro-BAT emission limits for the production of fertilizer and fertilizer intermediates.

The Directive on Integrated Pollution Prevention and Control was adopted by the EU in 1996. Its aim is to implement an integrated environmental solution. In controlling industrial installations, the environmental effects of every stage in the process are taken into account, not simply the pollution and waste at the end of the pipe. There is no pollution-free process and in designing a solution an optimized protection for the local environment, the relating receiving capacities of the media concerned must be taken into account. An optimized solution for one medium taken in isolation may result in a pollution load to another medium, for example where air pollution washes out into rivers or contaminates land.

The first element is the focus on outcomes, not on technologies. Under IPPC, the competent authority’s key duty is to set limit values or equivalent controls taking into account all elements of the environment, but without specifying a particular technology. In determining the appropriate control level, the authority will naturally look at what can be achieved by the best techniques already operating, and would discuss with the operator how they might apply in his case. This is the role of the IPPC concept of Best Available Techniques (BAT).

Controls are based on:

- an examination by the competent authority and the operator of the options for pollution control, with BAT as a key reference point, and
- an examination by the competent authority of the requirement of the local environment, in order to work out what distribution of pollution load represents the optimal solution.

The controls established will simply be emission values in the permit. At that point it is for the operator to decide how to meet them.

Existing installations do not have to come under IPPC until 2007 to give operators the time to innovate to meet strict controls. By establishing strict controls based on what a process might achieve, and then giving it the time to innovate, the most efficient solution will be brought out. Some Member States, such as Sweden, are already making use of this approach in their national pollution control systems.

In addition to the permitting procedure, the Directive requires the European Commission to organize “an exchange of information between Member States and the industries concerned on best available techniques, associating monitoring, and developments in them”, and to publish the results of the exchanges of information. The participation of industry and the general availability of the published results should in itself stimulate the uptake by industry of cleaner production techniques. The Commission is required by the Directive to publish the results of the exchange of information every three years.

The published results will not themselves be legally binding, although it is expected that they will have a considerable influence on permitting practice.

The list of industrial activities covered by the IPPC Directive comprises a total of 33 industrial sectors in seven groups, energy industries, production and processing of metals, mineral industry, chemical industry, waste management, and “other activities”.

Documents containing the results of the information exchange - called BAT Reference Documents or BREFs- will be published for each of the sectors.

The term “best available techniques” is defined in the Directive. There is a list of 12 items to be considered when determining BAT, including the consumption and nature of raw materials (including water) and the length of time needed to introduce the best available technique, as well as the items that follow more directly from the BAT definition or from the basic obligations of the operator.

The contents of the BREFs will be determined to a large extent by the definition of BAT. The BREFs should not only contain information on technologies to be used but also cover design, construction, maintenance, operation and decommissioning. The eight “Best available Techniques” booklets produced by EFMA during 1995 cover all these issues.

As regards the general content of the BREFs, practical experience shows that, in particular, the quality of operation and maintenance of an installation is frequently more important than, for example, the process route. Also the need to take costs and advantages into consideration when determining BAT implies that economic performance, as well as environmental performance, of a given technique should be addressed during the information exchange, and that information about this should be included in the published results.

For each sector, a BREF will include: general information about the sector, a description of the currently applied processes and techniques, present consumption and emission levels, a selection of “candidate BATs” together with an evaluation of their environmental and economic performance, a selection of BATs, and finally a description of emerging techniques.

A genuinely integrated BAT is one which achieves “a high general level of protection of the environment as a whole”. This requires a method for deciding on environmental trade-offs. It seems likely that a qualitative approach will be taken, refraining from establishing quantitative weightings but nevertheless giving some guidance at least on which of the environmental effects are more important.

An evaluation of the economic performance of candidate BATs should include investments costs and the operating costs of a particular abatement technique, and also take account of economic savings due to increased efficiency. A distinction is to be made between new and existing installations.

The IPPC Directive ensures that:

1. Local authorities will not be allowed to issue a “permit to pollute”. Competitive advantages from having a leaner operational permit than others can be expected to be reduced.
2. Local authorities will not be allowed to “penalize” local industry with a much stricter permit than elsewhere (unless there are good reasons for doing so). Competitive disadvantages based on environmental issues can be expected to be reduced.

The fertilizer industry’s position is that BAT should take account of:

- The complexity of the chemical process, the degree of integration between processes, and the availability of energy and raw material sources.
- The difference between 1) modern process, where pollution prevention can be part of the process design and 2) older, existing process, where end-of-pipe solutions are often the only solution.
- The geographical location may represent difference in ambient conditions (e.g. cooling water temperature), and thus giving rise to different BAT solutions.
- The local environment may justify differing permit conditions.
- Social and economic considerations may also justify local variations.
- In case a permit is deviating from the normal BAT, the reasons should be well documented for public viewing.
- The BAT documents should allow for several techniques to be nominated as Best Available, provided they satisfy agreed environmental objective.
- The industry welcomes the inclusion of cost-benefit considerations but it must be taken into account that each site and each process is unique.
- The analytical techniques for emission monitoring ought to be standardized.

■ 7.2 EMISSION STANDARDS

There are many emission standards in the world reflecting historical developments and the different underlying national conditions.

Some national authorities tend to use as an emission reference, plants that achieve good results. However, several factors have to be taken into account:

- a specific technology may not be commercially available to all producers,
- the technology used in one plant may not be suited to the processes used in other units,
- the required revamp costs may be excessively high for the other units,
- the basic operating conditions may be different,
- the degree of integration with other manufacturing units may give specific advantages,
- differences between countries may occur simply because the methods for emission measurement and analysis vary from country to country.

Two types of emission values are of importance:

- Legally binding emission limit values for specific pollutants which apply for ammonia production,
- Guideline values which are not legally binding but provide the background for requirements laid down in individual permits.

□ 7.2.1 West Europe

Specific legally binding emission limits for ammonia production plants are laid down only in Germany. In the Netherlands and in Germany limits for emissions from boilers have been laid down which include chemical reactors. However all plants have to comply with general emissions standards laid down in environmental regulations. Specific emission guideline values are laid down in the United Kingdom. There are instances in which a country establishes the maximum allowable limits for pollutants but where individual regions, depending on the local situation, require different values that can be much lower than the national standards.

Example: Italy Source: "Latest Developments in Pollution Control of Urea Plants" by F. Granelli, Snamprogetti SpA, Italy. IFA Technical Conference, South Africa, October 1996.

Gaseous Effluents

EU authorities just give general rules and recommendations. Each individual country fixes the maximum emission levels which must not be exceeded.

For urea plants the Italian national rules are as follows:

- urea dust: 100 mg/m³
- ammonia: 200 mg/m³

Inside the countries of the EU, each region has the possibility of reducing the national limits depending on several parameters, viz.:

- density of the population,
- existing emissions,
- climate (particularly wind).

For example in the Lombardia region of Italy, with its high population and low wind incidence, the values are as follows:

- urea dust: 20 mg/m³
- ammonia: 20 mg/m³

The values of three other Italian regions in mg/m³ are:

	Region		
	Emilia	Umbria	Puglia
– urea dust:	20	50	80
– ammonia:	35	50	80

Liquid Effluents

Also in the case of liquid effluents, the EU authorities give only general recommendations, giving precise maximum emission levels only for very toxic emissions. For the most common pollutants, each EU country has had strict laws since the 1970s. Regional authorities are just responsible for compliance.

The national Italian values for nitrogenous pollutants are:

- total ammonia as NH₄⁺: 15 mg/l
- nitrous nitrogen as N: 0.6 mg/l
- nitric nitrogen as N: 20 mg/l

Also in the case of *liquid effluents*, the EU authorities give only general recommendations, giving precise maximum emission levels only for very toxic emissions. For the most common pollutants, each EU country has had strict laws since the 1970s. Regional authorities are just responsible for compliance.

The European Fertilizer Manufacturers' Association, EFMA, has established emission guidelines for manufacturers in the European Union, the EU. They are set out in the series of booklets listed in section 6.3 'Enforcement and Sanctions'. The booklets use the same definition of best available techniques (BAT) as that given in the EU's IPPC Directive. Two sets of figures are given, one set is for new plants, the other is for existing plants - i.e. those built before 1990:

- For new plants, modern prevention technology can be readily integrated into the process design.
- For existing plants, say those built before 1990, emissions can be reduced only by installing end-of-pipe technologies, or through costly revamps.

In both cases, careful operation and maintenance is still necessary to achieve the "design" emissions.

These standards represent the best "balance" between emissions, wastes and energy consumption, based on the concept that a reduction of one emission may give an increase in another, or a higher energy consumption. It should, however, be kept in mind that local environmental conditions may require a different "balance" of what can be achieved. Deviations from these standards may be acceptable:

- if the environment can tolerate higher emissions, without local, regional or inter-regional negative effects,
- if the social cost of achieving the standard is too high,
- if the size of the production process, the availability of energy sources and raw materials or the product range being manufactured, are different from what is assumed in the EFMA BAT booklets,
- during start-up and shut-down operations and in emergencies.

EFMA's aim is that the association's member companies should comply with these standards by year 2005, where justified by BATNEEC principles. This will require substantial investment, and in the case of certain plants will be difficult to achieve.

Tables (1) and (2) provide summaries of EFMA's indicative emission levels, generally *achievable* by the European fertilizer industry, to water and air respectively.

► **Table 1.** Summary of EFMA emission limit values to water

Production Process	Emissionmg/l.....	mg/l.....	
		New	Existing	New	Existing
Ammonia	NH ₄ -N			0.1	0.1
Urea	Urea-N	1	150	0.0005	0.1
	NH ₃	5	150	0.0025	0.1
Ammonium nitrate	N	100	100	0.2	0.2
NPK (nitrophosphate)	P ₂ O ₅	30	28	0.06	0.11
	NH ₄ -N	60	120	0.12	0.5
	NO ₃ -N	15	150	0.03	0.3
	Fluoride	26	13	0.05	0.05
NPK (mixed acid)	N	0	100	0.0	0.2

► **Table 2.** Summary of EFMA emission limit values to air

Production process	Emissionmg/Nm ³ kg/t of product.....	
		New	Existing	New	Existing
<i>Ammonia</i>	NO _x	150	300	0.45	0.9
	SO ₂	as for combustion plants			
<i>Nitric acid</i>	NO ₂	300	800	1.6	4.2
		(of 100% acid)			
<i>Sulphuric acid</i>	SO ₂			2-4	10
	SO ₃			0.15	0.6
<i>Phosphoric acid</i>	Fluoride	5	30	0.04 (of P ₂ O ₅)	
	Dust	50	150		
<i>Urea</i>					
(Granulator)	Urea dust	50	70-80	0.25	0.35-0.4
	NH ₃	50	130-165	0.25	0.65-0.83
(Prill tower)	Urea dust	50	100-150	0.5	1.0-1.5
	NH ₃	50	65-100	0.5	0.65-1.0
(Vents)	NH ₃			0.06	0.75
<i>Ammonium nitrate</i>					
(Granulator/Prill tower)	NH ₃	*10	*10		
	Particulates	*15	*15		
(Neutraliser/cooler/drier)	NH ₃	50	50	Total to air	
	Particulates	30	30	particulates: 0.5	
				NH ₃ : 0.2	
<i>CAN</i>					
	NH ₃	50	50		
	Particulates	50	50		
<i>NPK (nitrophosphate)</i>	NH ₃	50	250	0.3	1.0
	NO _x (NO ₂)	500	500	0.2	0.2
	Fluoride	5	5	0.02	0.02
	Dust	50	50	0.3	0.3
<i>NPK (mixed acid)</i>	NH ₃	50	50	0.2	0.2
	NO _x (NO ₂)	70	70	0.3	0.3
	Fluoride	5	5	0.02	0.02
	Dust	50	50	0.2	0.2

* 50 when insoluble solids are present.

Source: EFMA. BAT, 1995.

7.2.2 USA

In the USA the Environment Protection Agency, EPA, sets limits. Any State of the Union can increase or decrease the limits after evaluating all the factors at the plant site. However, any increase in emission limits is subject to approval by EPA.

Table (3) gives selected federal environmental regulations to the fertilizer sector in the USA.

▶ **Table 3.** Selected federal environmental regulations to the fertilizer sector in the USA

Substance	Source of Effluent - Production Unit/Operation (limits)					
	Sulphuric acid	Nitric acid	Wet-process phosphoric acid ^f	DAP	TSP	Granular TSP storage facility
Ammonia (NH ₃)	(Ammonia discharged to the atmosphere is not covered by federal regulations; may be regulated by state and local authorities)					
Ammonia (expressed as N)		0.45-4.5 g/t HNO ₃ ^{b,c,d} (wastewater)				
Acid mist	0.075 kg/t H ₂ SO ₄ ^b					
Fluorides (expressed as F)			10 g/t P ₂ O ₅ 10 mg/L ^c (wastewater)	30 g/t P ₂ O ₅ 25-75 mg/L ^c (wastewater)	100 g/t P ₂ O ₅ 25-75 mg/L ^c (wastewater)	0.25 g/h-t P ₂ O ₅ ^e
Nitrogen oxides (expressed as NO ₂)		1.5 kg/t HNO ₃ ^b				
Nitrate (expressed as N)		23-170 g/t HNO ₃ ^{b,c,d} (wastewater)				
Phosphate (expressed as P)			10-35 mg/L ^c (wastewater)	35-105 mg/L ^c (wastewater)	35-105 mg/L ^c (wastewater)	
Sulphur dioxide (SO ₂)	2 kg/t H ₂ SO ₄ ^b					
Stack opacity	Less than 10%	Less than 10%				
Total suspended solids			50-150 mg/L ^c (wastewater)	50-150 mg/L ^c (wastewater)	50-150 mg/L ^c (wastewater)	
pH			6.0-8.5 (wastewater)			

a) Indicated limits for phosphate operations refer to phosphate rock or P₂O₅ equivalent fed to process. Except for wastewater as noted, all values refer to discharges to the atmosphere. Additional state and local regulations may also apply.

b) Based on acid produced; 100% H₂SO₄ or HNO₃. Atmospheric discharge values refer to a maximum 2-h average.

c) Lower value is average of daily values for 30 consecutive days; higher value is maximum for any one day. Total suspended solids is waived if water is treated to remove phosphorus and fluorides.

d) Standard for new facility based on gaseous ammonia raw material.

e) Based on tonnes P₂O₅ equivalent in storage facility.

f) Florida

Source: United States Code of Federal Regulations July 1, 1989 and July 1, 1990.

□ 7.2.3 Other Countries

In table (4) emission limits in certain other countries are given. The wide range of standards may be noted.

► **Table 4.** *Fertilizer Production - Discharge Guidelines*

Component	India	Egypt	Turkey	Saudi Arabia
Particulate (dust)	150 mg/m ³	200 mg/m ³	200 mg/m ³	340 mg/m ³
NH ₃				(3 mg/l)
HF				
HCL				
F	25 mg/m ³ (10 mg/l)	(1.0 mg/l)	10 mg/m ³ (15mg/l)	(25 mg/l)
NH ₄ ⁺ -N ^a	(50 mg/l)	(3.0 ppm)	(50 mg/l)	(5 mg/l)
NO ₃ ⁻ -N ^a	(10-20 mg/l) ^d	(40 ppm as NO ₃)	(50 mg/l)	
NO _x ^b			900 mg/m ³ ^f	660 mg/m ³
Cd			(0.5 mg/l)	(0.05 mg/l)
P	(5 mg/l)		(35 mg/l)	(2 mg/l)
Chemical Oxygen Demand			(200 mg/l)	(350 mg/l)
Total Suspended Solids	(100 mg/l)		(100 mg/l)	(40 mg/l)
pH	(6.5-8.0)		(6-9)	(6-9)
Temperature				DT 3°C

Values in parenthesis () indicate liquid effluents, all other indicate gaseous effluents. Values not shown do not necessarily indicate absence of legislated limits. Gaseous values assumed to be expressed in normal cubic meters (Nm³).

a) Allowable limit calculated as N existing in indicated form.

b) NO_x calculated and indicated as concentration of NO₂.

c) Fluoride value may be as low as 1.5 mg/l depending upon recipient stream of outfall.

d) High value (20 mg/l) is applicable to phosphate fertilizer production units.

e) Phosphoric acid production

f) or 5 bar operating pressure

Source: Derived from IFA Environmental Legislation Survey (1989) and other reported data. Figures updated in 1998.

8. NEGOTIATED AGREEMENTS AND VOLUNTARY INSTRUMENTS

Gradually the notions of supply-chain management and self-regulation in industry are coming together. Mechanisms that are now increasingly talked about include those of voluntary measures, negotiated agreements, and codes or principles of conduct. These complement government regulations rather than replace them, and can be useful in addressing issues on which it is difficult to legislate, or on which industry feels it is able to take a pro-active stance in order to avoid legislation altogether.

Many companies have already adopted environmental policies and programmes. Increasingly however there is a need to have them also follow a coherent industry-wide approach, and this leads to the idea of industry-wide codes or agreements developed by industry itself, perhaps with input also from outside stakeholders and partners. Ideally these codes should involve most parts of the supply-chain.

UNEP IE has recently compiled a list of selected voluntary codes to allow industries to compare experience and to engage in benchmarking. The fertilizer industry is included in this survey, with codes from IFA, FAO and others listed. The survey is not exhaustive, but it does serve a useful purpose in allowing us to see what is happening in other sectors, and to see if the fertilizer industry needs to take further action to ensure that its own codes continue to respond to the changing political and environmental context in which we find ourselves (and to which we contribute).

Three examples of voluntary agreements relevant to the fertilizer industry are as follows.

■ 8.1 RESPONSIBLE CARE®

In 1985, the Canadian Chemical Producers' Association launched the Responsible Care® initiative. This is a voluntary action programme. It is aimed at ongoing improvements in the fields of safety, health and the environment. It covers six areas; process safety, transport and storage, employment conditions, the environment, product stewardship and communication. Over 10000 companies are currently affiliated to the participating confederations. Firms can ensure that their suppliers implement environmental safeguards and can request information accordingly. In Europe development and implementation are coordinated by the European Chemical Industry Council (CEFIC), whose guidelines are given in Appendix 9.1.

■ 8.2 THE ICC “BUSINESS CHARTER FOR SUSTAINABLE DEVELOPMENT”

The International Chamber of Commerce’s Business Charter for Sustainable Development emphasizes the introduction and development of environmental management practices and systems within enterprises as an essential contribution to sustainable development. See Appendix 9.2.

■ 8.3 CADMIUM

Cadmium may enter the agricultural environment through a number of different products and industrial processes, including phosphorus-containing fertilizers. In 1991, the members of EFMA decided that they would try to discuss an agreement based on self-restraint rather than wait for an EU regulation. An update of EFMA’s 1989 cadmium study was made in order to obtain the latest figures, and in 1995, the members agreed to make every effort to reduce the cadmium content of the fertilizers they deliver to Western Europe to a maximum level of 60 mg cadmium per kg P₂O₅. It was agreed that this reduction should take place by 2007, in line with the implementation of the IPPC directive for existing plants. The EU Commission recently decided not to formalize a negotiated agreement or a regulation for the time being, but rather to assess the risk to humans from cadmium in fertilizers more carefully before taking any regulatory action.

Two UNEP reports provide further information on voluntary initiatives:

“*Voluntary Industry Codes of Conduct for the Environment* - Technical report No. 40”, UNEP IE, 1998.

“Voluntary Initiatives”, in *Industry and Environment*, UNEP IE, Volume 21 No. 1-2, January-June 1998.

9. APPENDICES

■ 9.1 RESPONSIBLE CARE® - ENVIRONMENTAL REPORTING

For the European Chemical Industry Council (CEFIC), environmental reporting is a “necessary element of the effective implementation of Responsible Care®”. In June 1993, the CEFIC Board adopted its own “Guidelines on Environmental Reporting for the European Chemical Industry”. These suggest a common structure for corporate environment reports, listing nine sections which should be included in a report, ranging from an introductory section (e.g. Chief Executive Officer’s statement, environmental policy and methodology for reporting), through production facilities and products, to a company’s plans (e.g. qualitative and quantitative objectives) and environmental management systems (e.g. human resources, environmental impact assessment, auditing and emergency preparedness). In addition, the guidelines provide threshold levels for reporting emissions to water and air of key substances (including suspended solids, biological and chemical oxygen demand, nitrogen, phosphorus, nitrogen oxide, sulphur dioxide, volatile organic compounds and heavy metals).

CEFIC member companies are also advised to release energy and safety data, details of complaints and environmental expenditures, along with their communications activities and a list of contact people.

Highlights of the CEFIC Guidelines

The CEFIC Guidelines propose a common approach to: (1) corporate environment reports; (2) site environment reports; and (3) presentation of data in emissions tables. Here we reproduce element (2), believing that it is helpful not only in respect of the preparation of site reports themselves but could also help small- and medium-sized companies, many of which operate from a single site, to decide what they should report.

Proposed Common Structure for Site Environment Reports

1. Foreword

- Site manager address
- Company environment policy
- Company environmental objectives (medium/long term)

2. Site Description

- Main units, main products
- Site put into perspective: usage of products; economic contribution, employment; relations with authorities, local community
- Environmental situation: local conditions of air, water, etc. in the neighbourhood, sensitive areas, etc.

- Legal requirements: permits, emission limit values, etc.
- Controlling authorities: national, local, etc.

3. Environmental Management

- Structure (human resources, organization)
- Programme, objectives
- Environmental protection techniques (water treatment, waste incinerator, waste minimization, etc.)
- Integrated approach (recycling, new technologies)
- Monitoring techniques/systems (data measured/calculated/estimated)
- Emergency plan

4. Data (with comparisons with data on previous years)

- Emission data (cross-referenced to CEFIC guidelines on presentation of data in emissions tables)
- Selected details (noise, odours, etc.)
- Energy generation and consumption
- Health and safety data
- Complaints (optional)
- Spending on environmental protection

5. Communications

- Community relations
- Open days

6. General Comments

7. Contact People

■ 9.2 THE INTERNATIONAL CHAMBER OF COMMERCE, “THE BUSINESS CHARTER FOR SUSTAINABLE DEVELOPMENT” 1991

“The objective is that the widest range of enterprises commit themselves to improving their environmental performance in accordance with the following Principles, to having in place management practices to effect such improvement, to measuring their progress, and to reporting this progress as appropriate internally and externally.

The principles are as follows:

1. Corporate Priority

To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programmes and practices for conducting operations in an environmentally sound manner.

2. Integrated Management

To integrate these policies, programmes and practices fully into each business as an essential element of management in all its functions.

3. Process of Improvement

To continue to improve corporate policies, programmes and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

4. Employee Education

To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.

5. Prior Assessment

To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

6. Products and Services

To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

7. Customer Advice

To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

8. Facilities and Operations

To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimization of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.

9. Research

To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimizing such adverse impacts.

10. Precautionary Approach

To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

11. Contractors and Suppliers

To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

12. Emergency Preparedness

To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, recognizing potential transboundary impacts.

13. Transfer of Technology

To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

14. Contributing to the Common Effort

To contribute to the development of public policy and to business, governmental and intergovernmental programmes and educational initiatives that will enhance environmental awareness and protection.

15. Openness to Concerns

To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance.

16. Compliance and Reporting

To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.”

■ 9.3 INTERNATIONAL DECLARATION ON CLEANER PRODUCTION

We recognize that achieving sustainable development is a collective responsibility. Action to protect the global environment must include the adoption of improved sustainable production and consumption practices.

We believe that Cleaner Production and other preventive strategies such as Eco-efficiency, Green Productivity and Pollution Prevention are preferred options. They require the development, support and implementation of appropriate measures.

We understand Cleaner Production to be the continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits.

To this end we are committed to:

LEADERSHIP	<i>using our influence</i>
	<ul style="list-style-type: none"> • to encourage the adoption of sustainable production and consumption practices through our relationships with stakeholders.
AWARENESS, EDUCATION AND TRAINING	<i>building capacity</i>
	<ul style="list-style-type: none"> • by developing and conducting awareness, education and training programmes within our organization; • by encouraging the inclusion of the concepts and principles into educational curricula at all levels.
INTEGRATION	<i>encouraging the integration of preventive strategies</i>
	<ul style="list-style-type: none"> • into all levels of our organization; • within environmental management systems; • by using tools such as environmental performance evaluation, environmental accounting, and environmental impact, life cycle, and cleaner production assessments

RESEARCH AND DEVELOPMENT	<p><i>creating innovative solutions</i></p> <ul style="list-style-type: none"> • by promoting a shift of priority from end-of-pipe to preventive strategies in our research and development policies and activities; • by supporting the development of products and services which are environmentally efficient and meet consumer needs.
COMMUNICATION	<p><i>sharing our experience</i></p> <ul style="list-style-type: none"> • by fostering dialogue on the implementation of preventive strategies and informing external stakeholders about their benefits.
IMPLEMENTATION	<p><i>taking action to adopt Cleaner Production</i></p> <ul style="list-style-type: none"> • by setting challenging goals and regularly reporting progress through established management systems; • by encouraging new and additional finance and investment in preventive technology options, and promoting environmentally-sound technology cooperation and transfer between countries; • through cooperation with UNEP and other partners and stakeholders in supporting this declaration and reviewing the success of its implementation.

■ 9.4 ABBREVIATIONS

AAPFCO	American Association of Plant Food Control Officials
ADR	Agreement on the Carriage of Dangerous Goods by Road
AOAC	Association of Official Analytical Chemists
APELL	Awareness and Preparedness for Emergencies at the Local Level
API	American Petroleum Institute
AQS	Air Quality Standard
BAT	Best Available Techniques
BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BOD	Biological Oxygen Demand
BPM	Best Practical Means
BCSD	Business Council for Sustainable Development
CAER	Community Awareness and Emergency Response
CEFIC	European Chemical Industry Council
CEN	European Standardization Organization
CFI	Canadian Fertilizer Institute
CMA	Chemical Manufacturers' Association (USA)
COD	Chemical Oxygen Demand
CP	Cleaner Production
EFMA	European Fertilizer Manufacturers' Association
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ELV	Emission Limit Value
EMAS	Eco-Management and Audit Schemes
EMS	Environmental Management System

EPA	Environment Protection Agency
ESCAP	Economic & Social Commission for Asia and the Pacific
ETA	Environmental Technology Assessment
EU	European Union, formerly European Economic Community, EEC
FADINAP	Fertilizer Advisory, Development & Information Network for Asia & the Pacific
FAI	Fertiliser Association of India
FAO	Food and Agriculture Organization
GEMI	Global Environmental Management Institute
GHG	Greenhouse Gases
IATA	International Air Transport Association
ICC	International Chamber of Commerce
ICCA	International Council of Chemical Associations
IFA	International Fertilizer Industry Association
IFDC	International Fertilizer Development Center
ILO	International Labour Organization
IMDG	International Maritime Dangerous Goods (Code)
IMO	International Maritime Organization
IPC	Integrated Pollution Control
IPCS	International Programme for Chemical Safety
IPPC	Integrated Pollution Prevention and Control
ISO	International Standards Organization
LCA	Life Cycle Analysis
MACT	Maximum Achievable Control Technology
NPRI	National Pollutant Release Inventory (Canada)
OEL	Occupational Exposure Limit
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Administration
RC	Responsible Care®
RCRA	Resource Conservation and Recovery Act
RID	Regulations concerning the carriage of Dangerous Goods by Rail
SHE	Safety, Health and Environment
STEL	Short Term Exposure Limit
TFI	The Fertilizer Institute (USA)
TLV	Threshold Limit Value
TQM	Total Quality Management
TQEM	Total Quality Environmental Management
TRI	Toxic Release Inventory (USA)
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
VOC	Volatile Organic Compounds
WHO	World Health Organization

■ 9.5 REFERENCES

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- Volume 1. *The Benchmark Survey, 1996*. Volume 2. *The Case Studies, 1996*

- *The 1997 Benchmark Survey, 1997*

- *The CEO Agenda, 1998*

Information on the availability of the EFMA, IFA and IFDC documents can be obtained from the relevant organization, whose address is given at the end of this publication. UNEP IE publications are available from:

SMI (Distribution Services Limited)
P.O. Box 119, Stevenage
Hertfordshire SG1 4TP
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UNEP and SustainAbility publications are available from:
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49-53 Kensington High Street,
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■ 9.6 CONTACT ORGANIZATIONS

IFA

IFA, the International Fertilizer Industry Association, comprises around 500 member companies worldwide, in over 80 countries. The membership includes manufacturers of fertilizers, raw material suppliers, regional and national associations, research institutes, traders and engineering companies.

IFA collects, compiles and disseminates information on the production and consumption of fertilizers, and acts as forum for its members and others to meet and address technical, agronomic, supply and environmental issues.

IFA liaises closely with relevant international organizations such as the World Bank, FAO, UNEP and other UN agencies.

IFA's mission

- To promote actively the efficient and responsible use of plant nutrients to maintain and increase agricultural production worldwide in a sustainable manner.
- To improve the operating environment of the fertilizer industry in the spirit of free enterprise and fair trade.
- To collect, compile and disseminate information, and to provide a discussion forum for its members and others on all aspects of the production, distribution and consumption of fertilizers, their intermediates and raw materials.

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UNEP

UNEP's Industry and Environment centre in Paris was established in 1975 to bring industry, governments and non-governmental organizations together to work towards environmentally-sound forms of industrial development. This is done by:

- encouraging the incorporation of environmental criteria in industrial development
- formulating and facilitating the implementation of principles and procedures to protect the environment
- promoting the use of low- and non-waste technologies
- stimulating the worldwide exchange of information and experience on environmentally-sound forms of industrial development.

The Centre has developed a programme on Awareness and Preparedness for Emergencies at Local Level (APELL) to prevent and to respond to technological accidents, and a programme to promote worldwide Cleaner Production.

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Web: <http://www.unepie.org>

UNIDO

The United Nations Industrial Development Organization works with 169 Member States to help people in developing countries attain their economic and social goals by means of environmentally sustainable industrial development. Its services are also available to countries seeking to strengthen their industrial base as part of their transition towards a market economy.

UNIDO was established on 1 January 1967 by General Assembly resolution 2152 (XXI) of 17 November 1966. It became the sixteenth specialized agency of the United Nations on 17 December 1985 with the mandate to act as the central coordinating body for industrial activities within the UN system.

United Nations Industrial Development Organization
Vienna International Centre
P.O. Box 300, 1400 Vienna, Austria
Tel: +43 1 26026 3883 - Fax: +43 1 26026 6819
Tel: +43 1 26026 3938 (direct I. Volodin)
Web: <http://www.unido.org>

Some International Organizations Providing Recommendations and Standards

International Standards Organization (ISO)

1, rue de Varembe, Case Postale 56, CH-1211 Geneva, Switzerland

Tel: (41) 22 749 0111 Fax: (41) 22 733 3430

Web: <http://www.iso.ch>

European Chemical Industry Council (CEFIC)

Avenue E. van Nieuwenhuysse 4, 1160 Brussels, Belgium

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Web: <http://www.cefic.be>

International Chamber of Commerce (ICC)

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