Pathways to Higher Education Project

Center for Advancement of Postgraduate Studies and Research in Engineering Sciences, Faculty of Engineering - Cairo University (CAPSCU)

Health, Safety and Environment

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Acknowledgment

On behalf of Pathways to Higher Education Management Team in Egypt, the Project Coordinator wishes to extend his thanks and appreciation to the Ford Foundation (FF) for its full support to reform higher education, postgraduate studies and research activities in Egypt. The Management Team extend their special thanks and appreciation to Dr. Bassma Kodmani, Senior Project Officer at the Ford Foundation office in Cairo, who helped initiate this endeavor, and who spared no effort to support the Egyptian overall reform activities, particularly research and quality assurance of the higher education system. Her efforts were culminated by the endorsement to fund our proposal to establish the Egyptian Pathways to Higher Education project by the Ford Foundation Headquarters in New York.

The role of our main partner, the Future Generation Foundation (FGF), during the initial phase of implementation of the Pathways to Higher Education Project is also acknowledged. The elaborate system of training they used in offering their Basic Business Skills Acquisition (BBSA) program was inspiring in developing the advanced training program under Pathways umbrella. This partnership with an NGO reflected a truly successful model of coordination between CAPSCU and FGF, and its continuity is mandatory in support of our young graduates interested in pursuing research activities and/or finding better job opportunities.

The contribution of our partner, The National Council for Women (NCW), is appreciated. It is worth mentioning that the percentage of females graduated from Pathways programs has exceeded 50%, which is in line with FF and NCW general objectives. The second phase of the project will witness a much more forceful contribution from the NCW, particularly when implementing the program on the governorates level as proposed by CAPSCU in a second phase of the program.

We also appreciate the efforts and collaborative attitude of all colleagues from Cairo University, particularly the Faculties of Commerce, Art, Mass Communication, Law, Economics and Political Sciences, and Engineering who contributed to the success of this project.

Finally, thanks and appreciation are also extended to every member of the Center for Advancement of Postgraduate Studies and Research in Engineering Sciences (CAPSCU), Steering Committee members, trainers, supervisors and lecturers who were carefully selected to oversee the successful implementation of this project, as well as to all those who are contributing towards the accomplishment of the project objectives.

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CU **Cairo University** **NCW National Council for Women**
FF **Ford Foundation** **FGF Future Generation Foundation**
CAPSCU **Center for Advancement of Postgraduate Studies and Research in Engineering Sciences, Faculty of Engineering - Cairo University**

Publisher Introduction

The Faculty of Engineering, Cairo University is a pioneer in the field of learning and continual education and training. The Center for Advancement of Postgraduate Studies and Research in Engineering Sciences, Faculty of Engineering - Cairo University (CAPSCU) is one of the pillars of the scientific research centers in the Faculty of Engineering. CAPSCU was established in 1974 in cooperation with UNIDO and UNESCO organizations of the United Nations. Since 1984, CAPSCU has been operating as a self-financed independent business unit within the overall goals of Cairo University strategy to render its services toward development of society and environment.

CAPSCU provides consultation services for public and private sectors and governmental organizations. The center offers consultation on contractual basis in all engineering disciplines. The expertise of the Faculty professors who represent the pool of consultants to CAPSCU, is supported by the laboratories, computational facilities, library and internet services to assist in conducting technical studies, research and development work, industrial research, continuous education, on-the-job training, feasibility studies, assessment of technical and financial projects, etc.

Pathways to Higher Education (PHE) Project is an international grant that was contracted between Cairo University and Ford Foundation (FF). During ten years, FF plans to invest 280 million dollars to develop human resources in a number of developing countries across the world. In Egypt, the project aims at enhancing university graduates' skills. PHE project is managed by CAPSCU according to the agreement signed in September 22nd, 2002 between Cairo University and Ford Foundation, grant No. 1020 - 1920.

The partners of the project are Future Generation Foundation (FGF), National Council for Women (NCW) and Faculties of Humanities and Social Sciences at Cairo University. A steering committee that includes representatives of these organizations has been formed. Its main tasks are to steer the project, develop project policies and supervise the implementation process.

Following the steps of CAPSCU to spread science and knowledge in order to participate in society development, this training material is published to enrich the Egyptian libraries. The material composes of 20 subjects especially prepared and developed for PHE programs.

Dr. Mohammad M. Megahed
CAPSCU Director
April 2005

Foreword by the Project Management

Pathways to Higher Education, Egypt (PHE) aims at training fresh university graduates in order to enhance their research skills to upgrade their chances in winning national and international postgraduate scholarships as well as obtaining better job.

Pathways steering committee defined the basic skills needed to bridge the gap between capabilities of fresh university graduates and requirements of society and scientific research. These skills are: mental, communication, personal and social, and managerial and team work, in addition to complementary knowledge. Consequently, specialized professors were assigned to prepare and deliver training material aiming at developing the previous skills through three main training programs:

1. Enhancement of Research Skills
2. Training of Trainers
3. Development of Leadership Skills

The activities and training programs offered by the project are numerous. These activities include:

1. Developing training courses to improve graduates' skills
2. Holding general lectures for PHE trainees and the stakeholders
3. Conducting graduation projects towards the training programs

Believing in the importance of spreading science and knowledge, Pathways management team would like to introduce this edition of the training material. The material is thoroughly developed to meet the needs of trainees. There have been previous versions for these course materials; each version was evaluated by trainees, trainers and Project team. The development process of both style and content of the material is continuing while more courses are being prepared.

To further enhance the achievement of the project goals, it is planned to dedicate complete copies of PHE scientific publications to all the libraries of the Egyptian universities and project partners in order to participate in institutional capacity building. Moreover, the training materials will be available online on the PHE website, www.Pathways-Egypt.com.

In the coming phases, the partners and project management team plan to widen project scope to cover graduates of all Egyptian universities. It is also planned that underprivileged distinguished senior undergraduates will be included in the targeted trainees in order to enable their speedy participation in development of society.

Finally, we would like to thank the authors and colleagues who exerted enormous efforts and continuous work to publish this book. Special credit goes to Prof. Fouad Khalaf for playing a major role in the development phases and initiation of this project. We greatly appreciate the efforts of all members of the steering committee of the project.

Dr. Sayed Kaseb

Project Manager

Dr. Mohsen Elmahdy Said

Project Coordinator

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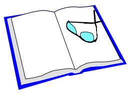
Chapter 1: Introduction

Definition



Environment is defined as the living organisms, climate, soil, water, land, fauna, flora and other physical features surrounding the human being and the biodiversity components.

Air pollution, water pollution, solid wastes are the negative impacts of the economic and public activities. Thus these pollutants need to be prevented and reduced to protect the environment from hazards and damages.

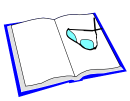
So, the study in this part includes the following two major topics:

1. Environmental Management System.
2. Environmental Impact Assessment.

Environmental Management System *comprises a management environmental policy, environmental monitoring and assessment, and environmental reporting.* The task of an **environmental impact assessment** *aims at identifying the environmental impact and mitigation measures of these impacts*.

Some Definitions

1.1 Some Definitions



Ecology is the study of organisms in relation to the surroundings in which they live. These surroundings are called environment of the organism.

This environment is made up of many different components, including other living organisms and effects, and purely physical features such as the climate and soil type. That is why we cannot separate ecology from environment and thus ecology and environment are interrelated. **Ecology and environment** can be considered as one science: Science of life. Both search and discuss items and points about organisms, populations, communities, ecosystems and their relations with the organisms.

Ecology

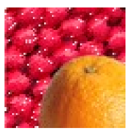
Ecology may be subdivided to:

a- Autoecology: علم البيئة الفردية is the study of the ecology of a single species.
b- Synecology: علم البيئة الجماعي is the study of the ecology of whole communities of organisms.

Ecology Divisions

Ecology may also be subdivided into Terrestrial Ecology علم البيئة البرية، Aquatic Ecology علم البيئة المائية ، Marine Ecology علم البيئة البحرية. Ecology is now related to many studies: Animal ecology علم البيئة الحيوانية ، Plant ecology علم البيئة النباتية ، Wildlife management علم إدارة البيئة ، Forestry علم الغابات Paleoecology علم بيئة المتحجرات Oceanography علم المحيطات Biogeography علم الجغرافية الحياتية Pollution ecology علم تلوث البيئة Ecological Technology تكنولوجيا البيئة Physiological ecology علم البيئة الفسيولوجي and others, like chemistry, engineering, medicine, agriculture, physics, computer science. The environment is of supreme importance to an organism and its ability to exist in the environment where it lives will determine its success or failure as an individual.

Ecologist



An ecologist could start any study by asking the question: why does this organism live or grow here and not there? For example**, an ecologist may ask:**

- How does the organism obtain its food?
- Is a particular nutrient limiting its growth or number?
- Is some thing else limiting its growth or number?
- Does it reproduce in this site and if so how?
- Is it absent from parts of the site because of some factors?
- How and when do the young disperse?
- What courses the death of the organisms?

In addition, there are many possible questions that demonstrate the complexity of ecology related topics.

On earth, the **abiotic environment** of an organism is composed of physical variables such as temperature, rain and snow fall, nutrient and toxic content of the soil, the power of wave action and wind speed. **An organism** also experiences the influence of other organisms through competition, perdition, herbivore, pollination and seed dispersal. The effect of such organisms forms the biotic art of the environment. Although the abiotic (physical) and biotic components of the environment can be treated separately, the relationships between them are complex.

The Complexity of The Environment

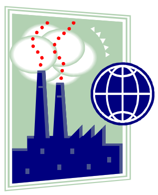
1.2 The Complexity of The Environment

The effects of changes in the environment always exert an influence directly on the organisms in a community. **Day, night, rain, drought, cold, and pollution affect the individual and**, because of this, they will also affect its interactions with other organisms, and therefore may alter the distribution or abundance of a particular species and its predators and so on throughout the biologic web. All communities, including human beings, will be affected by complex interactions of many factors in the environment.

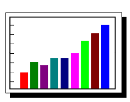
Example of Interactions: Effects of environmental pollution from an oil spill

Pollution

1.3 Pollution



Pollution occurs when substances are released into the environment in harmful amounts as a direct result of human activity. Most pollution is due to the presence of excessively high concentrations of substances. **Pollution is the result of human activities. Natural pollution is rare**. Though, *thermal pollution involves the release, not of a harmful chemical, but of excessive amounts of heated water.* These are discharged by many industries into rivers and seas. The main problem is that warm water holds less Oxygen than cold water, so *that the release of large quantities of warm water may kill fish and aquatic invertebrates through oxygen starvation, see Figure 1.1.*



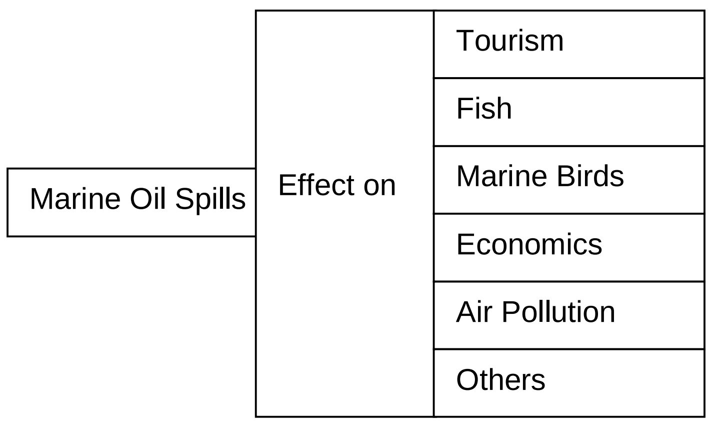


Figure1.1: Pollution effects

Classification and Forms of Pollution

1.3.1 Classification and Forms of Pollution

Pollutants can be classified into three types:

1- **Substances that occur in nature**, but because of human activity, are found in unusually large concentrations. An example is CO_2.
2- **Toxic substances** produced as a result of human activity and not found in nature. An example is the use of pesticides. Such unnatural substances often remain intact in the environment for considerable lengths of time being broken down or dispersed.
3- **Substances**, which are not themselves toxic are released into the environment as a result of human activity, but which then go on to have unfortunate consequences. An example is the effect of certain substances on the zone layer. With this classification in mind, we will now consider some particular examples of pollution.

Forms of pollution are numerous

Eutrophication

Forms of pollution are numerous:

1. Eutrophication is the name given to the release of large amounts of phosphate and nitrate or organic matter into water resulting in a lowering of oxygen levels and change in the fauna of the water. In their natural state most waters, whether freshwater or marine, contain only low levels of nitrate and phosphates. If substantial quantities of nitrate and phosphates enter water, they allow large numbers of algae and aerobic bacteria to build up. These organisms can require so much oxygen; this lowers the amount of free oxygen in the water to the point at which aerobic bacteria are unable to decompose organic matter in the water. **The Biological Oxygen Demand (BOD)** of unpolluted river water is typically less than **5 mg O_2/liter/day**. **Crude sewage has a BOD** of around **600 mg O_2/liter/day**. It is not surprising that pollution due to sewage can lead to permanent changes in the organisms found in the affected waters. However, good sewage treatment reduces the BOD of discharged effluent to less than 30 mg O_2/liter/day.

There are several causes of eutrophication. The main ones are sewage input (including that from farm animals and from fish farms) and the run-off from fertilizers applied to crops. Occasionally, the release of concentrated sugars or other organic substances may be a problem. The ecological consequences of eutrophication can be extensive.

Heavy-Metal Toxicity

2. Heavy-Metal Toxicity. Heavy metal toxicity occurs when elements such as **mercury**, **zinc** and the like are present in superabundance. The fundamental problem with heavy metals is that although some of them are needed by organisms in trace amounts; when present in excess, they become very toxic.

Acid Rain

3. Acid Rain. Acid Rain is the collective name given to a number of processes which involve the deposition of acidic gases from the atmosphere. **Unpolluted rain has a pH of about 5.6** due to the presence of dissolved carbon dioxide. However, **rainwater often has a pH between 4 and 4.5.** Results of killing unwanted species: **they are unnatural substances.** They can be classified as her biocides (chemicals synthesized expressly for killing unwanted plants), insecticides (which kill insects), fungicides (which kill fungi), and so on. They are used for two main purposes: to The difference is due to various oxides of nitrogen and sulfur, often collectively described as NO_X and SO_X. These are the result of the combustion of fossil fuel, whether petroleum in vehicles, or coal, oil or gas in power stations. Many environmentalists blame acid rain for the damage to, especially at high altitudes and at the edges of forests where large areas of land are covered by damaged or dying trees. Acid rain also has an important effect on Fresh water. Fish deaths are correlated with increasing acidification of the lakes. Acid rain has also been implicated in recent failures of a number of birds to breed normally in the Netherlands.

Pesticides

4. Pesticides. Pesticide pollution is rather different. Pesticides are chemicals synthesized expressly for the purpose of killing species which carry diseases harmful or fatal to humans; or to kill species which compete with us for food. Use of pesticides can develop into two problems:

- The pests they are designed to kill may evolve resistance to the pesticides: larger and larger doses have to be used or that new pesticides have to synthesize.
- Many pesticides are not biodegradable. Precisely because they are unnatural substances, they may be resistant to decay. This means that they accumulate in the environment.

CFC's and Ozone Layer

5.CFC's and the Ozone Layer. Ozone (O_3) is concentrated in the Earth's stratosphere 15-50 km above the surface of the earth and it is only present in concentrations of a few ppm or less. During mid 1980s, it was realized that ozone levels above Antarctica were falling dramatically. The substances most responsible for this sudden collapsed were identified as chlorofluoro-carbons, known as CFC's for short.

What seems to happen is that the chemical $CFCl_3$ may be broken down by a quantum of high-energy light as follows:

$$CF\ C_3 + Light \Rightarrow CF\ Cl^{-}_2 + Cl^{-}_2$$

The chlorine radical thus formed can then cause the conversion of ozone to Dimolecular oxygen without itself being used up in the process:

$$Cl^{-} + O_3 \Rightarrow ClO^{-} + O_2 \text{ and } ClO^{-} + 2O^{'} \Rightarrow Cl^{-} + O_2$$

In this way, a single molecule of **CF CL_3 can remove hundreds of thousands of ozone molecules.** CFCs used to be found in every refrigerator and the majority of aerosols and many pieces of firefighting equipment. In the late 1980s a number of measures were agreed internationally to reduce the use of CFCs. It is still too early to see whether these measures are adequate. If ozone levels continue to fall, the most obvious short-terms biological consequence will be a significant increase in the number of cases of skin cancer. Such cases have already developed in Australia and New Zealand.

6.Oil Spills. Oil spills are due to mistakes of human activities. The physical properties which effect the behavior of oil spilled to sea are:

Oil Spills properties

- **Specific Gravity**. Oil with a low specific gravity tends to be more volatile and highly fluid.
- **Distillation Characteristics (Volatility of an oil).** As temperature of oil is raised, different components distil at different

temperatures.

- **Viscosity (Resistance to flow).** High viscosity oils flow with difficulty, low viscosity oils are highly mobile, sea temperature and heat absorption of oils affect viscosity.
- **Pour point** (Temperature below which oil will not flow). If ambient temperature is below the pour point, the oil will behave as a solid.

1.4 Oil Weathering Processes

Oil Weathering Processes

The following processes normally occur after an oil spill, though their relative importance during the time span of a spill varies.

Spreading

- **Spreading.** During the early stages of a spill, **the oil will spread out to a thin film.** The spreading rate will be affected by oil viscosity, pour point, wax content, sea state, and weather conditions. After a few hours, the slick of oil begins to break up and form narrow bands parallel to the wind direction. The slicks normally move in the same direction and same speed as the current, and move in the same direction as the wind at approximately 3% of the wind speed. Normally the thickness of the oil within a slick varies considerably.

Evaporation

- **Evaporation.** The rate and extent of evaporation is determined primarily by the volatility of the oil. **Spills of non-persistent oils, such as Kerosene and Gasoline, may evaporate completely within a few hours,** and light crude's can lose up to 40 percent in the first day. However, heavy crudes and fuel oils undergo hardly any evaporation. The rate of evaporation depends upon the spreading rate, sea and wind conditions and temperature. The larger the surface area, rough seas, high winds and warm temperatures all increase the rate of evaporation. It is important to note that, when volatile oils are spilled in confined and even unconfined areas, there may be a risk of fire and explosion.

Dispersion

- **Dispersion.** Under certain conditions, **oil can be dispersed by the mechanical action of the sea.** Waves and turbulence act on the slick to produce oil droplets of different sizes. Small droplets remain in suspension while the larger droplets risk back to the surface. Droplets small enough to remain in suspension become mixed into the water column, which can enhance other processes such as bio-degradation. The rate of dispersion depends on the nature of the oil, the slick thickness and the Sea State. Oil which remain fluid can spread unhindered, may disperse in moderate sea conditions within a few days. Conversely, viscous oil or those that form stable water-in-oil emulsions show little tendency to disperse.

- **Emulsification.** Many oils show a tendency to absorb water to

Emulsification

form water-in-oil emulsions, which can increase the volume of pollutant by a factor of between, three and four. These emulsions are often extremely viscous and stabilize enough to form the phenomenon known as "chocolate mousse." Even calm sea conditions can generate the mousses, which are very persistent thus impeding the other processes of degradation and weathering. Low viscosity oils tend to form emulsions very quickly (i.e. 2-3 hours) and can have water content up to 80%. High viscosity oils take longer time to form emulsions; such emulsions will seldom exceed 40% water content. Emulsified oil normally has a brow-orange appearance.

Dissolution

§ **Dissolution.** Solution of oil in water is normally slight and confirmed mainly to the lighter components. This process rarely makes any significant contribution to the removal of oil from the sea surface.

Oxidation

§ **Oxidation.** Hydrocarbons can react with oxygen either to form soluble products or to form persistent tars. Sun light can promote oxidation reactions, but the overall effect is minor in relation to other weathering processes.

Biodegradation

§ **Biodegradation**. The main factors affecting the rate of biodegradation are temperature and the availability of oxygen and nutrients. Seawater contains of range of marine microorganisms which can utilize the oil as a source of carbon and energy. Biodegradation can have a significant effect on the removal of oil at sea because the microorganisms living in seawater can gain access to the oil/water interface. Beached oil will therefore break down a lot slower because the microorganisms are not so prevalent out of seawater.

Sedimentation

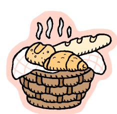
§ **Sedimentation**. Very few crude oils are sufficiently dense or weathered to such an extent that their resides will sink in seawater. Sinking is usually brought about by adhesion of particles of sediment or organic matter to the oil. Shallow waters are often laden with suspended solids providing favorable conditions for sedimentation.

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill whilst oxidation, sedimentation and biodegradation are long term processes which determine the ultimate fate of the oil. As a general rule, the lower the specific gravity of the oil the less persistent it will be. However, it is important to appreciate that some apparently light oils behave more like heavy ones due to the presence of waxes. Oils with wax contents greater than 10% tend to have high pour points and if the ambient temperature is low, the oil will be either a solid or a highly viscous liquid. Obviously throughout the lifetime of an oil slick, it continues to drift on the sea surface. The wind induced effect is normally taken as 3% of the wind velocity, and the current effect is taken as 100 percent of the current velocity. Reliable prediction of slick movement is clearly dependent upon availability of good wind and current data.

In order that a realistic response to an oil spill can be achieved, it is important to understand the limitations that will affect the nature of that response. The first priority must be one of prevention. Training of personnel and good house keeping practices will all minimize the risk of spillage. However, no matter what precautions are taken oil will occasionally be split and the first action must be to minimize the amount of spillage by stopping, or at least reducing the flow at source. There is the need to examine the options available for dealing with a spill.

1.5 Food and Environmental Pollution

Food and Environment Pollution

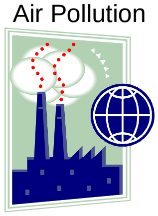


Contaminated food indicates environmental pollution, food contaminant may be:

- Biological with different microbes such as salmonella,
- Parasitical such as round and tape worms.
- Chemical as in case of pesticides, heavy metals, antibiotics and hormones
- Physical due to radiation
- Metallic as in the case of lead or copper. Knowledge and efforts are required in this field to over come problems of polluted food.

1.5.1 Air Pollution

Air Pollution



Man can withstand without food for 3 weeks, without water for 3 days and without air only for 3 minutes as a maximum. The pollution of air is mainly from effluent gases, which spreads quickly due to wind action and temperature and pressure changes. Winds also spread dust and minute solid particles.

In general, air pollution sources can be divided into three types:

Air pollution sources

Point Sources

- **Point Sources.** Sources with emissions released from a confined location. These are the most easily controlled sources. They include exhaust stacks from combustion devices, process vents, vents from storage tanks, and flares.

Fugitive Sources

- **Fugitive Sources**. Emissions that is associated with leaking pumping and piping equipment. These include pumps, compressors, valves, and flanges. These sources can be controlled, but is usually man power intensive.

- **Area sources**. Area Sources are sources that may have a large aerial extent. Examples of these may be lagoons or storage piles.

Area Source

Normally these sources, have a mall emission rate per unit area, but can represent significant emissions for the entry source.

However, the most important **toxic pollutants** for the oil and gas industry are:

Toxic pollutants

- Sulfur Dioxide (${SO_2}$)
- Carbon monoxide (CO)
- Nitrogen Dioxide (${NO_2}$), Nitric Oxide (NO) - Oxides of Nitrogen (NOx)
- Total hydrocarbons (HC) - volatile organic compounds (VOC) - - Benzene, Ethyl benzene, Toluene, Xylenes (BETX)
- Hydrogen Sulfide (H_2S)
- Sulfuric acid mist (H_2SO_4)
- Particulate matter (PM and PM_{10})
- Metals, natural or added to oil products
- Ozone (O_3)

Toxic pollutants are often divided into 2 classes:

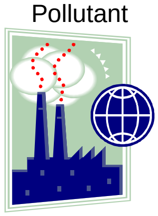
Divisions of pollutants

a- **Acutely** (short-term) toxic
b- **Chronically** (long-term) toxic.

Different exposure time periods may be of interest depending upon the toxic effects of the pollutant. In addition, "non-toxic" water vapor and carbon dioxide (CO_2) are emitted in significant amounts. It should be noted that CO_2 is considered by some to be detrimental to the earth and is responsible to heat retention around the earth (the so-called, green house effect).

1.5.2 Sources of Air Pollutant

Sources of Air Pollutant



- **Combustion:** (Boilers, Heaters, Engines, Turbines, Flares): produces NOx, CO,
- **Unburned** HC/VOC, SO_2, and PM
- **Evaporation** (Storage tanks, waste water treating) HC/VOC
- **Processing** (Cracking units, sulfur Recovery, Desulfurization): CO, HC/VOC, H_2S and PM
- **Production** H_2S
- **Fugitive** HC/VOC
- **Reactivity in Atmosphere** O_3 (VOC + NOx + Sunlight)
- Polluted air causes different diseases depending on the degree of pollution and type of the material causing this pollution.

1.5.3 Water Pollution

Water Pollution

Man's life is related to the presence of water. Quantity of water on the earth reaches about 1.35 Billion km^3. About 97% of this quantity are present in the seas & oceans. Fresh water quantity is about 37 million km^3.

There are four sources of general pollution affecting water:

Sources of water pollution

- **Waste water of animal origin, or of human origin**. Animal water most often affects the quality of wells. Domestic wastewater pollutes rivers, either by direct discharge or by discharge of the non-degraded fraction of effluent from purification plants. The pollutants in such waste are suspended matter, detergents, organic matter, phosphates, bacteria and sometimes viruses.
- **Industrial process waters or liquid effluents** vary so much that they may contain all known pollutant, including radioactive material, and sometimes mineral or organic carcinogens, in proportions which vary with the preceding treatment.
- **Run off water contains agricultural pollutants** such as fertilizers, pesticides, detergents, etc…
- **Accidental contamination** due to concentrated discharge of a pollutant liable to affect surface water or even deep-lying water.

Many pollutants and micro-pollutants liable to be found in water for human consumption can be classified:

1. Mineral pollutants
2. Organic pollutants
3. Viral particles

Suspended solids of organic or mineral origin (plastic bags, grit, clay, etc…) must also be taken into account and a suitable form of preliminary treatment must be selected to eliminate it.

1- Mineral pollutants and micro pollutants. These includes:

Mineral and micro pollutants

- **Undesirable or toxic substances**: heavy- metals, fluorine, arsenic, etc.…
- **Substances** such as iron, manganese, zinc and copper. Such elements are required in small quantities by the human body and become toxic if large doses are accumulated.
- **Phosphorous** and its compound, which are responsible for the growth of algae and the eutrophication of lakes.

2- Organic pollutants and micro-pollutants. These are very numerous and can be classified as phenols, hydrocarbons, detergents, pesticides and other impurities.

Organic and micro pollutants

Phenols and derivatives

a- Phenols and derivatives: Phenols and their derivatives are the mark of industrial pollution. Their worst effect is that, in the presence of chlorine, very small quantities of these products, depending on the organic matter in the water, leave a taste of chlorophenol. The biodegradability of phenol derivatives varies with their composition.

Hydrocarbons

b- Hydrocarbons: The hydrocarbons capable of polluting surface or underground water supplies come mainly from oil refinery waste, industrial effluents of various kinds, gas works effluent, fumes, etc. Such waste may contain paraffin, kerosene, petrol, diesel oil, fuel oil, other oils and lubricants. Biodegradability is slow. Accidental pollution is short lived at the intake of a river purification plant but can last a long time in the case of underground water (up to several years because of the soil's power of retention). This is why underground water supplies have to be strictly protected against the risk of hydrocarbon contamination.

Harmful and toxic effect of hydrocarbons

Harmful and toxic effects of hydrocarbons are:

- **Formation of a film** which interferes with the re-oxygenation and natural
- **Purification of surface water**;
- **Interference with the operation of drinking water treatment plants**; flocculation and sedimentation are affected and the hydro carbon is liable to remain in the filter material for a long time;
- **The undesirable taste and smell**
- There is a **danger of toxicity** in drinking water at concentrations above those at which taste and smell appear.
- **Skin troubles** have been caused by fuel oil additives.
- Some products as the derivatives of benzene are possible carcinogens and the risk is increased by the presence of other compounds such as surfactants.

Detergents

c- Detergents. Detergents are **synthetic surface-active compounds** which enter the water with municipal and industrial effluents. Commercial products contain active compounds in the form of surfactants and aids. Surfactants, with a structure that modifies the physical properties of surfaces by lowering surface tension and gives them cleaning power. Aids include substances to sequester dirt, to improve appearance, bleaching agents … etc.

The harmful effects caused by the presence of detergents in water are:

- **Formation of foam**, which slows down the transfer and dissolution of oxygen in the water concentrates impurities, and is liable to spread bacteria and viruses.
- **Formation of a barrier film on the surface**, even when there is no foam, it gives a soapy taste
- **Higher phosphate content** due to the presence of polyphosphates in surfactants, leading to eutrophication of lakes and the growth of plankton in rivers.

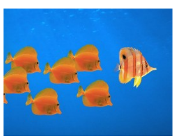
- **Gradual increase in the boron content** of surface and underground water supplies, due to the large quantities of sodium per-borate used in detergents. Detergents do not kill bacteria, algae, fish and other forms of river life, so long as the concentration does not exceed 3 mg/L.

Pesticides

c- **Pesticides**. Pesticides are products used to control organisms which are either harmful to health or attack materials, animal and vegetable source of food. They are themselves harmful to health and may, if allowed to accumulate in plant or animal cells, prove detrimental to the environment in general. Pesticides can leave a smell. Also pesticides have a direct effect on fauna in the form of slow or acute poisoning and indirect effect (represented by the disappearance of plankton) namely a drop in oxygen content and changes in pH value and CO_2 content. In general, pesticides are toxic to human beings and mammals. Their presence can cause cancer or fibrosis of the lever or kidney failure.

3- Biological pollutants and micro-pollutants

Biological and micro pollutants



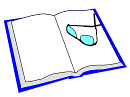
- **Microorganism and viruses.** This form of pollution is caused by microorganisms and viruses in the different types of waste. They can affect both surface and underground supplies.
- **Secretions of microfauna and microflora**. Many organisms (algae in particular) may develop in river water, especially if polluted by organic matter or substances causing eutrophication, in reservoirs and even in distribution systems. Biological pollutants give rise to highly unpleasant smells; some types of algae develop products which are toxic to higher animals; color and or turbidity may be caused by the secretions of microflora and excretions of micro fauna.

Impurities from reagents used in water treatment

4- Impurities from reagents used in water treatment. It is important that in the treatment of drinking water the reagents used should be relied on not to introduce any impurities which are likely to persist in the water after treatment. When for instance, caustic soda is used to correct the pH of filtered water before distribution through the system, care must be taken to ensure that it is mercury-free.

Chapter 2: Environmental Management System (EMS) Standards and Methods

EMS: Definition and Concepts



2.1 EMS: Definition and Concepts

For the last ten years various stakeholders defining standards of good environmental management practice have influenced corporate strategies for environmental management and environmental information. The growing importance of environmental management is reflected by number of important regulations and standards in force or being prepared, all with the aim of harmonizing environmental management practices and procedures. Standardization and its application to company systems are the most important aspects of effective environmental management Standards can be technical, related to performance, or can be process-based and they provide the foundation for continual improvement in relation to **established benchmarks**. *Among the most significant standards in recent time are BS 7750 (BSI 1992), the EU directive on EMS and standard ISO and 14004 (or ISO 14004 for companies not seeking certification of ISO (1994a, 1999a). ISO 14001, which is now being adopted widely, is a process standard ISO currently developing a family of environmental management' standards that address management systems and environmental aspects of products in the areas of life-cycle assessment, (LCA) (ISO 14040), labeling, (ISO 14020), and environmental performance evaluation*.

Benchmarks

Standard-setting organization

Standard-setting organization such as the BSI, ISO as other national standard-Isetan organization have formulated standards against which corporate management systems can be audited. These standardization organizations are private institutions financed by industry. Their markets (i.e. sales) depend on the price of auditing and certification services as well as on the reputation of organization for ensuring that the material audited is of a high quality. The quality of these auditing services is, in turn, checked by regulators, who verify corporate environmental audit.

BS 7750

BS 7750, released as a draft standard in 1992 (and released as an actual standard in 1994) was the first standard for corporate environmental management systems. It has substantially influenced ISO 14001, which was published as a draft version in 1994 and as final document in 1996 (Hillary 1995: 294 Sheldon 1996; Tibor and Feldman 1997). Although ISO 14001 encompasses the general element of 7750, it allows greater flexibility in application.

A major motivation for companies to establish environmental management systems comes from the **European Commission's (COM)** introduction of the voluntary EMS for production sites and companies. The term " audit " could be misleading, because EMS covers much more than a traditional legal compliance audit. EMS enables companies to have their audited according to criteria for good environmental management practices and, if they fulfill the requirements of the directive, to use (restrictively) a label that confirms that a specific site has an environmental management system in place and that it has successfully completed an external environmental audit. The label can only be used on a letterhead or on environmental and financial reports and is not attached to products.

As shown in the following in Figure 2.1, an important part of EMS focuses on the process of ensuring that an environmental management system is in place and functioning

EMS help

To comply with the provisions of EMS**,** a company must have implemented an environmental management system that helps to:

- § **Formulate an environmental policy** and goals for corporate environmental protection.
- § **Secure efficient environmental accounting** (or information management)
- § **Evaluate environmental performance** (and support decision-making)
- § **Plan and steer company activities**.

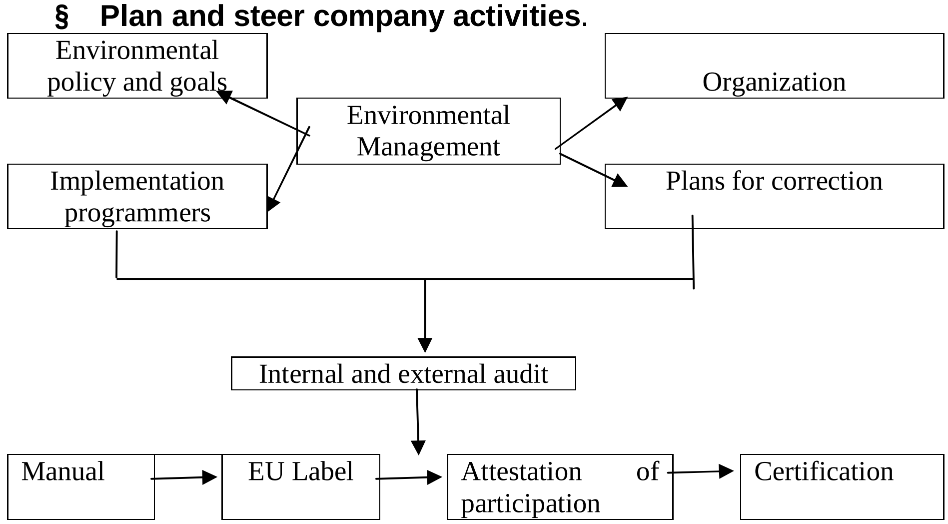


Figure 2.1: Important parts of EMS

- **Implement the respective plans**
- **Build up** an effective and efficient organization
- **Communicate with internal and external** stakeholders (Environmental Reporting)

In addition, the existence and functioning of the corporate Environmental management system has to be verified by external auditors.

Companies that comply with these requirements are free to display logo on their letterhead; something that it is hoped would become a mark of environmental excellence. It was expected that market pressure, especially in inter-corporate business relationships, would encourage companies to participate EMS. However, as an economic analysis of the incentives provided by EMS and early experience show, this reason for participation may be overestimated in the past In addition, competition continues between EMS and ISO 14001 as alternative Environmental management standards. Frequent reports on the relative take-up of these of these rival schemes continue Emphasis on membership and cost is critical; for example, ISO reversals More than 80% of 500 companies surveyed on their experiences with implementation of [ISO] Environmental management systems (EMS) found them to be cost-effective, with over 60% quoting payback periods on their investment of less than 12 months.

Idea behind ISO 14001

The Idea behind ISO 14001 can be shown in Figure 2.2. The main requirements for the ISO Environmental management system are similar to those of EMS. The company must establish:

- § An Environmental policy.
- § An Environmental accounting or monitoring system.
- § Implementation plans.
- § Plans for correction.
- § An effective and efficient organization.

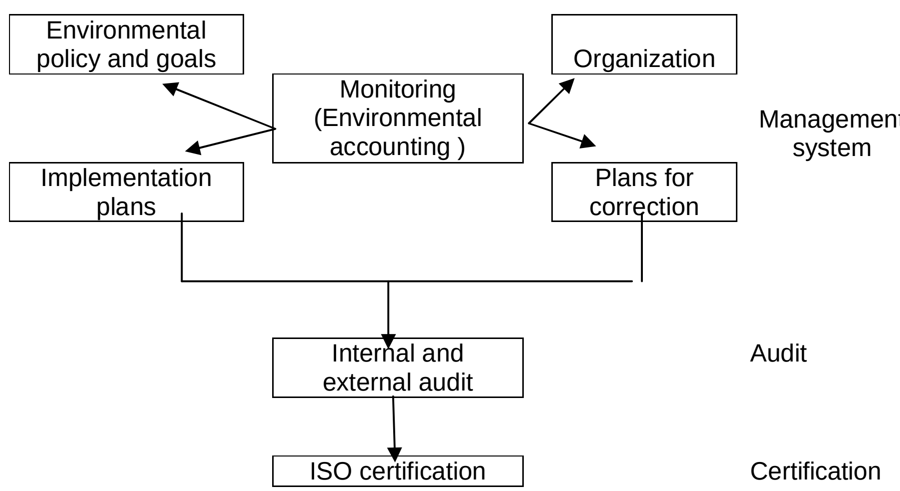


Figure 2.2: Core components of the EU Eco-management and audit scheme

As with EMS's 1998 changes that extended the scheme to non-industrial companies, external revision of the ISO corporate Environmental management system is necessary for companies to adopt external ecological reporting.

Also, EMS until 1998) and ISO were both site-oriented However 14001 does not exclude the application of its standard to products.

Just as with quality standard ISO 9000, strong pressure was expected to be exerted on companies which have their production sites certified. First tendencies show that in some business-to-business relationships the fulfillment of an environmental management standard is becoming a requirement for suppliers. Differences between the standards are small- apart from the fact that ISO 14001 does not require a public disclosure of environmental impacts.
BS 7755, EMS and ISO 14001 define requirements for corporate environmental management systems. However, none of these standards specifies how the requirements should be fulfilled, nor do they provide an indication of what goals corporate environmental management should strive to achieves for the importance of parallel changes to corporate culture,

All standards emphasize the need for Environmental management control as well as the need for Environmental, and particularly, accounting as an important part of corporate environmental management. Nonetheless, the standards do not provide any methods for the management or implementation of decision-making processes (i.e. through incentive systems).

Methods of Corporate Environmental Management

2.2 Methods of Corporate Environmental Management

This is not place to discuss specific environmental management tools in depth but rather to show the link between the main tools of corporate environmental management with environmental accounting and environmental management system which indicates that contemporary methods of corporate environmental management are not particularly new and that they rely on well-known traditional management tools, see Figure 2.3.

Environmental accounting auditing and reporting, eco-control total quality environmental management (TQEM) are all based on traditional accounting notions of auditing, reporting, control and total quality management (TQM) (Dobyns and Crawford-Masson 1991; Greenberg and Unger 1991; Petrauskas 1992 life-cycle assessment) LCA and costing is a special case of ecological accounting and simply corresponds to calculation (costing). It represents a single-time ecological calculation and simply corresponds to calculation (ecological costing) with its scope extended to cover the entire life-cycle of a product.

Whichever standard of environmental management is adopted –BS 7750 EMS, the EU regulation for a product eco-label or ISO 14001- all address some of **following key functions of good environmental management .**

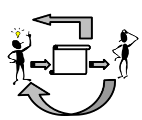
- Information management.

- Support for decision-making, organization or planning environmental management programs.
- Steering, implementation and control.
- Communication
- Internal and external auditing and/or review.

environmental management tools		environmental management
Calculation, costing	→	Life-cycle assessment
Accounting	→	Environmental accounting
Auditing	→	Environmental auditing
Reporting	→	Environmental reporting
Total quality management	→	Total quality environmental management
Control	→	Eco-control

Figure 2.3: Methods of environmental management derived from methods of environmental economic management.

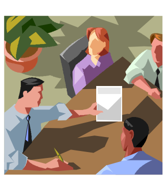
Life Cycle Assessment



2.3 Life-Cycle Assessment (LCA)

The main focus of LCA is on data management (single calculations) and assessment LCA also addresses some aspects of goal-setting (strategy and planning) and decision support. However, other functions of corporate environmental management, such as steering and communication, are not supported or are only partially supported by LCA.

Environmental Accounting and Reporting



2.4 Environmental Accounting and Reporting

Traditionally, accounting is the main corporate information management tool. Al management activities rely on or are at least influenced by accounting information. Environmental accounting is the application of an established of accounting (i.e. tools of information management, analysis and communication) to environmental management. However, environmental accounting is a management tool and must be comprehensively incorporated into the environmental management process. Only can environmental information be integrated into goal-setting, implementation and communication.

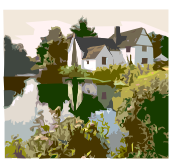
TQEM is application of the principles of TQM to environmental management. In this connection the term “quality" is expanded to include environmental quality. TQEM is based on statistical tool to achieve quality control, namely various charts for data analysis, steering and internal communication. In addition, TQEM is based on a statistical and engineering philosophy and supports goal-setting with an emphasis on the continuous improvement of quality In its original from TQEM, does not integrate measures of economic performance with measures of quality or, rather, environmental quality apart from an emphasis on statistical quality control and on continuous improvement (a notion central to environmental management standards), TQEM, is holistic, that is it looks at each part of environmental management as an integrated whole-a system in which all elements have to work together (including the environmental element) if goals are to be achieved.

Management Eco-control

2.5 Management Eco-control

Perspectives on Eco-control

2.5.1 Perspectives on Eco-control



Management eco-control is the application of financial and strategic control methods to environmental management. The concept of eco-control has also been applied to the state, to public administration and public policy (see Schaltegger *et al.*, 1996). It provides a decision to support system for management (Schneidewind *et al*. 1997; Vedso 1993). Econ-control is among the most popular corporate environmental management approaches in continental Europe but is largely unknown in English-speaking West. Several concepts of eco-control have been developed in the German – speaking parts of Europe (Austria, Germany and Switzerland) and successfully applied by an increasing number of multinational medium-sized and small companies.

Originally, eco-control was designed for the manufacturing industry. Recently, it has also been applied to service industries and to the management of fauna and flora.
As financial and strategic control is defined in a number of different ways, it is no surprise that a number of versions of eco-control have been published. Three main approaches to eco-control can be distinguished (Schaltegger and Kempk, 1996):

- § **Financially oriented eco-control methods** attempt to compute, analyze, steer and communicate environmental induced financial impacts.
- § **Ecologically oriented eco-control methods** are based on satellite systems of ecological accounting that are an extension of accounting and control system. Their purpose is to steer corporate impacts on the natural environment.
- § **Economical-ecologically integrated concepts** of eco-control

integrate the two approaches mentioned above They take into account the evaluation and steering of financial and ecological impacts of corporate activities Measurement is two-dimensional: in terms of monetary units per unit of environmental impact added.

All three eco-control perspectives can be used for strategic as for operation management.

The Process and Concept of Integrated Eco-control

2.6 The Process and Concept of Integrated Eco-control

Integrated eco-control is a permanent, institutionalized, internal management process based on environmental accounting and reporting. The concept of eco-control corresponding to financial and strategic control is concerned with the environmental and financial impacts of a company. Eco-control can be divided into five procedures, as it is shown in the following:

1. Goal and policy formulation.
2. Information management (environmental accounting and reporting).
3. Decision support.
4. Steering and implementation.
5. Internal and external communication.

All environmental management systems, including EMS and ISO 14001, require an environmental policy as well as clear and measurable annual environmental protection goals. With a focus on the aim of improving corporate eco-efficiency, economic and ecological aspects of operational goals should both be considered.

Information management is the only core of any environmental management system. In practice, it is often the case that only what is measured is very important. The establishment of an environmental accounting system is one way of increasing the efficiency of information management.

Managers frequently suffer from excessively detailed information that hampers efficient selection and use of relevant data. Any information concerning environmental intervention has therefore to be assessed according to relevance. Furthermore, integration of economic and environmental aspects is necessary. Effective environmental management requires incentive systems to steer (or pilot) and implement corporate plans in the most efficient manner. Internal communications play a central role in efficient implementation. However, communication with external stakeholders also supported internal processes and this increases the gains from sound internal environmental management.

Although it is important to establish a clear structure and plan for procedures, steps do not necessarily have to be completed in sequence. Nevertheless, the five procedures are present in logical order in the next five sections.

Specific guiding instrument are needed in order to implement the eco-control process. The process provides management with a detailed analysis the place, cause, extent and timing of environmental impacts. In addition, the total corporate environmental impact caused should be kept in mind when dealing with individual problems to avoid inefficient development (e.g. spending more and more on scrubbers to reduce smaller and smaller amounts of sulphur dioxide [SO_2] instead of reducing far worse environmental impacts from nitrogen oxides [NOx].

The importance of each eco-control procedure depends on the environmental issues faced by the company and on their effect on commercial success. However, companies should consider carefully whether they have given enough to every procedure. Too often, environmental management tools are introduced without any clear understanding of the corporate environmental strategy being followed.

Chapter 3: Environmental Impact Assessment

Goals and Characteristics

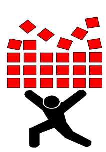
3.1 Goal and Characteristics

Impact assessment is a technical, quantitative and/or qualitative process for classifying, characterizing and assessing the effects of resources required for production and any associated environmental laudably, such an assessment should address ecological impacts, human health impacts and resource depletion, as well as effects such as habitat modification and noise pollution.

Ecological assessment of environmental interventions and, therefore, the reduction of numerous available physical measures to just a few units or even one unit of measurement, should occur only after aggregation has been carried out for each identified environmental interventions site. The advantage of this approach is that different assessment methods can be based on the same inventory data and then compared with each other. For this reason, ecological accounting is not restricted by today's level of knowledge about environmental harm caused by environmental interventions; it also allows new weights to be applied at a later time.

It would be desirable for an impact assessment to take into account direct, indirect, parallel and serial impacts as well as spatial, time, social, political and economic aspects so far however the complexity of the material allows only some of these criteria to be included.

Many disciplines



Today, **many disciplines** (e.g. natural sciences engineering and economic), universities, research institutes, environmental consultants, environmental protection agencies **EEAA (EGYPT)** the **USA, Canadian, Danish, Dutch, German and Swiss environmental protection agencies** are among those most active in the area of ecological accounting) and working groups with activities that are international (in scope) handle measures and criteria for environmental impact assessment and promote their own concepts. Over the past decade, impact assessment has emerged as a highly interdisciplinary field of research.

So far, there is no consensus among researchers or users, although much research has been competing. Moreover, the proponents of different assessment approaches are competing with each other to find the best approach. Competition is not merely at the scientific level, because several groups are also strongly lobbying regulators, environmental protection agencies, and international organizations and other opinion leaders.

As a result of the lack of an acknowledged ecological accounting standard-setting committee, recommendation and guidelines exist today, but there are no standards the political nature of decision-making has to be recognized as a constraint on standard-setting, especially where ecological issues are complex and where numerous competing stakeholders are engaged in the sociopolitical process. The lack of standards acts as a threat to the implementation and achievement of sustainable outcomes, to transparent accountability relationships and to attempts to meet the challenge of sustainability the issue is therefore considered in more detail in the next section.

Approaches to Impact Assessment

3.2 Approaches to Impact Assessment

Many different approaches to impact assessment have been published and numerous variations are available in practice. Differences between the approaches are caused mainly by fact that different researchers (scientists) ask different questions. In the past, the wide variety of assessment methods was perceived as a problem and a single, objective approach to assessment was judged to be most desirable. However, environmental impacts are, in fact viewed in different ways (through different lenses) by different social groups that recorded data need to be interpreted with use of different assessment concepts. When comparing impact assessment methods, it is important to realize that different methods provide answers to different questions. Table 3.1 surveys the main approaches to the impact assessment.

Table 3.1: The main approaches to the impact assessment

Impact assessment			
Non-monetary Approaches			Monetary Approaches
Natural science-oriented methods	Sociopolitical-oriented methods		Socioeconomic-oriented methods
Assessment according to the contribution to an environmental problem	Assessment according to social and political goals	Indirect measurement of preferences: Valuation by markets	Direct measurement of preferences questionnaires

Volume- or space –oriented methods	Freight-oriented methods	Damage-oriented methods	Laboratory experiment
Energy-oriented methods	Standards-oriented methods	Expense-oriented methods	Contingent valuation
Classification and characterization	ABC classification methods	Market price-oriented methods	Contingent valuation

Non-Monetary Approaches

3.2.1 Non- Monetary Approaches

A first group of assessment approaches covers non-monetary impact assessment concepts. These methods can be distinguished as being oriented towards natural science and sociopolitical concerns. The former can be subdivided into energy- oriented and volume-oriented methods that can be distinguished by their approaches to classification and characterization.

Socioeconomics (Monetary) Approaches

3.2.2 Socioeconomic (Monetary) Approaches

The group of monetary impact assessment concepts has evolved from socioeconomic research and can broadly be split into direct and indirect methods for measuring people's preferences. The second group of concept based on market valuation of environmental protection against environmental interventions. The first set approaches attempts to measure people's preferences directly by using laboratory experiments or contingent valuation methods. Monetary approaches have rarely been applied to impact assessment and ecological accounting at a corporate level. However, corporative (commercial) organizations in the public sector have experimented with the monetized concept.

Damage-oriented impact assessment methods measure the monetary caused by environmental damage (e.g. a forest). They are ex-post economic measures that are mostly used prove the severity of environmental intervention to politicians.

The expense-oriented assessment method provides an answer to the question of which direct specific environmental assets (e.g. a lake or a species).
The market-price method asks what costs people would accept to repair costs) or prevent (prevention costs) environmental damage or to protect themselves against environmental interventions e.g. buying noise protection devices).

People can also be asked about their preference as to environmental quality. This can be tested directly in an artificial laboratory situation or through contingent valuation approaches which ask about activities or problems that occur in concrete situations.

The basic questions raised in socioeconomic assessment methods are summarized in Table 3.2, Monetary assessment methods do not explicitly take indirect, antagonistic or synergetic environmental impacts into account although they might theoretically be taken into account under the heading of citizens' "willingness to pay" or "willingness to accept" .

Nonetheless, it must be assumed that time and spatial differences of environmental impacts are included in the valuations. All monetary assessment methods have to contend with the problem that derived monetary values cannot be linked to single environmental interventions. Compared with non-monetary concepts, results are not sufficiently desegregated. However, it is possible to link monetary with non-monetary assessment approaches to derive financial values for environmental interventions This can be achieved by determining monetary values for specific classes of environmental impacts (e.g. the greenhouse effect) to thereby allowing the relative contribution of different interventions (e.g. CO_2 and methane) to be traced back to particular environmental problem in question. Hence, monetaristion of the environmental interventions linked with specific environmental problems is possible. Table 3.2 shows the monetary assessment methods of the socio-economic approaches.

Table 3.2: Monetary assessment methods of socio-economic approach

Approach	Question
Expense	What costs do people accept to use or protect a specific environmental asset?
Willingness to pay	How much are people ready to pay for the reduction of a specific environmental problem?
Willingness to accept	How much has to be paid in order that people will be willing to accept a deterioration of environmental quality
Prevention costs	How much money do people spend to protect themselves against environmental problems? How much are they ready to spend on preventative measures?
Damage costs	What are the (monetary) costs of environmental impacts for society?

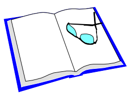
Keywords definitions

Environment	It is the living organisms, climate, soil, water, land fauna, flora and other physical features surrounding the human being and the biodiversity components.
EMS	It is the environmental management system designed for a business organization to prevent hazards of pollution.
ISO14001	It is process standard ISO which is developing environmental management standards. For a corporate.
Management Eco-Control	It is the application of Financial and strategic control methods to environmental management.
EIA,	It is a technical, quantitative and qualitative process for classifying, characterizing and assign the effect of resources required for production.

Part 2: Safety Management

Chapter 1: Introduction

Introduction



Getting hurt at work or at research is not a pleasant subject to think about. The reality is that many people a year lose their lives at work or on the road in Egypt, and many more get injured. Estimated millions suffer from ill health caused or made worse by work conditions. The mistake is to believe that these accidents happen in exceptional or unavoidable circumstances that may never occur to you. Some basic thinking and acting beforehand could usually have prevented these accidents or injuries from happening.

Governments have established defined minimum standards of health and safety for practically all occupation. Legal requirements are generally enforced on personnel and corporate by two methods, in that they are important considerations in the design of buildings, work processes, selection of equipment or any other industrial/non industrial plans:

- **Granting of permits** for establishing projects
- **Inspection of infrastructure** or verification of work processes when establishments physically exist

Implementing safety and health measures does not eliminate accidents but reduce them considerably to the unavoidable percentage. This does not have to be expensive, time consuming or complicated. In fact, safer work and more efficient work practices can often save money, and more importantly, can help to save lives.

This part shows the kind of things which cause the more common accidents and harm to people's health for the purpose of considering these hazards when designing or running any activity.

What is safety all about?

1.1 What Is Safety All About?

Safety

Safety *aims at preventing people from getting harmed or becoming ill at work or at home by taking the right precautions and providing a satisfactory working environment.* Because health and safety at work is so important, there are rules which require all of us not to put ourselves or others in danger. The law is also there to protect the public from dangers at the work place.

Hazard

Hazard *means any thing that can cause harm (chemicals, electricity, ...).*

Risk

Risk *is the chance, high or low, that someone will be harmed by a hazard*. Some countries impose that business having five or more persons has safety policy statement. The following is an example of statement

Company XYZ

- provides adequate control of the health and safety risk arising from work and activities
- consults with employees on matters affecting their health and safety; ensures safe handling and use of hazardous substances
- provides information for employees with regards to their safety and safety of company customers
- Ensures that employees are competent to do their tasks, and to give them adequate HSE training
- Prevents accidents and work-related ill health
- Reviews and revises its HSE policy as necessary at regular intervals.

Controlling danger at work is not different from tracking any other task: training personnel, being proactive (premising), recognizing the problem, knowing enough about it, deciding what to do, and putting the solution into place is a guarantees for minimizing risks.

Risk Examples

Risk Examples

- **Slipping** or tripping at work
- **Getting into contact with hazardous material** (asbestos, fumes, bacteria, for example)
- **Performing work at height**
- **Handling, transporting or supporting loads** while suffering from sprains, strains, or pains
- **Having long exposure to computers** or other display screen equipment
- **Working at a noisy place**: causes hearing loss or deafness.
- **Being exposed to vibration**: Using hand powered hand tools, equipment or processes causing hand-arm vibration syndrome that impair blood circulation, damage to the nerves and muscles, and of ability to grip things properly.
- **Getting hurt by electricity**. Caused by underground or overhead cables, shocks from faulty equipment, poor electrical insulation and faulty electric appliances, ... etc.
- **Improper selection of work equipment results from poor training** or lack of knowledge about equipment specifications or work requirements.
- **Neglecting maintenance** or doing unsafe maintenance work
- **Risks resulting from transport, road traffic, road conditions**
- **Risk associated with pressure systems**
- **Predictable or unpredictable, controlled or uncontrolled**

risk associated with natural or climate phenomena
- **Risks resulting from fire or explosions** or use or storage of explosive materials or chemicals
- **Risks due to radioactive materials**: **Non-ionizing radiation** (ultraviolet radiations from the sun) can damage skin, laser (can cause burns and damage eyes); **Ionizing radiations** naturally occurring radiations from radon gas or radiations from radiography or thickness measuring gauges
- **Feeling stressed by work** (adverse reaction people have to excessive pressure or other types of demand placed on them). Stress is identified by defining the hazard behind it. Treatment passes through assessing who is at risk, and defining the level of stress, and reducing it.

What to do if there is an accident?

1.2 What to Do If There Is an Accident?

If someone has been ill at work, it is important to take care of them straight away and make any dangerous condition safe:

- **Provide first-aid** by providing treatment for minor injuries at work and providing immediate attention until medical help is available.
- **Report accidents** at work are a legal requirement. The information provided in the report helps prevent recurrence of similar accidents.
- **Start investigation on how to prevent recurrence** of the type of accident.

Risk Assessment

Risk Assessment

Risk Assessment is a careful evaluation of what could cause harm to people. The aim is to make sure that no one gets hurt or becomes ill. The important thing is that no one gets hurt.

Procedure

- **Work around your workplace** and look for significant hazards
- **Ask your employees or peers what they think**; get feedback about hazardous situations or things
- **Look at manufacturers' instructions**, accidents and ill-health records
- **Consider whether any of the hazards** covered above exists in your work place.
- **Think about groups of people doing similar work**
- **Pay special attention to vulnerable groups**, e.g. young inexperienced persons, disabled people, lone workers
- **Do not forget those who may not be in your workplace all the time, e**.g. cleaners, contractors, people you share your workplace with, or members of the public who may be harmed

by your activities.
- **Aim to make the risk small**: meet standards, have good practice.
- **Record your findings**
- **Mitigate hazards and reduce risks**
- **Review your assessment** and revise it if necessary

Incident Management Plan

Incident Management Plan

Any professional business should have an incident management plan which will
- **Identify major risks and their potential impact** on business and the community
- **Describe the response strategies** and incident management organization
- **Set out roles and responsibilities** and the key personnel involved
- **Contain internal and external notification procedure**, community resources, response organization chart, personnel, ...
- **Describe the business establish communication** with the community in case of accidents
- **Describe how the local media will be addressed** and by whom
- **Link with national support resources** and organizations.

Safety and health management comprises the procedures of saving the workplace environment against hazards of indoor pollution. A sufficient and efficient safety system helps compete to protect its employees, and the other companies in the same economic sector.

Safety topics

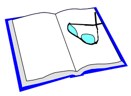
This part is divided into the following topics:

1. Total safety management (TMS) definition.
2. Sustainable competitive advantage.
3. Peak performance.
4. Continual improvement forever.
5. Translation TSM into action.
6. Implementing TSM: The model.
7. Executive commitment: A must.
8. Achieving executive commitment.
9. Total safety system implement action case study.
10. Evaluation of executive commitment.
11. Four–step for gaining executive commitment.
12. The safety management functions.
13. Safety and plant size.
14. Safety management propositions.
15. Analysis of the propositions.

Chapter 2: Total Safety Management

Total Safety Management Definition

2.1 Total Safety Management Definition



Total safety management **is a performance-oriented approach to safety and health management that gives organizations a sustainable competitive advantage in global marketplace** by establishing a safe and health work environment that is conducive to consistent peak performance and that is improved continually forever. This definition contains several key elements that must be understood if one is to fully understand TSM. These elements are as follow:

Sustainable competitive advantage

2.1.1 Sustainable competitive advantage

Every organization that competes at any level, but especially those that compete at the global level must have competitive advantages. These are capabilities or characteristics that allow them to outperform the competition. For example, if the organization in question is a baseball team, it might have such competitive advantages as an excellent pitching staff, several speedy base runners, two or three power hitters and/or outstanding fielders in key positions. These advantages, if exploited wisely, will help make the baseball team a winner. If these advantages can be sustained over time, they will help make team a consistent winner.

This same concept applies to organizations that compete in the global marketplace. In order to survive and proper, they need as many competitive advantages as possible. Traditionally, competitive advantages have been sought in the key of quality, productive, service, and distribution. However, peak-performing organization has learned that a safe and healthy work environment is essential to gaining competitive advantages in these critical areas. In fact, a safe and healthy work environment is itself a competitive advantage.

Peak Performance

2.2 Peak Performance

The primary driver behind TSM is organizational, team, and individual performance. An organization's ability to survive and proper in the global marketplace is determined largely by the collective performance of individuals and teams. Consistent peak performance by all individual and teams in an organization is essential to long-term success in the global marketplace. The quality of the work environment is a major determinant of the performance levels that individuals, teams and organizations are able to achieve. A better work environment promotes better performance.

2.3 Continual Improvement Forever

Continual Improvement Forever

People work in an environment, and the quality of that environment affects the quality of work. The work environment is a major determinant of the quality of an organization's products, and services. In the age of global competition, quality is an ever-changing phenomenon. A quality that is competitive today may not be tomorrow. Consequently, continual improvement is essential. If quality must be improved continually, it follows that the work environment must also be improved continually.

2.4 Translating TSM into Action

Translating TSM into action

There are three fundamental components through which the TSM philosophy is translated into action on a daily basis. These three components are the TSM steering Committee, Improvement Project Teams (IPTs) and the TSM Facilitator.

The TSM Steering Committee oversees the organization's safety and health program. It is responsible for formulation of safety and health policies, the approval of internal regulations and work procedures relating to safety and health, the allocation of resources, and approval of recommendations made by the IPTs.

2.5 Implementing TSM: the Model

Implementing TSM: the Model

Figure 2.1 contains a three-phase fifteen-step model that can be used for successfully implementing TSM in any organization.

Steps in the TSM implementation process

Planning and preparation

1. Gain Executive-Level Commitment
2. Establish the TSM Steering Committee
3. Mold the steering committee into Team
4. Give the Steering Committee Safety and Health Awareness Training
5. Develop the organization's Safety and Health Vision and Guiding Principles
6. The organization's Safety and Health Mission and Objectives
7. Communicate and Inform
8. Identification and Assessment

9. Identify the Organization's Safety and Health Strengths and Weaknesses.
10. Identify Safety and Health Advocates and Resisters.
11. Benchmark Initial Employee Perceptions Concerning The Work Environment.
12. Tailor Implementation to the organization.
13. Identify Specific Improvement Projects.
14. Establish, Train, and Activate Improvement Project Teams

Execution

15. Activate the Feedback Loop
16. Establish a TSM Culture

Figure 2.1: Model for implementation

Executive Commitment – A Must

2.6 Executive Commitment – A Must

In any organization, the aim and direction are decided by the chief executive officer (CEO) and the members of his or her executive management team. These individuals decide what will be emphasized where limited resources will be spent, what behavior will be rewarded and what won't, and how incentives will be used. Mid-managers and supervisors take their cues from executive mangers. They, in turn, pass perception along to employees.

The TSM philosophy requires that the total organization be involved continually improving the work environment. TSM cannot be implemented in just one department or by just a few employees. By definition, such an approach would not be total safety management, and anything short of total environment robs the organization of the full benefits of TSM.

Consider just a few of the things that must be done in order for TSM to be implemented:

- **Safety and health must be included as high priority** concerns in the organization's strategic plan.
- **Resources must be allocated** to cover implementation costs. Employee performance relative to safety and health must be monitored, evaluated, and rewarded as appropriate.
- **Safety and health must be monitored, evaluated, and rewarded** as appropriate.
- **Employees must be shown that safety is a must** no matter how pressed the organization becomes to meet deadlines
- **Who but the CEO and executive managers of the organization** has the authority to do these things? The answer is no one. Consequently, executive commitment is a must.

Achieving Executive Commitment

2.7 Achieving Executive Commitment

What does it mean to achieve executive commitment? The concept is defined by its three components as shown in Figure 2.2. Any other concept for that matter will be personally involved in its implementation.

Personal Involvement

\+

Commitment of Time

\+

Commitment of Resources

= Executive Commitment

Figure 2.2: Components of executive commitment

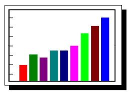
Figure 2.3 contains a checklist of ways in which an executive–level manager can be personally involved in TSM.

An executive manager who is completely committed to TSM will want to serve on the organization's TSM steering Committee. The ideal steering committee consists of the organization's executive managers, or if the CEO and his/her executive managers do not serve on the TSM Steering Committee, they will have to go to even greater lengths to demonstrate their commitment to safety health. Otherwise the committee's credibility will suffer.

———	Serving as a member of the organization's TSM Steering
———	Advocating for inclusion of safety and health concerns in the organization's strategic plan.
———	Personally giving improvement project teams (IPTs) their charges
———	Participating in training activities as appropriate ,
———	Maintaining a high profile in and supportive attitude toward all TSM activities

Figure 2.3: TSM personal – involvement checklist for executive- level mangers

Total Safety System Implementation Case Study



2.8 Total Safety System Implementation Case Study

Healthy Food is moving the company forward in implementing TSM, but it isn't sure what the process will mean for its executive management team. It is knows that each member of the team will have to be personally involved in the implementation, but what does personally involved really mean? The company wants to know as do Health Food's other executive mangers. If you are Company's TSM Facilitator. How would you explain personal involvement to Mary Earnst?

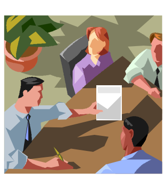
The safety and health manager for the organization meets with the executive management team whenever it sits as the TSM Steering Committee, and serves, in such cases as the committee's facilitator and consultant.

Executive managers committed to TSM will advocate on behalf of health and safety health when developing the organization's strategic plan. Through their involvement in the process, executives can ensure that safety and health concerns show up in the organization's strategic plan guiding principles and/or broad objectives, or both.

Each time an Improvement Project Team (IPT) is established to deal with a specific safety or health concern, executive managers can be personally involved by giving the team its charter. Receiving its charter directly from the CEO or another executive manager tells IPT that the activity in question is important.

Personal participation in the various training activities associated with implementing TSM is doubly beneficial for executive managers. First executives learn what they need to know in order to play a positive role in rendering the TSM philosophy operational.

Evaluation of Executive Comment



2.9 Evaluation of Executive Comment

Executive Commitment to TSM- with rare exceptions- will take time to achieve. Safety and health managers should expect to confront the evolutionary steps shown in Figure 2.4. Executive mangers may be skeptical when they first hear about TSM as normal human response to change, and TSM means change. A persuasive argument, persistent but patiently repeated often enough, may move executive managers to the next level: tentative. If so, the safety and health manager will probably be asked to make a presentation to the executive management team. If presentation goes well, TSM will probably be provisionally accepted.

At this point, **it's a good idea to undertake pilot project to demonstrate how TSM can make a difference.** For example, an IPT might be formed to confront a specific safety/health problem. If the pilot goes well, executive managers will probably move to the buy-in stage. Once TSM has been implemented widely and positive results have been demonstrated, executives will probably move to the commitment phase.

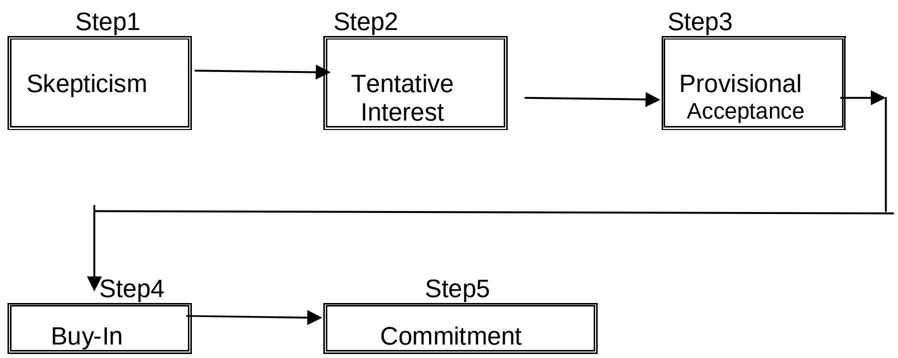


Figure 2.4: Evolution of commitment

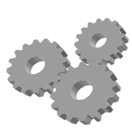
Four Steps for gaining Executive Commitment

2.10 Four-Steps for Gaining Executive Commitment

In order to gain executive commitment, the safety and health manager must show that TSM is good business. Figure 2.5 shows a four- step process that can be used to make this point. The following sections expand on steps.

Preparation

2.10.1 Preparation



Preparation involves conducting the research necessary to answer questions such as those shown in the figures. Notice that only one question in Figure 2.5 deals with regulatory compliance, and this question is cast economic, not compliance terms. TSM will ensure regulatory compliance, but this is a secondary, not a primary benefit.

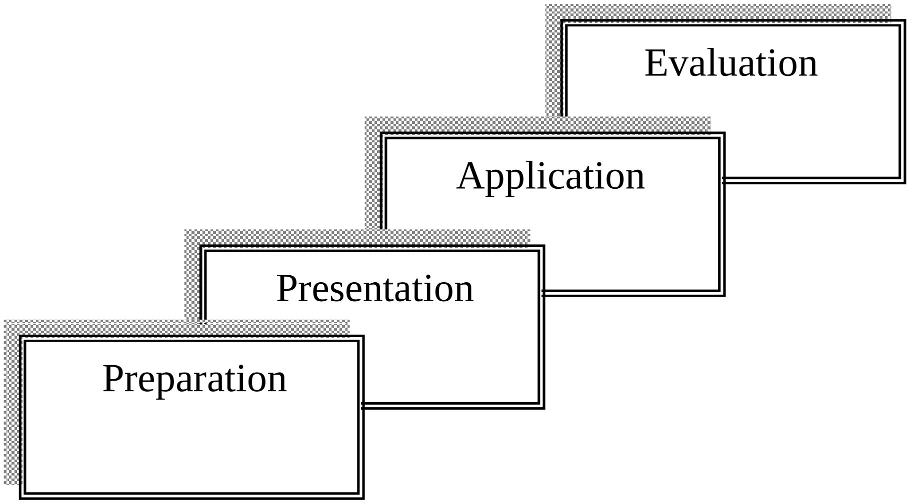


Figure 2.5: Process gaining effective commitment

2.10.2 Presentation

Once the research step has been completed, the next step involves presenting findings to executive management. The presentation consists of answering types of questions shown in Figure 2.6. An effective approach is to use visual aids.

2.10.3 Application and Evaluation

The purpose of the previous step (presentation) was to create enough executive buy-in to allow the TSM implementation to proceed. Full commitment is not likely to occur until executive management has the concept successfully applied. Consequently, it is important at this point to accomplish the following tasks:

Presentation

- **Convince executive management to commit to give TSM their full support** long enough to allow for positive results.
- **Clearly define success** and decide how it will be measured. It is important for everyone involved in the implementation of TSM to understand what is exacted, what they will be held accountable for, how progress will be assessed, and how performance will be evaluated.

Application and Evaluation

2.10.4 Maintaining Executive Commitment

Initial excitement followed by flagging interest is a common phenomenon when implementing a new concept, particularly when that concept represents major cultural change. Management executive commitment, long enough to allow TSM to break the bonds of cultural inertia and become, itself the cultural norm is a challenge**. Figure 2.7 is the plan-do-check–adjust (PDCA) cycle superimposed on a blanket of continual compunction.**

Maintaining Executive Commitment

1.	Is this company's performance in the marketplace as good as we would like it to be?
2.	Does this company have any sustainable competitive advantages over its competitors? If so what are they?
3.	Is this company spending more than it should on workers' compensation costs? Are works' compensation costs in this company increasing, decreasing or remaining stable?
4.	Are the company's insurance premiums acceptable? Are the premiums increasing, decreasing or remaining stable?
5.	Is product quality as good as we would like it to be?
6.	Is product price consistently below that of competitors?
7.	Is productivity in this company as high as we would like it to be?
8.	Is the number of hours lost due to accidents in this company as low as we would like it to be?
9.	Is the absenteeism rate in this company as low as we would like it to be? Is the rate increasing, decreasing or remaining stable?
10.	Is the sick leave utilization rate in this company low we would like it to be? Is the rate increasing, decreasing or remaining stable?
11.	How frequently is this company involved in safety/health related litigation? How much is spent annually on this type of litigation? Is the amount spent on safety/health litigation increasing, decreasing, or remaining stable?
12.	Is employee morale at this company as we would like it to be?
13.	Is the employee turnover rate at this company acceptable? Is it increasing, decreasing, or remaining stable?
14.	Do employees perceive the work environment in this company as a positive or negative factor?
15.`	Has this company been required regulatory agencies to pay safety/health related fines? If so, in what amounts?

Figure 2.6: Question for gaining executive commitment to TSM

Figure 2.7 is a checklist of tips that will help enhance the quality and effectiveness of presentation made to effective managers. These are tips that apply to presentations made to small groups- between five and fifteen people – in a conference room or similar setting.

●	Keep the presentation brief and to the point. Executives are busy people.
●	Base the presentation on documented facts. Never make claims you cannot support.
●	Use well-designed, attractive visual aids. Keep visual aids simple and make sure all information on them can be easily seen from the back of the room.
●	Do at least two complete trial runes (practice sessions) before making the presentation. During the actual presentation is no time to be working out the bugs.
●	Arrive early and set up. Test all equipment and have back-up strategies in case something malfunctions during the presentation
●	Make sure presentation has three distinct components: introduction, Body, and Summary.
●	If you nervous, concentrate on slowing down your rate of speech. Nervous speakers are prone to rust
●	Make eye contact with all members of the audience, and speed your attention equally. People don't like to be ignored.

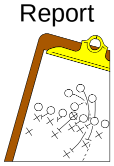
Figure 2.7: Presentation tips for safety and health mangers

2.10.5 Structure of Periodic Progress Reports

Periodic progress reports given to executive managers should pick up where the presentation made to win their initial commitment left off. The same criteria used to gain executive commitment should be used for maintaining it. If, for example, lost time due to accidents was criterion in the commitment presentation, it should be a criterion in the progress reports. Has the amount of lost time declined? If so is, by how much?

The need for continuity between the criteria used to gain commitment and that used to maintain it underscores the importance of basing the commitment presentation on documented facts. The safety and health manager who overstates during the commitment presentation will pay for it when making periodic progress reports. This can be a sure way to lose commitment.

Structure of Periodic Progress Report



2.11 The Safety Management Function

The concept of safety management began when a better description than safety engineer was needed for the work of the safety specialist. Whether an engineer or not, he or she is concerned largely with convincing others to follow applicable safety requirements. There are notable differences usually between managing as carried out by the head of an operating unit and that which is noted in a safety management position. Managers of units accomplishing the prime purposes of an organization have direct authority over the personnel in their unit. Safety management, however, is conducted generally as a staff assignment. The director or chief of safety has managerial authority over the professional personnel reporting directly to him or her, but the powers of line managers are not to be transmitted through the safety specialists.

The Safety Management Function

2.12 Safety and Plant Size

It has been widely believed that **small plants represent the greater occupational safety and health problem**. To be sure, they are far more numerous than locations with large numbers of employees, Table 2.1. And injury records show that generally the very large plants with more than 2,000 employees tend to have much better injury experience than smaller ones, particularly those in the 50 to 500 size range.

Safety and Plant Size

Table 2.1: Injury frequency rate related to number of employees

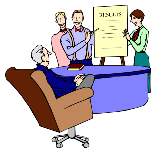
Reporting Units (number employed	Injury Frequency Rate
Less than 20	9.9
20 to 49	13.4
50 to 99	17.0
100 to 249	21.4
250 to 499	17.9
500 to 999	14.2
1.000 to 2.4	11.2
2.5 or more	7.3

2.13 Safety Management Propositions

Five safety management propositions emerge. The first three are addressed essentially to higher management in general, with numbers four and five to be carried out by the safety staff.

a. **Keep separate and visible the lines responsibilities** for safety from the staffs.
b. **Hold the line clearly accountable** for the operation's safety effectiveness.
c. **Hold the safety staff accountable** for the correctness and persuasiveness of the information it provides line management.
d. **Develop operating objectives** for safety with management's needs and goals, while leading to the fulfillment of establishment safety requirements.
e. **Measure hazard control effectiveness** on bases which

Safety Management Propositions



conform to management's appraisals of its performance.

2.14 Analysis of the Propositions

Analysis of the Propositions

A and B **are separating line responsibility for safety from staff** often has been easier to discuss than to accomplish. The principle is clear. On one side is the power line of authority, on the other is the authority of knowledge that competent specialists acquire.

C **The accountability of the safety staff is complicated**, but not difficult to define. Staff positions in general fall into one or two types, advisory and/or assisting or performance of a specialized function for the total organization to facilitate the operation of the line departments.

D **Operating objectives that fulfill safety requirements** and parallel management goods in effect energize the hazard – control mechanism. It cannot be assumed that safety requirements will be compiled with simply because they are called for. Therefore, means must be found which at least will harness the power of the hierarchy in mounting the attack on hazards. This is a reason, of course, for safety laws and regulations. They are expected to furnish the unambiguous motivation for safety needed for its fulfillment – as well as to specify the required controls. If the strength of the organization can be engaged for safety – health achievement, then compliance can be more reasonably assured. This may be assumed since the purpose of the organization is to marshal the abilities of its members in the pursuit of its mission. An institution's regulation of hazards, as with the accomplishment of its other requirements, must rely on the potency of its organization and management.

E **Measurements of hazard–control effectiveness** must be developed and presented in such a way that they are understood and appreciated by upper levels of management. They must be such that they provide some compelling interest and afford the opportunity for appraising management performance.

2.15 Definition of Terms Applicable to Safety Management

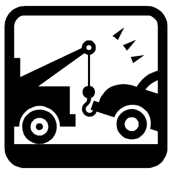
Accident: An event occurring by chance from unknown causes (and therefore unpreventable)

Hazard: The source of energy and the physiological and behavioral factors which, when uncontrolled, lead to harmful occurrences.

Persuasive methods and information: Discipline, required, punishment, and the power of facts well marshaled when presented in the way necessary to obtain the desired action.

Risk: The assumed effect of an uncontrolled hazard, appraised in terms of the probability it will happen, the maximum severity of any injuries or damages, and the public's sensitivity to the occurrence.

Definitions of Terms Applicable to Safety Management



Safe: Protected against hazard.

Safety: The elimination of hazard, or their control to levels of acceptable tolerance as determined by law, and institutional regulations, ethics, personal requirements, scientific and technological capability, experiential knowledge, economics, and the interpretations of cultural and popular practice.

Safety management: The accomplishment of safety through others.

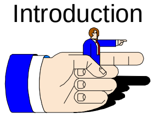
The work of safety management: Accomplishing safety by applying persuasive methods and information in a closed loop system.

Part 3: Industrial Hygiene

Chapter 1: Industrial Hygiene and Occupational Safety

In addition to safety responsibilities, supervisors – together with management and safety personnel – must make sure that the work area is free from conditions that could be detrimental to health. Supervisors can then request assistance from industrial hygienists, who work with medical, safety, and engineering personnel to eliminate or safeguard against such hazards. Industrial hygiene is defined by the American Industrial Hygiene Association (AIHA) as "that science and are devoted to the anticipation, recognition, evaluation and control of those environmental factors or stresses, arising in or from the workplace, which may cause sickness, impaired health and well-being, citizens of the community".

Introduction



1.1 Introduction

Most occupational diseases, however, develop relatively slowly. Exposure to an injurious contaminant may go on for many years before a pathological change occurs. These long – term exposures may eventually lead to a chronic disease that is usually irreversible. An example is the class of occupational diseases known as pneumoconiosis (diseases of the lungs), which are produced by the long–term inhalation of reparable particles of dust such as silica. Short–term or acute exposures usually refer to high exposures to a toxic substance over a short period of time, resulting in an acute effect that is an illness form which the individual usually recovers without a permanent effect. It is the prevention, evaluation, and control of these types of occurrences that is the role of the industrial hygienist.

OSHA

Occupational Safety and Health Act (OSHA) has in effect united safety and industrial hygiene. Although the two specialties will continue to be separate and distinct, the frequently general implementation problems with which both contented often may be solved with the same solutions. In the final analysis, it probably makes little difference to workers, for example, if they were to be fatally overcome by a sudden intense exposure to a chlorinated hydrocarbon or fatally sickened with cirrhosis of the liver after prolonged exposure to small, but still dangerous, amounts of the compound. The control approaches may be essentially the same in both instances, although the first case probably, would be in the safety specialist's area of responsibility, while the second would be in the industrial hygienist's. The frequent overlapping of interests leads to the advisability of each specialty having a good understanding of the other's methods and information.

Industrial hygiene is the professional specialty concerned with preserving the health of employees while at work. It is of major concern because many industrial processes and operations either produce or use compounds that may be harmful to the health of workers. The manager of a safety program will refer to a professional industrial hygienist in cases where the occupational health exposures have such significance and frequency that specialized assistance is necessary. In order to be familiar with industrial health hazard exposures, it is necessary for the safety program manager to have acknowledged of the more common toxic compounds found in industry and the principles for their control.

Industrial Toxicology

1.2 Industrial Toxicology

In order to be able to effectively deal with potential toxic chemical hazards in the workplace, the industrial hygienist must have an adequate understanding and knowledge of general toxicology. The word toxicology is derived from the Greek word for the poison that arrows were dipped in. Toxicology is the science that deals with the poisonous toxic properties of substances. A toxic effect can be defined as any noxious effect on the body. Reversible or irreversible, any chemically induced tumor, benign of malignant, any mutagenic or teratogenic effect, or death as a result of contact with a substance via the respiratory tract, skin, eye, mouth, or any other route.

Toxic effects are undesirable disturbances of physiological function caused by poisons. Toxicity is a property of matter. It is a physiological property that defines the capacity of a chemical to do harm or produce injury to a living organism by other than mechanical means.

Acute and Chronic Poisoning

1.3 Acute and Chronic Poisoning

Industrial poisoning accurse in two principal types: acute and chronic. **The first results from a single exposure to a heavy concentration** of a toxic substance. **The second is the result of repeated exposures to smaller concentrations.** For repeated prolonged periods may cause serious physiological damage, this would be a chronic poisoning. However, exposure to a concentration of between 64,000 to 80,000 parts per million for as short a period as 30 – 60 minutes has caused immediate of later fatality.
The chances of recovery from acute poisoning, if the dose is not

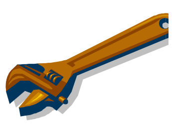
lethal, are greater than for chronic poisoning. The later effects are much more significant, for they are not so readily apparent and their slowly developing, insidious results are apt to be more damaging.

Industrial Health Hazards

1.4 Industrial Heath Hazards

The list of known industrial poisons is long, and their effects and means of control are generally understood. However, the problem of safeguarding personnel is complicated by the introduction annually of many new compounds whose toxicity is somewhat uncertain. Also, compounds of chemical materials often will sell their products under trade names that do not indicate the chemical constituents of the compounds. Request for information on the compounding formulas of proprietary industrial chemicals often produces a negative response from the supplier, who will wish, understandably, to protect the secrecy of the formulation. It is generally possible to secure from him or her sufficient knowledge of the toxic and other properties of the compound without asking for divulgence of its formula.

Industrial hygienists



Industrial hygienists define their work as “the recognition, evaluation, and control of environmental conditions that may have adverse effects on health, that may be uncomfortable or irritating, or that may have some undesired effect upon the ability of individuals to perform their normal work”. It is possible to group these environmental conditions or stresses into four general categories: chemical, physical, and ergonomic.

Chemical Stresses

1.5 Chemical Stresses

Chemical compounds in the form of dusts, fumes, smoke, aerosols, mists, gases, vapors, and liquids may cause health problems by:

- **Inhalation** (breathing): Contaminants inhaled into the lungs can be classified as gases, vapors, and particulate matter.
- **Absorption** (through direct with the skin): Many compounds that exist either in liquid or gaseous form, or both, can be absorbed through intact skin. Ex: arsenic, mercury, nitrobenzene, aniline…
- **Ingestion** (eating and drinking): Toxic compounds capable of being absorbed from the gastrointestinal tract into the blood – for example, lead oxide – can create serious exposure problems if people working with these substances are allowed to eat or smoke in their work areas.

Liquid Chemical: Solvents

1.5.1 Liquid Chemicals: Solvents

Solvents are usually further categorized as aqueous or organic. *Aqueous solvents* are those that readily dissolve in water. Many acids, alkalis, or detergents, when mixed with water, form aqueous solvent systems.

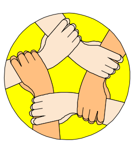
The term solvent, however, is commonly used to mean *organic solvents*. Many of these chemicals do not mix easily with water but do dissolve other organic materials, such as greases, oils, and fats.

Organic solvents generally have some effect on the central nervous system. They may cause nervous system depression, in which the victim experiences short-term (acute) dizziness, feelings of intoxication and nausea, and a decrease in muscular coordination. Higher levels of exposure may cause loss of consciousness, coma, long-term damage to the liver or other organs, or affect the worker's reproductive ability, and, in some cases, death.

Substantial exposures, fortunately, can be controlled – spry-painting booths can be ventilated and degreasing tanks can be exhausted.

The point to remember is not how much solvent is used at the job site, but the actual degree of exposure by inhalation or by skin absorption.

Selection and Handling of Solvents



1.5.2 Selection and Handling of Solvents

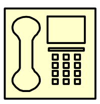
Getting the job done without hazard to employees or property is dependent upon the proper selection, application, handling, and control of solvents and an understanding of their properties. A good working knowledge of the nomenclature and effects of exposure to solvents is helpful in making a proper assessment of damage or harm. Here Table 1.1 of potentially hazardous operations and air contaminants:

Table 1.1: Potentially hazardous operations and air contaminants

Process Types	Contaminant Type	Contaminant Examples
Hot operations Welding Chemical reactions Soldering Melting Burning	Gases (g) Particulates (p) (dusts, fumes, mists)	Chromates (p) Zinc, Manganese and compounds (p) Carbon monoxide (g) Fluorides (p) Vinyl chloride (g)

Liquid operations Painting Degreasing Cleaning	Vapors (v) Gases (g) Mists (m)	Benzene (v) Sulfuric acid (m) Hydrogen chloride (g)
Shaping operations Cutting Grinding Drilling	Dusts (d)	Asbestos Uranium Zinc

Hazard Communications



1.5.3 Hazard Communication

Many state regulations and the federal hazard communication standard require that management provide information about chemical hazards to the workforce. Many of these regulations require:

- **An inventory and assessment** of chemical hazards in the workplace
- **Development and use of labels** that describe the hazards of chemicals and the protective measures to use
- **Material Safety Data Sheets** (MSDS's) that detail chemical hazard and precaution information
- **Training on identifying hazards**, including specific chemicals or groups of chemicals with which employees work
- **A written program that describes how the company intends to accomplish these tasks** and provides documentation that workers have been trained

Degree of Hazard Severity

1.5.4 Degree of Hazard Severity

The severity of hazard in the use of organic solvents depends on the following facts:

- How the solvent is used?
  Type of job operation (determines how the workers are exposed)
- Work pattern
- Duration of exposure
- Operating temperature
- Exposed liquid surface
- Ventilation efficiency
- Evaporation rate of solvent
- Pattern of air flow
- Concentration of vapor in workroom air
- Housekeeping

Physical Stresses

1.6 Physical Stresses

Physical Classification

1.6.1 Physical Classification

Here the physical classification of airborne compounds or materials.

Dusts
- **Dusts**: These are solid particles generated by handling, crushing, grinding, rapid impact, detonation, and decrepitating of organic or inorganic materials, such a rock, ore, metal, coal, wood, and grain.

Fumes
- **Fumes**: Fumes are formed when volatilized solids, such as metals, condense in cool air. In most cases, the hot material reacts with the air to form an oxide.

Smoke
- **Smoke**: This hazard is created when carbon or soot particles result from the incomplete combustion of such carbonaceous materials as coal or oil. Smoke generally contains liquid droplets as well as dry particles.

Aerosols
- **Aerosols**: Liquid droplets or solid particles fine enough to be dispersed and to remain airborne for some times are called aerosols. If inhaled, these can irritate or injure workers' mucus membranes: eyes, noses, throats and lungs.

Mists
- **Mists**: Mists are suspended liquid droplets generated by chemicals condensing from the gaseous to the liquid state or by a liquid breaking into a dispersed state by splashing, foaming, or atomizing. Mist is formed when a finely divided liquid is suspended in the atmosphere.

Gases
- **Gases**: Gases are formless fluids that can change to the liquid or solid state only by the combined effect of increased pressure and decreased temperature.

Vapors
- **Vapors**: The gaseous forms of substances that appear normally in the solid or liquid state (at room temperature and pressure) are called "vapors".

Hazard involved
- **Hazards involved**

The hazard associated with breathing a gas, vapor, or mist usually depends upon the solubility of the substance. For example, if the compound is very soluble – such as ammonia, sulfuric acid or hydrochloric acid – it is rapidly absorbed in the upper respiratory tract and does not penetrate deeply into the lungs. Consequently, the nose and throat become irritated. Nevertheless, exposures even for brief periods to high concentrations of these compounds can produce serious health effects.

Compounds that are not soluble in body fluids cause considerably less pain than the soluble ones, but they can penetrate deeply into the lungs. Thus a serious hazard can be present but not be immediately recognized (ex: nitrogen dioxide and phosgene).

However, numerous chemical compounds do not follow the general solubility rule. They are not especially soluble in water and yet are irritating to the eyes and respiratory tract. They can also cause lung damage and even death under the right conditions (ex: acrolein).

Particulates

1.6.2 Particulates

Dusts

Dusts

When dust can be seen in the air around an operation, there are probably more invisible dust particles than visible ones present. The main hazard to personnel occurs when dust becomes airborne. Also, airborne dusts can be flammable and potentially explosive. An air-monitoring survey of airborne chemicals present in the workplace can determine employee exposure levels and the overall relative safety.

Fumes

Fumes

Welding, metalizing, and other hot operations produce fumes, which may be harmful under certain conditions. For example, arc welding volatilizes metal that then condenses – as the metal or its oxide – in the air around the arc. In addition, the rod coating is in part volatilized. Because they are extremely find, these fumes are readily inhaled.

Highly toxic materials, such as those formed when welding structures painted with red lead or when welding galvanized metal, may produce severe symptoms of toxicity rather rapidly. Fumes could be controlled with good local exhaust ventilation or by protecting the welder with respiratory equipment.

Most soldering operations, fortunately, do not require temperatures high enough to volatilize an appreciable amount of lead. However, some of the lead in the molten solder is oxidized by contact with the air surface. If this oxide, often called dross, is mechanically dispersed into the air, it may produce a severe lead-poisoning hazard.

Gases

Gases

Gases are used or generated in many industrial processes that often produce toxic waste gases. For example, welding in the presence of chlorinated solvent vapors (from an open tank or degreaser) can produce phosgene, a very toxic gas that causes respiratory distress and damage.

Many gases are odorless and colorless, which makes detection unlikely unless appropriate air-sampling equipment is used.

Respiratory Hazards

1.6.3 Respiratory Hazards

When a respiratory hazard exits or is suspected, the actual airborne concentration of the air contaminant(s) must be measured by an industrial hygienist. Some hazards, such as gases and vapors, can produce an immediate threat to life and health when present in high concentrations.

Oxygen deficiency results when the atmosphere in question contains less than the normal amount of oxygen found in the atmosphere, about 21 percent. An environment is immediately hazardous to life and health when the oxygen level is 16 percent or lower.
Other physical categories include hazards such as noise, ionizing radiation, visible radiation, temperature extremes, skin problems, and pressure extremes.

Noise

1.6.4 Noise

Noise- defined as unwanted sound – is a form of vibration that can be conducted through solids, liquids, or gases. The effects of noise on people include the following:

- **Psychological effects** – noise can startle, annoy, and disrupt concentration, sleep, or relaxation.
- **Interference with verbal communication**, and as a consequence, interference with job performance and safety.
- **Physiological effects** – noise induced hearing loss, aural pain, or even nausea (when the exposure is severe). Some research even links long-time ever exposure to noise to circulatory problems and heart attack, see Table 1.2.

Table 1.2: Regulation of occupational noise exposure

Duration per Day Hours	Sound Level dB
8	90
6	92
4	95
2	100
1	105
3/4	107
1/2	110
1/4	115

Factors in Hearing loss

Factors in hearing loss

If the ear is subjected to high levels of noise for a sufficient time, some hearing loss may occur. A number of factors can influence the effect of noise exposure. Among these are:

- Variation in individual susceptibility
- Total energy of the sound
- Frequency distribution of the sound
- Other characteristics of noise exposure, whether it is continuous, intermittent, or made up of a series of impacts
- Total daily time of exposure

- Length of employment in the noisy environment

OSHA has established a regulation for Occupational Noise Exposure, Table 1.2, which sets allowable noise levels based on the number of hours of exposure.

Hearing Protection

Hearing protection

The most commonly used hearing protection equipment is **ear plugs**, **canal caps, and ear muffs**. Many health and safety personnel try to provide hearing protection that will reduce an employee's exposure below 85 dB. However, hearing protection often is not the sole answer to noise exposure. At sound levels over 90-100 dB, engineering controls must be considered to reduce exposure. In addition, in selecting protection, the company and employee should also consider the advantages and disadvantages of the different devices for their workplace.

Ionizing Radiation

1.6.5 Ionizing Radiation

Certain chemicals, when exposed to radiation, may form hazardous compounds or more hazardous forms of an already toxic substance. For example, when oxygen is electrified, ozone is formed. Ozone is highly irritating to the nose, throat, and lung tissues. Different kinds of radiation exist:

Gamma radiation

- **Gamma radiation**

This type of radiation is highly penetrating and can damage body tissues.

Alpha and beta radiation

- **Alpha and beta radiation**

Although alpha particles are usually stopped by the skin, if they are inhaled or ingested, they can do considerable internal damage.

High-energy protons and neutrons

- **High-energy protons and neutrons**

A harmful dose is dependent on both the number if these particles and their energy distribution.

X-radiation

- **X-radiation**

If a worker is overexposed to the radiation of a comparatively low-voltage X-ray tube, dermatitis of the hand is generally the first result. It is characterized by rough, dry skin, a wart like growth, and dry, brittle nails. Continued exposure and more penetrating X-rays can cause bone destruction.

Radiation protection

- **Radiation protection**

There are two general methods for preventing injuries from any penetrating radiation. First, workers can be separated from the hazard by distance or by shielding with appropriate materials to reduce the radiation received to below the maximum permissible dose. Second, the time of exposure can be limited so that workers will not receive a harmful dose.

Visible radiation or Lightening

1.6.6 Visible Radiation or Lighting

Good lighting invariably results in increased product quality with less spoilage and increased production.

Proper lighting

1.6.7 Proper lighting

Good lighting is the result of several factors: the amount and color of the light, direction and diffusion, and the nature of illuminated surfaces.
One of the biggest problems associated with lighting is glare – brightness within the field of vision that causes discomfort or interferes with proper vision. The brightness can be caused by either direct or reflected light. To prevent glare, keep the source of light well above the line of vision, or shield it with opaque or translucent material.

Lasers

1.6.8 Lasers

Biological hazards

Biological hazards

The eye is the organ most vulnerable to injury induced by laser energy. This is because the cornea and lens focus the parallel laser beam onto a small spot on the retina. Workers must be instructed never to observe a laser beam or its reflection directly or to look at it with an optical aid, such as a binocular or a microscope.

Also, the work area should contain no reflective surfaces (such as mirrors or highly polished furniture) as even a reflected laser beam can be hazardous. The fact that infrared radiation of certain lasers may not be visible to the naked eye contributes to the potential hazard. Eyes must be protected. Lasers generating in the ultraviolet range of the electromagnetic spectrum produce corneal burns rather than retinal damage, because of the way the eye handles ultraviolet light.

Other factors that influence the degree of eye injury induced by laser light include the following:

- **Pupil size –** the smaller the pupil diameter, the smaller the amount of laser energy permitted to the retina
- **Power of the cornea** and lens to focus the incident light on the retina
- **Distance from the source** of energy to the retina
- **Energy and wavelength** of the laser
- **Pigmentation** of the subject
- **Place on the retina** where light is focused
- **Divergence** of the laser light
- **Presence of scattering** media in the light path

Temperatures Extremes

1.6.9 Temperatures Extremes

General experience shows that extremes of temperature affect the amount of work that people can do and the manner in which they do it. In industry, people are more often exposed to hazards associated with high temperatures than with low temperatures.

The body is continuously producing heat through its metabolic processes. Since these processes are designed to operate efficiently within only a narrow temperature range, the body must dissipate excess heat as rapidly as it is produced. Body temperature is regulated by a complex set of thermostatic controls that react quickly to significant changes in internal temperatures.

Sweating

Sweating

Radian heat

Radian heat

It is electromagnetic energy that does not heat the air it passes through. It affects the body's ability to remain in equilibrium with its surroundings.

Preventing heat stress

Preventing heat stress

Most heat-related health problems can be prevented or, at least, the risk can be reduced.

- Mechanical cooling
- Acclimatization
- Rehydration

Dermatitis

1.6.10 Dermatitis

Although rarely a direct cause if death, skin disorders cause much discomfort and are often hard to cure.
Causes of occupational skin are classified in these ways:

- Mechanical agents – friction, pressure, trauma
- Physical agents – heat, cold, radiation

- Chemical agents – organic and inorganic
- Biological agents – bacteria, fungi, parasites
- Plant poisons

Atmospheric pressures

Atmospheric Pressures

Ergonomic Stresses

1.7 Ergonomic Stresses

Involved are human reactions to monotony, fatigue, repeated motion, and repeated shock. The ergonomics approach goes beyond productivity, health, and safety. It includes consideration of the total physiological demands of the upon the workers. The human body can endure considerable discomfort and stress and can perform many awkward and unnatural movements, but only for a limited time. When unnatural conditions or motions continue for prolonged periods, they may exceed workers' physiological limitations. To ensure a continuously high level of performance, work systems must be tailored to human capacities and limitations.
Biotechnology studies some aspects to improve stress problems:

- **Strictly biomechanical aspects** – the consideration of stress on muscles, bone, nerves, and joints
- **Sensory aspects** – the consideration of eye fatigue, odor, audio signals, tactile surfaces, and the like
- **External environment aspects** – the consideration of lighting, glare, temperature, humidity, noise, atmospheric contaminants, and vibration
- **The psychological and social aspects** of the working environment

Detection and Sampling

1.8 Detection and Sampling

Although the presence of number of industrial atmospheric contaminants may be indicated by the senses of smell and vision (dusts, for example, in the latter instance), these senses are by no means so refined that they will detect harmful concentrations of a distinguished toxic substance, which may be masked by the presence of an innocuous compound.

The qualitative and quantitative measurement of a work atmosphere's contaminants generally is the job of an industrial hygiene engineer. Manufacturers, however, have introduced commercially available instruments that permit the detection and concentration evaluation of some contaminants. It may be expected that the number of such instruments marketed will increase, since they often are a more convenient means for performing an analysis and will give results directly, without the necessity of a laboratory determination. Because of their relative simplicity of use, they may be conveniently employed by safety specialists in their inspection program, but it should not be considered that knowledge of their use completely obviated the need for the industrial hygienist's services. In the hands of the inexpert, an instrument may seem to indicate a degree of safety that may not exist. When the readings are quite close to the threshold limit, it is advisable for the evaluation to be made by the industrial hygiene specialist, who can properly weigh the determination and make practical suggestions for controls, if necessary.

Variations in determinations can occur due to the method employed when taking samples. Frequently, it is necessary to take air samples at a particular place and time. Samples must be taken with a purpose. For example, it must be decided whether the sample is to be representative of the workroom air, the site of the worker, or the source of the contaminant. It must also be decided what time the samples should be taken in order to obtain conditions representative of the problem. Generally the objective is to sample the air breathed by the workers, at the point they breathed it, for a part of or the full work period.

1.9 Environmental Control

Environmental Control

Health hazards in industry warranting engineering control may consist of atmospheric contaminants (vapors, gases, dusts, fumes, mists, and smoker), noise, radiant energy other than heat, unsanitary conditions, and high of low temperature and humidity conditions.

From the point of view of application of information, the first three groups (atmospheric contaminant, noise, and radiant energy) require discussion, for the controls for each are not obvious, and, although highly technical, some understanding of the factors involved may be provided.

1.10 Atmospheric Contamination

Atmospheric Contamination

There are many approaches that should be considered for preventing the inhalation of hazardously contaminated air. One or probably more of the following approaches may ordinarily be successful in achieving the desired objective:

1. Substitution, for hazardous compounds, with less toxic materials.
2. Process of operation revision.
3. Segregation of hazardous processes.
4. Enclosing of hazardous operations.
5. Local exhaust ventilation.
6. Design, alteration, maintenance, and housekeeping of

buildings and equipment.

7. General ventilation.
8. Use of special methods, such a Wetting" for dust control.
9. Education.

In today's competitive marketplace, high performance employers are adding one more critical area to the list of those in which competitive advantages are sought. This new addition to the list is the work environment

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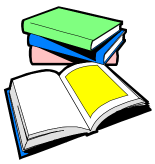

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Glossary

Glossary

Industrial Hygiene	It is set of procedures which are conducted by the Industrial Hygiene to prevent, evaluate, and control short-term or acute exposures, and toxic substances in the workplace for preserving the health of employees.
Industrial Toxicology	It deals with the poisonous or toxic properties of substances arisen from the workplace in a plant
Acute poisoning	It results from a single exposure to a heavy concentration of a toxic substance
Chronic poisoning	It is the result of repeated exposures to smaller concentrations.
Environmental Control	It includes methods of preventing the inhalation of hazardously air contaminated in the workplace.
Substitution	with less Toxic materials It is the decision taken by management to replace the currently used material(s) by a safe material
Local Exhaust Ventilation	It is removing the contaminant or heavily contaminated air from a place as close to the point of operation as possible.
Related Effects of Noise	It is the process of identifying a nose in terms of its sound level.
Vibration	It is the transmittal of energy to the human body, usually by contact with a surface or system that is in oscillatory motion.

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