

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 5, May 2019

HOZOP Study in Paper and Pulp Industry

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ABSTRACT: Pulp and paper making process requires large amount of water, energy, chemicals and wood resources, and produces various wastes and emissions that must be controlled or treated. The aim of the study is to determine the economic impacts of pollution in pulp and paper industry and to investigate the root causes of pollution and develop a model that can bring down pollution in pulp and paper industry. A detailed review related with Pollution in chemical Industries especially in Pulp and Paper Industry was conducted. After Identifying major pollutants in paper industry and impacts in human health as well as plant machineries from literature review, the next step was to prove the existence of pollution scientifically using statistical tools and techniques. It was identified that pollution not only has a direct impact on employee health but also has an effect on the management of the company economically. Also pollutant atmosphere in highly chemical exposed areas may lead to inefficient utilization of working hours. At the heart of this approach is to calculate the cost of pollution as there were no studies conducted in India related to cost of pollution in Chemical industries. By using the software package SPSS, the statistical part of this research was carried out in future. The phase comprises of the frequency analysis of the variables to chi-square test. The descriptive statistics computed for the study are first presented in an outline of the characteristics of the sample with regards to the variables included in the study. Thereafter the analysis of the constructs relevant to the study, which is the effect of pollution on employee health, employee absenteeism and inefficient utilization of working hours are presented with the aid of inferential statistical procedures. The study was concluded on the basis of the obtained results.

KEYWORDS: Pulp and Paper, Control Pollution, SPSS.

I. INTRODUCTION

Chemical industries have come under increasing criticism over the last two decades for increasing air pollution and soil/groundwater contamination. Pulp and papermaking requires large inputs of water, energy, chemicals, and wood resources, and produces various wastes and emissions that must be controlled or treated. The industry is

taking steps to minimize environmental impacts by increasing the use of recycled paper, improving energy efficiency, and making capital investments for effective compliance with regulations.

Pulp and papermaking processes have traditionally consumed large amounts of water, generating wastewater that can contain chlorinated compounds, volatile organics, sulphur compounds, and other chemicals. The pulp and paper industry also generates more than 12 million tons per year of solid waste, consisting primarily of de-watered sludge. The standard treatment for these wastes in the past was to deposit them in landfills. Today they are more often being handled by incineration, conversion to useful products, and land application. Most solid waste from mills, such as sludge from deinking plants, is non-hazardous and requires no special handling.

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Role of Industrial Engineers In Pollution Prevention

This section reviews the potential role of industrial Engineers in preventing pollution caused by manufacturing processes. It outlines what is currently being done in order to control pollution within systems and how there needs to be a focus on how to prevent it at the source. The paper ends with proposed solutions in applying industrial engineering concepts to minimize waste by-products and leaves the door open to the creation of standardized programs that would benefit many businesses worldwide.

II. NEED AND SIGNIFICANCE OF THE STUDY

The topic is significant in this era of green sustainability. The topic looks in to the economic effects of pollution considering the huge expenses for employee health care, plant maintenance and for the surrounding villages. There are only a very few studies showing the impact of air pollution on the entrepreneur of the industry.

Solid and hazardous wastes

Wastewater and consequently solid wastes are the main environmental problem of the pulp and paper mills because this industry has a very water intensive production processes Solid wastes from pulp and paper industries are mainly treatment sludge, lime mud, lime slacker grits, green liquor dregs, boiler and furnace ash, scrubber sludge, and wood processing residuals.

Waste minimization

Modern waste minimization approach is by two means. This first way is chemical recovery and recycling. This system especially in chemical pulping process significantly reduces pollutants and additionally economical return is another important aspect. Chemical recovery is necessary because of the basic economic viability of the Kraft process. According to EPA, all Kraft pulp mills worldwide use chemical recovery systems. Additionally, scrubber system particulate "baghouses" or electrostatic precipitators (ESPs) are often mill air pollution control components. The second way to minimize waste production from pulp and paper mills is the application of best available techniques (BAT) according to the Integrated Pollution, Prevention and Control (IPPC) Regulation. An effective waste minimization method reduces cost, liability, regulatory burdens of hazardous waste management. Furthermore, hazardous waste generation can be reduced by waste management methods including: -

- Production, planning and sequencing
- process adjustment and/or modification
- raw material replacement
- housekeeping waste segregation and separation
- Recycling

Environmental issues

Paper mills are responsible for many environmental problems. The production of paper and pulp with the help of wood produces a large volume of waste. The production of this waste badly affects the environment. The waste produced in paper and pulp industries are termed as paper pollution. It contributes to the air, water and land pollution. The paper which is discarded is major component of landfill sites.

Deforestation

Due to rise in the consumption of papers day by day, the numbers of trees are decreasing. It is calculated that worldwide, the use of paper is raised by 400% in last 40 years. Due to decrease in the number of trees, the percentage of CO₂ is going to increase in atmospheric air which is responsible for global warming and causes change in climatic conditions.

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Water pollution

The waste discharge from paper and pulp industries includes two categories of pollutants i.e. suspended particles and dissolves organic compounds. When these particles come in contact with water resources i.e. rivers lakes then causes water pollution. The suspended matter present in the paper mills is in the form of the particulates of wood, fibber, filling and material coating. Whereas the organic pollutants when acted by microorganisms are converted into inorganic compounds and reduces the oxygen level.

Waste disposal and recycling problems

In waste recycling materials, 40% of the total waste is paper waste which contributes to 71.6 million tons of waste per year. The waste disposal is the main problem and hence causes land pollution. Also under ground water is get effected by land filling of wastes of paper mills.

There are three classes of the paper wastes i.e.

- Mill broke, pre-consumer waste and postconsumer waste which can be used as a feedstock for producing recycled paper.
 - Mill broke includes basically paper trimmings and other paper scrap by the paper manufacturer and can be recycled.
 - Pre-consumer waste includes the waste that is removed before the use for the consumer.
 - Post-consumer waste includes the waste after the consumer use i.e. old magazines, old newspapers and note pads.
- Another problem with wood pulp recycling is the fibers which are discarded becomes too small and weak after they get 4 or 5 times recycled and then they are not required in making paper. Also, the ink used for printing of paper has many environmental issues. The three important components of ink are volatile organic compounds, heavy metals and non-renewable oils. These deinking paper pulp when recycled results in waste slurry which goes to land fill and causes land pollution.

Evolution of harmful gases and chemicals

In making of wood pulp, sulphur based products are used. They release sulphur dioxide during combustion. Sulphur dioxide that is produced is water soluble and even a main cause of acid rain.

Other gases released from paper mills are the following

- Carbon monoxide
- Ammonia
- Nitrogen oxide
- Mercury
- Nitrates
- Methanol
- Benzene
- Volatile organic compounds or chloroform

Bleaching process

The bleaching process of chemical pulps causes major environmental destruction by the organic materials release in the water bodies. The paper and pulp industries are normally situated closer to the large water bodies as they use water for several processes in industries

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III. RESEARCH METHODOLOGIES

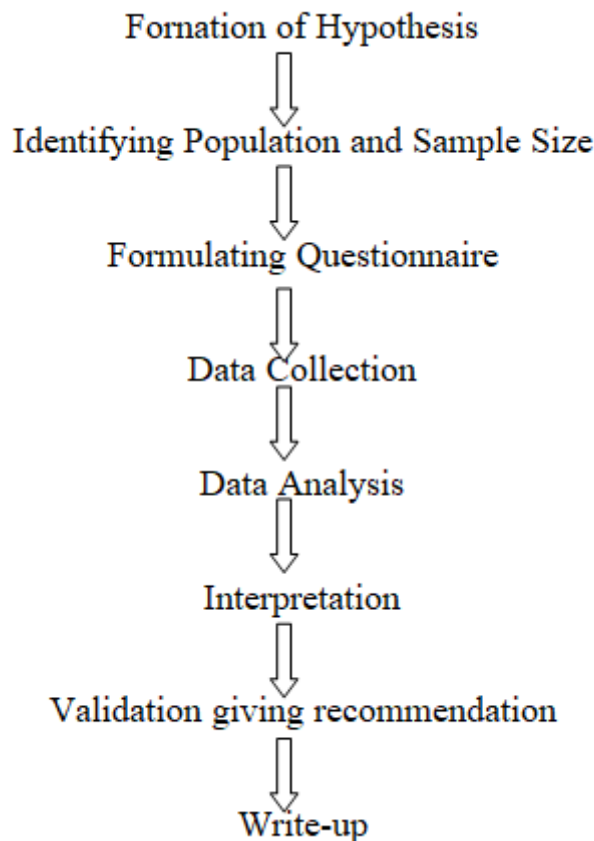


Figure 1 Research Methodology

The overall goal of the project proposed herein is to identify the various air and water pollutants affecting the health of employees in Pulp and Paper industry. The purpose, objectives, scope and methodology of the study was identified clearly.

Hypothesis Testing

Hypotheses are formulated to verify the effect of pollution of Employees health, employee absenteeism and inefficient utilization of working hours.

Cost of Pollution

This section discusses the economic impact of pollution on the management of Pulp and Paper Industry. The first phase of the research proves the existence of pollution in the industry with its impacts on employee health, employee absenteeism and its impacts on the utilization of working hours.

- Maintenance Cost
- Cost of Pollution due to Inefficient Utilization of working Hours
- Cost of Pollution due to Employee Absenteeism

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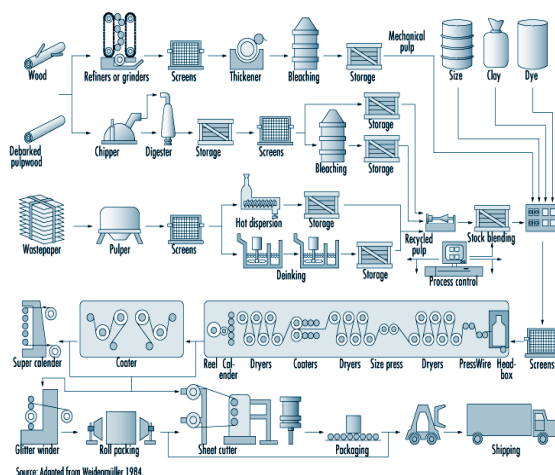


Figure 2 Modern pulp and paper mill complex situated on a coastal waterway

IV. PULPS AND PAPER PRODUCTION

The production of paper from wood pulp. Logs are first debarked. Stripped bark is then used for fuel or to enrich soil. Wood can be broken down into fibers by mechanical or chemical methods. The mechanical pulping process uses considerable amounts of electricity (2,000 kWh/ton of pulp) but has a high yield (about 90 percent). The wood requirements for mechanical pulping are less than in chemical pulping. Most of the electrical energy that goes into the refiner is liberated as steam, which is subsequently used to dry the paper.

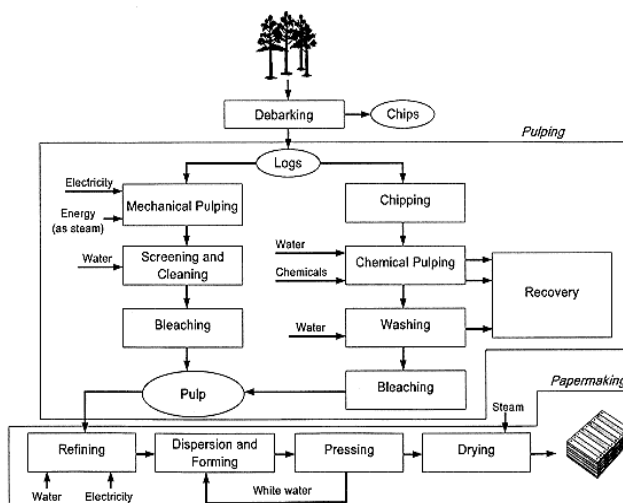


Figure 3 Pulp production and paper making

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V. PAPER PRODUCTIONS RECYCLING

To recycle fiber, the paper is slurred in water and then run through cleaning and screening operations to remove such contaminants as wire, plastics, paper clips, and staples. In some mills the pulp is also deinked. In mills without deinking processes, excess paper-machine white water is sufficient to run the recycle mill. With deinking, fresh water makeup is required. The volume of fresh water makeup can vary widely, from 1,500 gal/ton of pulp to almost 20,000 gal/ton of pulp, depending on the deinking system.

Reclamation and Recycling

About 80-90% reduction in pollution load and 70 % reduction in effluent volume in chipper house can be achieved through effluent reuse. Similarly recirculation in multi-stage bleaching operation reduces pollution loads by 30- 80%. Effective fiber recovery from paper machine can reduce the pollution load by 20- 60% and volume by 60-80% (Birdie and Birdie, 2008). Primary

Treatment

It includes coagulation & flocculation, floatation and sedimentation. A well designed clarifier is considered most suitable and is expected to settle 90-95 % of the settle able solids and removes 25-30% of BOD. Clarifier should be designed for an overflow rate of 30 cubic meters per square meter per day and a detention time of three hours. Settled sludge is regularly pumped out at about 3% solid consistency.

Biological Treatment

Depending upon the conditions at site and degree of treatment required for final disposal of effluents, biological treatment methods that can be adopted include; oxidation pond, aeration lagoon, trickling filter with secondary clarifier and activated sludge process.

VI. CONCLUSIONS

The Pollution in Chemical industries especially Pulp and Paper Industry was studied in detail. Various diseases associated with chemical pollutions have been studied during the research work. The impact of pollution on the employees for the company was studied in detail. The pollution has a major role in employee absenteeism, and inefficient utilization of working hours etc. From the company records it was found that a considerable amount is spending to meet the health requirements of the employees.

FUTURE ENHANCEMENT

By using the software package SPSS, the statistical part of this research was carried out. The phase comprises of the frequency analysis of the variables to chi-square test .The descriptive statistics computed for the study are first presented in an outline of the characteristics of the sample with regards to the variables included in the study. Thereafter the analysis of the constructs relevant to the study, which is the effect of pollution on employee health, employee absenteeism and inefficient utilization of working hours are presented with the aid of inferential statistical procedures. The study was concluded on the basis of the obtained results.

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ISSN(Online): 2319-8753
ISSN(Print): 2347-6710

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