

13. AN APPROACH TO ENVIRONMENTAL AUDIT

13.1 PREAMBLE

Environmental auditing, the process of determining whether all or selected levels of an organisation are in compliance with regulatory requirements and internal policies and standards, has proven to be a powerful component of environmental management programmes. Today many companies are devoting a sizeable and increasing proportions of capital expenditure and managerial energies to programmes for pollution control, worker health and safety, product safety and loss prevention. In addition to using sophisticated environmental control technologies, many of these corporations are also devoting considerable attention to environmental auditing as one way of formalising some aspects of their environmental health and safety management system.

Auditing, in general, is a methodical examination involving analysis, tests, and confirmation of local procedures and practices whose goal is to verify whether they comply with legal requirements, internal policies and accepted practices. Auditing differs from assessment in that it requires collection and documentation of competent and sufficient evidence rather than an opinion based primarily on professional judgement.

The concept of environmental auditing is still relatively new. Consequently, there are still many interpretations of exactly what is meant by the term. The term describes the nature of environmental auditing and discusses the role of auditing in the overall environmental, health and safety management systems.

13.2 THE NATURE OF ENVIRONMENTAL AUDITING

Whatever the name used to describe an environmental auditing programme - audit, review, surveillance, survey, assessment, evaluation, or appraisal, the key point is that such programmes audit or review the environmental status of individual facilities.

One key difference between environmental audits and other types of audits is the existence or absence of standards. Few standards exist for environmental auditing. Financial audits have standards promulgated by the Financial Accounting Standards Board, and Food and Drug Administration audits use Good Manufacturing Practices. Another difference is the number of systems in place. The detailed, coordinated financial accounting systems that are in place can be subjected to a financial audit.

13.3 AUDITING AS A COMPONENT OF ENVIRONMENTAL MANAGEMENT

An environmental management system is the framework for or method of guiding an organisation to achieve and sustain performance in accordance with established goals and in response to constantly changing regulations, social, financial, economic, competitive pressures and environmental risks. When operating effectively, a corporate environmental management system provides management and the board of directors with the knowledge that:

- The corporation is in compliance with federal, state, and local environmental laws and regulations.

- Policies and procedures are clearly defined and promulgated throughout the organisation.
- Corporate risks resulting from environmental risks are being acknowledged and brought under control.
- The company has the right resources and staff for environmental work, is applying those resources, and is in control of its future.

Both, the formality and complexity of environmental management systems vary tremendously. Generally speaking, the more critical to the organisation a desired action or outcome becomes, the more appropriate or desirable a formal environmental management system may be. Regardless of formality, however, most environmental management systems consist of several interrelated functions.

- Planning : Setting goals, establishing policies, defining procedures, and establishing programme budgets.
- Organising : Establishing the organisational structure, delineating roles and responsibilities, creating position descriptions, establishing position qualifications, and training staff.
- Guiding & Coordinating, Motivating, Setting priorities & Directing : Developing and implementing effectively
- Communicating : Communication channels within corporate, within the division, and with external groups, including regulators, as appropriate.
- Controlling : Measuring results, acknowledging performance, diagnosing and Reviewing problems, taking corrective action and purposely seeking ways to learn from past mistakes and thereby creating improvements in the system.

Comparison of Different Audits

	Financial Auditing (1)	Pollution Control Auditing (2)
Basic purpose	To protect stockholders by showing that proper procedures are being employed to account for financial transactions and presume corporate assets.	To provide assurance to corporate management that environment and public care protected against acute or chronic hazards.
Group of interested parties	Board of directors, Stockholders, Corporate management, Investment community, Public.	Board of directors, Neighbour, General Public, Environment Consumers.

Nature of significant surprises	Misrepresentation of net worth, profits, assets, inventory or reserves, Unaccountable funds Embezzlement.	Damage to the environment Contamination of food chain Cronic or acute health effects.
Current status of auditing	Firmly established Widely accepted Separable accepted Auditing principles and standards Detailed procedures.	Evolving Growing acceptance of auditing concept, Few auditing standards or principles, Considerable diversity of auditing practices.

	Occupational Safety Auditing (3)	Occupational Health Auditing (4)
Basic purpose	To ensure corporate management that workers are protected from being hurt or killed in an accident or gradually harmed as a result of long term adverse working.	To assure corporate management that workers are protected from acute or chronic health hazards.
Group of interested parties	Board of directors, Employees and Unions, Families of Employees	Board of directors Employees, Families of Employees
Current status of auditing	Evolving Few auditing principles or standards, Long history of safety inspections, Good Records generally available, Auditing.	Embryonic Environmental auditing principles or standards, Sometimes combined with occupational safety.

	Product Safety Auditing (5)
Basic purpose	To provide assurance to corporate management that consumers are protected from being hurt or killed by the purchase or use of a product.
Group of interested parties	Board of Directors Consumers Public Interest groups Public interest.
Nature of significant surprises	Injury or death of consumer(s).
Current status of auditing	Embryonic considerable interest, however, relative diversity between auditing programmes Few auditing Principles or standards.

13.4 BASIC ENVIRONMENTAL MANAGEMENT PHILOSOPHIES

The purpose of an environmental auditing programme varies considerably with the overall philosophy or thrust of environmental management within a corporation.

Stage I: Problem Solving

In Stage I, a company's environmental management efforts can be characterised by the desire to "stay out of trouble". The principal focus is on solving the immediate and most recognised environmental problems and on avoiding unnecessary costs resulting from increased staff or capital expenditures. Here, environmental management systems tend to be nonformal, and the responsibility for environmental management for the most part, lies with lawyers, engineers and other specialists who tend to focus on specific plant problems and concerns. They tend to address only the "necessary" laws and regulation, those that leave no room for interpretation and the most significant hazards.

Few Stage I companies have a formal environmental audit effort. They frequently see little need to look for problems and often feel that an audit might simply add to costs. Where audit programmes do exist in stage I companies, they focus on assessing whether any major problems are present.

Stage II: Managing for Compliance

In stage II, a company builds a more formal system to management for the desired level or degree of compliance. This shift may stem from management's desire to better manage what is prescribed by the law or company policies and procedures. The principal focus of the environmental, health, and safety management system is on achieving and maintaining the desired level of compliance with various regulatory requirements. Here, environmental audit programmes tend to include not only an assessment of problems (and perhaps of good practices), but also determination and/or verification that compliance is being achieved.

State III: Managing for Environmental Assurance

In Stage III, the basic management philosophy is that the full range of potential environmental risks to the corporation and to the environment (not just those covered by the current regulatory framework) must be managed. Said another way, not only are compliance-related risks important to the corporation, but also other risks not yet adequately covered by regulatory requirements or existing external standards are important. The principal focus is on building an environmental management system that emphasises protecting internal resources and the external environment from injury by looking for and anticipating hazards as well as by managing the consequent risks. In stage III companies, the environmental audit programme often assesses the appropriateness of the environmental management system and verifies its effectiveness in addition to assessing problems and verifying compliance.

13.5 KEY STEPS TO ENVIRONMENTAL AUDIT

Despite the variety of audit programme objectives, some elements are common to most audit programmes. Each audit programme involves having a team of individuals to conduct a field assessment, gather information, analyse information, make judgements about the facility's environmental compliance status, and report audit findings. While not all audit programmes are designed precisely as outlined below, each makes some provision for including these steps in their audit process. What does vary among companies is the time and effort devoted to pre-audit, and post-audit activities.

13.6 PRE-AUDIT ACTIVITIES

The environmental audit process actually begins with a number of activities before the actual on-site audit takes place. These activities include the selection of the facilities to be audited, the schedule of the facilities to be audited, the selection of the audit team, and the development of an audit plan which includes defining the scope of the audit, selecting priority topics to include, modifying the audit protocols, and allocating audit team resources. They may also include an advance visit to the facility to gather background information and/or administer questionnaires.

13.7 ON-SITE ACTIVITIES

The actual on-site audit typically includes five basic steps.

1. Understanding Internal Management Systems and Procedures

The first step that the audit team takes is to develop an accurate understanding of the facility's internal environmental, health, and safety management system, the set of formal and informal actions taken by the facility to assist in regulating and directing its activities that can impact the environment. Internal controls, in its broadest sense, refers to both the management procedures and the equipment or engineered controls that affect environmental, health or safety performance. The auditor's understanding is usually gathered from multiple resources such as staff discussions, questionnaires, plant tours and in some cases, a limited amount of verification testing conducted to help confirm the auditor's initial understanding. The auditor usually records his or her understanding in a flow chart, narrative description, or some combination of the two in order to have a written description against which to audit.

It is important that an environmental auditor does not take too narrow view of what is or is not an internal management control system. The basic goal in this step is to understand the various ways in which the facility intends that its environmental concerns be managed. In almost all organisations, many aspects of the facility's internal environmental management systems (such as a complete description of the programme in place for National Pollutant Discharge Elimination System (NPDES) sampling, analysis, monitoring, and reporting) will not be documented or described in writing. However, selected management systems (such as a Spill Prevention Control and Countermeasure Plan (SPCC) may be documented in enough detail to provide both an understanding of the basic procedures and a bench mark against which the audit team can make comparisons to determine compliance status after the team has gained an accurate understanding of the facility's management approach and processes. Similarly, many companies have developed fairly extensive written hazardous waste management programmes that outline responsibilities and accountabilities, inspection procedures, training programmes and other aspects of the organization's internal control system for hazardous waste management. Such plans can be especially useful to the auditor in understanding the facility's intended management approach.

2. Assessing Strengths and Weaknesses

The second step in the on-site audit process involves assessing the strengths and weaknesses of those internal management procedures and systems identified and described in Step 1. Here, the auditor looks for indicators such as clearly defined responsibilities, an adequate system of authorisations, the awareness and capability of personnel, documentation and record keeping, and internal verification. This step provided the rationale for conducting

➤ **Set Priorities :**

Be realistic. Start with those areas where you can bring in improvements relatively quickly and with obvious cost benefits to the business. For example, you may be operating with a high energy use manufacturing process. By concentrating initially on energy conservation to cut consumption, either by good management or even by a change of process, the resultant energy savings will significantly cut the costs and will contribute to reducing the 'greenhouse effect'.

However, not all environmental projects are glamorous or large. Many small improvements will add upto significant benefits for the environment and the business. Success is the best encouragement and the audit team to move in and tackle more difficult problems.

13.10 AUDIT PREPARATION

Good preparation is essential. Having set objectives and defined the scope of the study, now turn attention to its management.

- ***Elect and Appoint the Audit Team*** : In smaller companies this may involve only one or two people but they should still be of sufficient seniority to carry through the whole process and should have good understanding of the scientific principles/technologies involved. Where possible the team should include both environmental experts and people familiar with the type of operation being audited. For 'corporate audits' it is advisable to have as many of the operating functions as practicable represented in the team, including purchasing, production, marketing and distribution.
- ***Decide on the Need for External Assistance*** : Where internal resources are lacking or familiarity needs to be avoided, or where you simply do not have the time to manage or carry out the audit yourself, you may wish to call in outside help. Where consultants are employed ideally use them as part of, or in support of, the overall audit team. Of course, you may want to bring in expertise to give an impartial overview or to handle detailed assessments of a particular activity of certain stages of the audit. Make sure in the contract that such consultants work to the requirements and especially that confidentiality is respected; it should be your decision as to which results, if any, might be made public or available to control authorities.
- ***Set Out the Terms of Reference of the Audit Team*** : All employees should be made aware of its objectives so that they can contribute appropriately.
- ***Agree Time Scales***: There should be clear time limits for conducting the audit and reporting to the Board.
- ***Gathering the Information*** : Draw up a simple procedure to assist the audit team and site or line management to obtain data in a common format. You may wish to conduct interviews on the basis of a questionnaire. Use the headings of the following section as your guide. Encourage operational managers to check their processes. Consideration should be given to the methods of assessment and where computer processing is to be employed, appropriate forms designed.

existing management framework is able to determine what, if any, actions are required. Some companies use a multiple or hierarchical reporting scheme. Whichever approach is used, an effective reporting process will communicate the audit results and identify issues to the appropriate persons within the Company.

13.8 POST-AUDIT ACTIVITIES

The audit process does not end at the conclusion of the on site audit. Typically, the audit team leader prepares a draft report of the findings and observations within two weeks of the on-site audit. This draft report may be reviewed by the Environmental Department, the Legal Department, facility being prepared, the action planning process is usually initiated. This process include determining potential solution and preparing recommendations, assigning responsibility for corrective action, and establishing time tables. The final step in the overall audit process commences with the follow up to the action plan to ensure that all deficiencies have, in fact, been corrected.

13.9 THE STEP BY STEP APPROACH TO ENVIRONMENTAL AUDITING

➤ Define What You Want to Achieve

From preliminary assessment you will have identified the environmentally sensitive areas of the business. You now need to assess where changes can be made, by providing answers to the following basic questions in relation to your environmental performance :

- What are we doing ?
- Can we do it better ?
- Can we do more ?
- Can we do it more cheaply ?

Ultimately, as far as one should seek to maximise the efficiency of the company and at the same time minimise the impact of all its activities on the environment.

➤ Set the Scope of the Audit :

Depending on the size of the operation, you may decide to audit the entire company (corporate audit) or to tackle it department by department (activity audit) or site by site (site audit). The principles remain the same, irrespective of your objectives.

➤ Define Your Baseline : You will need to know :

- a) What regulations and standards are relevant to your industry ?
Include those which are currently in force as well as those which are in the pipeline. For this information start by asking the manager responsible within the company.
- b) What technological and product developments have occurred recently in your sector which could improve environmental performance ? For this, contact your technical department, trade association and the technical press. Exchange experiences through trade associations.

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- **Identify Target Sources of Information** : E.g. individual factory sites or operating departments suppliers of raw materials, distribution companies, waste management contractors, etc.
 - Brief the staff in the target sectors and where ‘whole site’ audits are to be conducted by personal visits of the team, ensure prior cooperation of the staff involved.
 - Where questionnaires are sent out these should be accompanied by a brief statement of the objectives and include a fixed time scale for their return.
 - Introduce a suggestion scheme for your employees to provide a constant supply of ideas – and rewards. This is an excellent way of increasing employee awareness of environmental issues.

- **What to look for** : Be selective but ensure that information is obtained on all important aspects of the industry. Company management structures include this an analysis of some or all of the following :
 - ◆ The overall company environment policy : How do you communicate about environmental matters with shareholders, employees, customers, neighbours, suppliers, local politicians and control authorities? Examples would be – internal notice boards, newsletters, liaison committees, local press, annual report, etc.
 - ◆ Staff training and participation : Do you have a system for informing your employees about improving your company’s environmental performance? e.g. through training programmes, suggestion schemes, performance targets, operational and maintenance schedules. Many of these may have an added advantage of increasing employee awareness of environmental issues in their everyday lives.
 - ◆ Accidents and emergencies : Do you have adequate contingency plans for dealing with accidents and emergencies and, in the event of their happening, for communicating with employees, neighbours, the press, etc.?
 - ◆ Operational factors : Examples of specific topics are :
 - Permits : All are planning and operating permits and the conditions being complied with e.g. noise limits landscaping, use of authorised routes for access.
 - Raw materials types and sources : Are there alternatives which could be more environmentally acceptable and even cheaper? Could you modify raw material specifications without unduly affecting product quality? Could recycled materials be used?
 - Process Technology : Is it the most practicable? Have you conducted ‘mass balance assessment’ of production processes? Are there modifications or alternative processes which could be introduced to improve efficiency, productivity and lessen or eliminate environmental impact?
 - Products : What are the environmental impacts of your products and services? Consider the design, materials of construction, packaging, recyclability and post-consumer effects.

- Energy Use : Are your electricity, steam and water metered at the major points of use and targets set to reduce their usage? Are you making full use of alternative energy sources e.g. combined heat and power, landfill gas, waste derived fuel, solar and wind energy? Are energy conservation systems adequate? Are building and plant properly insulated? Could savings be made by reviewing general building heating and lighting systems?
- Waste : How and where is waste of all types generated? Can it be minimised/eliminated/recycled? Where production of waste is unavoidable, would it provide a suitable raw material for another organisation, either business or voluntary group? Are you losing recycling opportunities or increasing disposal costs by not segregating different types of waste? Who removes your waste, is it carried land disposed of responsibly?
- Recycling : Consider opportunities for using recycled materials at all stages of the business. Could you use redundant post-consumer products?
- Water Use : Look at all the discharges, including air, water, noise, etc. Are process controls and management systems adequate to ensure compliance with current legislation and your future objectives as well as to avoid complaints? Remember monitoring process more effectively.
- Site Tidiness : Are there sufficient measures for eliminating litter and general sources of untidiness inside company buildings, throughout the site and the immediate surroundings? Can steps be taken to improve the appearance of the site by landscaping? There may be grants available or local authority and voluntary organisations which could collaborate on projects of this type to bring benefit to the whole community.
- Transport : Are you using the most efficient and environmentally sound systems for transporting your goods and materials? Would alternative systems make less demands on the environment? Similarly, do staff travelling on business use the most efficient system or merely the most 'convenient'? Would use of public transport bring cost savings without significantly increasing travelling times? Do you encourage staff to travel to work by public transport and could you increase availability of communal transport by providing additional company funded services?

These are the major issues, which apply to most business. There may be other important areas to be included depending on the exact nature of your operation.

13.11 ASSESSMENT

- Any assessment of the data gathered should be factual and objective, not subjective. Where insufficient data are available, further requests or visits should be made.
- Aim to present data in a form which can be easily understood and from which clear conclusions may be drawn.
- Where appropriate, possible conclusions should be discussed with personnel directly concerned with that operation as a part of an interim procedure, before inclusion in the final report.

13.12 REPORTING

- Where significant defects are identified, they should be reported immediately to the Chief Executive to ensure that quick action can be taken.
- The main findings of the audit should be presented to the Board as an 'executive summary' with clear recommendations for action.
- Recommendations should include an estimation of their cost, resource needs and optimum time of introduction and also when the next review should be made.
- The report and its recommendations should be agreed by the Board and have its approval for implementation.

13.13 IMPLEMENTATION

- Incorporate the decisions on necessary remedial actions into corporate policy as an agreed Action Plan. This should be published internally as appropriate and all employees made aware of the implications in their everyday working practices.
- Include in the Action Plan time scales for completion of specific actions.

13.14 MONITORING AND FOLLOW UP

- Establish a monitoring procedure, which forms a part of the continuous process of management control of every aspect of the business.
- Periodically check specific areas to ensure compliance with agreed procedures and controls. Include external operations where appropriate.
- Management systems should be subjected to periodic reviews to ensure that they meet current needs for controlling operations. These needs will change in the light of new demands for environmental safeguards.

13.15 THE ENVIRONMENT AUDIT ACTION PLAN – A SUMMARY

1. Set the objectives
Define what you want to achieve
Set the scope of the audit within the organisation
Define your baseline for regulations, standards and current technologies
Set priorities
2. Preparation
Select and appoint the audit team
Assess internal resources and the need for external assistance
Establish terms of reference of the audit
Set time scales

3. Data collection
 - Permits
 - Raw materials
 - Process technology
 - Products energy use
 - Wastes
 - Recycling
 - Water use
 - Discharges
 - Site tidiness
 - Transport

4. Reporting
 - Immediate action on significant defects
 - Board presentation
 - Recommend actions
 - Board approval

5. Implementation of the action plan
 - Remedial actions
 - Time scales
 - Monitoring results and follow up
 - Monitoring procedure
 - Periodic checks
 - Management System

13.16 ENERGY MANAGEMENT

The basic principle of energy management is to register energy consumption and compare it to an estimated energy budget. It is a continuous process which also includes control and maintenance, process adjustments, etc.

In order to obtain an estimate of efficiency of an industry, many industries have used specific energy consumption or energy key figures i.e. the energy consumption per kg or ton of production. The main activities that form the energy management is to make up an energy budget, record energy consumption and compare the energy budget to the energy consumption in all process operations. The energy management system can be described for an industry with four different and separated processes which include energy budget, instructions and procedures of the processes e.g. energy conservation and maintenance (O&M). The O&M staff records the relevant data and information concerning the process and then analysed and compared to the plans to have energy consumption/efficiency pattern. If efficiency of the processes is improved by energy conservation measures, the energy budget and O&M activities must also be suitably regulated and monitored. Energy consumption can be controlled by energy key figures for energy management. The analysis can be carried out based on weekly/monthly/yearly data. The monthly production data and the respective energy consumption in terms of fuel used are recorded for the purpose.

As an example, the monthly data of pulp production and the respective furnace oil consumption for a chemical plant was considered. The data on monthly pulp production and

the respective energy consumption are collected and energy key figures are computed. The recorded data is shown in graphical form in Figure 9 as pulp production v/s energy consumption.

Mathematical Consideration

The energy key figures are actually a mathematical description of the process, and they state that the energy consumption depends only on the production

$$E = (K_f) P$$

- Where E = Energy consumption (KJ)
- P = Production (Tonnes) and
- K_f = Energy key factor

The expression is a description of a straight line passing through origin. The energy balance for most thermal processes is

$$Q_i = Q_1 + Q_u + Q_{11} + Q_a$$

Where

- Q_i = Energy input to the process (energy consumption)
- Q₁ = Energy loss
- Q_u = Utilised energy in the process
- Q₁₁ = Extra energy loss depending on the mass flow in process.
- Q_a = Accumulated energy in the process equipment

For many of the stationary operating processes, the simple energy balance equation can be written as

$$Q_i = Q_1 + C_m$$

- Where Q₁ = Energy loss
- C_m = Utilised energy per unit of mass flow in the process

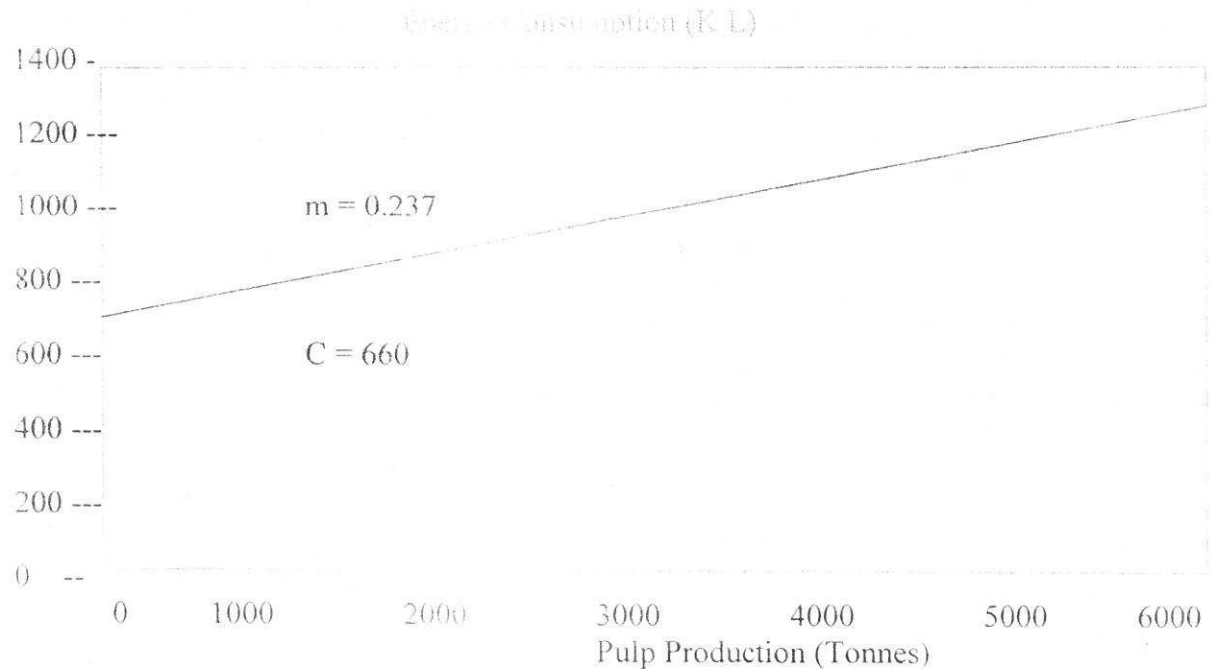


Figure 9 Energy Consumption V/s. Pulp Production (Best fit Line)

The energy balance is only true when the utilised is (linearly) dependent on the mass flow in the process. The equation is the mathematical expression for a straight line with the slope 'C' and intersection point Q1 with the axis of ordinates.

Figure 9 shows that how production and energy consumption depend upon each other. By adjusting a straight line to the data points (best fit line) it reveals that the line will not pass through origin. The straight line obtained from the monthly data is the energy budget and compares the recorded data with it. If the data points are above the line, something might have failed in the operation of the process. It should be noted that analysis based on monthly data will give less variation than analysis on weekly data. The key figures higher than the average energy budget key figure concludes that there is something wrong in the operation in that month as well. The points below the energy budget line shows that during these months the efficiency is very good.

If one carries out weekly analysis of energy consumption and respective production failure, irregularities in the operation can be traced. The key energy figures also indicate the over consumption/under consumption of fuel during different weeks.

From Figure-9, one can understand directly that monthly average heat loss is 660 KL and the energy utilisation is 0.237 KL/tonne of production. A change in the slope is mostly due to the efficiency of the utilised energy, that is, a change/improvement in the Q11.

On weekly basis, one can control the energy consumption by comparing it to the energy budget, and with other relevant data recorded on process operation, and equipment efficiency. We can arrive towards an explanation of why over consumption has arisen. Usually, it is very complicated to improve (decrease) the slope (Figure-9). The most easy way is to decrease the extra energy loss that depends on the mass flow in the process. It is less complicated to improve in order to reduce the energy loss as this is directly related to the standard of process, operation and maintenance. Energy conservation measures will have a direct effect on the energy loss.

The overall principles of energy management is to establish an energy budget, record the energy consumption for every product production and analyse the consumption comparing it to the budget.

Energy audit programme in a process chemical industry focuses on the usage of energy in different process sections and find out the energy conservation methods by improving the efficiency of operation. It also emphasis in identifying the energy key figures for energy consumption and product production. The energy key figure methodology is the preliminary approach to find out the energy consumption and reveals way and means for energy consumption.

13.17 ENVIRONMENTAL AUDIT PROGRAMME

Many managers view environmental problems solely on a cost basis. While making a profit as a primary concern, management must realise that environmental regulation is here to stay. These attitudes have been a barrier to energy and environmental solutions. Management must adopt new attitudes about waste including environmental problems.

- If you pollute now, you pay to clean up later. Its cheaper to pay now than later.
- If you don't generate waste, it doesn't have to be managed. Its cheaper to prevent waste at the source and save the cost of disposal.

To arrive at the above objectives, Environmental Audit Studies are conducted under the following major heads.

1. Water Audit
2. Material/Process Audit
3. Pollution Audit
4. Health and Safety Audit

13.18 WATER AUDIT

“Water Audit” studies are conducted aimed at evaluation of raw water intake facilities and performance of existing water and wastewater treatment plants, development of water balance scenario based on water consumption data in various process units, characterisation of waste waters and identification of reuse/recycle opportunities to reduce pollution load “at – source”.

The following areas have to be studied under water Audit.

- Palliation of raw water intake facilities.
- Performance of existing water and wastewater treatment plants.
- Development of water balance scenario based on water consumption data in various process units.
- Characterisation of wastewater.
- Identification of recycle/reuse opportunities.

13.19 MATERIAL AUDIT

“Material Audit” is a vital link in the entire material management chain and it serves to identify all the process streams in the facility and quantity material-use in different unit operations. Material audit conducted is based on in-depth process study, observations, discussions with process personnel and collection of data to develop material balance scenario. The salient steps involved are :

- a) Broad process-materials profile is drawn
- b) Material saving opportunities are examined at various stages in the process.
- c) Areas/process sections are identified for in-depth study and development of material balance diagram.
- d) Suggestions are drawn on the basis of material balance diagram developed and tests conducted.

13.20 GUIDELINES IN DEVELOPING MATERIAL BALANCE

Steps

1. Draw a diagram or a flow sheet for the problem.
2. Decide on the basis for solving the problem-time interval of one day.
3. Identify tie components
4. Select the boundaries of the region over which material balance will be made.

13.21 POLLUTION AUDIT

1. Ambient Air Quality monitoring is carried out to assess the status of existing air quality within the industrial complex.
2. In order to quantify the stack emissions, stack monitoring is carried out at steam boiler, and other existing units.
3. Noise levels are measured after identifying critical noisy zones.
4. Existing facilities for handling/disposal of solid/hazardous wastes are critically examined.

The critical areas to be considered in pollution Audit are :

- Ambient air quality monitoring within the industrial complex
- Work zone air quality monitoring
- Stack monitoring
- Noise levels at Critical Noise Zones
- Solid/Hazardous waste disposal facilities
- Checking all the effluent/emission levels against standards prescribed by competent authorities.

13.22 SAFETY AUDIT

A safety audit subjects each area of a process activity to a systematic critical examination with the object of minimising loss. The total safety system includes, management policy, attitudes to training, features of process design, layout and construction of plant, operating procedures, emergency plans, personnel protection standards, accident records, etc. Safety audit aims to disclose the strength and weakness and main areas of vulnerability or risk.

Safety audit may be defined as to advise and assist operational manager through provision of authoritative written assessment of ways in which they can avoid abnormal occurrences and obtain improved safety control systems within their operating plant.

Safety audit can be organised as given below :

- Audit team should rigorously examine relevant process, engineering and safety criteria.
- Operational standards and plant performance to confirm safe working conditions.
- Assessment in hazard control system on chemical and engineering reaction, i.e. bursting, relief valves, thermal cut out., etc.
- Investigation of safety support services i.e. laboratories, use of safety equipment, maintenance services, etc.
- Receipts, storage and transfer of intermediate chemicals.
- Explanation of operations on a flow chart with functions of equipment and major safety aspects.
- Point by point inspection with the help of the checklist.
- Finally formulation of report by audit team.

BIBLIOGRAPHY

A . MEHROTRA , etc. (2001), A – Z of Environmental Audit.

14. POLLUTION CONTROL BOARDS

14.1 PREAMBLE

The Water (Prevention and Control of Pollution) Act, 1974, vide Sec. 3, empowers the Central Government to constitute a Central Board for the prevention and control of water pollution in the Union Territories of India. Under the same Act, vide Sec. 4, the State Governments have also been empowered to constitute State Boards for the prevention and control of air pollution in the respective States. Accordingly, the Central Pollution Control Board and the State Pollution Control Boards have been constituted for the prevention and control of water and air pollution. Central Pollution Control Board acts under the directions of the Central Government. For a Union Territory, the Central Pollution Control Board exercises the powers and performs the functions of State Pollution Control. Every State Pollution Control Board shall be bound by the directions as the Central Board or the State Government may give to it. Members of Central/State Pollution Control Boards are nominated by Central/State Governments. The addresses of the State Pollution Control Boards and the Central Pollution Control Board are given at Annexure-15. The main functions of the Central Board and the State Boards are given below :

14.2 CONSTITUTION OF THE CENTRAL POLLUTION CONTROL BOARD

- (a) A full-time Chairman, being a person having special knowledge or practical experience in respect of matters relating to environmental protection or a person having knowledge and experience in administering institutions dealing with the matters aforesaid, to be nominated by the Central Government.
- (b) Such number of officials, not exceeding five to be nominated by the Central Government to represent that Government.
- (c) Such number of persons, not exceeding five, to be nominated by the Central Government, from amongst the members of the State Boards, of whom not exceeding two shall be from those referred to in CL (c) of sub-section (2) of Sec. 4.
- (d) Such number of officials, not exceeding five to be nominated by the Central Government to represent the interests of agriculture, fishery or industry or trade or any other interest which, in the opinion of the Central Government ought to be represented.
- (e) Two persons to represent the companies or corporations owned, controlled or managed by the Central Government, to be nominated by that Government.
- (f) A full-time member-secretary, possessing qualifications, knowledge and experience of scientific engineering or management aspects of pollution control to be appointed by the Central Government.

14.3 FUNCTIONS OF CENTRAL POLLUTION CONTROL BOARD

- (i) To advise the Central Government on any matter concerning the improvement of the quality of air and water and the prevention and control or abatement of air/water pollution.
- (ii) Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of air and water pollution.