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ANALYSIS OF IMPLEMENTATION OF SAFETY MEASURES IN RUBBER RECYCLING INDUSTRY AND CORRECTIVE MEASURES FOR IMPROVEMENT

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Abstract: Safe workplace environment is a major concern for all involved in the industry premises especially recycling industries. Workplace injury and disease impacts heavily on the human and financial resources of organization. Environment, health, and safety (EHS) is a discipline and specialty that studies and implements practical aspects of environmental protection and safety at work. In simple terms it is what organizations must do to make sure that their activities do not cause harm to anyone. Hence this project is aimed to analyze the EHS Implementation in Rubber Recycling industry and finding out corrective measures to improve safety of Workmen. This thesis envisages the study of the hazards, risks and Challenges faced in rubber recycling operations and finding out practical solution for effective implementation of EHS Standards.

Keywords: rubber recycling, combustible dust, machine guarding, fire safety, chemical exposure

1.INTRODUCTION

Workplace injury and disease impacts heavily on the human and financial resources of organization. Recent studies show the indirect cost of workplace injury is between 7 and 20 times higher. Indirect costs include such things as absenteeism, loss of productivity, retraining, position backfilling, and labour turnover, loss of skill and experience, and decreased morale. Workplace injury is a major cause of concern for all involved in occupational health and safety. The factors which cause workplace accidents and occupational illnesses are called hazards. It is important to distinguish between hazard, risk and exposure when undertaking risk management. Hazard is the potential for harm, or adverse effect on an employee's health. Anything which may cause injury or ill health to anyone at or near a workplace is a hazard. Risk is the likelihood that a hazard will cause injury or ill health to anyone at or near a workplace. The level of risk increases with the severity of the hazard and the duration and frequency of exposure. Exposure occurs when a person encounters a hazard.

This results in the need of industrial Safety management and its promotion. Accidents or Incidents and consequent human injuries result in untold misery to the workers and in addition cause damage to product, property and environment. like production management, the safety management is also given priority by proper Planning, training, organizing, directing, and controlling of the human activities. It is well known that accidents do not happen; they are caused by unsafe conditions and unsafe practices. So, prevention of accidents should be given top priority in the present management system of any Enterprise by undertaking safety promotional activities. Safety is the responsibility of all managerial personnel, supervisory staff and workers in any organization. Top management's commitment to welfare of employees and formulation and implementation of safety policy is increased productivity. Safety measures result in achieving reduced level of occupational stress and improved quality of work life. Safety management can be defined as the accomplishment of safety objectives by first establishing the safety objectives and then by attaining them through process of planning, organizing, staffing, directing and controlling i.e. motivating and coordinating all efforts to attain those objectives and also innovating to improve them for future.

As it involveshazardous operations like dust and fumes exposure, interaction with equipment, pedestrian movement, Maintenance related hazards, Hazards while manual handling, the severity of any such accidents can be very high, often leading to fatality.

The project aims the study of the hazards, risks and Challenges faced in rubber recycling operations and finding out

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practical solution for effective implementation of EHS Standards.

2. LITERATURE SURVEY

2.1 INTRODUCTION

Industrial organization, safety is of prime importance (Akyuz and Cedik, 2014). The failure of industrial organization may have wide devastating consequences for worker's safety and the society in which such organizations are located (Reiman, 2007).The psychologists, sociologists and industrial engineers have been playing a major role in addressing employee safety and health problems at work and in advising on how to achieve safe and reliable operations in the industrial organization (Azadh et al., 2012; Battaglia et al., 2015). Chaudhary S.K. (2010) made a SWOT analysis which helps us to understand the Strengths, Weaknesses, Opportunities and Treats that the Small scale sector faced.

2.2 INDUSTRIAL SAFETY:

Cohen (1977) the success of an Industrial Safety Program is best defined by lower injury rates and accidents and as far as occupational safety is concerned, strong company commitment to safety, and informal/ formal communication between various levels of a company, careful staff selection and continuous training throughout the lifetime are the most contributing factors to make a safety program successful. The safety climate is related to the general safety level in the organizations and can be regarded as a characteristic of industrial organizations Zohar, (1980). Col S Rajeev (2000), concluded that in India most of industries and factory move into production without incorporate without all safety measures and safety arrangement are not keeping pace with the industrial development.

Alli (2001), worker participation is one of the most essential aspects of the occupational health safety management system of the organization and it is the responsibility of the employer to ensure that workers and their safety are taken seriously. Gupta J.P (2002),pointed out the major causes of Bhopal gas tragedy as, indifferent attitude of the management towards safety, lack of enforcement of existing regulations by regulatory bodies, lack of financial problems, reduction in workers amenities and cost cutting procedure. Girish Gundesha (2003) Accident happens due to unsafe working condition, defective plants, inadequate ventilation, insufficient space in or movement inside the plan can be prevented by taking precautionary measures in the work place by creating a safe work area.

Beriha, G S et al. (2011)determined the expenses in safety training were relatively more sensitive for improving safety performance of the organization as compared to expenses in health care and he underlines the importance of prevention over cure.Taderera, 2012 observed that the International Labour Organization (ILO) planned to facilitate the implementation, creation, and appraisal of occupational health and safety management system (OSH-MS) at different levels in all countries. The primary objective of ILO was to provide a unique international model to promote occupational health and safety. The industries that required heavy equipment used unsafe and primitive tools, injurious materials, and processes which produced injurious dust. Gouri Shanker et al. (2012) stated, that the workers who are overexposed to occupational injury know little or nothing about their rights or duties, or about the prevention methods available to them. It is important to make the workers to know about their rights and duties. As a matter of fact, the workers would know their rights and duties only after understanding the relevant provisions of law.

2.3 SAFETY RULES AND PROCEDURES:

Manufacturers of equipment and machinery conduct safety audits of their product as a part of product safety management programme during the design and manufacture (Hagan et al., 2001). This results in establishing the correct and safe operating and maintenance procedure for the equipment and these details will be supplied to the user on purchasing the same. Managers, supervisors and workers will be trained by the manufacturer to use the equipment safely and correctly. In India, The Factories Act, 1948 is the guiding document and various states have made Factories Rules based on the above central Act (e.g., `The Kerala Factories Rules, 1950'). Every organization has to prepare a Safety Manual based on these documents, covering the various activities employed in the organization. To what extent these are practiced in reality depends on the supervisors or first line officers who supervise the work. It is reported that, only if the supervisors are given the responsibility of worker's safety, with authority to stop work for safety lapses and award punishments to workers for noncompliance, the required priority will be achieved (Zohar, 1980; Hansen, 1993). Hagan et al. (2001) determined that safety of employees should not be considered as the botheration of the safety officers, but responsibility of all those who manage work and proper delegation of authority should accompany responsibility.In spite of all efforts, workers tend to deviate from correct and safe operating and maintenance procedures due to reasons such as work pace, over-experience, indifferent attitude, over-confidence etc. Enforcement of safety rules and procedures by supervisors achieve significance in such situations as reliable (Glendon and Lither land, 2001). Lee (1995), Donald (1995), Cox and Cheyne (2000), Flin et al. (2000) and Silva et al. (2004) considered safety rules and procedures as a factor influencing safety performance of employees in their studies.

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2.4 SAFETY PROMOTION POLICIES:

Activities from the management side to promote safe behavior include conducting recreational activities at relevant occasions to inculcate safety awareness among employees, giving rewards / incentives for notable contributions to improve or promote safety, giving safety records of employees due weightage in job promotions etc. The use of incentives, awards and recognition to motivate employees to perform safely is an accepted feature of both organization behavior management and total quality management models (Hagan et al., 2001). They can add interest to an established hazard control programmer which could enhance self-protection action on the part of the workforce (Cohen et al., 1979). Individuals are motivated to behave in particular ways that lead to preferred consequences. Thompson and Luthans (1990) states, "Organizational culture formation, maintenance, and change occur in a setting where there are multiple reinforcements and reinforcing agents, changing the organization which involves the identification of the various reinforcing agents so that an understanding of their effects on the change process might be determined". It is reported that reward system can be used to reinforce employees who call attention to safety problems and those who are innovative in finding ways to locate and assess and remove workplace hazards (Ostrom et al., 1993).

Laws (1996) has reported that, the city of Port Lavaca, Texas implemented a new reward system, accidents almost immediately dropped by more than half. Vredenburgh, (2002) determined the important feature of a good incentive programme is that it receives an elevated level of visibility inside the organization. Participants must be competent to understand what the incentive programme is designed to achieve and they must be made aware about how their performance would be measured (Halloran, 1996). Swearington, 1996, stated that a properly planned safety-incentive programme rewards the reporting of a vulnerability or an unsafe act that leads to an accident while giving bonuses for lesser lost-time accidents. A safety incentive programme must be a part and parcel of a drive that runs parallel to safety training programs. It should be intended for preventing accidents and not penalty after an accident takes place (Peavey, 1995). Social recognition, Informational feedback, and tangible reinforces (bonuses, incentives, etc.) have been used as well as non-monetary (perquisites) privileges (Komaki et al., 1978).

S. Prabakar (2013), emphasizes that there are several situational factors that contribute to the job satisfaction on a person. In his opinion, when safety measures are implemented as per the provisions of the Factories Act, 1948, it leads to employees being motivated. Webb (1989), agrees that people are in a better position to work efficiently only if when they are physically and psychologically comfortable stable to perform the allotted task and he establishes a strong link between implementation of safety measures and business productivity. Brandt-Rauf (2001), have reported the four determinant factors that attempt to explain the link between productivity of the employees and their overall health and safety. The factors are as follows:

1. Using innovative production/ working methods to reduce injuries at work place.
2. Being liberal and just as far as compensation costs go,
3. Increasing productivity without creating mental/ physical stress to the employees,
4. Offering good working conditions in order to ensure employee retention.

Pike (2000) states that health and safety should be given a different kind of priority. Safety measures should be, in a broader sense, considered as an initiative undertaken to raise efficiency, productivity and profitability of an organization. According Dubey, A.K. (2000), the working conditions pose a great risk to the health and safety of the people who work in such setups.

2.5 STUDIES ON ACCIDENTS, HAZARDS AND RISKS IN INDUSTRIES

Reveille (1980) determined the safety training methods in industries should be conducted for first aid and emergency procedures should be done as well as hazardous conditions and practices should be reported. Kjellen& Larsson (1981) developed an accident causation model as a result of research work within the Occupational Accident Research Unit (OARU) of the Royal Institute of Technology in Stockholm, Sweden. It was developed to serve as a common conceptual framework for the members of the OARU and as a basis for research into the development of a systematic safety management system. Dawson & Stevens (1983) proposed a safety management model designed around technical controls and motivational controls. They defined technical controls as those employed against specific hazards. Rasmussen and Jenson (1984) presented a three-level skill-rule knowledge model for describing the origins of the different types of errors. The errors done by a single person

Kurzman (1987) investigated the Bhopal gas leak accident due to the release of methyl-isocynaide gas and found that the lack of safety was the reason for this accident which killed around twenty-five hundered people and injured two-hundred thousand people. Sulzer-Azaroff (1987) studied employees attitude towards risks and risk taking. Employees often behaved unsafely, even when they were fully aware of the risks involved. Lakshmanan (1989) obtained a comprehensive picture of the accident scene in all its ramifications in the industrial precincts and to synthesize the factors and to explore the possibility of determining the “inductive indices” of jobs to signify the hazard potential of an industry. Stout et al (1990) analysed the accidents and found that despite differences in data acquisition methods, the traumatic work-related fatalities are the same in United States of America and Australia. LaFlamme (1990) devised a four-level model based on a system approach. The four levels were: work organization, working situation, accidental

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sequence, and the accident.

Reason Causation Model (1990) introduced the concept of organizational error. The author stated that corporate culture is the starting point of the accident sequence. Local conditions and human behavior are only contributing factors, in the build-up of the undesired event. Feyer & Williamson (1991) studied the role of work practices in occupational accidents and aimed at conclusion that the relationship between human and other factors provide insights about the causes of occupational accidents and their prevention. Greenwich Causation Model (1992)has developed reason's model by classifying the typical latent error types. The author's tripod models called the different error or general failure types. The concept of organizational error is in conjunction with the fact that some organizations behave more safety than others. Go-Etch (1993)found out that the advances in technology, new safety legislation, the potential for costly litigation, and a proliferation of standards have increased the importance of education and training for health and safety managers. Go-Etch highlighted the need for formal education prior to entering the profession supplemented by in-service training on a lifelong basis.

Tolley (1997)found that two-fifth of all major injuries are caused by falls from a height and it is the most common cause of fatality for workers. The National Occupational Health and Society Commission, Blair (1997) studied the perception of safety and health professionals on the importance of the management competencies needed by the safety educators. His study revealed that the respondent safety professionals believed that there were differences in the importance of various management competencies. Cooper (1998) noted that accidents were blamed solely on employees rather than the work process or poor management practices. Sundaraj (1998) investigated the risks associated with special purpose processes and evolved a methodology to reduce or eliminate loss producing event and to investigate the feasibility of employing neural network in predicting the severity of accidents in manufacturing enterprises.

Khan (2000) investigated on work environment in industries and found that 90% of the workers perceived that their work environment was unhygienic causing health risk problems and 70% of the workers developed illness after joining their jobs.

Elangovan (2003) determined pre-level of awareness score and post-level of awareness score on industrial safety following a well designed and implemented safety education program. The study revealed that there were significant differences in mean achievement scores obtained in the pretest and post-test due to the effect of implementation of the designed safety education program. If employees recognize in their executives genuine interest and vigilance, and if they know that this will be coupled with a swift word of encouragement – or correction when the occasion demands – they will also recognize that there is no lip service to safety, and will respond accordingly (Creber, 1967).

Arularasu (2005)tried to determine the personal beliefs and habits of employees, hazardous working conditions and machinery, lake of management commitment and lake of systematic and effective safety education and training. The study of safety education in improving safety awareness among the employees working in the manufacturing industries in the Indian context had not been studied so far. It was therefore felt that a systematic study of the safety education in industries was necessary and hence addressed in the paper. Chen et al. (2009)carried a survey in PCB manufactures and to was reported that the implementation of OHSAS 18001 in the PCB industries was driven by customers was noted that the most essential factor which influence the successful achievement of OHSAS in implementation practices was the top management commitment and support.

Battagha et al. (2015) reported an analysis of the maturity level of the policy and performance measurements were weakly emphasized in the system. It was concluded that companies had well-developed level of maturity with respect to their OHS management system. Koivupalo et al. (2015) mentioned kind health and safety management practices as well as tools to efficiency run a global steel company. The result of the investigation was that all the sites had a health and safety management system hinged on the requirements of OHSAS 18001 requirements. Nair et al. (2015) discussed how practitioners deal with safety evidence management for computer-based systems. Ramli et al. (2011) evolved an in intelligent data analysis in which possibilistic regression was used. This was hinged on a convex hull approach that was used as pillar of support for factors that influence occupational health and safety management system (OHSAS).

2.6 CORRELATING FMEA AND OVERALL EQUIPMENT EFFECTIVENESS

Chandrajit P Ahire , et, al., states that they had made an attempt relation between OEE & FMEA , all the parameters of OEE are evaluated with respect to FMEA . The performance and quality rate are to be calculated using the similar data from OEE and RPN and to be computed. The correlation and mini tab techniques are being used.

2.7 OCCUPATIONAL HEALTH AND SAFETY

Gouri Shanker et al. (2012) "that the workers who are overexposed to occupational injury know little or nothing about their rights or duties, or about the prevention methods available to them." It is quite evident that the study underlines the importance of the workers knowing about their rights and duties. As a matter of fact, the workers would know their rights and duties only after understanding the relevant provisions of law.

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2.8 FAILURE MODE EFFECT ANALSIS

Marc Banghart Mississippi State University(2014)discussed about Failure mode effect analysis of the objective of this contribution is to provide a review and suggest possible extensions of the Failure Mode Effects Analysis(FMEA),Hazard Risk Assessment (HRA) and to demonstrate the importance of these tools to general probabilistic design for reliability (PDfR).FMEAwasfirstintroducedinthe1960sby the U.S. National Aeronautics and Space Administration(NASA) and is currently used extensively across many industries. FMEA issue ful in understanding the failure modes of various products, qualifying the effect so failure and aiding in the development of mitigation strategies. It is a useful too lin improving quality, reliability, and the maintainability of designs, and is a critical component in risk management strategies and evaluations. This is, actually, the approach of the prognostics and health monitoring/management(PHM)engineering. Failure mode effects and criticality analysis(FMECA) [1) is an extension of (FMEA). While FMEA is a bottom-up, inductive analytical method which may be performed at either the functional or piece- part level, FMECA extends FMEA by including a criticality analysis that is aimed, like PDFR is, at charting the probability of failure modes against the severity of their consequences. Theres ulthigh lights failure modes with relatively high probability and severity of consequences, allowing remedial effort to be directed where it will produce the greatest value. FMECA tends to be preferred over FMEA inspace and North Atlantic Treaty Organization(NATO)military applications, while various forms of FMEA predominate in other industries. Being extensions of the FMEAs, FMECA sadd severity and probability ranking aspects to the problems of interest.

3. EXISTING SYSTEM

Major Safety hazards observed in rubber recycling industry are

CHEMICAL EXPOSURE: Recycling tire, rubber tubes and flap components as well as metal scrap recycling typically involves separating scrap into its component metals and rubber crumps. These materials pose a potential health hazard to employees when they are ground/shredded, blasted, roasted, or melted and fumes or metal dusts are produced and distributed in the air.

COMBUSTIBLE DUST EXPLOSIONS: Processes that grind combustible dust such as metals and rubber may have the potential for a combustible dust explosion.

MACHINE GUARDING HAZARDS: Scrap rubber and flaps is commonly grinded with crushing and milling machines to more effectively process the material. .

LACK OF LOCKOUT/TAGOUT: As stated in recycling safety challenge #3 (machine guarding hazards), recycling involves powerful equipment with moving parts. This equipment must be routinely cleaned and serviced.

FREQUENT BURNING / FIRES: Fires and explosions routinely occur in the recycling industry due to poor housekeeping and lack of safety awareness of workers. It is also observed that workers rest room and cooking area is very close to the plant hall and workers uses kerosene as fuel for cooking. Similarly hot work activities such as welding and cutting performed without a work permit system. This possesses very high risk of fire incidents

4. PROPOSED WORK

4.1 METHODOLOGY

Conducting a risk assessment for all the hazards identified initially and then conduct detailed risk assessment of five high safety risk activities. Find out whether the controls measure like crusher and milling operations can have any operational shortfalls and recommend standard operating procedure to overcome the same.

Risk assessment:

Risk assessment considers those hazards which are found to have a significant risk rating even after the current level of control measures.

Risk Ranking method

Level	Descriptor	Example detailed Description
1	Rare	May occur only in exceptional circumstances(e.g once in 100 years)
2	Unlikely	Could occur some time(e.g once in 10 years)
3	Possible	Might occur some time(e.g Once in 5 years
4	Likely	Will probably occur some time (e.g .Every year)
5	Almost Certain	Is expected to occur in many circumstances(e.g many times a year)

Table 4.1 Likelihood ranking method

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Severity level	Safety
1 Insignificant	Hazard identified with no injury
2 Minor	First aid treatment, 1-2 days workdays lost
3 Moderate	Medical treatment injury ,> 3 days lost time
4 Major	Single fatality, Extensive injuries such as permanent disability/amputation
5 Catastrophic	Multiple fatalities

Table 4.2 Consequence /Severity RankingTable

	Severity					
Likelihood	Almost Certain	M (5)	H(10)	H(15)	E(20)	E(25)
	Likely	M (4)	M (8)	H(12)	H(16)	E(20)
	Possible	L (3)	M (6)	M (9)	H(12)	H(15)
	Unlikely	L (2)	M (4)	M (6)	M (8)	H(10)
	Rare	L (1)	L (2)	L (3)	M (4)	M (5)

Table 4.3Risk Assessment Rating Matrix

4.2 Proposed Solutions for implementation

4.2.1 CHEMICAL EXPOSURE: Proper work practices are needed to minimize employee exposure to these materials. Engineering control measures such as local exhaust ventilation equipped with dust collection systems are also valuable in controlling workplace and environmental exposures. In addition, periodic air sampling should be performed to verify air contaminants are below acceptable levels. Some contaminants found in this industry include lead, cadmium, mercury, and hexavalent chromium. Noise exposure to be controlled by creating noise isolating zones and earmuff for those exposed.

4.2.2 COMBUSTIBLE DUST EXPLOSIONS: Recyclers with combustible dust hazards need adequate protective systems such as: spark detection; automatic suppression systems; and deflagration venting. NFPA 654: Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids should be consulted for guidance.

4.2.3 MACHINE GUARDING HAZARDS

All moving parts of the crusher and milling machines need to be guarded to protect against employee contact. Also, all other equipment with moving parts such as rotating belts, pulleys, as well as grinders need adequate guarding to protect employees against crushing hazards.

4.2.4 LOCKOUT/TAGOUT:

As stated in recycling safety challenge #3 (machine guarding hazards), recycling involves powerful equipment with moving parts. This equipment must be routinely cleaned and serviced. It is imperative that employees do not place any part of their body into moving machinery until the equipment has been locked/tagged out.

4.2.5 BURNING / FIRES:

To prevent against similar incidents, a hot work permit should be issued to verify all equipment has been properly purged of flammable liquids/materials and ventilated as needed. In addition, a combustible gas meter may be needed to verify the absence of flammable vapor.

8. RESULT

This project mainly presents to reduce the hazards and risks in the rubber recycling plant premises with effective implementation of EHS Standards eliminating all the Practical difficulties.

In Phase 1, I have covered all the EHS Standard developed for eliminating hazards in a Rubber recycling Industry. Based on this Survey results of Phase I, I have assessed top five significant hazards and developed control and preventive action plan in Phase 2 of the Project. The control measure must be able to eliminate the hazard practically by forming a system which controls the EHS drive of the rubber recycling factory.

9. FUTURE WORK

The framework for a systematic implementation of significant risks reduction which can prevent the major hazards to a great extent is prepared. This need to be included as part of organisational policy and health and safety program so that

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this can be enforced by all departments and any future chances of accidents related to high risk activities and exposure eliminated.

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