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PROACTIVE HUMAN BEHAVIOR BASEDSAFETY ANALYSIS IN INDUSTRY

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Abstract: Safety is an essential thing which we need to focus in every act and conditions. In day to day life every individual person has to ensure their safety. If not it may lead to any unplanned or unwanted event which will make more severe consequences. to avoid such situations, we need to find the causes of the unsafe incidents. Most of the accidents are happening in industries, because of multi-disciplinary activities are held. In which we can classify the accidents into two major categories. They are unsafe act and unsafe conditions. According to previous strategy, 90% of accidents are happening due to unsafe acts. It's purely relay on Human (Individual) Behaviour. So, in this study the analysis and control measures of Human Behaviour Based Safety are discussed below. For analysing the human behaviour safety, Job safety analysis methodology has been followed. After analysing this, gathered more information which helps to reduce the accidents caused by human behaviour. Risk matrix is used to find out the corrective measures which are appropriate to the hazard. Thus the accidents will be reduce and create the safe work area in Industry.

Keywords: Job Safety Analysis, Risk Assessment, Risk Matrix, Behaviour Based Safety. Dyeing Process, Peer Group Pressure, Safety Culture.

INTRODUCTION

In Industry there are various methods or approaches followed to reduce the accident rates and improve the employee safety. Approximately most of the accidents are caused by unsafe human behaviour. Among that BBS is the one effective method which is implemented to reduce accidents in workplaces. This will help to analysis the dangerous occur in prior to the operation around the workplace. The process is to know about all the possible causes of failures and effects which will harm to persons and equipments. These method shows the idea which to make counter measures for the particular failure. This will help to lead a healthy environment in working area.

IMPORTANCE OF BBS IN AN ORGANIZATION

Behavior safety involves on the behavior of employee within an organization are

- Identifies the behaviour which will harmful and causes injury or accidents.
- Reduces the risk of accidents or injury.
- Collects the data regarding frequency rate of those behaviours.
- Identifies behavior which will reduce and stops injury.
- Feedback and reinforcement to create positive types of behavior in industry.

FACTORS LEADS TO SAFETY

To maintain a good health and safety practice we have to fulfil moral, legal and economic factors.
Moral reason relates to the moral duty that one person has to another. Many people are killed, injured or made sick by their work. This is morally unacceptable and society as a whole demands that people are safe while at work.
The **legal** reason relates to the framework of laws that govern the conduct of businesses and organisations. An employer has a duty to provide a safe plant and equipment, safe systems of work, adequate training and supervision and competent employees.
The **economic** reason relates to the fact that accidents and ill health cost money. When an accident occurs there will be direct and indirect costs as a result of that event. Some of these losses can be insured against many of them will be uninsured.
Management has to provide safe work place, equipment safety, and awareness training programme to ensure employee safety. Here employer's responsibilities to workers, safety indicators, influencing factors of individuals and control measures are discussed below. Good health and safety practice often relies on the perfect behaviour of individuals and people sometimes do not behave in this ideal way. The solution to a health and safety problem usually requires a worker to carry out their job in a particular way. But people are not robots, they do not behave as they are supposed to all the time.
Workers sometimes make mistakes (they do the wrong thing thinking that it is the right thing to do). Sometimes they deliberately do the wrong thing, knowing that it is wrong, but doing it anyway. The fact that health and safety standards are affected by worker behaviour can be a significant barrier to maintaining good standards in a workplace.

REVIEW OF LITERATURE

Agraz-Boeneker R, Groves W A [1] (2007) conducted a study about BBS in oil production. From the examination the information shows the 'number' and 'type' of "safe" and "at risk" behavior observed. Types of incidents -injuries, near miss, fires, spills are obtaining by (OW) observation worksheet the (KSP) key safe practices which are classified and examined using an ordinal logistic regression model.

Dawei chen, Hanzhi tian [3] (2012) established a study on the safety Index (SI) in construction .It was used to evaluate safety behavior& change trend. The result of the experiment showed that BBS made huge impact on accident prevention and the trail employee safety index was enhanced upto 10% than the base line while the experiment . The BBS approach is implemented in DO IT process. D-Define the target behaviors, O-observe target behavior, I-Intervene to improve behavior, T-Test impact of intervention. Employee's key behavior checklist will be searched under the parameters like –ABC analysis, effect audit, HSE effect, change climate, safety behavior, and decrease accident.

Faridah Ismail [4] (2011) carried a case study approach on oil & gas industry by Implementing BBS approach. Four basic steps of BBS are Identification, Observation, Intervention, Review and Monitoring. The preliminary enquiry among safety and health related practitioners will leads to implement the BBS in oil and gas industry effectively. The data collections are done by questionnaire survey, semi- structured interview, and observation. These question survey will help to seek the current implementation of BBS and the barriers. There are five principles which will help to assist the programs. They are-to increase level of risk awareness, feedback communication and bottom-up program approach, minimize paperwork and keep the process simple.

HengLi **et al** [6] (2015) done a study about the Extension of BBS in construction industry. In this proactive construction management system and BBS are merged and implemented in industry. The accident prevention rates are increased by introducing this concept. The proactive approach is enhancing the capacity of on-site workers in detecting sources of key location related dangers and early warnings. The second one is recording the behavior of site workers when they are giving warning signals and observation of unsafe behaviors. PCMS is consists of RTLS-real time location system. VCS-virtual construction simulation.

Kean Eng Koo **et al** [7] (2013) carried a study on engineering students for their self intension & behavior in practicing safety at workshop &lab by using theory of planned behaviour (TPB).Using TpB the research model ,the results of this study has shown that subjective norm, attitude towards safety practices and perceived behavioral control have a significant effect on behavioral intension to practice safety. As a result TpB with the used of safety knowledge has increased the capability of predicting and evaluate young adult students intension and behavior.

LIU Jianhua and SONG xia oyan [8] (2014) conducted a study on the Mechanism of BBS management idea & ABC (Activator-behavior-consequence) behavior analysis to reduce accidents & improve safety of coal mine. This research says that to pay attention to behavior observation and measures. A represents the antecedents, belongs to the stimulation factor, appear in behavior, incentive and encourage people to finish some behaviors. B – it's a series action of human can be observed and measured caused by the incentive factor. C-the results, after the behavior .Counter measures like pay attention, positive and negative reinforcement strengthen the staff behavior, feedback are discussed.

Rahmatul Hidayah Salimin, Razidah Ismail [2] (2011) evaluated the influence of environment –behavior factors towards safety culture development like internal & external. Internal - safety management system.External-Industry norms, government policies and regulations, economic climate. Interviews among senior management, acknowledged their state of safety culture were contributed by the system established. In internal factors the fundamental basis of effective management is summarized in the simple management circle Model,based on the Plan-Do-Check-Act.

SulastreMatzin and Fariadh Ismail [9] (2011) done a study to Identify Employer's behavior safety compliance factor which encourages them. It's an initial study which will lead the establishment of safety indicators for BBS. Ranking value method is used to determine factors compliance in safety improvement. The value for one is "strongly disagree" and to five is for "strongly agree". There are nearly ten variables which are used to improve safety with the help of giving values. The factors are management commitment and followed by organizational commitment, safety communication, safety leadership, effective safety training, safety motivation, safety rules and regulation, safety and health officer and personal protective equipment were ranked in an ascending order of importance.

YUAN xiongiun and WANG kaiquan [11] (2012) conducted a study on the Countermeasures for BBS of Small and medium –sized enterprises are discussed. The safety of work places SME's have also become more serious and improved urgently. The procedure for BBS is Identify critical actions, collect action data, provide dual communication and eliminate the hindrance for safety behavior. Some of the measures are enterprise responsible person, establish safety management ideas full participation of employee, motivation. These measures will decrease the accident rates.

Yueng-hsianghuang **et al** [12] (2014) researched about examining employee safety climate perception & supervisory interpretation of safety climate how they similar or different and how they related to important safety outcomes. The results are direct only if its employee perception of self-reported safety behavior and objective injury is indirect. Here the research says that we should rely on only employee perspectives instead of supervisory interpretation. This will increase to understanding of lone worker context by examining employee safety climate and supervisory interpretations of safety climate.

BEHAVIOUR BASED SAFETY

Safe Place of Work

The employer creates the place of work, which should be reasonably safe and without risk to health. The employer should also provide safe access to and from the workplace.

Safe Plant and Equipment

All the machinery, tools, plant and equipment used on by employees at work should be reasonably safe and without health risk. The greater the risk involved, the greater the care that must be taken.

Safe Systems of Work

There should be recognised procedures for the safe conduct of all work activities. These procedures should cover all foreseeable possibilities. It should cover the routine day to day activities of the organization and non routine occasional or one-off activities as well as any foresee able emergencies that might arise.

Training, Supervision and Competency of Staff

Employers have a duty to provide appropriate training so that workers are aware of the hazards and risks inherent in their work, the safe systems of work and the emergency procedures. This training can be reinforced by providing information and instruction. They also should supervise workers to ensure that they are carrying out their work with minimal risk to themselves and others. This doesn't mean that supervisors have to stand and watch every worker, they just have to provide adequate levels of supervision. Finally employer should ensure that all workers supervisors and managers are competent.

WORKERS RESPONSIBILITIES AND RIGHTS

- Take reasonable care of their own safety and that of other people who might be affected by the things that they do and the things that they fail to do.
- Comply with safety instructions and procedures.
- Use all safety equipment properly and not tamper with its.
- Report any situation which they believe could be a hazard and which they cannot themselves correct.
- Report any work related accident or ill health.

SAFETY CULTURE

It is defines as the shared attitudes, values, beliefs and behaviours relating to health and safety. Every individual persons behaviour creates culture in organisation.

Positive Culture

In an organisation, majority of the workers think that health and safety is important. Every one works safely because they want to. People who do not share this positive view are in the minority and are likely to come round to the group.

This is because the culture of an organisation tends to observed by its workers over time. Workers who do not adjust to the group way of thinking may either leave or possibly be dismissed for working unsafely.

Negative Culture

In an organisation, majority of the workers think that health and safety is not important. They are poorly educated and see it as unnecessary or unimportant. Managers do not think about health and safety in their decision making and so let other priorities dictate their actions.

Safety conscious workers are in the minority and are likely to come round to the group way of thinking over time if not they may well leave because they do not like the organisational culture and feel unsafe in the work situation.

Factors that influences Negative impact on health and safety culture in an organisation

- Lack of leadership from management.
- Presence of a blame culture
- Lack of management commitment to safety
- Health and safety receiving lower priority that other business issues.
- Organisational changes (frequent or poorly communicated change)
- High staff turnover rated.
- Lack of resources
- Lack of work consultation
- Interpersonal issues
- External influences (climate resulting in difficult operating conditions)

INDICATORS USED TO ASSESS SAFETY CULTURE

It makes sense to try to assess an organisation's safety culture to see whether it is strong and positive, or if there is room for improvement. But in an organisation it is difficult to assess because there is no one single feature that can be measured.

It is impossible to measure and they are intangible concept. So rather than trying to assess the safety culture directly it is perhaps better to assess it indirectly by looking at the tangible outputs that can be used as indicators.

Accidents

It can be used to work out how many accidents are happening as a rate and compared with Organisation's performance in previous years (indicates whether the rate is increasing or decreasing. decreasing rate might be seen as a positive safety culture) and rate for other organisations that do the same work (an accident rate that is higher than the national average might be seen as indicator of a negative safety culture.

Absenteeism

A high level of worker absenteeism indicates that workers are either not able or not willing. If not able to come means they are suffering ill – health caused. If not willing means they are with holding their labour for some reasons. This is caused by poor workforce morale which in turn can sometimes be linked to poor safety culture.

Sickness Rates

A lot of ill health is caused or made worse by work. It can be used in the same way that accident rate. If the rate increases it shows negative culture.

Staff Turnover

Organisation with positive work culture often feel safe morale is good, training is available. As a result workers stay with their employer for longer, so low staff turnover may indicates a good safety culture while high staff turnover may indicates the opposite.

Compliance with Safety Rules

Formal and informal inspections or audits usually find that there is a high level of compliance, that they influence the positive safety culture. Negative safety culture indicates the reverse, in which workers do not follow the rules either because they do not aware of them or they know but do not want to follow it.

Complaints with Working Conditions

Positive culture organisation may actively encourage complaints, but few serious ones will be made. Negative culture organisation may actively not encourage complaints.

Influence of Peers

When people put into a group, some individuals will have a lot of influences over the group. In this way hierarchy develops. A person wishing to become a member will have to comply with the group norms. This pressure to comply with group norms is "**Peer group pressure**", which is important factor to take into consideration in thought of behaviour based safety. They way to deal with this problem is usually to tackle the influence people within the group who are the ones responsible. This might be done by training, education, involvement in safety – related projects.

FACTORS INFLUENCING WORKER'S BEHAVIOUR

- The individual – their personal characteristics
- The job – the task that they are carrying out
- The organisation – characteristics of the organisation that they are working for

Organisational Factors

- Safety culture of the organisation
- Policies and procedures – the way that might encourage or discourage safety related behaviour
- Commitment and leadership from management – whether this is visibly demonstrated outside the boardroom
- Levels of supervision – presence or absence of and the competence of supervision.
- Peer group pressure- the extent to which this is allowed to drive unsafe behaviours
- Consultation and worker involvement – the extent to which workers are involved in the management of health and safety issue and in the decision making
- Communication – how effective at using various communication methods to convey health and safety messages and information and how well the organisation then checks understanding of those messages
- Resources – availability of any necessary equipment and allocation of time to provide training in health and safety
- Training – how good the organisation is at identifying health and safety training needs and opportunities and how well it then meets hose needs to create well informed, competent staff
- Work patterns – such as shift systems, work at night, extended hours – these can adversely affect workers health and cause fatigue which can lead to poor performance and increase risks

Job Factors

- Task – the characteristics of the work itself in particular the ergonomic requirements. In the absence of ergonomic design workers will find the most comfortable way and it may lead to be not safe
- Workload – amount and rate of work, deadlines and variety of work that individuals have to cope with and the degree to which these are under the direct control of the worker or imposed externally.
- Environment – workplace conditions such as space, lighting, noise, temperature and humidity and the way of that these parameters are controlled so as to minimise their impact on worker performance. They may also start to suffer degradation in physical and mental performance as a result of heat stress.
- Displays and controls – design of these and the way that poorly designed displays and controls can contribute to the likelihood of human errors.
- Procedures – the existence and quality of working procedures. Alack of written procedures or poorly written procedures that are out of date overly complex or impractical can be why workers do not comply. To be effective, procedures should be accurate, concise, use familiar language and they must be do – able.

Individual Factors

Key characteristics of an individual worker's personality that influence their safety related behaviour:

- Attitude – how they think about a particular safety issue.
- Competence – a combination of knowledge, ability, training and experience
- Motivation – the incentives at work.

Attitude

It is a person's point of view or way of looking at something, how they think and feel about it. Changing the attitude is difficult but can be done using various methods. They are:

- Education and Training.
- High impact interventions.
- Enforcement.
- Consultation and involvement in decision making.

Competence

It's a combination of knowledge, experience, training and ability that brings a person to a level where they are able to perform to an acceptable standard and them aware of their own limitations.

Motivation

A person's drive towards a goal. The thing that is making them do what they do is called motivation.

Perception of risk also another important factor for an individual safety behaviour.

CASE STUDY

STUDY AREA

Study was carried out in Talma Garments, Trippur**.** In this industry many process are carried out, among that dyeing unit area was looked out. The unit area was covered by nearly around 40 to 50 workers and storage area of chemicals which is used for dyeing process.

DYEING

Dyeing is the process of adding color to textile products like fibers, yarns, and fabrics. Dyeing is normally done in a special solution containing dyes and particular chemical material. After dyeing, dye molecules have uncut chemical bond with fiber molecules.

DYEING PROCESS

The dyeing process is one of the key factors in the successful trading of textile products. In addition to the design and beautiful color, the consumer usually looks for some basic product characteristics, such as good fixation with respect to light, perspiration and washing both initially and after prolonged use. To ensure these properties, the substances that give color to the fiber must show high affinity, uniform color, resistance to fading, and be economically feasible.

Modern dyeing technology consists of several steps selected according to the nature of the fiber and properties of the dyes and pigments for use in fabrics, such as chemical structure, classification, commercial availability, fixing properties compatible with the target material to be dyed, economic considerations and many others.

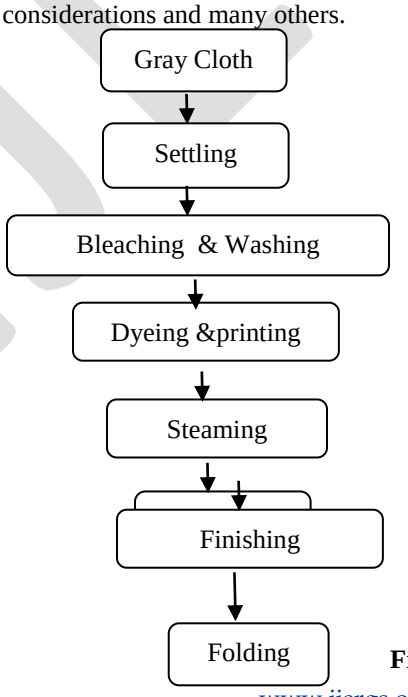

Fig 4.1 Process involved in dyeing

Dyeing methods have not changed much with time. Basically water is used to clean, dyeand apply auxiliary chemicals to the fabrics, and also to rinse the treated fibers or fabrics.

Process Involved

- Preparation
- Dyeing
- Finishing

Preparation

In this step the unwanted impurities are removed from the fabrics before dyeing. This can be carried out by cleaning with aqueous alkaline substances and detergents.

Many fabrics are bleached with hydrogen peroxide or chlorine containing compounds in order to remove their natural color, and if the fabric is to be sold white and not dyed, optical brightening agents are added.

Dyeing

Dyeing is the aqueous application of color to the textile substrates, mainly using synthetic organic dyes and frequently at elevated temperatures and pressures in some of the steps.

It is important to point out that there is no dye which dyes all existing fibers and no fiber which can be dyed by all known dyes. During this step, the dyes and chemical aids such as surfactants, acids, alkali/bases, electrolytes, levelling agents, promoting agents, softening agents are applied to the textile to get a uniform depth of color with the color fastness properties suitable for the end use of the fabric.

This process includes diffusion of the dye into the liquid phase followed by adsorption onto the outer surface of the fibers, and finally diffusion and adsorption on the inner surface of the fibers. Depending on the expected end use of the fabrics, different fastness properties may be required.

Different types of dye and chemical additives are used to obtain these properties, which is carried out during the finishing step. Dyeing can also be accomplished by applying pigments (pigments differ from dyes by not showing chemical or physical affinity for the fibers) together with binders (polymers which fix the pigment to the fibers).

Finishing

Here involves treatments with chemical compounds aimed at improving the quality of the fabric. Permanent press treatments, water proofing, softening, stain release and microbial/fungal protection are all examples of fabric treatments applied in the finishing process.

Process Methodology

Dyeing can be carried out as a continuous or batch process. The most appropriate process to use depends on several factors, such as type of material (fiber, yarn, fabric, fabric construction, and garment), generic type of fiber, size of dye batch and quality requirements for the dyed fabric, but batch processes are more commonly used to dye textile materials.

In continuous processing, heat and steam are applied to long rolls of fabric as they pass through a series of concentrated chemical solutions. The fabric retains the greater part of the Eco-Friendly Textile Dyeing and Finishing chemicals while rinsing removes most of the preparation chemicals.

Each time a fabric is passed through a solution, an amount of water equivalent to the weight of the fabric must be used. In batch processing, sometimes called exhaust dyeing, since the dye is gradually transferred from the dye bath to the material being dyed over a relatively long period of time, the dyeing occurs in the presence of dilute chemicals in a closed equipment.

Unlike the continuous process, instead of being passed through various baths in a long series of equipment sections, in the batch process the fabric remains in a single piece of equipment, which is alternately filled with water and then drained, at each step of the process. Each time the fabric is exposed to a separate bath, it uses five to ten times its own weight in water.

Some batch dyeing machines only operate at temperatures up to 100ºC. However, the system can be pressurized, allowing for the use of temperatures above 100ºC. Cotton, rayon, nylon, wool and some other fibers dye well at temperatures of 100ºC or below. Polyester and some other synthetic fibers dye more easily at temperatures above 100ºC.

Since the degree of dye fixation depends on the nature of the fiber, it is important to consider this topic. The fibers used in the textile industry can be divided into two main groups denominated **natural fibers** and **synthetic fibers**.

Natural fibers are derived from the environment (plants or animals), such as wool, cotton, flax, silk, jute, hemp and sisal, most of which are based on cellulose and proteins.

On the other hand, **synthetic fibers** are organic polymers, mostly derived from petroleum sources, for example, polyester, polyamide, rayon, acetate and acrylic. The two most important textile fibers are cotton, the largest, and polyester. Cotton has been used for over 7000 years, and consists of mainly cellulose, natural waxes and proteins. The large number of hydroxyl groups on the cellulose provides a great water absorption capacity.

ANALYSIS AND METHODLOGY

JOB SAFETY ANALYSIS

JSA is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In this each step of the job is to identify potential hazards and to recommend the safest way to do the job.

STEPS INVOLVED IN JSA

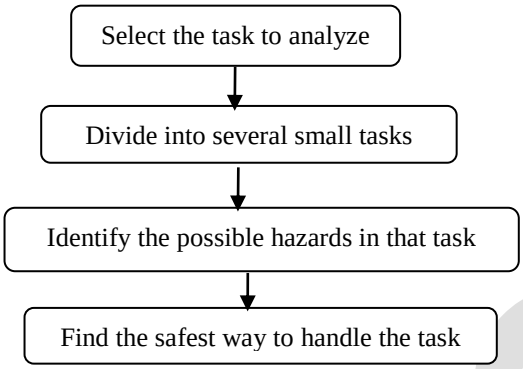

Fig. 5.1Steps involved in JSA

The legal requirement for risk evaluation or assessment applies to all employers. The process for carrying out a risk assessment can be broken down into a series of steps:

Hazards and Those at Risk

Looking for those things at work that have the potential to cause harm, and identifying workers who may be exposed to the hazards. Using workers' knowledge helps to ensure hazards are spotted and workable solutions implemented. Consultation encourages workers to commit themselves to health and safety procedures and improvements.

A risk assessment should cover all workers regardless of whether they are employed on long- or short-term contracts. Where there are persons employed by another organisation on site, there is a duty on the two employers to cooperate and safeguard the health and safety of workers.

Risk assessment should take account of differences in workers, such as by gender, age, or disability. For example, older employees may learn differently than a younger worker, and also have different concepts of risk due to a lack of experience. Different prevention measures may be required for these worker groups. Work, its organisation and the equipment used should be adapted to the worker, not the other way around. This principle is enshrined in EU legislation.

Workers with disabilities should be considered specifically in the risk assessment process. For example, people with disabilities may be subjected to bullying, which can lead to work-related stress. Consultation with workers with disabilities is vital to ensure a risk assessment is appropriate.

Evaluating and Prioritising Risks

Evaluate how likely it is that the hazard will lead to harm or injury, and how severe that injury is likely to be. Consider what control measures are in place and whether they are sufficient. It is essential that the work to be done to eliminate or prevent risks is prioritised. The focus for cost-effective and sustainable risk management should be on collective protection and preventative measures.

Deciding on Preventive Action

Identifying the appropriate measures to eliminate or control the risks. List the preventive measures needed in order of priority, then take action, involving the workers and their representatives in the process. Targeting the underlying problems is the most cost-effective method of risk management.

Taking Action

Risk assessment is the first step to successful risk management. Put in place the preventive and protective measures through a prioritisation plan (most probably all the problems cannot be resolved immediately) and specify who does what and when, when a task is to be completed, and the means allocated to implement the measures.

Interventions should be agreed with the workforce, either directly or through worker safety representatives. The agreed solutions should be carefully implemented, monitored and evaluated. The information arising from the risk assessment must be shared with the appropriate persons. Action should be supported by appropriate training.

Monitoring and Reviewing

The assessment should be reviewed at regular intervals to ensure it remains up to date. It has to be revised whenever significant changes occur in the organisation or as a result of the findings of an accident or "near miss" investigation.

JSA IN TEXTILE INDUSTRY

In the textile process dyeing unit is an essential one where the chemicals are used in hugely by the persons. More usage of chemicals will harm the individuals health and safety. To avoid that the dyeing unit area has been selected to make an analyze to find out the possible hazards involve in that.

After selecting the task dyeing unit has been divided into smaller tasks to find out exact hazards can occur. This can be classified into three major types. They are preparation, dyeing and finishing.

To make an analyze risk assessment had been carried out in order to find out the hazardous area and tasks. This will help to choose the appropriate safe way to follow the operation and shows the exact hazard to make a corrective action. It shows the individual person error or attitude which leads to an accidents.

After that area has identified the corrective action like monitoring, individual training, motivation schemes will be implement to encourage the workers to do the job safely. This will reduce the accident rates and injury rates in the industry. It will also help to choose the safe work procedure which prevents unsafe acts by an individual.

This way human behaviour based safety can improve the safe work standard in working industry area.

RISK ASSESSMENT AND ANALYSIS

Risk assessment is a process which is a key tool to find out the hazards involved in that particular process/area. Based on this we can easily identify the hazards and can give control measures to reduce the number of accidents.

Areas Taken for Assessment

- Preparation
- Dyeing
- Finishing
- Storage area of chemicals

Risk Matrix

Risk matrix is a universally acceptable method to make an assessment easier by making hazard and its risk into some numerical value.

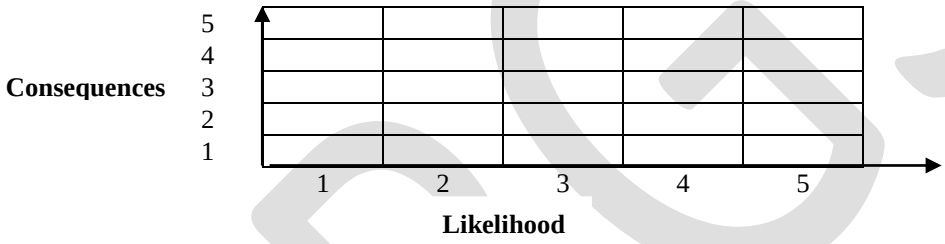

Fig. 5.2 Structure of Risk Matrix

Table 5.1 Showing likelihood of harms and its severity outcomes

Likelihood of harm	Severity of outcomes
1– Extremely unlikely	1-Very minor injury
2- unlikely	2-First aid injury
3 – possible	3-lost time injury
4 - Likely	4-hospital treatment
5 – Very Probable	5 – disabling injury

Data Collected From Industry

Major accident scenario in previous years

Accidents data were collected from the industry for the selected process for the period from 2013 to2015 which is showing in Table 5.2.

Table 5.2 Accident data from 2013 to 2016

Year	2013	2014	2015
Preparation	2	3	3
Dyeing	4	4	3
Finishing	3	3	4
Chemical storage area	6	5	5
Total no of accidents	17	16	16

The collected data were converted into percentage data and presented in Table 5.3

Table 5.3 Year wise accidents in Percentage

Year	2013	2014	2015
Preparation (%)	11.76	18.75	18.75
Dyeing (%)	23.53	25.00	18.75

Finishing (%)	29.41	25.00	31.25
Chemical storage area (%)	35.29	31.25	31.25

The accident variation percentage in each year with respect to particular area were compared and it's showing in Figure 5.3

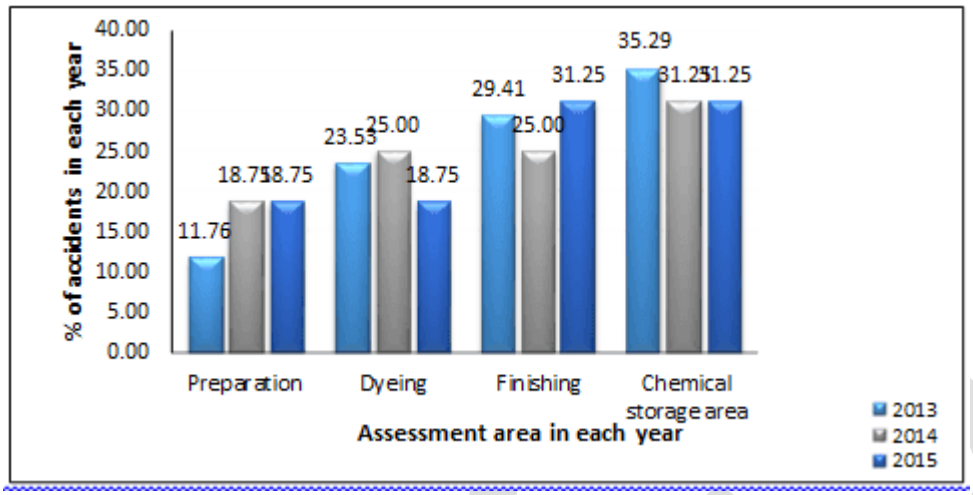

Figure 5.3 Graph between Percentage of Accidents and Assessed Area in Each Year

The present condition in each assessed area in 2016 (till date) and the possible reduced number of accidents by applying safety measures were presented in Table 5.4.

Table 5.4 Collected accident data in 2016 and effect of safety measures

Year	2016 (till date)	Possible Reduced accidents
Preparation	2	1
Dyeing	3	2
Finishing	4	2
Chemical storage area	6	4
Total no of accidents	15	2

The percentage of accidents in 2016 and after applying safety measures the reduced percentage are shown in Table 5.5

Table 5.5 Percentage of Accident Data in 2016 and Effect of Safety Measures

Year	2016 (till date)	Possible Reduced accidents
Preparation (%)	13.33	6.67
Dyeing (%)	20.00	13.33
Finishing (%)	26.67	13.33
Chemical storage area (%)	40.00	26.67

The accident percentage in 2016 (till date) with respect to particular assessed area were compared with reduced percentage of accidents by applying safety measures is showing in Figure 5.4

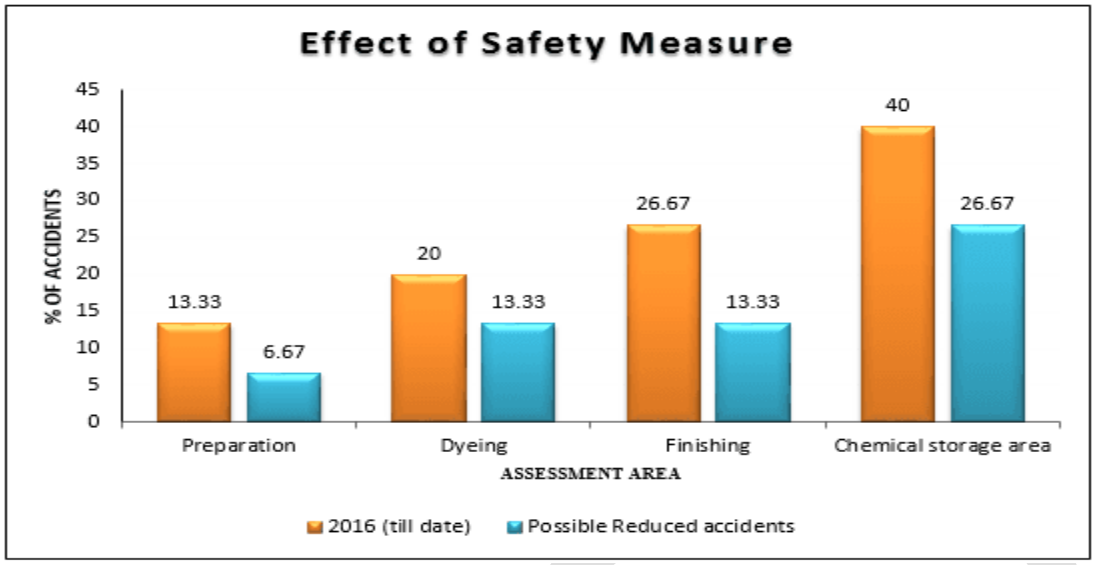

Figure 5.4 Percentage of Accident Data in 2016 and Effect of Safety Measures

By comparing the accidents in each year it showing that in 2013, the maximum number of accidents were occurred. So keeping the maximum value, the percentage of accident in 2013, 2014, 2015, 2016 (till date) and possible reduced accident in each assessed area were carried out and presented in Table 5.6

Table 5.6 percentage of accident in each assessed area

Year	2013	2014	2015	2016 (Till Date)	Possible Reduced accidents
Preparation (%)	11.76	17.65	17.65	11.76	5.88
Dyeing (%)	23.53	23.53	17.65	17.65	11.76
Finishing (%)	29.41	23.53	29.41	23.53	11.76
Chemical storage area (%)	35.29	29.41	29.41	35.29	23.53

The comparison in each assessed area in each period are compared and shown in following Figure 5.5 (a), (b), (c) and (d).

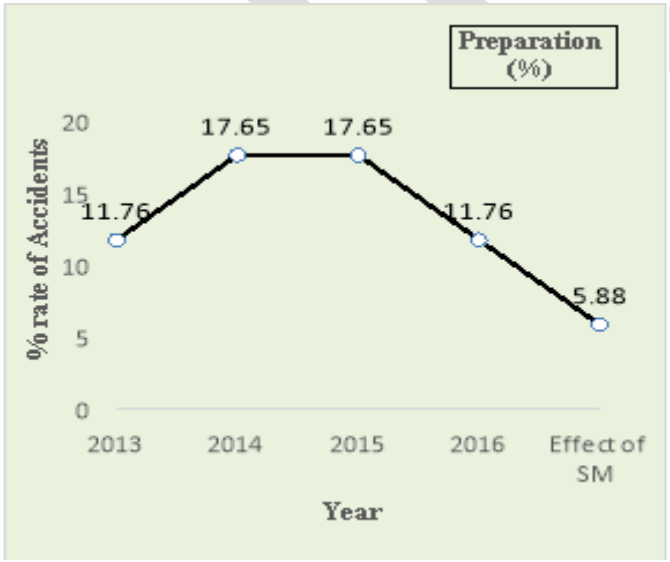

Fig. 5.4 Comparison in Preparation Area between Each Period in Percentage

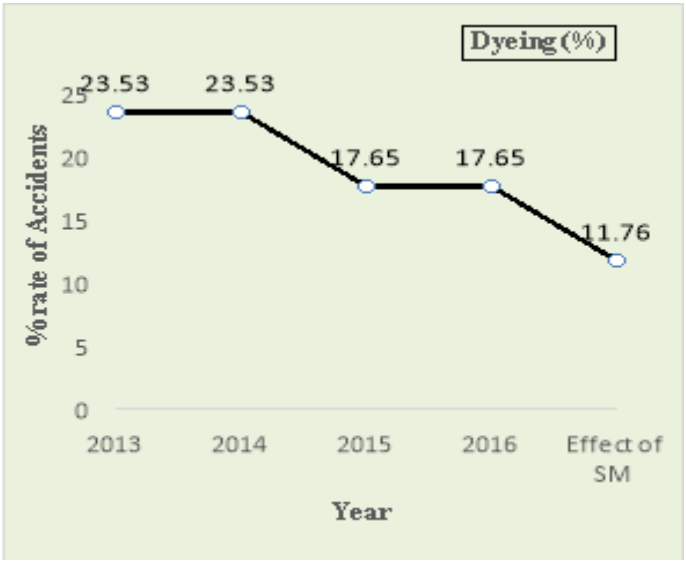

Fig 5.5Comparison in Dyeing Area between Each Period in Percentage

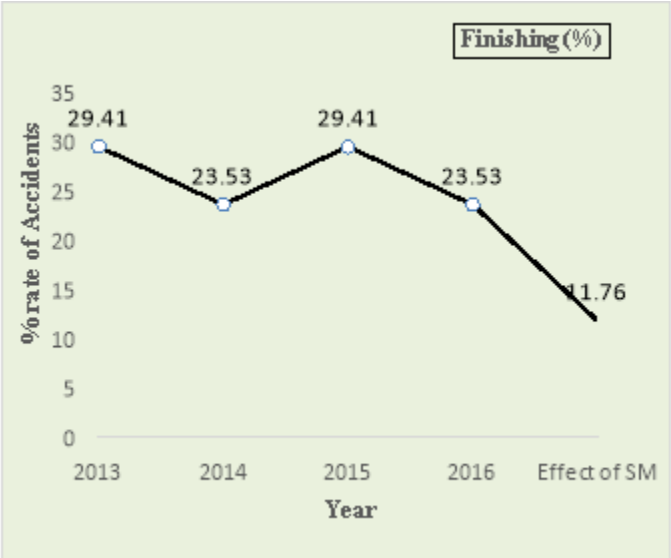

Fig. 5.6 Comparison in Finishing Area between Each Period in Percentage

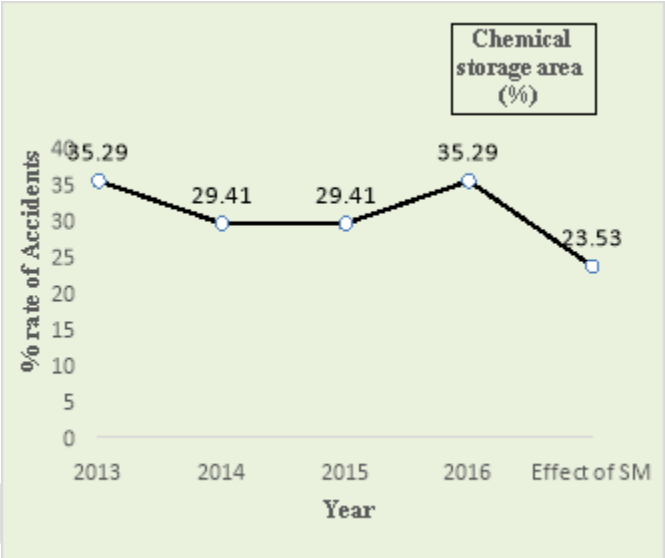

Fig 5.7 Comparison in Chemical Storage Area between Each Period in Percentage

Control Measures for Behaviour Based Safety Culture

- Management commitment and leadership.
- Disciplinary procedures.
- Competent staff.
- Effective communication.
- Co-operation and consultation.
- Training.

Management commitment and leadership

The commitments start from top level of the organisation. The senior managers provide the leadership to inspire and motivate the others. To show the visible commitment they need to involve in such activities like behaving themselves safely in the organisation, involvement in daily day-to-day operations and management's health and safety like safety meetings, taking part in safety audits and tours.

Disciplinary procedures

Sometimes it's necessary to take disciplinary action procedures to ensure the health and safety rules in organisation.

Competent staff

A competent person is a person who has sufficient training, knowledge, experience and other abilities to carry out their work safely and without any risk to health. It will make some responsibilities among them. This has a positive influence on safety culture.

Effective communication

Communication is a process of delivering information from sender to a recipient. To get that effective it should be a correct information and clear with details. This can be achieved by verbal, written and graphic.

Consultation

A positively safety culture can be created only when the organisation appreciate the workers involvement and co-operation with them. If the workers feel they are being consulted then it will make them some responsibilities to them and it leads to follow the safety culture. This can be done by direct consultation or worker representatives.

Training

It is defined as the planned, formal process of acquiring and practising knowledge and skills in relative field. The effect of training has the major influence among the workers to follow the safe behaviour.

Risk Matrix Calculation

Risk = Likelihood * consequences

According to the data collected and based on the chances of getting harm with the severity it can cause the risk value will be made and it may help to reduce rate of occurrence by making the effective corrective measures.

In this study, the chemical storage area will be the most harmful and so the risk value should be as 4*5=20.

After implementing the safe BBS culture in the working area the risk value will be reduce as 3*3=9. Similarly the other area also comes under the risk matrix value and it helps to reduces the effect of accidents and safe working area.

CONCLUSION

In Industry there is always a chance for accidents. This can be occur due to many ways like mechanical fault, human error, improper handling of machines, improper maintenance of the machines and working area.
In those areas can be assessed with the help of risk assessment to find out the hazards involve in it. This will be used as a data to calculate the risk values of each hazard. By make use of risk values, the appropriate corrective measures are taken to control it.
Those corrective measures are all relevant to the human behavior which is more needed to avoid accidents in working area. Thus the human behavior based safety concept is used to control and avoid accidents and leads to safe working places.

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