

# Environmental Pollution Prevention and Control: The Current Perspective (A Review)

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**Abstract**—The review has examined the current perspective of environmental protection prevention and control in our present day world. The gravity of environmental pollution has been brought to the fore. The paper has highlighted that most pollution issues of today are not localized and poses very serious threats to the earth as a whole. Efforts at national and global levels towards abatement have been highlighted and various management techniques and innovations in pollution prevention and control have been here discussed. It has x-rayed the subject, the current situation and practice, as well as our roles as human beings in environmental protection. In conclusion the paper is saying that the future of the earth depends solely on how well we manage it. Should this current recklessness exhibited by advanced countries, developing economies, and even under-develop countries continue; the earth stands a great risk of destruction as predicted by Higgins.

**Keywords**—*pollution, prevention; control; environment; current perspective.*

## 1. Introduction

Environmental pollution is a global problem and that is why efforts are on to tackle it at the global level. For instance emissions released in Nigeria may precipitate acid rains in Cameroun or any other country. Several world conventions and protocols have been held to address the issue of environmental pollution. See fig. 1 below. As Japan Economic Review [1] puts it 'Japan is not the only country plagued by the problem of washed ashore trash. Solid waste generated in one country may find its way through the waters and be washed on the shores of another country. This is a big environmental issue in the US, Central American Countries, the Philippines, Indonesia, and other countries around the world'. This is another form of pollution that has a global effect. At a meeting of the G8 held over a three day period from July 8- July10, 2009 at L' Aquila Italy the meeting was expanded to include 14 countries with the inclusion of China, India and other new emerging economies. The meeting noted that with regard to the issue of reducing greenhouse gas emissions, there was a strong backlash among new emerging economies. See fig. 2 for amount of CO<sub>2</sub> emissions produced in each country [2]. A recent WHO [3] report has revealed that air pollution has become worse in many cities around the world in recent years, especially in

Africa and South-East Asia. The UN agency's report showed that nearly 90 per cent of the world population breathes air that is markedly above the limits recommended by the WHO. Experts from the agency identified car traffic, the burning of coal, oil and gas as well as badly insulated houses as the main culprits. The UN agency had said in April that polluted air killed 3.7 million people under the age of 60 in 2012.

Prof. Lord Nicholas Stern, a professor of the London school of Economics and a recipient of Blue Planet Prize in 2006, published the Stern Review on the economics of climate change as the first ever comprehensive report on climate change economics. The report state "if counter measures are not taken and the current situation continues, total economic losses resulting from climate change over the next 200 years will result in a colossal cost of 5% of global gross domestic product (GDP). It added that should counter measures be taken immediately such as reducing the emissions of greenhouse gases (the major cause of climate change) the cost of climate change countermeasures which would be needed up to 2050 would reach no more than around 1% of global GDP." The report argues that when taking countermeasures to reduce emissions of greenhouse gases, it is essential that the world responds to climate change on an international scale, based on understanding between different countries on long-term objectives and agreement on a framework for countermeasures' [4]. A long awaited report from United Nations on how to curb climate change says the world must rapidly move away from carbon – intensive fuels [5].

Today several counter measures are on ground to check environmental pollution. In Nigeria today NESREA is at the forefront of environmental pollution prevention and control. NESREA is National Environmental Standards and Regulations Enforcement Agency; it is an agency of government saddled with the responsibility of promulgating environmental pollution protection laws and ensuring that they are implemented. They enforce environmental laws in conjunction with the state environmental protection agencies. There are several environmental policies put in place by government all over the world to protect the environment and this include; reduction in emissions released to the atmosphere, refuse gathering, sorting, disposal, recycling, solid waste conversion to energy, effluent treatment / waste water treatment, use of renewable energy, green chemistry, zero waste manufacturing

system etc all of these policies must be implemented in conformity with standard sets by

nations' environmental regulatory bodies [6] [7].

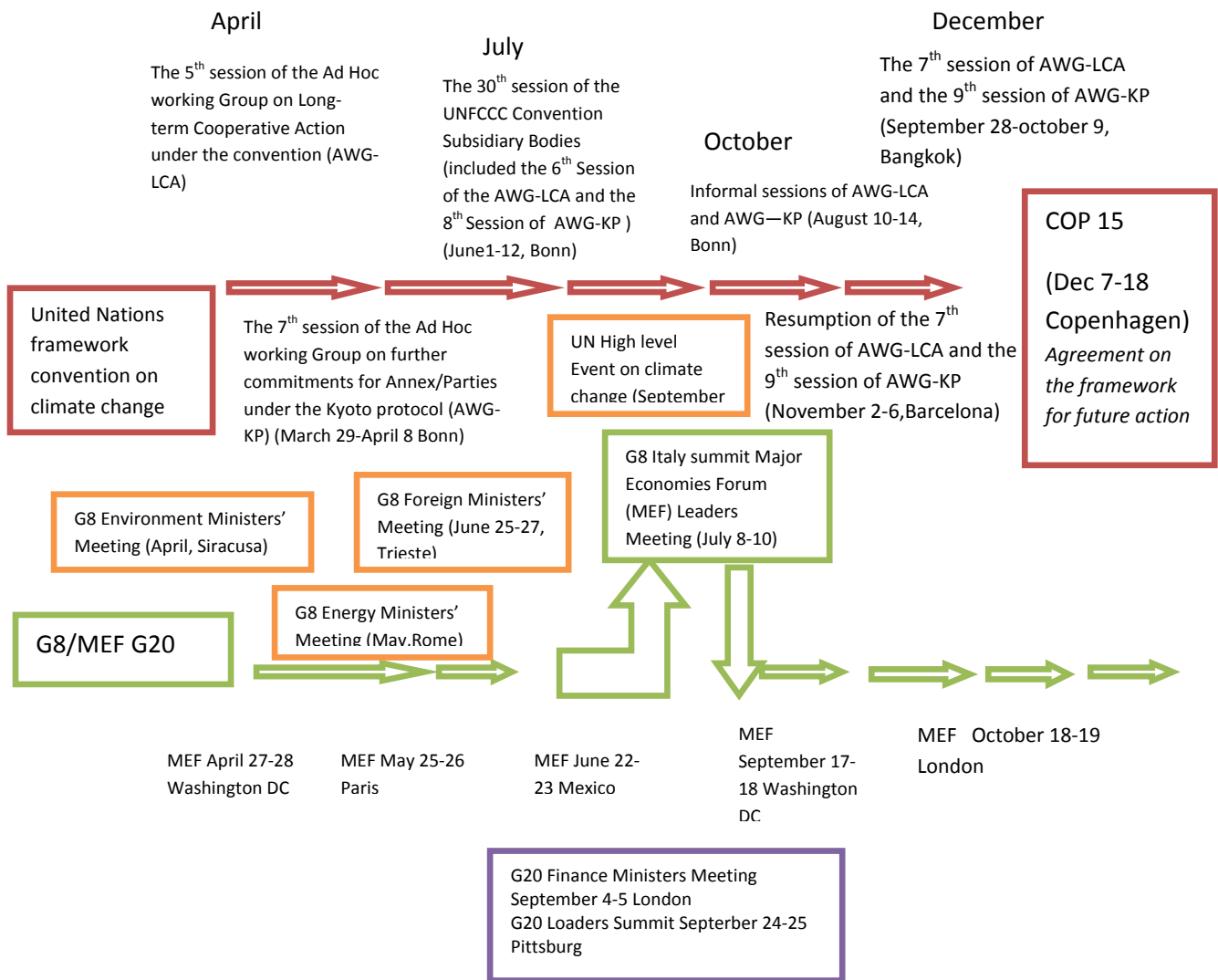
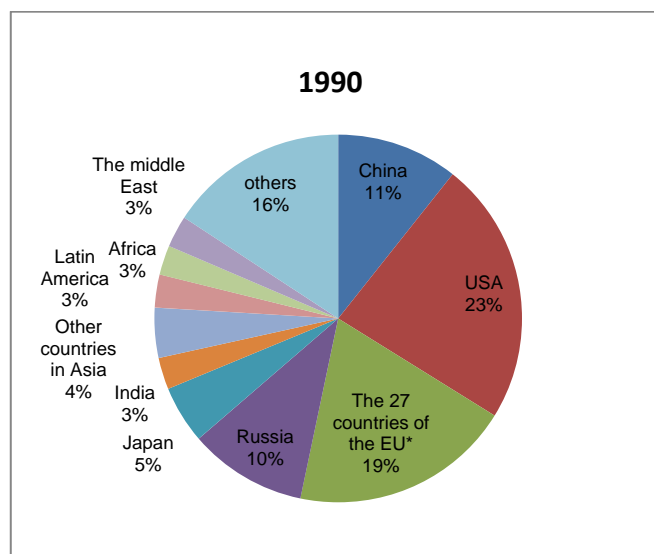


Fig.1 Schedule of Major Diplomatic Events Related to Climate Change for 2009, source: [2]



Global total for 1990: 20.9 Trillion Tons CO<sub>2</sub>

\*A combination of the total emissions of the current 27 member countries of the EU

Fig.2a: Amount of CO<sub>2</sub> Emissions Product in Each Country for 1990. Source: IEA (2009) CO<sub>2</sub> Emissions from Fossil fuel combustion [2]

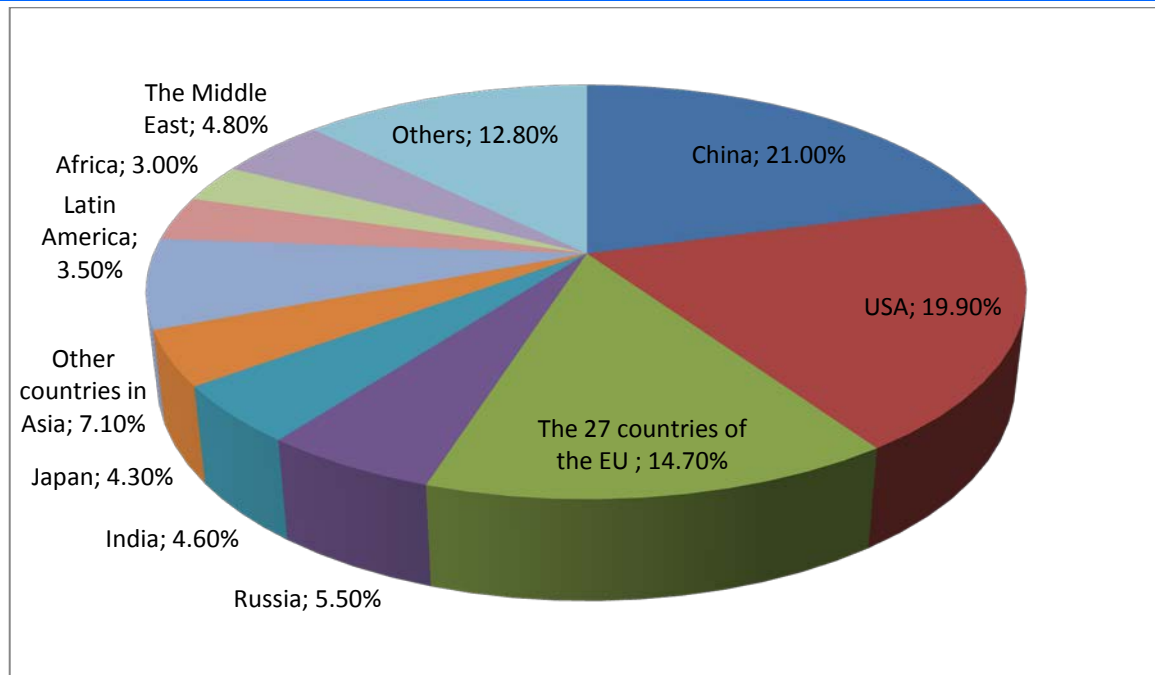


Fig.2b: Amount of CO<sub>2</sub> Emissions Product in Each Country for 2007. Source: IEA (2009) CO<sub>2</sub> Emissions from Fossil Fuel Combustion [2]

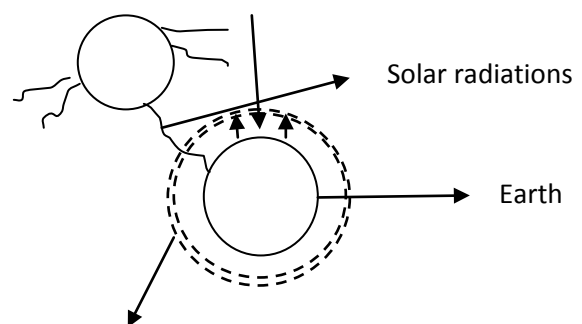
It is now universally realized that any future developmental activity has to be viewed in the light of its ultimate environmental impact. The tremendous increase in industrial activity during the last few decades and the release of obnoxious industrial wastes into the environment, have been of considerable concern in recent years from the point of view of environmental pollution. Environmental pollution on one hand and deforestation and population explosion on the other, are threatening the very existence of life on the earth. This situation can improve only if people from all walks of life realize the importance of environmental protection. Hence, environmental education which includes basic concept of environmental chemistry, at all levels of non-formal and formal education is of paramount importance [8].

The word environment is derived from French word "Enviromer" means to "encircle" or surround". Hence environment can be defined as one's surroundings which include everything around the environment. Abiotic environment consists of soil, water, air, etc while the biotic environment includes all other organisms with which the organisms comes into regular contact.

Pollution can be defined as the introduction deliberately or inadvertently of substances or energy into the environment by man / any other resulting in a deleterious effect. Pollution involves contaminations but contaminations need not constitute pollution. Huge industrial installations, fast mode of transportation, urbanization are the main outcomes of the modern civilization. These and large numbers of others are contributing to what is called "environmental pollution" [8].

## 2. Environmental Pollution

Environmental pollution can be defined as "the addition of the constituents to water, air and land, which adversely alter the natural quality of the environment". It also means the addition of any foreign material like inorganic, organic, biological or radiological or any physical change occurring in nature, which may harm or affect living organisms directly or indirectly, immediately or after a long time. The rapid industrialization has left us with polluted rivers, contaminated soils, depleted wild life, and exhausted, natural resources. Now the environment has become foul, contaminated, undesirable and therefore harmful for the health of living organisms, including man [8]. A very serious problem today in the world is that of global warming caused by green house gases. The phenomenon is illustrated in fig. 3 below



CO<sub>2</sub> and particulates (in atmosphere)  
Solar heat in reflection blocked

Fig.3 Global Warming Illustrated.

Types of pollution include the following; air pollution, soil or land pollution, water pollution, noise pollution, thermal pollution, nuclear pollution, marine pollution, industrial pollution, estuarine or oceanic

pollution, oil pollution, drug pollution, chemical pollution, acid rain pollution, biocide pollution, toxicity pollution, and sewage pollution. Regulating these pollutions have been a major and a daunting task for environmental agencies around the world' [8].

### 3. Control of Pollution in Industry

It has long been realized by governments of the world that for environmental pollution control and abatement to be effective it must be targeted at the industrial sector. This is because the activities of companies can lead to serious pollution problems. Environmental standards have to be set to which the regulatory bodies of government must ensure that industries or the industrial sector conform to. Energy conversion processes produce by-products that constitute environmental pollution. The manufacturing process produces by-products in the form of gases, liquid and solid wastes. These all constitute serious pollution problems. The transport sector accounts for 74% of the entire global CO emission [7][9]. Industrial operations such as electric and blast furnaces in iron and steel industry, petroleum refining, paper industry, gas manufacture, and coal mining accounts for 9.6% of CO emission. The concentration of CO in city air is about 55 ppm. Measures that are currently being taken to reduce CO emission at the industrial level include modification of engine design, fuel modification and development of substitute fuels, treatment of exhaust gases, and exhaust gas recirculation, is another approach that is being studied for the purpose of automobile pollution abatement. The annual global release of NO<sub>x</sub> from man-made sources is about  $5 \times 10^7$  tonnes, which is only slightly less than that discharged by natural bacterial activity. Oxides of nitrogen are produced by the combustion of coal, oil, natural gas and other organic matter. This NO<sub>x</sub> is also introduced into the atmosphere from automobile exhausts, incinerators, furnace stacks, coal fired power plants and other similar sources. The control of NO<sub>x</sub> in automobile emissions can be minimized in automobile by the use of two stage catalytic converters. Similarly, NO<sub>x</sub> from power plant emissions can be reduced by 90% by using a two-stage combustion process. The fuel can be first fired at a relatively high temperature using only about 90% of the stoichiometric air required so that only a minimum quantity of NO is formed under these conditions. Then the combustion of fuel may be completed at a relatively low temperature, in the excess air. NO is not formed under these conditions. 33% of SO<sub>2</sub> emission is due to human activities such as combustion of fuels, coal-fired power stations, transportation, refineries, metallurgical operations such as smelting of sulphide ores and chemical plants [9].

Pollution sources at the industrial level include emissions, effluents and solid waste. Government sets standard on the quality of wastes to be discharged to the environment and also specifies disposal procedures and methods for all types of wastes generated by industries. In line with the above;

industries are normally required by law to have facilities for treating emissions, effluents and solid wastes before disposal. The polluter pay principle is also adopted in some countries. For instance automobile companies that refuse to change to the manufacturing of less polluting cars are made to pay high taxes as penalties [10][11]. The fig. 4 below shows hydrogen car, hybrid car and electric car which are less polluting in terms of emissions [12]. The same applies to other manufacturing companies. Companies are made to purchase license permits and are required to submit regular report or environmental audit report on their activities to the regulatory agency, which also from time to time carry out inspection monitoring activities to see if the companies are complying with the set standards. Green awards are also instituted by monitoring agencies to encourage companies whose activities are environmentally friendly. Some companies on their own do institute stringent environmental rules for several reasons which may be:

- i) To produce quality products
- ii) For the safety and health of their workers
- iii) To receive eco-label (eco-mark)
- iv) They see themselves as stakeholders in the protection of the environment (part of their corporate responsibility)

A comprehensive approach to pollution control is being undertaken based on the following

- i) Prevent pollution at source
- ii) Encourage, develop, and apply the best available practicable technical solution
- iii) Ensure that polluter pays for pollution and control arrangements
- iv) Focus on protection of heavily polluted areas and river stretches
- v) Involve the NGOs in educating the public about pollution control measures to be taken



Fig. 4: Hydrogen car, Hybrid car and Electric car

#### 4. The Menace of Municipal Solid Waste

Municipal solid waste if not well handled can lead to air pollution, water pollution, soil pollution and even marine pollution. These include garbage and rubbish from households, offices, hotels, markets, etc, and also the street refuse such as street sweepings, dirt, leaves, contents of litter receptacles, etc. owing to increasing industrialization and ever increasing population, the production of paper, leather, rubber, metals, plastics and ceramics has been steeply increasing over the last few decades. This in turn resulted in steep increase in the generation of solid wastes both in the developed and developing countries. For example, the annual urban refuse of USA is estimated to be over 400 megatons (i.e  $400 \times 10^9$  kg). The national average of solid waste generated in North America is 1tonne per capita per year (i.e about 2.7 kg per person per day) the annual cost of collection and disposal of urban waste in USA is estimated to be 6 billion dollars. The quantity of domestic and municipal solid wastes generated in some major cities of India is 300 to 600g per person per day. Since the quantity of waste generated depends on the affluence of the society, the per capita waste produced in India is naturally lesser as compared to that produced in affluent western countries [8].

Nigeria's annual urban refuse should be in the range of 150-200 megaton with increasing population in the cities. Some cities lack the capacity and the proper organization skills for handling this waste and this constitutes environmental pollution. The benchmarking of the handling of municipal waste by some advanced countries will be of great importance to Nigeria in order to avoid the outbreak of diseases like malaria fever, typhoid fever, cholera and others. In Japan for instance municipal waste is sorted at source. Garbage goes into one place, plastic materials including pet bottles all in one place. Metal containers also have their separate containers. The collection of these wastes is also done on a regular basis. The presorting arrangement makes it easy for the refuse collectors to know where to deliver the refuse. The garbage is processed into manure or energy. Paper, plastic, ceramic and metal wastes can be recycled. The paper and plastic materials can also be converted to energy and fuel to be used for various purposes. The rate at which we are having plastic materials, and polythene wastes, littering everywhere, if something urgent is not done we may end up having serious soil pollution problem, since these materials are not biodegradable. Most countries are unwilling to actively participate in pollution control this is not helping matters at all. Some countries have recently bane the use of certain polyethene bags used for packaging in supermarkets. The fig. 5 below shows typical solid waste problem in most cities in the world.



(a)



(b)

Fig. 5: Solid Waste Sites in some Cities.Source: [8]

#### 5. New Approaches for Pollution Prevention

The level of environmental pollution is becoming alarming. Fig. 6 shows an industrial facility releasing a huge amount of emissions to the atmosphere. Today generators in Nigeria release the same kind of emission that is seen in that figure. New approaches for pollution prevention are being adopted and encouraged by Nations all over the world. Higgins [13] while stressing the danger facing the earth said 'the sun radiates energy at the rate of approximately  $4 \times 10^{13}$  kiloWatts. Nevertheless, if we assume that this energy is produced in this present manner the process should continue at the present rate of energy release for a further  $10^{11}$  years. He added that it is however unlikely that man will still be here on earth to receive it having doubtless annihilated himself long before then in some other ingenious

manner. Looking at present events in the world like ozone layer depletion from chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and

others I completely agree with Higgins. These chemicals were again detected over Antarctica early April, 2014 after a long period of absence. Some of the new approaches of pollution prevention are here considered.



Fig.6: Huge Emissions from an Industrial Facility.  
Source: [8]

### 5.1 Environmental Impact Assessment (EIA)

It is a tool in environmental Management. It is an activity designed to identify and predict the impact on the biogeophysical environment and on human health and well being, it contains legislative proposal, policies, programmes, projects, and operational procedures, and also interpret and communicate information about the impacts.

### 5.2 Environmental Impact Statement (EIS)

EIS is a public document written in a format specified by authorized national, state, and/ or local agencies

### 5.3 Environmental Inventory (EI)

Environmental inventory is a description of the environment as it exists in an area where a particular proposed action is being considered.

### 5.4 Environmental Audit (EA)

Environmental audit is an important tool for environmental management because it enables the environmental pollution control agencies to ensure the compliance with the environmental protection laws. It comprises of a systematic, periodic, objective, and documented evaluation and assessment as to how well the environmental management systems are organized to facilitate control of environmental practices and how well the company policies, are complying with regulatory requirements. Environmental review, environmental surveillance or environmental assurance is the other synonyms used for environmental audit.

### 5.5 Eco-Mark (Eco-labeling)

The scheme of eco-labeling of environment-friendly products provides accreditation and labeling for consumer products which meet certain environmental criteria along with quality requirements.

### 5.6 Approaches from Sustainable Development Point of View

The World Commission on Environment and Development in its report to the United Nations in 1987 defined "sustainable development" as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". The ultimate objective of all these efforts is the quest for zero-emissions from the industrial processes. Two important programs arising from this new strategy are: pollution prevention and design for environment [8].

#### Pollution Prevention

Production process is managed to reduce pollution at the "front end". It eliminates the transfer of pollutants from one media to another because pollutants are not generated in the first place.

#### Design for Environment

Pollution prevention is incorporated in the design process of the manufacturing system.

#### Industrial Ecology

Industrial ecology promotes a system view of industrial products and process and processes that considers the total materials and energy cycle to minimize adverse environmental effects. The same approach is utilized in zero waste manufacturing concepts.

#### Green Chemistry

The green chemistry program initiated by the United States Environmental Protection Agency is another initiative under the "Design for environmental Program". Green chemistry is the use of chemistry for pollution prevention by environmentally-conscious design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances [8][11].

#### Life Cycle Approach

This approach mandates that environmental impacts, broadly including relevant safety, health and social factors, be considered across the life time of products, process, material, technology, or services.

#### Life Cycle Assessment

Provides a comprehensive profile of energy and material inputs to, and environment impact of, manufacturing, using and retiring of products.

#### Concurrent Engineering

Environmental factors can be considered as an element of the concurrent engineering.

#### Preventive Environmental Management (PEM)

PEM involves minimization or elimination of wastes and pollutants at their sources, rather than at the end-of-pipe stage.

#### Forestation

Emphasizes the need for planting of trees to check deforestation and desertification.

### Recycling

This concept emphasizes the need to recycle materials instead of disposing them to the environment.

### Clean Technology

There is a great deal of emphasis on the use of clean technology to reduce the current pollution load on the environment.

Another concept is that known as harmonious living with the environment under this concept every project has to be carried out in harmony with the environment.

## 6. Our Roles as Human Beings in Environmental Protection.

The following should be our roles as human beings in our various communities:

i) To educate students about pollution problem and harmful effects of pollution

ii) we should minimize the use of plastic cover for different purposes

iii) Buy only environment friendly products i.e. the products which are not reducing the natural resources.

iv) Water should be used judiciously, avoiding waste.

v) To plant and grow trees in the house garden

vi) We should discourage littering of waste.

vi) To support the NGOs financially, which are rendering service to the health and environment sector.

vii) To motivate research on different measures to be taken to solve environmental problems

viii) To support the initiative taken by the central and state government in protecting our environment.

ix) Engineers should be involved in concurrent engineering

x) Engineers and professionals should support clean technology and green chemistry.

## 7. Conclusion

This paper has examined environmental pollution and control holistically. It has x-rayed the subject, the current situation and practice, as well as our roles as

human beings in environmental protection. In conclusion the paper is saying that the future of the earth depends solely on how well we manage it. Should this current recklessness exhibited by advanced countries, developing economies, and even under-develop countries continue; the earth stands a great risk of destruction as predicted by Higgins.

## References

[1] The Japan Economic Review, "fuel to be created from washed ashore trash", vol.41 No8, p1, 2009a

[2] Kitamura, T., "A Sustainable Economic Society", in TJER, November 15, 2009 Issue p3

[3] WHO, "WHO Report Worsening Air Quality in Cities".in The Guardian Mobile, 7 May, 2014

[4] Japan overseas Enterprises Association, Winner Chosen for this year's blue planet prize, a global Environmental Award (Asahi Glass Foundation) Magazine of Global Management, June Issue, 2007.

[5] BBC, "World Must end Dirty Fuel use- UN", BBC Science and Environment, 13 April, 2014.

[6]TJER, "The 41<sup>st</sup> Tokyo Motor Show 2009: all about the Environment", November 15 issue, 2009f, p8

[7] S. Rao, and B.B. Parulekar, Energy Technology, 5<sup>th</sup> Reprint, Delhi-India: published by Khanna, Nai-Sarak, 2007, pp909-964

[8] S.S. Dara, and D.D. Mishra, A Textbook of Environmental Chemistry and Pollution Control, Revised Ed., New Delhi-India: S. Chand and Company Ltd., 2010, pp 24-446

[9] A.P.lhom, "Zinc- Plated Roofing Sheets and the Effect of Atmospheric Pollution on the Durability", Journal of Multidisciplinary Engineering Science and Technology (JMEST) ISSN: 3159-0040 Vol. 1 Issue 4, November – 2014,pp125-132

[10] TJER, "Mazda builds first RX-8 Hydrogen RE for Norway", Friday May 15, 2009b ,Issue, p11

[11] TJER, "AIST Constructs bench plant for manufacturing bioethanol without sulphuric acid", p5, 2009c

[12] TJER, "Toyota launches third-generation Prius" June 15, 2009d,issue p9

[13] R.A. Higgins, "Properties of Engineering Materials", 5<sup>th</sup> Ed. London: Published by Hodder and Stoughton, 1985, pp 60-400