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# The Role of Technical Audit in Environmental Impact Assessment

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**Abstract**: The paper reviews the initial attempts being made in India to commence the practice of environmental audit. Environmental auditing has been developed for industrial (chemical, manufacturing, fuel consumption) applications or process. Technical audit or fuel audit fall into a category of statutory environmental audits required to be undertaken by the Environment Protection Authority. The paper takes a quick look at how the discipline of fuel audit can be viewed as s vital pragmatic management tool to conserve fuels, to optimize costs, to improve system safety and to enhance operational reliability.

**Keywords**: Technical audit, fuel audit, fuel input, heat utilized/wasted.

## I. INTRODUCTION

A paradox of modern technological society is that some of our very efforts towards economic prosperity and increased standard of living could be detrimental to the overall quality of life due to encroachment upon nature beyond its sustenance level or rejection or pollutants to the environment exceeding its assimilative capability. Unless utmost consideration is given to the environmental aspects in our industrial development, we may end up with irreparable damage to the environment. On the other environmental sanctity which carried strong social concern and emotions I appeal, it is easy to lose scientific objectivity and become rhetoric. For a developing country like India, lack or industrial development and consequent unmitigated poverty could also cause damage to the environment. If we have to guard our environment without seriously blocking the technological development, we need to have a thorough understanding of the environmental processes and their dynamics, we need to develop/ adopt environmentally begin strategies and technologies. Recognizing this need, Ministry of Environment and Forest (MEF) has made "Environmental Audit" compulsory for all industries which require authorization under the air, water and environment protection acts in each financial year beginning April 1992, to submit an environmental Audit report to the concerned state Pollution Control Board. By an amendment (vide MEF notification No. GSR 386 (E) dated 22 April 1993), the term for the document has been revised from "Environmental Audit Report" to "Environmental Statement".

In the context of safeguarding the environment, probably no other issue has drawn so much of attention as Environmental Audit. Scientifically speaking, the concern should be whether Environmental Audit Concept has alerted the industries to any significant degree. This calls for an integrated perspective, of an Environmental Audit comprising material, process, fuel, energy, water, health & safety and environmental quality audits.

## II. ENVIRONMENTAL AUDIT

The emergence of the concept of "SUSTAINABLE DEVELOPMENT" in recent years warrants the implementation of preventive environmental management measures like Environmental Audit (EA) which is an instrument for resource conserving made in an industrial sector.

EA may be defined as a pragmatic management tool comprising a systematic, periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of helping to regulate the environment by:

a) Facilitating management control of environmental practices.
b) Assessing compliance with industry policies, which would include meeting regulator) requirements.

Precisely, Environmental Audit is a technical process of detecting wasteful use of resources and environmental damage that can be avoided in any productive activity Environmental Audit may not be a totally new concept, but it is certainly a brand new practice in India. The objectives of Environmental Audit comprise minimization of waste, reduction in consumption of fuel and materials, and improvement in environmental conditions.

Recognizing the importance of Environmental Audit, procedure for Environmental Audit was first notified under the Environment (protection) Rules. 1986, by the Ministry of Environment and Forests (vide their nullification No. GSR 329 (E) dated 13$^{1h}$ March 1992).

Environmental statement has to be submitted by every person carrying an industry, operation or process requiring consent under section 25 of the water (Prevention and Control of Pollution) Act of 1974 or under section 21 of the Air (Prevention and Control of Pollution) Act of 1981 or both or authorization under the Hazardous Waste (Management and Handling) Rules of 1989 issued under the Environment (Protection) Act of 1986. The statement has to be submitted to the concerned State Pollution Control Board for the period ending on 31$^{st}$ March is a prescribed format by 30 September 1993. The prescribed proforma has nine parts (A to I) and covers the items like water and raw material consumption, pollution discharged to environment per unit of output of the parameters specified in the consent, Hazardous wastes from the pollution control facilities, solid wastes from the processes and from the pollution control facilities, impact of pollution abatement measures on conservation of natural resources and on cost of production.

EIA and environmental auditing, therefore, should (but rarely do) form a continuum of environmental assessment. In fact, a special category of environmental audit assesses the predictions in an EIA, measures whether those predictions are accurate and, if not, makes recommendations to ensure that the environment is protected.

**2.1 Common Environmental Audits**

There are many different types of environmental audit that may be carried out on an individual facility, operation or site. It is very important when commissioning an environmental audit of a mining operation or site to ensure that the objectives of that audit are clearly defined. This clear definition of objectives will determine the protocol to be used by the auditors, the qualifications needed by the auditor, or the audit team, and whether or not legal input should be included in the environmental auditing process. Following are the types of environmental audit.

a. Environmental Management Audits
- Environmental Management Program Audits for companies with no formalised Environment Management System.
- Environmental Management Systems Audits for those companies with a formalised Environmental Management System.

b. Three levels:
- First Party Audit - internal (by organization)
- Second Party Audit - usually by a customer on a supplier
- Third Party Audit - independently against the appropriate standard

c. Compliance Audits - usually against environmental legislation, regulations, licenses, approvals and internal policies.

d. Audits for Mergers, Acquisitions and Divestments - usually by banks and other financial lending institutions or by vendors and purchasers to assess environmental liability.

e. Environmental Impairment Liability Audits - a prerequisite to Environmental Impairment Liability (EIL) insurance.

f. Environmental Marketing Audits - usually a cradle-to-grave analysis of a company's products and operations to assess the environmental standing.

g. Environmental Impact Audits - to assess monitoring of Environmental Impact Statement commitments or concerns during operations.

h. Environmental Performance Audit - assesses environmental performance of ongoing activity.

i. Phase One Audit - assesses environmental liablity related to acquisition or divestment of an asset.

j. Technical Audits - assess the environmental impact of a specific part of an operation or a process.

Technical audits may be undertaken by industry or government agencies to assess whether a particular operation is having a detrimental effect on the environment, or to assess the environmental impact of a specific part of an operation or process (eg, a coal preparation plant or a minerals concentrate or ,fuel consumption). Technical audits fall into a category of statutory environmental audits required to be undertaken by the Environment Protection Authority. Results of statutory environmental audits are made public.

### 2.2 Fuel Audit

Fuel Audit" is a vital link in all entire energy management chain and it serves to identify all the fuel streams into facility and to quantity fuel use according to discrete information.

The simplest definition for a fuel audit is "a fuel audit serves the purpose or identifying where the industry uses fuel and identified fuel conservation opportunities."

### 2.3 Fuel Audit Methodology

Fuel audit comprises
a) Recording fuel inputs in boilers / furnaces / kilns
b) Recording steam quantities supplied to each section / equipment in an industry
c) Developing fuel/material balance
d) Critical analysis of fuel/material balances to identify areas of losses and poorest area of operation / maintenance.
e) Identification of areas of substitution of fuels by cleaner alternative fuels.
f) Planning conservation opportunities
g) Implementation of conservation/ corrective measures.

### 2.4 A Fuel Audit Protocol

A fuel audit protocol is to be prepared as a first step which outlines a series of activities to undertake in reviewing specific areas of fuel conservation. Fuel audit protocol lists the step by step procedures that are to be followed during the audit.

### 2.5 Fuel Audit Elements

Fuel audit elements can be listed as boilers, furnaces, storages and handling of fuel oils, combustion equipments like burners, air control dampers, steam turbines, steam utilization and steam distribution.

A boiler or furnace utilizes the heat generated by combustion of fuel to head water or air or any process material. The efficiency of a boiler or furnace in as important criteria to be seen during a fuel audit and depend on how efficient the combustion system is and how best the generated heat is utilized. Combustion of oil is effected by means of a burner, which mixes fuel and air in proper proportions for complete combustion and the consequent release of head energy.

During a fuel audit, basic combustion reactions are to be checked.

In any combustion process, the reaction between fuel and oxygen in the air releases heat energy. The combustion products are primarily carbon-di-oxide ($CO_2$), water vapour ($H_2O$) and sulphur dioxide ($SO_2$) which passes through the chimney along with the Nitrogen ($N_2$). After surrendering useful heat in the heat absorption area of a furnace or a boiler, the combustion products of flue gases leave the system through the chimney, carrying away a significant quantity of heat with them.

### 2.6 Ideal or Stoichiometric Combustion

Figure 1. depicts the ideal combustion process for burning one kg of a typical fuel oil containing 2% sulphur, 86% carbon and 12% hydrogen. During fuel audit, use is made of theoretically required minimum quantity of air i.e., 14.1 kg (comprising 3.27 kg of oxygen and 10.83 kg of nitrogen) to check the efficiency. Carbon reacts with oxygen to

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form 3.15 kg of carbon-di-oxide and hydrogen reacts with water to form 1.08kg of water. Nitrogen in the air does not take part in the reaction. Carbon is fully converted to carbon-di-oxide releasing complete heat. In addition, carbon dioxide, along with sulphur dioxide, constitutes 15.76% by volume of flue gases. 14.1 kg of air for every kg of fuel oil is required for complete combustion. This is the minimum air that would be theoretically required if mixing of fuel and air by the burner is perfect. This is to be checked during fuel audit. In actual practice, since mixing is never perfect, a certain amount of excess air is needed to complete combustion and ensure the release of entire heat contained in the fuel oil. If too much air than what is required for completing the combustion is allowed to enter, additional heat would be lost in heating the surplus air to the chimney temperature. Less air would lead to increased stack losses. Hence during fuel audit, optimum excess air level for type of fuel used is to be checked, because fuel savings are the most at the optimum excess air level.
During fuel audit, by measuring either the content of carbon dioxide (CO2) or Oxygen (O2) in flue gases, percentage of excess air in flue gases is to be estimated.

In ideal combustion, carbon dioxide and sulphur dioxide together constitute 15.76% by the volume of flue gases. An excess air increases, the concentration of these gases (CO2 and SO2) decreases and the concentration of oxygen steadily increases in the flue gases. This should form the basis for determination or excess air through chemical analysis during fuel audit.

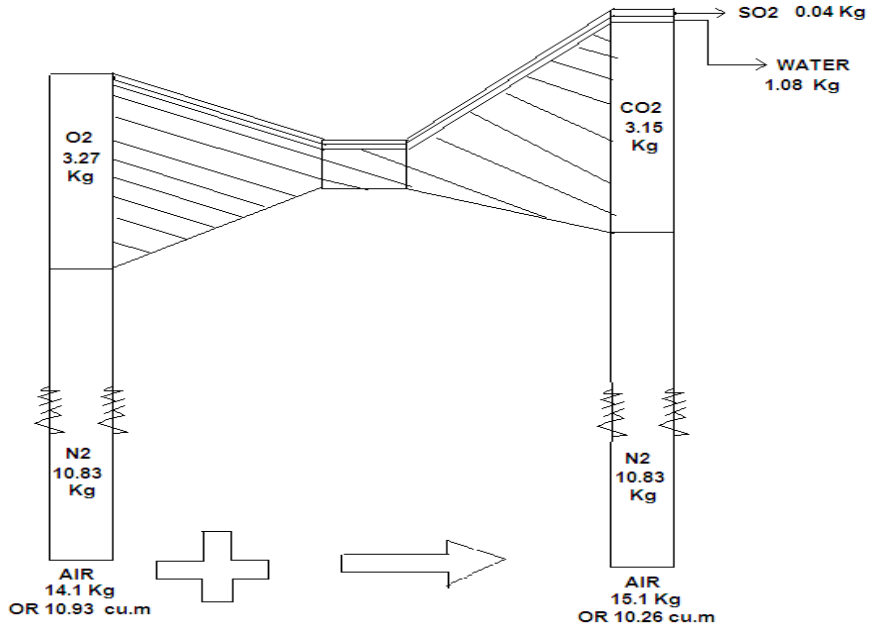


Figure 1A: Stoichiometric Combustion

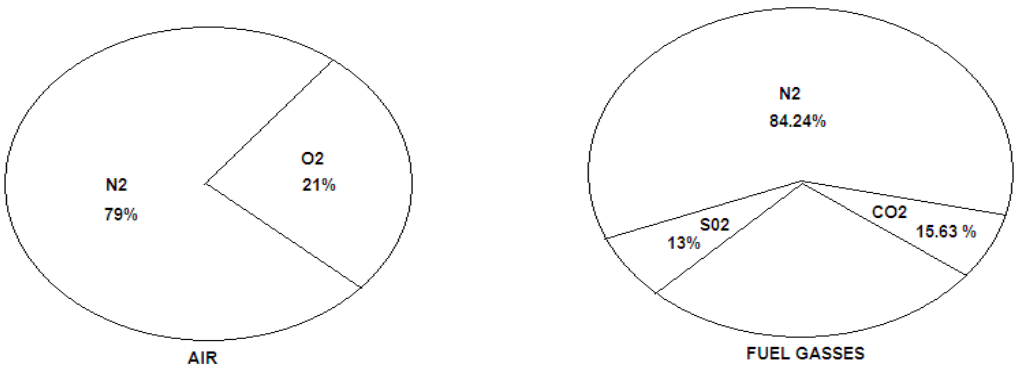


Figure 1B: Composition by Volume

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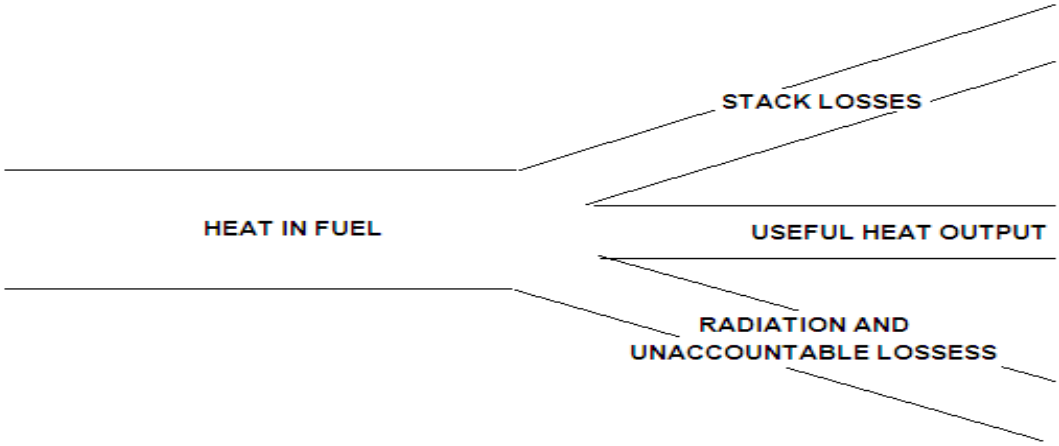


Figure 1C: Heat Balance of a Combustion Cycle

### 2.7 Development of Fuel / Heat Balance Scenario

In any system, there are certain amounts of unavoidable losses. From the heat / fuel balances, we can analysis where and how much fuel/ material loses can be avoided. The losses over and above the unavoidable losses should be eliminated to the maximum extent, by initiating corrective measures.

A typical fuel balance scenario can be developed in any industry as shown below:

| FUEL INPUT | HEAT UTILIZED / WASTED |
|---|---|
| a. Fuel consumed in a boiler.<br><br>b. Heat inputs from outside heat sources other than the same system like heat in feed water, heat in combustion air supply, and heat in fuel supplied. | a. Heat in steam generated<br><br>b. Radiation losses<br><br>c. Heat escape from furnace openings.<br>d. Un-burnt<br>e. Steam leaks<br>f. Fuel oil leakages<br>g. Stack losses |

Table 1. Fuel Balance Scenario

Similarly, heat / material balances for each equipment of an industry should be developed.

A heat balance of a boiler indicates what type of heat losses occur and construction of such a balance is an important step in a fuel audit to identify the areas for improvement.

### 2.8 Fuel Conservation Potential

"Fuel Conservation" should be aimed at while conducting a fuel audit in an industry by considering the following key elements for study:

a) Selection of equipment / burners.
b) Maintenance of process equipments, burners, furnaces, boilers, storage facilities and filters.
c) Proper fuel preparation for combustion like preheating of fuel oil and sizing of coal.
d) Proper distribution of combustion air, furnace draughts.
e) Air filtration and heat escape form furnaces.
f) Furnace / heat transfer surfaces.
g) Condensate recovery.

### 2.9 Fuel Economy

During fuel audit, the following aspects are to be given due importance:

a) Fuel loss due to decreased boiler efficiency.
b) Loss of fuel due to high excess air.
c) Fuel loss due to high stack temperatures.
d) Fuel loss due to high radiation losses.
e) Fuel loss due to steam leakages.
f) Fuel loss due to non recovery or condensate from steam system.
g) Fuel loss due to non recovery of flash steam from condensate system.

## III. EPILOGUE

We are standing on the threshold of an era, when development of environmental awareness can only guarantee security and happiness to present and future generations. Keeping in view this necessity of time, environmental audit must urgently be established as a profession, duly recognized by the government and industry. Environmental Audit should be viewed as an effective management tool in achieving a wide set of objectives comprising conservation of fuel (fuel audit), pollution control and enhancement of productivity.

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