ENVIRONMENTAL POLLUTION RISK ANALYSIS AND MANAGEMENT IN TEXTILE INDUSTRY: A PREVENTIVE MECHANISM

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Abstract

The textile industry is major contributor in many nations in terms of economies and employment. The small and large scale operations in this textile sector though contribute much to the economy also cause hazardous effect to environment. The textile manufacturing processes involve large consumption of water, energy and various chemicals which will generate waste at the end or as a by-product. The major problem with regard to water usage is the untreated effluents which are discharged directly into nearby water bodies. Not only water bodies cause environmental damage other factors like gas emissions, excessive odors etc are also considered to be pollutants. Environmental pollution risk analysis and risk management in textile industry is vital in order to prevent chemical disaster which may lead to terrible results. It is also important to maintain production level at the same time. This paper aims to identify and analyze the pollution due to water and air in a textile industry and steps to reduce the risk which arises due to pollution.

Keywords: Air pollution, dyes, environmental hazard, risk analysis, textile industry, water pollution

Introduction

Textile industry not only comprises large quantity of water for the process but also need various chemicals and dyeing agents for the process. When a manufacturing process starts there arise large quantity of waste in terms of water, energy and other chemical substances which will readily or indirectly affects the environment to a greater extent. The pollution created by this textile processing may be in the form of air, water or noise which is considered to be hazardous to health for the surroundings. Each time the manufacturing process varies according to the requirement of the customer so the waste generated varies each time depending up on the type of chemicals and raw materials used (Parvathi.C et.al, 2009). Pollution is considered to be the unwanted material into the environment. These residues may be unwanted or unprocessed raw materials, or they may be by-products. Though these pollutants are unavoidable they can be reduced to some extent and can be discharged

which will reduce the effect on environment. The pollution in a textile mill can be air pollution or water pollution or noise pollution. Among the three types water pollution is considered to be more hazardous. Because of scarcity of land many textile industries are located nearby households. So any minor disaster will ultimately cause greater damage to large population near and far the unit. According to United Nations Environment Programme (UNEP, 2010) every year 400-500 million tons of deadly chemicals like cyanide, sulphur and other radioactive substances are discharged into water.

Many industries like oil refineries, textiles, and chemical industries in India create water pollution above the permissible level. These industries can't be separated from each other. One way or the other they are interdependent to each other so continues the process of environmental pollution. The industries aim at higher profit rate hence they withdrew the act of ethical behavior. When technology and science was lagging the textile industries used natural dyes which are no harm to living beings and surroundings, but gone are those days. In order to achieve target the industries stick on to the usage of synthetic fibers which are non biodegradable and ultimately spoil the water and land resources when discharged without proper treatment. Thus the rate of water pollution depends upon the amount of water and chemical substances used for the manufacturing process. According to WHO (2004) people in the universe irrespective of their status and societal conditions they have right to have sufficient quantity of water with high quality similar to their basic needs. In recent years the fatality of death endorsed because of water pollution everywhere and majority of the diseases are due to this pollution (Chikogu Vivien et.al, 2012). The water born diseases are not initially identified and it may get your hands on right from childhood and detected in later stage of criticality. The pollution due to untreated water causes major environmental pollution and becoming a threat in many industrialist areas of developing countries. These effluents may be infectious or radioactive some times.

Water Pollution

Water pollution is considered to be the biggest environmental threat all over the world. In India government is investing more to control water pollution but the results are below the satisfactory level (Chakraborty et.al, 2012). Water quality is usually measured in terms of rate of occurrence of a substance in aqueous solution. There are many tests like BOD (Bio chemical Oxygen Demand) test, pH test and dissolved solvent tests are available to test the purity of water. The consumption of water by different industrial sectors is shown in Fig.1. Among them thermal power plants is the thirstiest sector among others. The textile industry accounts for 2.07% of water consumption. The consumption for the textile industry includes various processes such as sizing, dyeing, and other end product processes. The major problem arises when these chemicals are directly discharged into water bodies thus causing water pollution. This water pollution not only affects human beings and house hold animals but also aquatic animals to the same extent. The textile fabric production consist of various stages, initially the cotton are mixed in various proportions to make fibers. The fibers now undergo the process of spinning and convert into yarn.

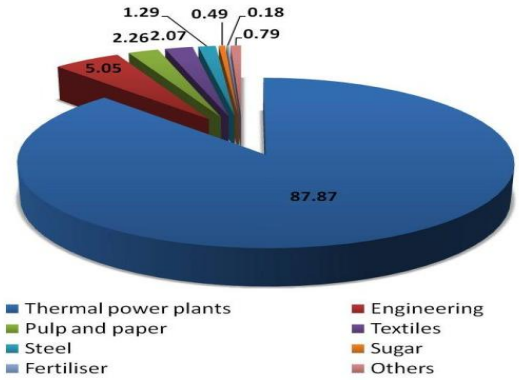

Fig.1 Consumption of Water by Various Industrial Sectors
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Now the process of dyeing takes place where many chemical agents for coloring purpose is used. In order to avoid detaching the yarns undergo the process of sizing where they are washed with cellulose and amylase substances. Now the processed yarns are weaved into end product (Meral et.al, 2008) while undergoing these processes various pollutants are discharged as chemical waste which is depicted in Table.1. When these water are discharged without any proper treatment then it will lead to hazardous effects to living organisms, so before discharging they should be properly treated either biological or physical or chemical means.

Measures to Control Water Pollution

In order to reduce water pollution some measures should be taken for betterment of life. Before entering into major treatment it will be easy to carry over preliminary steps for removing hazards (Little. A. H) The preliminary process may be a removal of waste material or other solid materials followed by neutralization of acids or salts and other intermediate components can be achieved by proper pH test or chemical oxidation or aeration methods.

S.NO	PROCESS	CHEMICAL DISCHARGE	POLLUTANTS	HEALTH EFFECTS
1.	Sizing	Benzene	Resins, fats, waxes, starch and glucose	Carcinogenic, mutagenic and affects central nervous system,
2.	Bleaching	Cyanide	Wax, grease, soda ash, sodium silicate	Prolonged exposure will affect kidney and liver and leads to death
3.	Dyeing	Sulphate	Sulphides, acetic acid, mordant	Eye and respiratory problem
4.	Printing	Nitrate, phosphate	Starch, gums, mordant acids,	Harmful health hazards
5.	Finishing	Lead	Starch, salts, finishing agents.	Suppression of hematological system

Table.1 Effluent Discharge from Textile Industry

Following are the few recommended control mechanism which industries can carry out before discharging effluents into ground water. According to the IUPAC definition, flocculation is “a process of contact and adhesion whereby the particles of dispersion form larger-size clusters”. Ferric form of iron salts are considered to be good flocculating agents and are less sensitive to pH as like aluminum salts. Under suitable condition colloids come out of suspension in the form of floc or flake and remove most of floating particle. Ozonation is a major oxidizing agent which is helpful in the decomposition of organic pollutants of industrial waste. The major advantage of this process is it can be applied in the form of gas thus reducing the volume of waste water and other impurities like sludge. Ozone molecule is

an electron acceptor in which the hydroxide ions are catalyzed and decomposition of ozone to hydroxyl radicals which react with both organic and in organic matters. Aerobic treatment is considered to be preliminary process particularly for decolourization of dyes. Photo catalysis is a biological means of removing waste from water in which has lesser retention time and little expensive (Zaharia et.al, 2012).

Air Pollution

As we all know air is a mixture of several gases like nitrogen (79%), oxygen (20%), and noble gases like argon, carbon-dioxide (1%). As air is a mixture the composition and proposition of the gases varies time to time depending upon the places. Air pollution is the state where air gets polluted with high concentration of chemicals which will usually harm living beings and cause serious damage to non-living beings. More recently, attention has been growing towards the control of emerging issues of hazardous air pollutants, which are mostly exposed in our homes or work places where majority of the life span is spent. In the house hold usage of burning fuels, solvents, glue, paints consist of Volatile Organic compounds like benzene, toluene, methylene chloride.

S.NO	TREATMENT NAME	TREATMENT TYPE	EFFECT
1	Coagulation/Precipitation/ Flocculation	Physio-chemical Treatment with alum and potash	Separates agglomerates
2	Ozonation	Physio-chemical Treatment	Removal of azo dyes
3	Wood saw dust	Adsorption treatment	Effective Removal of acid dyes
4	Aerobic Process	Biological Treatment	Decolurization of dyes
5	Photo catalysis	Biological Treatment	Mineralization with lesser confinement time

Table.2 Control Mechanism for Water Pollution

T he Fig.2 shows the contribution of each industrial, household, commercial and agricultural sector for air pollution. It's clear from the chart that industrial sectors pollute more the environment at a rate of 52% percentage. When the industries are taken into account probably the textile sector account for 17-20% of the industrial air pollution with 72 chemicals being let out as waste out of these 30 of them are can't be removed.

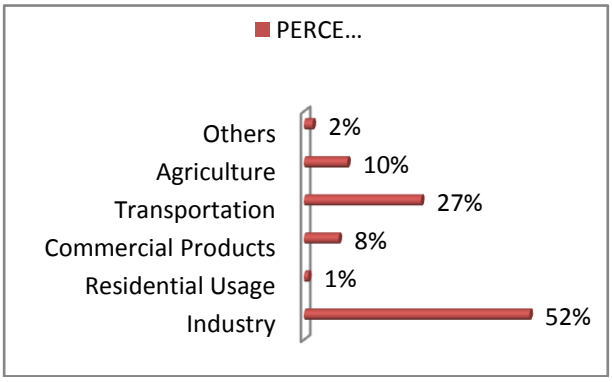

Fig.2 Sources of Air Pollution

Major Sources of Air Pollution

There are many sources of gases that pollute our atmosphere. The sources of such gases are broadly divided into Primary pollutants and Secondary pollutants. The primary pollutants are oxides of nitrogen and other sulphur and hydrocarbons emitted when the fuels are being burned. There are also secondary pollutants which are formed due to physical processes and chemical reactions, one such compound is the ozone. In a textile processing usually sulphur dioxide, sulphates, emanate from the poly-condensation, spinning the fibers and the fur generated during the weaving and spinning process. In the textile industry coal

and water are used which will generate steam comprising of carbon, carbon dioxide, carbon monoxide and sulphur polluting the air to greater extent. The following Table.3 explains about the major pollutants of air and their effect on environment.

S.NO	POLLUTANTS	EFFECTS
1	Carbon-mono-oxide	Reacts with blood and form carboxy-haemoglobin which will rest the blood transportation to other parts of body
2	Oxides of nitrogen (NO, NO_2)	Acid rain, bronchitis, eye irritation
3	Sulphur-dioxide, sulphates	Eye irritation, breathing problem, acid rain
4	Methane	Lungs disorder
5	Carbon-dioxide	Head ache, nausea, increase in global temperature
6	Hydrocarbons (methane, ethylene, acetylene etc.,)	Carcinogenic effects

Table.3 Major Air Pollutants

Measures to Prevent Air Pollution

In order to prevent the hazards due to such emission from the industry the workers can be advised to use Material Safety Data Sheets to handle all the substances individually. This material data sheet can include physical properties, toxic rate, ill effects and first aid for effective handling of all the resources (Samiya et.al,). The manufacturer can provide the material data sheet while they deliver the goods so that the textile industry can make it visible to all the workers for their easy access. Staff members who regularly handle the chemicals can be given adequate training regarding the over usage of particular chemical and their ill effects on health and environment. The another way to control air pollution is placing chimneys to height not less than 30m so that all deadly gases are released out of the living organisms. The pollution can also be controlled with the help of settling chambers in which the polluted air is passed through chambers in which the solid particles with particular weight gets settled down. Filtration method can also be used for filtering the hazardous pollutants in which bed filter, fiber filters and fabric filters are widely used.

Results and discussions

Risk analysis

Risk is defined as uncertainty and in uncertainty lays opportunity, without uncertainty there is little chance to profit. Ignoring the risk will certainly affect the employee's health issues, lower the reputation of the company, and at last the environment also. So a better risk management technique should be adopted by each textile industry with which the organization can make a better decision considering the political, economical and social factors. The effect of risk depends on vulnerability of the factors involving risk and it may be either in terms of financial or non-financial terms.

Steps in Risk Management

In order to control the effect of risk there should be proper risk management technique adopted strictly by all the firms. So an agenda should be created such that all the actions should be carried over based upon the action plan devised. There are six steps in risk management process they are Identify, Analyze and Prioritize Evaluate, Track and Report, Monitor and Review. These steps are shown in Fig.3.

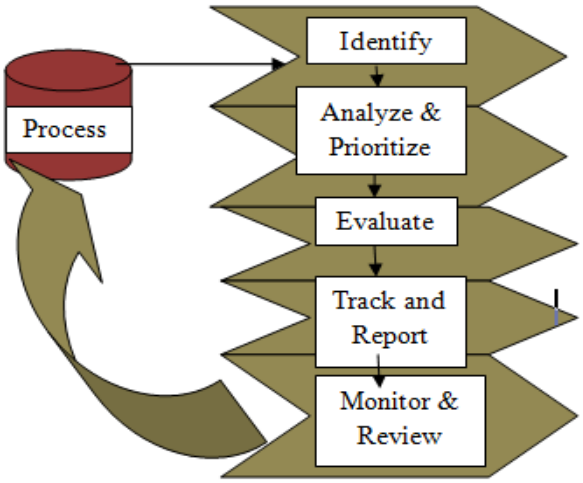

Fig. 3 Risk Management Process

Identify

This is the preliminary phase in the process of risk management. Identification of risk allows individuals to find out the potential risks so that the operation level employees will be aware of handling the problems. This identification step should not be a one step process it should be carried over frequently to avoid damage. The risk arises either due to internal or external sources of problem.

Analyze and prioritize

As soon as risk has been identified they must be assessed to their potentiality of loss and severity of occurrence. Analyzing the risk to health from hazardous substances created during the work process should be assessed well. Organization should take utmost care from preventing employees exposed to hazardous chemical substances. When the risk is identified and analyzed well then only it becomes possible to prioritize the risk. This prioritization of risk enables the employees to manage the most important risk.

Evaluate

The major problem with evaluation of risk is determining the rate of occurrence because the availability of information's regarding the past incidents may not be recorded. The evaluation of risk is concerned with how the people affected by risk perceive them and there should be trade-off between perceived risks and benefits.

Track and report

Risk tracking is the process of monitoring about specific risk and the progress in their devised actions plans. Tracking the risk is monitoring the prospects, impact and other measures of risk for changes that could change the precedence or risk plans and eventually the availability of the service. Risk reporting should give guarantee that the operations staff, service manager, and other stakeholders are responsive of the status of top risks and the plans to manage them. It should be ensured that control measures are used and maintained properly and the safety procedures are followed accordingly.

Monitor and review

Monitoring the risk is the process of implementing the action plan and their related tasks. Monitoring also involves the change initiatives and when changes in risk take place it could automatically affects the available service levels. Reviewing the risk involves learning the new technology, tools and reusable techniques that can be shared effectively with others.

Plans and procedures should be prepared to deal with accidents and other hazardous incidents wherever necessary.

Conclusion

In order to protect the environment every organization should regularly check and file the documents related to regulations concerning work place safety. The management must ensure that the organization has protocol to implement all the rules regarding the environmental and workers safety. Majority of the organization certainly will have the code of conduct like corporate social responsibility and environmental responsibility. The workers of the textile industry should ensure that the production area is distant from the place where they take food in order to avoid the consumption of chemicals through air. Thus the paper assess the hazardous substances that pollute water and air substantially, their sources and the steps to assess and control the risk in the textile industry is seen.

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