

# PREVENT SAFETY & ERGONOMY HAZARDS BY ELIMINATING RISK ASSESSED DURING SCRAP BALING OPERATION

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**Abstract—** to be successful in any industry, it is vital to identify hazards, analyze associated risks, and reduce risks to a bearable level. Due to the complex nature of the operation, systems, procedures, and methods in the scrap baling machine always involve some level of risk. The various hazard of risk assessment are huge regarding out industry as contribute crucial to improve in the safety of implementation operations and equipment. Aim of risk reduction process is find and analyzing hazards, and safety as well as the event of sequenced that lead to hazards and the risk of hazard occurrence. This article examines the use of the Workplace Risk Assessment and Control technique to detect, analyze, and control hazards in a scrap baling machine in a stainless steel facility. The result of the inspection while the demo practices in various orchard and plantation regarding the performance of the machinery, farmers' habits, and pruning residues harvesting formulate presented, in the order of diagnose and find any crucial risks that may find and opposite impact the major environment. While the storage and transportation test is similar to actions were carried out. The assessment of the safety strategy was carried out in accordance with the inspecting and offering list of orient to constructive to find the environmental impacts. Further particular plans and discussions have been developed to prevent the risk assess went to minimize the hazard of accidental and harmful interacts with the safety and environment help of ISO 14001 this methodology definition of risk and prevention of safety proposals.

**Index Terms—** Fabrication and production industries, Ergonomics risk assessment, Un aware Related injuries, Enhance the PPE, Occupational hazards Prevent safety, Control measures

## I. INTRODUCTION

Loading person operate the scrap machinery with cotton hand gloves without metal gloves will result in finger cut injury, standard goggles and no face shield will result in face cut injury, and operator utilizing cotton hand sleeve without leather hand sleeve will result in forearm cut harm Operator wearing a regular PVC apron without a leather apron may suffer a chest skin cut, and the likelihood of the compression plate falling down when the control valve fails will result in a deadly and serious harm. The facility had not suffered any ergonomic injuries as a result of the baling operation, but previous corporate records indicated that lumbar injuries were related with medical and disability costs. The installation of engineering controls resulted in a slew of beneficial health, business, and risk-management outcomes. Tooling life was extended, and so tooling expenses were lowered, which enhanced the business process. The intervention had a number of risk-management benefits, including improved connections between the division and the rest of the company.

(ColeHP et al., 2012) “Ergonomic Assessment Of Working Postures This is a method of assessing the work environment and the work to be done in order to identify all dangers inherent in the job or present on the working site. Several factors can aid in the detection of hazards on the working site and in the work area. I'm going for a walk around the office to see what's there. Inquiring about what other employees think about what they've noticed. Examining a job safety analysis or work instruction. Examining the operator's manual. Previous incident reports are being reviewed. After a danger has been contribute to the risk before beginning a risk assessment. A examination of regulations, past injury reports discovered, the risk associated with it must be investigated..

(EipperJet et al., 2019)[3] “Ergonomic Evaluation of Work Place in One of the least-publicized properties of the energy business is the scrap metal sheet and storage markets associated with platforms and cutting process. Structures, rigs, and marine vessels participated to scrap supply in coastal department and are a significant industry for many major economies, but they are considered minor contribute to total supply when compared to other scrap recycle process. There are three Part of this four section series following out shore diagram through the scrapping procedure and manage market area that affect major competitive. The cost of scrap metal sheet metal is influenced by several of methods. We wrap up with a quick rundown of the major stakeholders in the scrap business.

(Kaizer M.J & A.G Pulshiper et al., 2017) “Rapid Entire Body Assessment (REBA)”. ANSYS WORKBENCH software was used to apply topology optimization to various components of a scrap baling press and a 5Ton hydraulic press in this project. On the original design space of the components, appropriate loads and limitations are applied. ANSYS software has also been used to provide an integrated approach for verifying structural performance. Finally, the shape optimized design model is compared to the actual press part that is being made. Topology optimization, it is assumed, leads to During the garbage baling operation, the dangers connected with manual handling were minimized. The new baler collects garbage directly from packaging production equipment and bales and stacks it mechanically. The intervention eliminated the need for three operators to spend 30 minutes at the end of

three daily shifts hand-loading scrap on to the old baler, in addition to removing the ergonomic concerns. The intervention also reduced the requirement for operators to wear personal protective equipment (PPE).

(McMahon K et al., 2021)[3] “As a result of a miscommunication between two primary design groups, the system design requirements were misunderstood. The mechanical group had planned for the system to function in one of three modes, but the electrical group's design only allowed for one. This was not discovered until late in the programmer, when two mechanical engineers were sent to inspect the overall system and test processes. They discovered that the device could only be operated in a fully automatic mode; semiautomatic or manual operation was not conceivable. This was an extremely humiliating turn of events for the contractor, and it surely harmed their reputation with the consumer. This might have been avoided if the overall system and procedures had been examined and tested early in the design phase, and the design process had been updated on a regular basis. Another strategy that requires little effort or expenditure but provides significant benefits in specific scenarios during design and development programmers is the Simple models are used.

## II. ELIMINATION OF ERGONOMICS RISK ASSESSMENT

Ergonomic risk assessment is a component of the risk management process, which will include a systematic analysis of potential hazards to health and accidents. The goal of an ergonomic risk assessment is to eliminate work-related health risks by identifying existing or potential hazards that could lead. Once risk factors have been identified, interventions to reduce or minimize them must be implemented. Risk assessments can also be used to assess the effectiveness of a workplace intervention.

### *Objectives of ergonomics risk assessment*

Hazard analysis is described as the process of gathering and analyzing data on hazards and the factors that lead to their presence in order to determine which are important for food safety and should be addressed in the HACCP plan. All the Member of the department also invited to internship closely with their chief and staffs in the department or at the university who have knowledge, information department, or experience with the work they are prepared

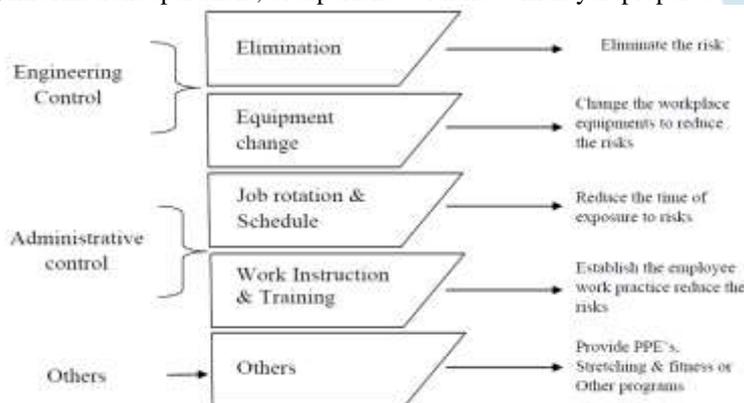


Fig.1 Hierarchy Chart

Standing table, modification chairs and workstations, footrests, anti-fatigue standing mats, occupational therapy, and training to improve aware the safety posture are all possible workplace modifications.

### *Work Related Injuries*

The hand is an incredible feat of anatomic engineering, both in terms of design and function. If any injuries in hand, form follows first aid section; thus, hand injury to the under discussion treatment of the hand has the medical to cause crucial injuries. Even minor hand injuries should be analyzed by doctor to prevent this danger injuries. When it happen the hand injuries, achieve is to have a immediate and suitable diagnosis and treatment. In other words, after an injury occurs, the doctor tries to start medical therapy as soon as possible to reduce the short- and long-term impacts on the hand.

Saphead fractures are a form of wrist fracture that is very prevalent. Tenderness and swelling are seen at the base of the thumb. Striking the ground with a stick or producing a divot while playing golf can cause hamate hook fractures. Thumb sprains (also known as gamekeeper's thumb or skier's thumb) are tears in the ligaments that connect the thumb to the hand, most commonly on the palm side. People cannot pinch a ligament that has been severely sprained. A sprained ligament requires surgery or splinting to be repaired. Falling on an outstretched hand can rupture the scapholunate ligament, a ligament in the wrist. The word "pain" comes to mind.

Keep your face and eyes safe. Face shields and safety glasses protect you from flying debris, shattered parts, and chemical or hot substance splashes. If you're working with hot materials, use face shields made of heat-resistant materials that won't melt, burn, or shatter. Hats, hair bands, and hair nets help keep your hair out of moving machine parts. The face and eyes have a structure that ideally suited to protecting the eyes from harm. The orbit, a socket enclosed by a strong, bony ridge, houses the eyeball.



Fig 2 Initial stage of working style

### III. PROBLEM OF STATEMENT

Process control is the ability to monitor and adjust a process to give a desired output. Many types of process control systems exist, including supervisory control and data acquisition (SCADA), programmable logic controllers (PLC), or distributed control systems (DCS), and they work together and transmit data obtained during the manufacturing process.

#### *Fatigue Of Workplace*

Workplace fatigue is defined as a person's reduced ability to perform their job effectively. This could be due to both physical and mental exhaustion. These symptoms can develop over time and, if not addressed, can be detrimental to overall well-being and productivity. The symptoms of fatigue can include-Extreme tiredness, Feeling sleepy, Muscle pain, Struggling to concentrate, Feeling dizzy, Low mood, Blurred vision, Headaches, Poor judgments.

Workplace fatigue can have a negative impact on safety and productivity. Fatigue symptoms can contribute to more accidents and injuries. Musculoskeletal Disorders can be long-term consequences of workplace fatigue. Work-related Musculoskeletal Disorders are frequently associated with jobs that require workers to stand for the majority of the day. They are typically defined as issues that can affect the upper limbs, back, and lower limbs.

These signs can often indicate if an employee is suffering from fatigue-Visible signs of pain or discomfort while standing or sitting, Absenteeism, Regular yawning, Looking drowsy, Changes in working behavior, Lower productivity, Struggle to concentrate, Reduced level of good judgments, Slower reflexes.

#### *Injuries among Scrap Baling Operators*

SL.NO	BODY PART	NUMBER OF CASES	PERCENTAGES
1	head	8	7.08%
2	hand including fingers	41	36.28%
3	back	4	3.54%
4	foot	11	9.73%
5	leg	11	9.73%
6	abdomen	3	2.65%
7	face	2	1.77%
8	eye	3	2.65%
9	chest	1	0.88%
10	shoulder	4	3.54%
11	multiple body parts	1	0.88%

Tab 1 Body Parts Injured In Scrap Baling machine

#### *General Ergonomic Risk Factors*

These are the factors for developing an operator accidents and injuries: Force, Heaving lifting, Push or pull, Carrying, Gripping, Awkward or prolonged postures, Repetitive activities, Overhead work, Contact stress, Vibration load.

### IV. METHODOLOGY

A well-designed assessment tool's goal is to take information gained from research on the causes and effects of strain on the human system and organize questions, calculations, or data to help visualize and predict when this strain reaches levels that could lead to work-related musculoskeletal disorders.

#### *Entire Body Assessment of operator*

A hydraulic structure is mechanical devices that lift or compress a different of components and parts. Hydraulic oils are used to strength of the inside the cylinder, which generates the force. Pascal's principle is used to operate the hydraulic press machine. Bramah receive a right for his hydraulic load. While Brahma and William George Armstrong are the two pioneers in this industry, we have evolved the press machine designs to an advanced degree over time. A hydraulic press machine is made up of basic hydraulic system components such as a hydraulic cylinder, piston, ram, fluid flow pipelines, oil reservoir, and controller. The

hydraulic oil press the piston inside the cylinder, awaking the piston to move. The material is subsequently compressed by a ram attached to a piston.

The inquiry examines the machine's theoretical and experimental model in order to establish an accurately optimal design analysis and further development of the current machine in the shortest possible time and at the lowest possible cost. The theoretical model uses Finite Element Analysis to account for both traditional analytical formulas and numerical techniques. The goal of modeling the construction of this press is to provide an empirical technique of calculation for determining the stiffness and strength of the press structure. The current work's data acquisition system has been built to establish a diverse measurement system so that the computer can measure the processing of the experimental variables of interest using Computer Aided Design.

### **Importance of Body Assessment Method**

It is concluded that the use of the Rapid Entire Body Assessment method has increased over the last decade, most likely due to the digitization of knowledge. It is almost always used in conjunction with other methods, and its use can be a good indicator of a company's long-term viability.

The intervention also improved operator morale by removing an unpleasant chore that was routinely rotated among the facility's 47 production personnel. The automated baler significantly lowered the amount of paper dust generated during the scrap-handling operation, in addition to the direct labor savings. This resulted in less paper dust being spread across the site, resulting in less cleaning space and labor time, as well as a cleaner process and product. The property insurance carrier deemed the facility's risk being lower as a result of the reduced dust build-up.

### **Rapid Entire Body Assessment processes Steps**

In a recent advisory, the National Institute for Occupational Safety and Health (NIOSH) recommends many workplace precautions for minimizing job-related deaths and injuries connected with baling and compacting devices.

Ahead fractures are a form of wrist fracture that is very prevalent. Tenderness and swelling are seen at the base of the thumb. Striking the ground with a stick or producing a divot while playing golf can cause hamate hook fractures. Thumb sprains (also known as gamekeeper's thumb or skier's thumb) are tears in the ligaments that connect the thumb to the hand, most commonly on the palm side. People cannot pinch a ligament that has been severely sprained. A sprained ligament requires surgery or splinting to be repaired. Falling on an outstretched hand can rupture the schoolmate ligament, a ligament in the wrist.

**Identify a job-**We can identify a job to assess by reviewing work postures, strained postures, and repetitive tasks, as well as where previous injuries have occurred, operator complaints have been reported, or quality issues have been raised.

**Understanding the Tasks within the Job-**Interview the operator to learn about the main job tasks, the task demands, and the operator's perception of the most difficult component(s) of the job. Identify the job-related tasks- Intuitively; they appear to be the most vulnerable to hand injuries. Choose the "worst" parts of the task to evaluate based on personal observation and information gathered from the operator interview. This should be determined by the most awkward postures present, the most force exerted, awkward postures held for an extended period of time, or awkward postures repeated multiple times. Take a photograph of the "worst" moment

**Complete the data collection form-**The Body Assessment assesses the entire body, including the upper and lower arms, the wrist, the neck, the back, and the legs. Compare the position or postures of each body segment in the photo to those outlined on the REBA data collection form. Based on these postures, the REBA assigns a score to each body segment. It should be noted that if the upper limbs are performing different actions, they must be analyzed separately.

**Determine the REBA score-**The Rapid Entire Body Assessment assigns a single final score based on the evaluated posture, force requirements, type of movement, frequency of movement, and coupling within the task. This single value, ranging from 1 to 15, represents the operator's work-related human organs risk. It also adds a sense of urgency to workstation engineering changes. A score of 8 or higher indicates that the workers completing the task are at high risk of Musculoskeletal Disorders and that engineering controls are recommended.

**Continue the job improvement process:** If we have a low- to very high-risk final score, we may need to develop solutions to reduce the worker's Musculoskeletal Disorders risk. Check the work after the improvement(s) have been implemented. Complete another REBA data collection form; if our improvements were successful, our final score should be lower. This is a critical step because it allows the evaluator to check in with the operators (do they like the change or are they adapting to it) and ensures that the improvement did not introduce new Musculoskeletal Disorders risk factors.

### **V. DATE COLLECTIONS**

Domestic or industrial mishaps (for example, from using a hammer or liquid chemicals or cleansers), sports injuries, and motor vehicle incidents are all common causes of eye injury. The clear dome on the front surface of the eye can be damaged by powerful UV light, such as that emitted by a welding arc or bright sunlight reflected off snow. People who suffer from eye injuries are more likely to suffer from additional head or neck problems. Structures at the front of the eye Structures in the back of the eye Structures surrounding the eye may be damaged by an impact. Impact can result in bruises and wounds (lacerations) to the eye's tissues. Bleeding at the front and rear of the eye (vitreous hemorrhage), tearing of the cornea



Fig.3 Ideal stage of scrap baling machine

## VI. CONTROL MEASURES & RECOMMENDATIONS PROPOSED

Table 2 Final Assessment & Control Measures

S.No	Injuries in human organs	REBA Final Risk Level	Control Measures					
			Engineering Control		Administrative		Others	
			Elimination & substitution	fabrication Change	Awareness of operator	Training provide to operator	Current PPE's	Enhance the PPE
1.	Loading of scrap	Medium, High risk	NP	P	P	P	P	P
2.	Operate of scrap machine	Medium, High risk Very High risk	NP	P	P	P	P	P
3.	Unloading of scrap	Medium, High risk,	NP	P	P	P	P	P

NP: Not Possible

P: Possible

Following an assessment of all sections of work and worker interviews, we proposed some recommendations to reduce the very high risk, high risk, and medium risk levels to a lower risk level. These are the

- Automatic start with sensor control will reduce the hand and head and eye body injuries
- To be provided safety crucial training, to reduce the extensive reach of the workers and ease of handling.
- Fabricate the baling machine bed clamp used to secure operate and material handling in place
- To be provided partitions suitable PPE, to reduce the extensive reach of the material handling.
- Safety Guard implemented, mechanical safety device to control compressing plate system implemented.
- Electrical safety interlock system implemented safety control is in pool proof.
- Adequate PPE provided adequate material handling system implemented appropriate PPE usage.
- Eliminate all Unsafe Act and Unsafe condition identified & reduce all operational Risk of operators and Improve Ergonomics.
- Enhance PPE and Ensure effective utilization. Implemented sensor control device with electrical interlock control setup
- Design & Develop safety mechanism with Special Pneumatic Latch Enhance Material Handling equipment to improve Ergonomics.
- Loading scrap in to the with cotton hand gloves and plain goggles as the PPE chamber. Possibility for finger cut injury during Scrap loading to bale chamber.
- Loading scrap in to the chamber with cotton hand gloves as the PPE Possibility for forearm injury during Scrap loading to bale chamber
- Loading scrap in to the chamber with cotton hand gloves and cotton sleeve as the PPE Possibility for scrap to tear the chest skin during Scrap loading to bale chamber.
- Loading scrap in to the chamber with cotton hand gloves, cotton sleeve & apron as the PPE. Possibility for scrap to tear the face skin during Scrap loading to bale chamber.
- Possible injuries in Scrap Cut finger ,Scrap cut forearm, Scrap Cut chest skin, Scrap Cut face skin
- Loading scrap in to the chamber with Metal hand gloves, plain goggles, leather sleeve, leather apron & Plastic face shield as the PPE Zero Harm, Revised and ensured 100% adherence.
- Operator operates the start button to enable the compression plate movement and the plate begin to move with No interruption in between. Possibility for other person to press the start button leading to compression plate movement while

the main operator is loading the scrap in the chamber leads to fatal, Compression Plate press operator head, Provide mechanical safety guard and sensor control device with electrical interlock.

- Mechanical guard and sensor controls are provided such that the possibility of Body and hand movement in to the chamber is totally prevented and also controls are provided to stop the plate abruptly on interruption, zero harm, Fool proof safety device system in place.
- Operator insert his hand in to the chamber and lift the bale while compression plate is free to fall in case of mechanical failure Over period of use, Possibility for compression plate joint to get broken and fall on operator hand during unloading, Compression Plate fall and cut operator hand Provide Pneumatic operated mechanical safety latch with sensor based electrical interlocking.
- Pneumatic operated mechanical latch is provided to prevent free fall in case of mechanical failure. Zero harm, the latch will hold compression plate inspite of plate getting broken.
- Operator lifts the bale and bends 90degree to unload bale to pallet truck leading to Musculoskeletal Disorders. based on REBA study, as REBA score is between 11-15 due to possibility for Musculoskeletal Disorders and hence treated as Very high risk level. Poor Ergonomics. Improve material handling system and ensure usage
- Material handling system is improved such that Bending is totally avoided, Zero harm, No possibility for Musculoskeletal Disorders.



## VII. CONCLUSION

In this study and control measures of prevent safety and ergonomics risk assessment in scrap baling operation, The number of complicated problems facing engineers has risen dramatically in the recent decade, as has the technical expertise and understanding in science and engineering required to solve and mitigate these issues. As new opportunities and very complex issues emerge, the globe is becoming increasingly interconnected in ways we are only beginning to comprehend. When packing recycled stainless steel scrap materials in a baling machine, operators should not wear simple goggles, cotton gloves, or cotton handsleeves. They have to be careful in protecting themselves with the utilization of protective equipment such as iron tubes and rods around the machine. If they do not wear protective equipment, they will sustain several injuries, thus PPE must be improved to allow the engineering fabrication process to be excellent around the machine to protect the machine operator from the step baling machine. After addressing all the risk assessed, we are confident that we will have no possibility's for injury's and incidents happening in the process .They are confident that the process is fully safe and operator friendly.

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