Elearning Modules On Environmental Issues And Management For Leather Industry

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Abstract

The 21st century demands better and greener technologies, so there is a need to know the issues and concerns regarding environmental pollution in an industry. Developing an e-portal on environmental issues will help an organization to increase its efficiency in natural resource management and diminish wastes and emissions. This helps in increasing the organization's public image.An e learning portal is a website that offers learners or organizations consolidated access to learning and training resources from multiple sources. The portal created will be according to the norms put forward by SCORM (Sharable Content Object Reference Model). SCORM defines a specific way of constructing Learning Management Systems (LMS) so that they work well with other SCORM conformant systems.This portal focuses on the various principles of environmental management, its goals and the need for sustainable development, the policies and legal aspects of environmental management. It deals with the carbon footprints and an attempt to calculate the carbon footprint of various processes in the leather industry mainly focusing on chrome tanning and vegetable tanning processes. The portal gives an insight on the environmental auditing.The various environmental management techniques like environmental monitoring, environmental modeling, sensitivity analysis, GIS in environmental management, and eco mapping are discussed. A safety manual on leather processing is also included. Our attempts will serve as a knowledge resource for undergraduate students.

Keywords

E-portal, Environmental Management, Carbon Footprint Calculator, Environmental Audit, Environmental Impact Assessment, Tannery Management

1.0 Introduction

Society's level of concern about the environment today is reflected in almost daily reports in the news media about environmental issues. Developing an e-portal on environmental issues will help an organization to increase its efficiency in natural resource management and diminish wastes and emissions.

2.0 Materials and Methods:

Environmental Audit

As a response to growing concern for the environment, companies are increasingly reporting on their environmental performance. Society's concern led to the emergence of formal standards such as ISO 14001: Environmental management systems [1].There is also another type of audit known as the compliance audit. These audits are intended to review the site's/company's legal compliance status in an operational context. The concept of environmental auditing in industrial units in India was formally introduced in March 1992 with the overall objective being minimising consumption of resources and promoting use of clean technologies in industrial production to minimise generation of wastes.

Environmental Impact Assessment (EIA)

An environmental impact assessment is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. EIA is an exercise to be carried out before any project or major activity is undertaken to ensure that it will not in any way harm the environment on a short term or long term basis. Any developmental endeavour requires not only the analysis of the need of such a project, the monetary costs and benefits involved but most important, it requires a consideration and detailed assessment of the effect of a proposed development on the environment.

Environmental management

Environmental management is the "Measures and controls which are directed at environmental conservation, the rational and sustainable allocation and utilization of natural resources, the optimization of interrelations between society and the environment and the improvement of

human welfare for present and future generations."Environmental performance efforts at different levels:

1. Environmental Engineering
2. Pollution Prevention
3. Environmental Conscious Design and Manufacturing
4. Industrial Ecology
5. Sustainable Development

Environmental Life Cycle Assessment (LCA)

The LCA-methodology is the most extensive method for studying environmental impacts throughout a product's life cycle. It is now being standardised by the International Organisation of Standardisation. The main steps are Goal and scope definition, Inventory analysis, Impact assessment and Interpretation. According to goal and scope definition the application, depth and subject of the study, the functional unit and the system boundaries must be defined. In line with the defined goal and scope, interpretation is the phase of an LCA in which a synthesis is drawn from the findings of either the inventory analysis or the impact assessment, or both. The findings of this interpretation may form conclusions and recommendations to decision makers.

Environmental monitoring describes the processes and activities that need to take place to characterise and monitor the quality of the environment. Remote sensing and bio-monitoring are examples of environmental monitoring. Some of the best-known environmental management and environmental performance improvement tools are:

• Cleaner Production (CP)
• Environmental Accounting (Each)
• Life Cycle Assessment (LCA)
• Material, Energy and Toxic-analysis (MET)
• Material Input per Service Unit (MIPS)
• Environmental Auditing (EA)
• Environmental Performance Evaluation (EPE)
• Environmental Management Systems (EMS)

Environmental Issues in Leather Industry

About 130 different types of chemicals are used in leather manufacturing which ranges from common salt (Sodium Chloride) to very expensive Chrome Sulphate. The chrome tanning process is widely employed. Many chemicals are used to prepare hides for tanning and after performing their function these chemicals find their way into the environment. All three categories of waste, i.e. gaseous, liquid, and solid are generated from the tanneries.

The chemicals used in the leather industry can be divided into three broad categories [2]:

- Pre-tanning Chemicals
- Tanning Chemicals

- Finishing Chemicals

A good amount of these chemicals is discharged into wastewater. Chrome Sulphate is the basic tanning chemical. Apart from being expensive, Chrome Sulphate is also a serious pollutant. It is shown that that 50-150 liter water is used for conversion of one kg of raw skin into leather. Ground water is mainly used as processing water.

POLLUTANTS

All the three categories of waste solid, liquid, and gaseous, are emitted by the leather industry in the form of:

1. Wastewater
2. Solid Wastes
3. Air Emissions

The results of environmental auditing are described below:

Wastewater

Water is used as the carrier for chemicals to render the cleaning of raw hides and skins. The water after completion of the process is drained out in the same quantity as it was used in the process. Normally water consumption of 50 liter/kg is recommended for tanneries but it is found that tanneries generally consume more water and in some cases it is found to be as high as 150 liter/kg. Samples of water were taken from different processes of leather manufacturing and were analyzed. Tannery wastewater is highly polluted in terms of biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, Nitrogen, Sulphate, Sulphide, and Chromium.

Solid Wastes

The major solid wastes consist of dusted curing salt, wet trimmings, dry trimmings, wet shaving, buffing, etc. These wastes are generally separated at the source. During handling of raw skins, adhered dusted salt, which is contaminated with blood, hair, dirt and certain type of bacteria is removed and dumped. Trimmings are cuttings of edges of raw skins. Fleshing is the flesh material of the limed skins generated during fleshing operation. Chrome wet shaving is produced when skins are shaved for proper thickness after chrome tanning. The main problem with these wastes is their high Chromium content. The Chrome tanned waste contains Chromium in trivalent form but it was found that when the solid wastes are used in making poultry feed the Chromium is converted to hexavalent form which is carcinogenic. The mixing of this metal in poultry feed could produce serious human health problems. It is estimated that for a tannery producing on an average 10,000 kilograms of skins per day, a total of about 5,500 kilograms of solid waste would be produced per day.

Air Emissions

In tanneries air emissions are produced from the stacks of boilers and generators and during the processing of leather. Emissions from the stacks are well within the limits and pose no serious environmental impact. But hydrogen Sulphide and ammonia gases which are emitted during different processes are a health hazard for the workers.

The wastewater is a serious threat to the environment. Tanneries are disposing of their wastewater into drains, which finally find its way into natural water bodies. Therefore major environmental problems are linked with the wastewater of tanneries. The pH of directly discharged tannery effluent varies between 3.5 and 13.5. Water with a low pH is corrosive to water-carrying systems and can lead to metal dissolving in the water. The high pH water can cause scaling in the sewers. Also large fluctuation in the pH value is detrimental to some aquatic species.

Pollution Prevention Assessment:

Pollution prevention is the process of reducing or preventing pollution at the source through changes in production, operation, and materials use. Pollution prevention can result in reduced materials usage, pollution control, and liability costs. It will also help protect the environment and may reduce risks to worker health and safety.

A Pollution Prevention Assessment is the first step toward identifying a site's pollution risks. It also helps ensure that a site complies with the industrial or trade processes provisions of the regional plan. There are a wide range of benefits such as increased efficiencies, reduced risk of spills, reduced risks of abatement notices, fines or prosecution reduced liability if site soils become polluted.

Occupational Safety and Health in the Tanning Industry[3]

Manufacture of leather from hides and skins involves use of a large number and variety of chemicals, machinery and equipment. The problem areas pertaining to occupational safety and health of workers have been identified with specific reference to potential sources of hazards, which are chemicals at work, machines and workplace parameters.
The general occupational problems in a leather processing unit include Chemical poisoning, Skin afflictions, Bronchitis, Carcinogens, Brucellosis and Leptospirosis.

Noxious smelling chemicals used include Sulphides, Fatty Acids, Solvents, Lacquers, Formaldehyde, Finishing chemicals and old lime liquor containing Ammonia and Sodium sulphide.

Remedial measures

Several remedial measures are suggested to lessen the environmental impact of tanneries. They include staff training, protective gear like masks, proper waste disposal, effluent treatment and improvement of production methods.

Wastewater should be treated at two levels: primary and secondary. Primary treatment is consists of mechanical screening, pH levelling, coagulation and flocculation, and sedimentation. Secondary treatment uses biological processes to remove most of the organic matter form the wastewater.

Carbon Footprint Calculator

A carbon footprint has historically been defined as "the total set of greenhouse gas (GHG) emissions caused by an organization, event, product or person." A more practicable definition: "A measure of the total amount of carbon dioxide (CO2) and methane (CH4) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest."

We developed a carbon footprint calculator and it calculates the carbon footprint of the various steps involved in the tanning process. Table 2.0, 3.0 are used for the Carbon footprint calculation. The calculator uses HTML forms to input the data from the user and displays the result in a separate HTML page. The calculations are done using PHP, by taking the data entered using POST method and then the required calculations are performed and the net carbon footprint is printed out.

Kyoto gas	GWP*	Example sources
Carbon dioxide (CO_2)	1	Burning fossil fuels
Methane (CH_4)	23	Cattle, landfill sites, leaks from disused mines, burning fossil fuels.
Nitrous oxide (N_2O)	296	Emissions from fertilised soils, burning fossil fuels.
Sulphur Hexafluoride (SF_6)	22,200	Leaks from electrical and electronics industries.
Perfluorocarbons (PFCs)	4,800 – 9,200	Electronics industries, fire extinguishers
Hydrofluorocarbons (HFCs)	12-12,000	Leaks from air conditioning and refrigeration systems. LPG storage.

*Note: the 'global warming potential' of a gas is its relative potential contribution to climate change over a 100 year period, where CO_2 = 1 Source: IPCC (2001)

Table 1.0 Global Warming Potential of Gases

Process step	Amount of water	pH	COD	N_{kj}	Cr
	(m^3/ton)	-	kg COD/m^3	kg N/m^3	kg Cr/m^3
Pretanning:					
Soaking	4-6	6-9	30-40	1-1.5	-
Unhairing, liming	5-9	12-13	40-60	3-5	-
Fleshing	1-3	-	-	-	-
Deliming, bating	5-7	8.5-9	5-8	3.5-4	-
Tanning:					
Chrome tanning	0.5-1	3.8-4	2-3	0.3-0.6	0.5-5
Pressing	0.4-0.6	3.6-4.5	1.2-1.8	0.11-0.22	0.5-5
Neutralisation	1-1.5	4.5-4.7	2.5-3	0.5-0.8	0-1.0
Dyeing,Fatliquor	3-4.5	3.8-4.5	5-6	0.2-0.3	0-5.0
Finishing:					
Drying	3-6				
Finishing	1-2				
Cleaning	5				

Table 2.0 Look up table for CF calculation due to tannin processes

fuel type	unit	CO2 emitted per unit
Petrol	1 gallon (UK)	10.4 kg
Petrol	1 liter	2.3 kg
Gasoline	1 gallon (USA)	8.7 kg
Gasoline	1 liter	2.3 kg
Diesel	1 gallon (UK)	12.2 kg
Diesel	1 gallon (USA)	9.95 kg
Diesel	1 liter	2.7 kg
Oil (heating)	1 gallon (UK)	13.6 kg
Oil (heating)	1 gallon (USA)	11.26 kg
Oil (heating)	1 liter	3 kg

Table 3.0 Look up table for CF calculation for transport related

Results

environmental portal (Fig 1.0) is built with all the above topics. It calculates the carbon footprint of the various steps involved in the tanning process. The calculator uses HTML forms to input the data from the user and displays the result in a separate HTML page. The calculations are done using PHP, by taking the data entered using POST method and then the required calculations are performed and the net carbon footprint is printed out.

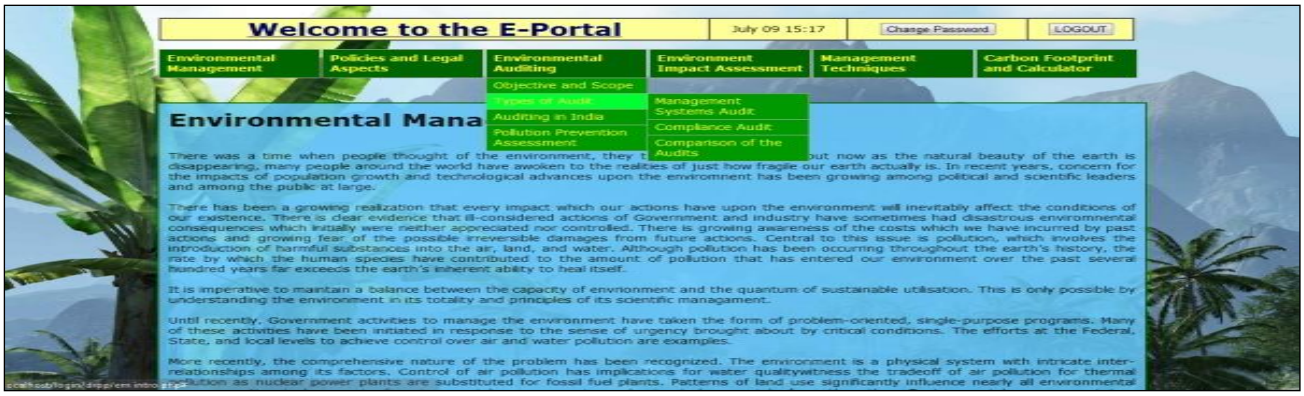

Fig 1.0 Environmental Portal

Let us assume the following condition:

Mileage of Vehicle: 13 (Petrol)
Distance travelled: 12 KM
Tons of raw hide to be processed: 24
The table 4.0 lists the Carbon dioxide emission due to vehicular and the COD (Kg/M^3) during pre-tan, tanning and finishing is calculated using the above listed look up tables.

Vehicular Carbon Dioxide Emission	22.23333 kg
Solid waste during pre-tanning process	270 kg
Solid waste during tanning process	225 kg
Solid waste during finishing process	34 kg
COD during pre-tanning soaking process	175 kg
COD during pre-tanning liming process	375 kg
COD during pre-tanning fleshing process	0 kg
COD during pre-tanning de-liming process	39 kg
COD during pre-tanning process	589 kg
COD during tanning - chrome tanning process	1.875 kg
COD during tanning - pressing process	.75 kg
COD during tanning - neutralisation process	3.4375 kg
COD during tanning - painting, fatting process	26.6875 kg
COD during tanning process	26.6875 kg
COD during finishing process	Zero
COD during complete tanning process	615.6875 kg

Table 4.0 COD during pretan,tan and post tanning

Conclusion:

In recent years the awareness towards improving the quality of environment has increased substantially and all efforts are being made at different levels to minimize environmental pollution and thus help in improving the quality of life. The balanced eco-system must be preserved. Different nations should co-operate in controlling the air, water and soil pollution, in protecting the marine atmosphere, and in improving the environmental conditions of human settlements. This work can be extended to online monitoring and data gathering of pollutants and remedial measures to bring in the pollutant levels within the prescribed limit by the governing body for each tannery.This along with GIS can serve as an IT tool to make the leather industries cleaner and make the environment a better place. The values indicated in this paper are only indicative and suggest the method of calculation .

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