"Energy Conservation And Management" – A Tool For Environmental Protection And Sustainable Development

M.Sarada
Lecturer in Physics, Govt. College for Men, Doctors Colony,
B-Camp, Kurnool, Andhra Pradesh

Abstract
Increasing population, basic human needs and consumeristic life style and large scale industrialization are regarded as the major culprits contributing to the gradual environmental degradation of our space ship called Earth. The rate at which factories, big industrial units, thermal plants and increasing vehicular traffics are coming up, indicates economic development on one hand and environmental damage on the other. The modern technologies, their exceedingly high rate of rapacious exploitation of natural resources and uncontrolled development by developed countries are responsible for alarming situation of environmental crisis and ecological disturbances all over the world. Now threat to humanity comes from the destruction of earth's environment. Hence there is an urgent need of a movement of planetary dimensions to stop or arrest the holocaust. To protect environment and to have sustainable development the management staff at all levels and in all departments of an industry need to be sensitive to environmental management principles and the related practices. Conservation principle is one such practice to combat environmental damage. Conservation and management of natural resources is the need of the hour. The present paper deals with the conservation of natural resources like water, wild life, forest, soil, biodiversity, energy and management principles like energy audit, environmental audit, environmental impact assessment (ELA) and environmental management system(EMS).

Keywords : Industrialization, pollution, environmental degradation, Energy conversation and management.

1. Introduction

Today man has made remarkable progress in various fields of Science and technology. This would have not been possible had he not exploited natural resources. Science has given us all the material comforts which we could not have dreamt of some decades ago. The second half of the 20th century experienced a spurt of industrial activity never seen in the past. There has been a phenomenal increase in the production of goods and services. Industrial activity has both positive and negative impacts on the environment. A well planned and sustainable industrial project minimizes the negative impacts and maximizes the positive ones. In the absence of good planning and environmental safeguards, industrial development becomes a bane rather than a boon for us[1].

The rivers, lakes, seas and oceans have been polluted by the industrial affluent being discharged into them. Another factor that contribute to environmental damage is the reckless felling of trees. It is sad that our forest cover is fast dwindling bringing in its wake the problems of soil erosion, floods and global warming. In fact, today we can drink, breath, smell and see pollution [2]. Now threat to humanity comes mainly from the destruction of earth's environment. Hence there is an urgent need of a movement of

planetary dimensions to stop or arrest the holocaust. It was once erroneously believed that investment in pollution control in an industry is a dead investment and cut down the profits. It has now been realized that "pollution prevention pay".

All major industries for example Sugar Industry, Cement Industry etc. are captive intensive and Energy Intensive. Electrical energy is generated from natural resources like coal, water etc. By optimum utilization of electrical energy (conservation) the utilization of natural resources is minimized thereby reducing pollution. This is the principle of sustainable development. "Energy Crisis" is the major problem a mankind is facing today (present scenario). We are witnessing power shutdowns irrespective of the seasons that hamper economic development of a nation. Conservation of natural resources and conservation of energy is the "need of the hour" conservation means a precautionary / preventive measure to protect environment and to sustain development.

2.Environment

The term Environment, which etymologically means Surroundings, is considered as a composite terms for the conditions in which organisms live and thus consists of air, water, food and sunlight which are the basic needs of all living beings and plant life to carry on their life functions. Environment consists of both biotic and abiotic substances. Environment creates favorable conditions for the existence and development of living organisms. Environment is the sum of all social, economic, biological, physical or chemical factors which constitutes the surrounding of man, who is both creator and moulder of his environment.

Components of Environment

(a) **Abiotic Component :** It is sub divided into 3 categories
Lithosphere (Solid Earth)
Hydrosphere (Water Component)
Atmosphere (Gaseous envelope)

(b) **Biotic Component :** It consists of Flora, Fauna and including man as the important factor.

(c) **Energy Component :** It includes solar energy, geochemical energy, hydro-electrical energy, thermo electrical energy, nuclear atomic energy etc.

3. Man And Environment

Today the man equipped with a variety of skills and superior technology has ruined the natural resources without understanding the rebounding repercussions even on his own existence. Huge industrial installation every year, introduction of faster mode of transport and sprouting of large crowded cities (urbanization) are the main outcomes of Modern Civilization. These and a large number of many others are contributing to what is called Environmental Pollution. Man is the most powerful environmental agent spear headed by modern technologies capable of modifying the environment according to his needs to a great extent.[3]

Man made environment includes Technology, Transportation, Housing, Agricultural Implements, Dam Building, Channelisation of energy sources, Revolution in communication (eg) Satellite, Remote Sensing, Telex, Fax etc., Industrial Revolution, Mechanization, Space Acceleration, Space laboratories, computerization etc.

Today the modern technologies, their exceedingly high rate of rapacious exploitation of natural resources and uncontrolled development by developed countries are responsible for alarming situation of environmental crisis and ecological disturbances all over the globe. So the scientists, climatologists and environmentalists have alarmed the modern man against the devastating impact of unscientific and reckless exploitation of natural environment and pleaded to save the life existing on earth. Today numerous issues like quality of Environment, ecological imbalance, environmental degradation, ozone layer depletion, ozone-hole, global warming and sick environment have been raised.

4. Environment and Development

During recent years there has been a lot of emphasis on new areas of science such as Ocean Development, Biotechnology, Renewable sources of energy, nanotechnology, telecommunications and environmental developments. There has been considerable research and development activities in these fields which have resulted in sustainable improvement in the quality of life. Biotechnology, which is fast emerging has a wide impact on health, agriculture, medicine, energy, industry and environment. The energy crisis has given rise to the struggle for supremacy in the matter of energy. Accelerated economic development needs increasing amount of energy without creating any hazardous effect on the environment. Consequently production of energy from conventional sources like coal, oil, thermal power, hydropower and nuclear energy as well as the production of Solar Photovoltaic cells has to be supplemented with production from non-conventional sources.

5. Conservation of Natural Resources

a. Conservation of Water

Water is a common property resource. Its main use is in three sectors, such as agriculture, industry and domestic, all of which are important for improved quality of life. Population explosion, increased industrialization and life style changes are putting ever increasing demand on each of these sectors. The per capita consumption of water has increased more than 10 folds between 1900-2000 and is likely to increase further in the 21st Century [4]. There is a regional and seasonal imbalance of distribution of water resources in India, while rivers in North India, Originating from the Himalayas, are perennial; most of those in the peninsular India have very scanty flows in dry seasons. This calls for a planned action for water conservation and consequently, reduced waste water generation in industries. To conserve and harvest rain water, water shed programme such as digging of ponds is done to compensate scarcity of water. As far as industry is considered, water conservation is done as follows:

- Each unit of the process plant has its own effluent treatment plant which treats the waste water specific to the plant. Treated waste water is recirculated to the maximum extent and only the remaining amount is discharged to a central waste water reservoir.
- The central waste water reservoir collects waste water from unit processes, boiler and cooling tower blow down and domestic sewage (after treatment) from which the waste water is reused after a low-cost biological treatment (facultative pond, root-zone treatment etc.).

- Maximum recycling of water is done in individual as well as total unit processes. Discharge to the environment is limited to the minimum, mainly in emergency situation. The conservation scheme should be at the time of installation of plants and machineries.
- Water Act: Water conservation is enforced through law. The water Act 1974 (Prevention and control of pollution), was passed by a parliament under Art. 252(1) of the constitution of India.

b. Conservation of Wild Life (Endangered Species)

Wild life is a biotic component of biosphere of ecosystem, preservation of wild life is a must for a sustainable food chain and ecological balance. The wild life (protection) Act, 1972 was enacted by the Parliament with a view to protect the wild animals and birds. Every state or Union Territory is to have a wild life advisory board to advise the state government/union territory in the selection of protection areas to be declared as sanctuaries, national parks and closed areas (ex: biosphere reserves).

A biosphere reserves are closed ones where no human interference, except non-invasive research and wild life watching is permitted. Sanctuaries are areas where specific species are protected. National parks are areas where plants and animal species are protected for tourism (eg: Botanical gardens, Zoological parks).

c. Conservation of Forests (Afforestation)

Plants are source of food for all living things on this planet Earth. Plants are the primary producers which prepare starch by means of photosynthesis. Now-a-days the forests are cut down due to overgrazing of cattle and for expansion of area. Plants play very important role in absorbing carbon dioxide from atmosphere and evolution of Oxygen. The clouds get precipitated under vegetation land. Keeping in view all the benefits of plant, there is a need to protect the planet by planting plants and trees.

Forest (Conservation) Act, 1980 was passed by Indian Parliament in 1980 and amended in 1988, emphasizing the need for protecting the rich biodiversity of the country.

d. Conservation of Soil

Soil is a media where plants and trees take nutrients and grow. The fertility of a soil is lost due to heavy flow of water (i.e.) flood. This is called Soil Erosion. The fertility of a soil should be retained by soil conservation methods like contour trenching, contour cultivation, farm ponds, check dams, planting in barren lands etc, to reduce the flow of water velocity.

e. Conservation of Biodiversity

Biodiversity is defined as the totality of genes, species and ecosystems in a region or the world. Biodiversity has served the humanity in the form of food, fiber, fuel, drugs, building material etc. The ecological value of biodiversity provides stability and sustains evolution.

Erosion of Biodiversity

Species get extinct in the natural evolutionary process. The natural extinction rate is of the order of one per ten million species a year. As per the report of the IUCN (International Union for Conservation of Nature), since 1600, more than 700 known species of vertebrates, invertebrates and vascular plants have been recorded to be extinct from the surface of the earth. 2/3 of world's bird species are endangered. Out of the total 4,771 known reptile species, 169 are threatened.

Causes of Biodiversity loss

- Habitat destruction due to building of dams, high ways, establishment of industries, mining activities.
- Over harvesting, pollution, hunting and luxury trade of animals and plants.
- Monoculture in Agriculture, forestry, fisheries and animal husbandry.

Legal Methods

Acts enforcing wild life and plant life protection i.e., Wildlife protection Act and the forest conservation Act, 1980, Environmental Protection Act, 1986.

Biodiversity conservation will not be possible without people's participation. They should be sensitized to the issue through media and mass awareness programmes.

6. Energy (Electrical Energy)

Electrical energy is the main input for any type of industry. It is widely used in agricultural practices and in domestic purposes. With increased population explosion, Urbanization, industrialization, the requirement of energy is increased. Electrical energy is ultimate form of energy that is derived from natural resources like water, coal, radioactive fuel etc. As the demand for energy increases, these fuels get exhausted. There is a need to conserve water and coal thereby conserving electrical energy.

The sources of energy are of two types.

(a) Conventional source (Non-Renewable sources) Water, coal, radioactive materials, Hydel Power

The electrical energy is generated by water. The water is stored in dam and the flow of water is restricted. Allowing the water to fall on a turbine, the conversion of potential energy into kinetic energy takes place. The turbine is connected to a motor, that converts mechanical energy into electrical energy.

Thermal Power

Coal is the source of thermal power. Coal undergoes combustion and release energy with emission of carbon dioxide into air. The carbon dioxide emissions are responsible for global warming and green house effect.

Nuclear Power

The source is the radioactive material. In a nuclear plant, a nuclear reactor is constructed with moderator, control rods and water circulating system. The radioactive material undergoes radioactive fission under controlled chain reaction and releases huge amount of energy. There are several human health problems

regarding the disposal of the radioactive waste which undergoes radioactive disintegration in long duration of time. Nearly 80% of energy demand is met from thermal power (coal).

In order to meet the existing and future energy demand, we have to go for alternative sources of energy which are environmentally friendly. The one such alternative is renewable sources which are eco-friendly and replenishable.

(b) Non-conventional sources (Renewable sources) solar, biomass, geothermal, tidal, wave and wind.

Solar Energy

Sun, the astronomical body is the only source of energy for living creatures on earth. India lies in tropic and subtropics area, there is a huge potential to draw solar power. Solar energy is renewable, non-exhaustible and replenishable. Sun is continuously emitting radiation without any interruption and solar energy is receiving at Zero Cost. The only thing, solar radiation should be trapped properly and get converted into electrical energy. As a conservative technique, to conserve coal and other fossil fuels, solar energy is the only alternative. The fusion of Hydrogen nucleui is the result of continuous solar radiation. There exist two different devices for the conversion of solar radiation into electrical energy.

Solar Thermal Devices

These are solar cookers, solar water heaters, solar driers etc.

Solar Photovoltaic Devices

Solar Cell, Solar lanter, solar street light (rural electrification), solar invertors etc.

Solar Panel

It is a device that is an assemblage of solar cells in parallel and series. By means of solar panel, solar radiation is converted into electrical energy.

Solar Cell

It works on the principle of photo electric effect. Still today an extensive research is going on in improvement of technology for the conversion of solar energy into electrical energy. The installation cost and initial investment is high regarding solar devices. The pay back period will be nearly 5-6 years. The Ministry of non-conventional energy sources is encouraging to use solar devices as solar energy is free from pollution and it is eco-friendly. The Central Government under MNES is subsidizing solar devices.

Wind Energy

Moving air is called wind. When the speed of the wind is about 8 km/second then the wind is highly potential to convert into electricity. The wind mills are located at the places of high altitudes. By means of motors attached to wind mill, mechanical energy is converted into electricity. Energy from wind is free from pollution and eco-friendly.

Biomass

India is an Agro based nation. All agricultural wastes such as leaves, cow dung etc. is termed as biomass. Biomass is allowed to ferment, the result of which is the Methane Gas that is used for cooking in rural areas. (Gobar Gas Plant).

Geothermal

As we go deeper and deeper in to earth's crust, the temperature of the earth increases. By adopting a suitable technology the heat at the centre of the earth can be converted into electricity.

Tidal Energy / Wave Energy

In coastal areas, there is an occurrence of Tides and Waves continuously. Tides carry huge amount of energy. By means of a turbine, tidal energy is converted into mechanical energy.

7. Conservation of Energy (Techniques / Methods)

Energy is one of the main inputs in any industry. Conservation of energy increases efficiency and productivity.

- It has been declared by State/Central Government that the number of LPG cylinders that are issued to an individual householder is restricted to 12 per annum. It means utilizing domestic gas to the least possible extent. In this context, one should make use of utensils coated with copper as it is good conductor of heat. To conserve fuel one should use pressure cookers and aluminium containers.
- At home / office , lights and fans should be put off when not in use.
- LED lamps and Fluorescent bulbs instead of incandescent bulbs should be used for illumination purposes.
- Emergency power requirement must be kept at minimum.
- One must go back to conventional method of cycle as a mode of transport.
- The techniques in industries to conserve power / energy.

Modernization: Replacing old machine by newer ones. Older machines consume more energy to run due to wear and tear of parts.

Optimization: In an any industry the optimal level of power consumed by each machine should be maintained.

Captive Co-generation Technique : Electrical energy (supplied from Power Grid) is the only source of energy for any machinery to run in an industry. Now-a-days we are witnessing power shut downs very frequently due to shortage in power generation. Under these circumstances, the industrial production decreases thereby hampering economic growth. Therefore in order to meet power requirement in the presence of the power shut down and as conservative technique , each industry should adopt co-generation. Co-generation means the energy can be generated from one of the byproduct of the process industry. For example in sugar industry Molasses is the byproduct from which power is generated. Another co-generation principle is using Diesel based generators and thermal power generation.

- Like financial audit, energy audit should be conducted at each and every level in the industry. Energy auditors verify the records and check whether power norms are strictly followed or not.

- Efficiency of operation is important. Use of high calorific value fuel, efficient heat utilization and proper heat balance in the process and minimum consumption of fuel/energy should be aimed at.
- Emergency arising out of shut down, low load running, variation in quality inputs and varying frequency/voltage are some of the reasons, often beyond control, which increases fuel consumption. These incidents can be reduced by adhering to schedule maintenance and operation guidelines along with proper instrumentation control system.
- Electrical energy losses in transmission and distribution system need to be minimized. It can be done by installing capacitors.
- Energy conservation can be achieved by using fuel efficient automobiles and transport vehicles.
- Efficient operation of boiler is an important activity in the power generation sector for energy conservation.
- Efficient turbine operation is also important in the power generation sector for energy conservation. The operating efficiency depends upon the regenerating feed-cycle operation, stoppage of leakage of steam and water reducing requirement, operation of super-heaters and pre-heaters in circuit linked to atmospheric temperature etc.

8. Management Practices

a. Environment Management

Environmentalism is a fairly new movement in the world in recent years. It is getting a top priority in national policies among the developed and developing countries.

Objectives of Environmental Management

- Maintenance of Environmental Quality
- Balancing the ecosystem
- To restrict and regulate the exploitation of natural resources
- To protect the environment from degradation
- To renew natural resources and reduce natural disasters
- To adopt engineered technology without creating adverse effects on the environment
- To formulate laws and regulations to control pollution.

Components of Environmental Management

- Environmental perception and people awareness.
- Control of environmental degradation and pollution
- Environmental Impact Assessment (EIA) to review the existing technology.
- Environmental education and training
- To control over population and over-consumption.

b. Environment Impact Assessment (EIA)

Any project is meant to give economic benefits to the society. In addition to that, the project also causes social and environmental losses and gains. The losses include depletion of non-renewable sources, pollution, deforestation and are often missed in the cost-benefit analysis of the project. A project should be taken up based on techno-economic feasibility and environmental compatibility.

Objective is to identify and evaluate the potential impacts (both beneficial and adverse) of development projects on environmental systems. This helps in selecting environmentally compatible sites and planning environmental safeguards [5].

It is a process designed to ensure that all potentially significant impacts are satisfactorily assessed and taken into account in planning, designing, authorization and implementation of all relevant types of actions of a development project.

c. Environmental Audit

The concept of auditing has been extended to many other areas like energy and environment. Environmental auditing is used to assess the environmental performance of an industry. This helps to plan strategy and formulate action plans in an environmentally sound (green) management.

d. Energy Audit

It is a management tool comprising a systematic, documented, periodic and objective evaluation of how well the environmental organization, management and equipment are performing with an aim of helping to safeguard the environment by facilitating management and control of environmental practices and assessing compliance with company policies, which include meeting regulatory requirements.

e. Environmental Management System (EMS)

It involves a proactive approach and incorporates a set of policy measures, management actions, operating procedures, documentation and record keeping with defined responsibilities and accountabilities of personnel engaged in each of the environmental issues of the organization. The EMS programme brings about a continuous environmental improvement following a defined sequence of steps [6].

- Environmental review (review of environmental consequences of various operations)
- Defining environmental performances, policies and objectives.
- Preparation and establishment of action plans
- Monitoring the performance.
- Reporting the results of monitoring
- Review the system and adopting suitable measures for continuous improvement.

9. Conclusion

The Economic development of any nation depends on the industrial growth. To start any process industry land, raw material (natural resources) and electric power are the main inputs. Environmental implications/impact should be thoroughly studied, reviewed and monitored at later stage. Energy conservation, resource conservation, energy audit, environment audit, environment impact assessment (EIA) should be strictly followed so as to minimize environmental damage and for sustainable development.

As an individual, it is the sole responsibility and accountability of all of us to safeguard our planet Earth by reducing pollution by conservation and management of resources. “Energy is life”, “Energy saved is Energy produced.”

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