

Environmental Auditing

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ABSTRACT

The environmental audit help in pollution control. Improved production safety and health and conservation of natural resources and hence its overall objective can be stated as achieving sustainable development. However for conducting environmental audit objectives are to be defined clearly or else the audit procedure will be subject to varying interpretations which may yield and contribute to differences in approach thereby influencing the end results. The objectives of environmental audit in an industry are (i) to determine the mass balance of various materials used and the performance of various process equipment so as to identify usage of materials in excess than required. To review the conversion efficiencies of process equipment and accordingly fix up norms for equipment/operation performance and minimization of the wastes. (ii) (a) To identify the areas of water usage and wastewater generation and determine the characteristics of wastewater..^[3]

Keywords: Environmental Audit, Audit Team, Field Observations, Synthesis of Data, ETP

I. INTRODUCTION

1.1 Philosophy of Environmental Auditing

1.1.1 Definition

Environmental auditing is management tool comprising systematic documented, periodic & objective evaluation of how well the management systems are performing with the aim of

- (i) Waste prevention and reduction.
- (ii) Assessing, compliance, with, regulatory, requirements.
- (iii) Facilitating control of environmental practices

Because of the limitations on practically achievable operational efficiencies and the raw materials purity. These excess usages of raw materials unless recovered find their way to environment causing pollution. Wastes from an industry include non-product discharges in gaseous, liquid and solid phases. End -of-the-pipe waste treatment techniques, where in all the wastes are carried to a common facility for treatment is proving to be ineffective and uneconomical due to the complexity of problems associated with waste generation, their quantity and characteristics. The waste generation may

vary hourly, daily and seasonally especially in case of the multiplicity of manufacturing product in the same premises. The wastewater characteristics also widely vary from stream to stream discharged from various unit operations of a particular product. In this growing complexity of problems. The concept of waste prevention implementation within a reasonable time frame keeping in view the financial and other considerations of a company. In cases of gaps for compliance with the regulatory requirements the regulatory bodies could be apprised of these action plans and time obtained for implementation. Thus the regulatory risk on and reduction can work out to be more effective. It is important to find out whether an industry is complying with environmental standards and other regulatory requirements. It is also very essential to periodically monitor this aspect, determine the gaps and workout action plans for could be overcome and effective steps taken for pollution control. .^[3]

1.1.2 Objectives of Environmental Audit

The environmental audit help in pollution control. Improved production safety and health and conservation of natural resources and hence its overall objective can be stated as achieving sustainable development.

However for conducting environmental audit objectives are to be defined clearly or else the audit procedure will be subject to varying interpretations which may yield and contribute to differences in approach thereby influencing the end results. The objectives of environmental audit in an industry are

- (i). Equipment and accordingly fix up norms for equipment/operation performance and minimization of the wastes.
- (ii). (a) To identify the areas of water usage and wastewater generation and determine the characteristics of wastewater.
(b) To determine the emissions, their sources, quantities and characteristics.
(c) To determine the solid wastes and hazardous wastes generated, their sources, quantities characteristics.
- (iii). To identify the possibilities of waste minimization, recovery and recycling of wastes.
- (iv). To determine the performance of the existing waste treatment control systems so as to modify or install additional or alternative control equipment accordingly.
- (v). To determine the impact on the surrounding environment (groundwater, stream, residential area, agricultural area, sensitive zone) due to the disposal of wastewater, emissions and solid wastes from the industry and accordingly identify suitable preventive measures, if necessary.
- (vi). To verify compliance with the standards and conditions prescribed by the regulatory bodies under the Water Act, Air Act and the Environmental Protection Act.
- (vii). To check the effectiveness of
 - (a) organizational set up of the industry for decision making and environmental management with special reference to their technical view point, attitudinal view point.
 - (b) Environmental policy of company.^[3]

1.1.3 Benefits of Environmental Audit

Environmental auditing has far reaching benefits to the industry, to the society and the nation at large. The benefits of environmental audit are

- (i). Determines how well the process systems and pollution control systems are performing and identifies the operations of poor performance. To determine the mass balance of various materials

- used and the performance of various process equipment so as to identify usage of materials in excess than required. To review the conversion efficiencies of process paper may present orig
- (ii). Identifies potential cost savings which can be accrued through reduction in raw material consumption by way of waste minimization and adoption of recycle/recovery reduction in pollution load.
- (iii). Increases awareness of environmental requirements policies and responsibilities.
- (iv). Helps in understanding the technical capabilities and attitude of the environmental organization in a company.
- (v). Provides upto date environmental data base for use in plant modification emergencies (vi) Unreveals surprises and hidden liabilities due to which regulatory risk and exposure to litigation can be reduced.
- (vi). Ensures independent verification, identifies matters needing attention and provides timely warning to management on potential future problems.
- (vii). Helps to safeguard environment and assists in complying with local regional and national laws and regulations, with the company's policy and with the environmental standard

II. METHODS AND MATERIAL

2.1 Environmental Audit: Indian Scenario

Industrial pollution in our country is on increase and is creating a high risk environment. Various/legislations/viz The water (Prevention & Control of pollution) Act 1974, the Air (Prevention & Control of Pollution) Act 1981 and the Environment Protection Act 1986 have come into force and organizations created to combat pollution. Gone are the days when industrialization means profit-making and environment was grossly neglected. It is being realized that industry and environment should go hand in hand so as to achieve sustainable development. Also over the years awareness has brought in realization to consider environmental protection a bare necessity. Yet, the investments for such a protection are still considered a liability by many a industrialists mainly due to lack of up-to-date scientific practices of environmental factors at par with production helps in minimizing material losses and also in reduction of liabilities in the long run.

The growing environmental pollution and the complexity of this problem with increasing risks from the regulatory controls needs an effective management tool so as to prevent pollution and to make pollution control programmes cost effective and feasible.

Environmental audit' is a technique being introduced for integrating the interest of the industry and the environment so that these could be mutually supportive. This technique is basically a part of industry's internal procedures in meeting their responsibilities towards better environment. Also the policy statement for abatement of pollution by the Government of India provides for submission of environmental statement by all concerned industries, which would subsequently evolve into an environmental audit. A notification under the Environment (Protection) Rules, 1986 has been issued on April 22, 1993, requiring industries to submit an environmental statement for the financial year ending on March 31 in Form V to the concerned State pollution Control Boards on or before September 30 every year beginning 1993. The Department of Company Affairs also agreed to include this requirement as a part of the Director's Annual Report. The submission of an environmental statement is applicable to the following (i) Those who require consent under the Water (Prevention & Control of Pollution Act 1974 (ii) Those who require consent under the Air (Prevention & Control of Pollution) Act 1981. (iii) Those who require authorization under Hazardous wastes (Management & Handling) 1989.

2.2 Environmental audit procedure

The audit procedure includes broadly the following

- (i) Pre-audit activities.
- (ii) Activities at the site.
- (iii) Post audit activities.

The details of these activities and this procedure are discussed in detail below.

(i) Pre-audit activities

(A) Preliminary information Pre-audit activities include various preparatory works. Having chosen the industry to be audited, preliminary information on the industry are to be obtained through a questionnaire. The information include location of the industry with

surrounding land uses climatic conditions, products manufactured, raw materials used, details on water utilization, wastewater generation and disposal of gaseous emissions, solid waste/hazardous waste and organizational set up and policies of the company for environmental management. The preliminary information received on the industry should be reviewed to identify main areas of concern. Thereafter it is required to prepare and organize audit team and resources and allocate specific tasks to team members. Resources such as the sampling and monitoring equipment and laboratory facilities for analysis should be checked if available at site or else arrangements should be made for their availability through external sources such as private/government laboratories, loan from other industries. The visit programmer should then be intimated to the industry mentioning that the environmental audit should not be considered as a raid. The prior intimation to the industry helps them convince the senior management and staff at various levels of the purpose of audit and the cooperation they have to extend to the audit team. The staff should not feel that the audit would lead to surfacing problems and hence they would be subject to criticism by the management. They should be made clear about the purpose and objectives of the audit and how beneficial it would be for the industry. This would also increase employee's awareness towards waste reduction and promote input and support for the audit.

(B) Audit team Audit team should be carefully selected to cover various aspects of the audit. The team should include employee from production, quality control laboratory R&D, pollution control operations technical staff for monitoring and analysis of waste samples and environment and an environment specialist. The number of people may vary from 4 to 8 depending on the size and complexity of the facility being audited.

The team should be sufficiently detached to provide an independent view. The members should be so chooses that they would not hesitate bringing out even criticism, owing to obligations with Supervisor. Sometimes it is advantageous to include members from the headquarters of the industry.

It is important to have well defined and systematic procedures which are known and understood by all

concerned. The audit may take 3-10 days depending on the industry.

Effectiveness of audit is a direct result of the qualification, confidence training and proficiency of the personnel who conduct audits. The team should understand regulatory requirements, relevant waste control technologies and their operations and process. They should have capability to examine question, sample and analysis waste and interpret data. The management should be provided with a realistic assessment of environmental performance.

(ii) Activities at Site

(A) General

The activities at site include deriving material balance, identifying waste flow lines, monitoring of characteristics, evaluating performance of pollution control equipment/system, assessing environmental quality, holding discussions with the management and finally preparing the draft report. Interviews should be carried out with various cross sections of the staff engaged in production, laboratory/quality control, R & D, environment management, so as to understand different operation mechanisms. Having a fair idea on the manufacturing process reconnaissance surveys should be made to be familiar with layout of the plant and process operations, and to understand possible impact on the surrounding environment. Various activities to be carried out at site are discussed in detail in the following paragraphs.

(B) Material Balance

The entire manufacturing process of each product should be drawn into a process flow sheet representing various unit operations as blocks. A unit operation is a process where materials are input a function occurs and materials are output mostly in a different form state or composition.

The quantities of inputs and outputs at each unit operation should be worked out for the entire process and data incorporated in the process flow sheet. Discussions with the staff, perusal of the records of the company and the reconnaissance survey will help in arriving at these flow sheets. From these flow sheets

data sheets incorporating the raw material requirement, water consumption, wastewater and solid waste generation, and gaseous emissions should be worked out for each product manufactured.

The water balance sheet which shows areas of water usage and wastewater generation and their quantities is depicted.

(C) Waste flow

From the material balance the sources and quantities of generation of wastewater gaseous emissions and solid waste should be identified. The waste pre-treatment, final treatment and disposal path should be identified.

The production staff should be consulted as these people are likely to know about waste discharge points and about unplanned waste generations such as spills, leaks, washings, etc. Also visits to the process plants may disclose many other discharge points due to overflows, spills and other material handling practices which are not accounted and recorded. The quantities and sources should be accordingly finalized and a waste flow sheet prepared.

(D) Monitoring

The characteristics of the wastes as generated from the sources are important to understand its use for recycle, recovery of treatment. Also the performance of the treatment facilities is to be monitored so as to check their efficiencies and to modify or install additional equipment/ facility, if necessary. The surrounding environment groundwater, stream, soil, surrounding land uses residential agricultural and ambient air quality should be monitored to determine the impact due to the industry. With the above objectives sampling points should be identified and monitoring network established. Parameters to be analyzed should be determined from the material balances of the wastes generated.

The frequency of sampling should be fixed so as to cover hourly and daily variation in characteristics. It should also covers attest one full cycle of operations. More than one such set of data can result in more realistic results. Samples collected should be of grab type where characteristics do not vary significantly and of composite type where characteristics fluctuate. Grab

sampling means collection of sample in one pick while composite sampling requires collection of sample continuously or at predetermined frequency (1-hour, 2-hour, etc) and compositing it in proportion to the flow rate observed at each sampling time. The method of analysis of samples should be done as per standard procedure and by trained analysis.\

(E) Field Observations

The entire plant should be inspected thoroughly. The aspects of site layout, material handling, storage, drainage system, safety aspects, lapses/negligence in operations, and attitude of operators in process, waste treatment facilities, handling of scrap and wastes, instruction, color codes should be observed.

The attitude and technical capability of various staff including senior management should be observed as is very critical in achieving the goal of safer environment. The training requirements can be assessed based on these observations.

(F) Draft Report

After completing the above mentioned activities including determining material balance identifying waste flow monitoring and analysis of various samples and field observations, a draft report should be prepared with findings and possible recommendations.

The draft report should be presented before the senior management and various points should be thoroughly discussed. The Management should put forward their views. The participation of the Management and their acceptance of various observations and recommendations make the task of implementation meaningful.

(iii) Post Audit Activities

(A) Synthesis of Data

The requirement of various raw materials according to the mass balance of chemical equation involved in the manufacture of a product is called stoichiometric requirement. A comparison of these requirements with the actually used in the industry given an indication of excess usage of various raw materials. These excesses

may be presumed to be finding their way to air, water and soil thus causing pollution. Hence, it is important to reduce these excesses. The unit operation should be checked up to find out the cause of excess usage of the materials and accordingly modifications made. Norms should then be fixed for performance of each of the unit operations, for wastes generated from each of these unit operations, the production and environment staffs are simply to adhere to the norms. The "Environment Manager" thus can have a control over production as well as wastes generation too.

(B) Evaluation of Waste Treatment Facilities

Performance of various pre-treatment and final treatment facilities should be evaluated based on the analysis reports. If the treated wastewater, gaseous emissions and solid waste do not conform to the standards prescribed by the Pollution Control Board, reasons for the same should be diagnosed.

From the individual streams of wastewater recyclable and recoverable materials should be identified and provisions made for the same. All the avoidable wastes should be completely controlled and only the unavoidable allowed for discharge. The wastewater should be segregated based on the characteristics such as inorganic, organic, acidic, alkaline, easily biodegradable, not easily biodegradable, and toxic to streams, pretreatment units viz oil separator, neutralization, detoxification should be provided wherever required at the source so as to minimize cost of final treatment.

The wastewater of similar nature should be combined and common treatment facilities provided. This would be efficient and economical. Many a times it is observed that inorganic wastes and non-biodegradable wastes are treated in biological treatment plants which on the contrary render biological treatment ineffective. Toxic wastes should be detoxified before treating in biological treatment plant. Highly toxic wastes may be isolated and incinerated. The rate of wastewater flow and polluted loads to the effluent treatment plant (ETP) should be properly regulated to keep off shock loads to micro-organisms. The designed criteria and the actual operating conditions of various treatment units should be compared and norms fixed for the operation of these units.

Similarly the problems related to gaseous emission and solid waste generation may be identified. Recommendations for the best practicable waste management systems should be formulated.

The environment division of the industry should have an environment specialist to look into matters related to pollution control and evolve norms for resource conservation/waste minimization vis a vis process control. Besides, he should also evolve norms for optimal utilization of resources and performance of various pollution control systems. The members of this division and the operators of the treatment facilities should be well trained.

To oversee the implementation of the measures for pollution control and the overall management of environment, there should be a Peer group comprising members from production, quality control/laboratory, R&D and waste treatment divisions, the top management and an environment specialist.

(C) Final Report

Various aspects discussed above should be compiled and final report prepared along with recommendations. The final report may if necessary be sent to the top management for comments so as to make further modifications.

(D) Action Plans

The recommendations include measures for best practicable environmental management. If the annual burden that is the annualized capital cost of the pollution control measures and their operating cost for the implementation of all the recommendations is high and the investment not feasible for the industry then these recommendations, should be implemented in phases. Priorities should be fixed and action plans with time frame should be formulated.

(E) Follow-up Actions

Follow-up actions should be taken to check the progress of implementation of recommendations. The environment division of the industry should meet the other divisional heads periodically to review the progress.^[3]

III. RESULTS AND DISCUSSION

- Make auditing of material used, different exhaust, solid waste etc.
- Ground water characteristics & waste water characteristics should be included in the report
- Figures showing in variation of characteristics should be drawn
- Characteristics of each treatment units and efficiency of each treatment unit should be done separately.

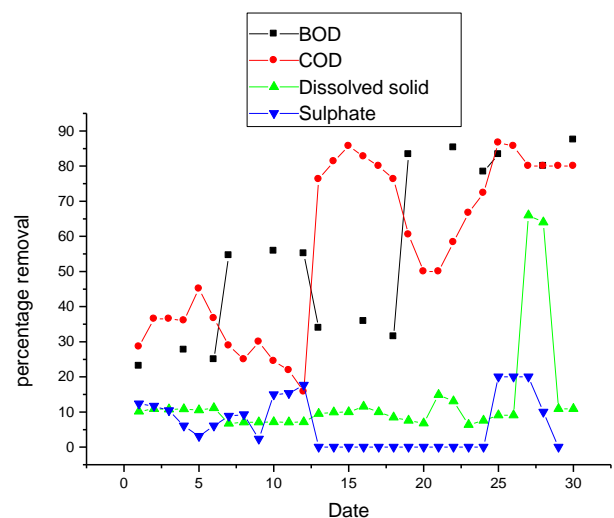


Figure 1: Efficiency against characteristics

IV. CONCLUSION

- 1) Correlation coefficient between the analyzed parameters has to be finding out.
- 2) Positive relationship between any substance for ground water & waste water has to be observed considering the limit $+0.67$ & (-0.67) also.
- 3) Efficiency of each unit should be calculated separately..
- 4) Condensate water, cooling, make up water, boiler expansion tank water are initially softened and necessary to recycle
- 5) The variation in effluent characteristics can be studied by varying the temperature of influent.
- 6) The influent flow rate can be varied to check the changes in performance.
- 7) Rate of flow to aeration tanks in the ETP should be kept constant to avoid shock loads.
- 8) Transfer of materials should be done through closed operations.

- 9) Evaporation losses from storage tanks should be checked by proper insulation and putting the suitable dip columns.
- 10) Water consumption is looking high, cleaner technology scenario needed to study.

V. REFERENCES

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