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Occupational health hazards of welding workers: Piping Industry Perspective

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Abstract
The ergonomic safety standards are focused on the interaction between welders and the welding activities. Welders who perform the welding tasks under heat stress always experience with various types of injuries such as MSD, CTD, low back pain, skin burns, eyes pain and others. It influences the concentration in their welding task because of the injuries suffers. The study conducted at DEE PIPING SYSTEM Ltd. for the ergonomic safety in the welding workshop. The study aimed at enhancing the safety awareness of users in the welding workshop. The lack of knowledge on ergonomic safety concepts affects the performance of the welders in their works. The study briefs various postural analyses in welding activities. The observation method approach has been used. The welding safety awareness checklist has been used to expose the safety precaution, and to provide suggestions for the work improvement. The various safety issues have been observed that must be taken care of such as the hazards precaution, personal protective equipment, workstation, etc. The welding postures must be improved as most of the postures posed were out of the safe range. The recommendations have been made to introduce the ergonomics concept so that users may practice healthier life, and avoid injuries while performing welding in welding workshop.
Keywords: Ergonomics, Safety, Welding Work, Musculoskeletal Disorder, Carpaltunel Syndrome disorder

1. Introduction

Ergonomics can be defined as the scientific discipline that concerns with the understanding of the interaction between humans and work system. Ergonomics was about designing to achieve maximum efficiency and to avoid physical discomfort or pain in the working environment. Ergonomics looks at ways of reducing fatigue by focusing on how work affects people [1]. Ergonomics risks factors are the aspect of a job or task that impose a biomechanical stress on the worker, and it can be classified into several types such as force, vibration, repetition, contact stress, awkward postures, extreme temperature and static posture. In the research study, investigated the safety problems faced in the welding workshop of DEE PIPING SYSTEMS that may bring adverse effects to the human and hence influence the healthy life of the welders. The safety welding can be investigated to increase the safety awareness of users in the welding workshop. It is very important for every welder to know about the safety in the workshop. Although there are many safety rules in the workshop the most significant question is how strictly the safety rules of the workshop is enforced. The paper also presents the unsafe working posture that may produce diseases to the welders when they operate with the welding machine in long and short-term duration. This investigation is mostly carried out by using the ergonomics concept in safety approach towards work improvement. A postural analysis tool is available for assessing exposure of workers to the risks and potentially hazardous task within the workstation. Postural analysis tools are classified into observation method and direct measurement method. The postural analysis tools has used in the paper is belonging to the observation method

such as awareness checklist. The solutions to improve the safety in the welding workshop are proposed to reduce the risks that confronted by the welders. It is important to remember that prevention is the vaccine for the disease of injury [2,3].

2. Literature Review

Ergonomics hazards are workplace conditions and physical stressors that cause a risk of injury or illness to the workers musculoskeletal system of specific interest are those hazards that pose a cumulative effect on the workers and which are called cumulative trauma disorders (CTD) or work-related musculoskeletal disorders (WMSDs). They are also known as repetitive strain injury (RSI) in Canada and the United Kingdom and cervicobrachial syndrome or occupational cervicobrachial disorder in Japan and Sweden. It gives the list of disorders commonly attributed to repetitive strain injury [4]. The term musculoskeletal disorders as described in the disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs disorders that are not typically the result of any immediate or acute event such as a slip, trip, or fall - disorders diagnosed by a medical history, physical examination, or other medical tests that can range in severity from mild and intermittent to debilitating and chronic [5].

The ergonomic risk factors that can lead to CTD include repetitive and forceful motions, static muscle load, mechanical stress, vibration, temperatures extreme, and awkward postures [6]. There are also psychosocial and physical factors to consider. These include cognitive and emotional stress relating to work task, social relationships, individual psychological factors, administrative concerns, lighting, noise and indoor climate [7]. The previously mentioned factors present a musculoskeletal hazard independently of mechanical exposure [8]. In a landmark study [9] it was argued that, in addition to prior back problems, work perceptions and some psychosocial responses were the only factors linked with reporting low back pain during a four-year follow-up period.

It has been a considerable increase of CTD in the last few decades. In the United States, the number of reported upper-extremity disorders has tripled between 1986 and 1993 [10]. A similar trend is seen in other industrialized nations. Indicates, "Work-related musculoskeletal disorders constitute a major problem in many industrialized countries." CTD's accounted in the United States for over 60% of all occupational illnesses in 1990 [11]. Part of this increase is attributed to better recognition and reporting [12]. Also, of considerable importance, is the fact that work in a stressful and highly competitive global economy tends to be highly paced and repetitious [13]. The economic burden CTD because employers are enormous. In the United States, it is estimated that the cost of compensation exceeds twenty billion per year. These types of disorders are also more expensive than disorders of similar pathology caused from acute trauma [14].

3. Work Methodology

The main methodology used for this project is the observational method. The advantages of using this technique includes the work tasks were not designed for the purpose of the investigation but represented the real conditions under which the welders worked. There was little interference with the tasks that the workers performed. Therefore, the pace and work practices of the welders were a good representation of the actual working conditions. Data was collected using informal interviews, photos, and observation. This work was a five months ergonomics assessment of a pipe manufacturing industry name DEE Piping System located in Palwal on February 2013. This industry deals in pre-fabricated piping spools for oil, gas and power sectors. Specifically, specialty 80% piping fittings are done inside the industry remaining 20% done on the site. The industry layout is setup in workstations that flow from the receiving/shipping area through different process shops. In these shops workers, machines, tools, and material come together to craft the final product. This work is based upon welding shops of Dee Piping System. The majority of the welders at the welding shop is skilled and enjoys a certain degree of work variety. Consequently, the ergonomics concerns and solutions are somewhat different from those commonly attributed to facilities using welding shops. The main ergonomics risk factor observed in the welding shop deals with awkward postures. These poor postures can be detected when welder performs tasks at their worktables. Lifting issues can be solved by the use of proper material handling devices in conjunction with correct lifting

techniques. Worktable tasks that require the employee to take on an awkward posture can also be improved. The first alternative should always look into system redesign. This can be applied to the worktable, vise, fixture or any equipment to improve welding posture. Training is an essential tool that can be used in the welding shop. Welders should be trained on how to identify ergonomics risk factors and how to properly avoid them and report them to management. Training is a good investment since the welding shop workforce is already skilled and will tend to have a low turnover. Further, management should also be trained on recognizing these risk factors and how to effectively control them. Training and ergonomics awareness is especially important in these types of industries since having a full-time safety professional might not be cost effective. The overall work environment at this industry from an ergonomics point of view is acceptable. The changes recommended in this project would help to reduce ergonomics problem and improve the work quality, safety, and job satisfaction of the entire workforce. To perform the ergonomics evaluation, the following method was followed that was meeting with the Operations Manager, A plant tour guided by the Operations Manager, Plant walk through, Station-by-Station ergonomics analysis according to the informal interviews.

3.1 Observation during Welding

Fig.1. Welding in awkward postures on one side of the pipe

Fig. 2. Welder Bending His Neck & back when Performing Task.

In figure 1 the welder performs their task in awkward posture on one side of the pipe. His back is slightly bent, but his neck is more bend. The posture of the neck is awkward posture. The same welder was performing welding in the center of the pipe. The welder performing this task is bending his back, neck more as compared to previous when performing the task as seen in figure 2.

The manner in which the work area is setup required him to constantly bend his back, neck, and deviate his wrists from the natural posture. It is the stress on the neck caused by this poor posture. The neck is subjected to the continuous load produced by the weight of the head. It was also mentioned that a shorter employee also had difficulty in adjusting to this particular work stand. Each work stand should be adjustable to the necessities of short and tall welders. The purpose behind this feature is to allow the welders to perform their tasks with a posture that closely approximates his/her natural stance. The work stand could also be improved by designing it was desirable to the type of parts. For example, the parts, in this case, are a pipe and consequently of heavy weight. These features should be considered when designing or choosing an appropriate work stand. In the next section the welder weld a big pipe inside. It requires constantly swing a handle observed in the figure 3.

Fig.3. Arm of the employee in an awkward posture causing stress to the shoulder

Fig. 4 Welding on sitting on a ladder inside the pipe is bending his back, neck.

The welder is performing the task with high repetition. It also positions the arm of the employee in an awkward posture causing stress to the shoulder, elbow, and wrist. This is especially of concern in periods of high production to meet increased demands. This risk factor can lead to disorders called repetitive-motion disorders, and its effects range from joint inflammation, muscle soreness, to nerve entrapment. It is a common shoulder, neck, and back pain complaints associated with repetitive tasks as in working above chest height or with extended forwarding reaches. It is suggested after the study to take frequent breaks to reduce these problems.

In the same task, a ladder used to sit on it inside the pipe for welding the lower part of the pipe. This constant action from the welder causes unnecessary stress to his back, hands, wrists, and fingers. This task can also be characterized as repetitive since this procedure is repeated continuously observed in figure 4. In the welder is joining a small pipe but the area around him is very dirty. There are lots of weirs and object at that place which are not placed systematically. This can lead to trips, falls, contusion, abrasion, and sprain ankles are shown in figure 5.

Fig.5. Welding in a dirty area and awkward posture of back

Fig.6. Good Housekeeping can increase Workers Safety

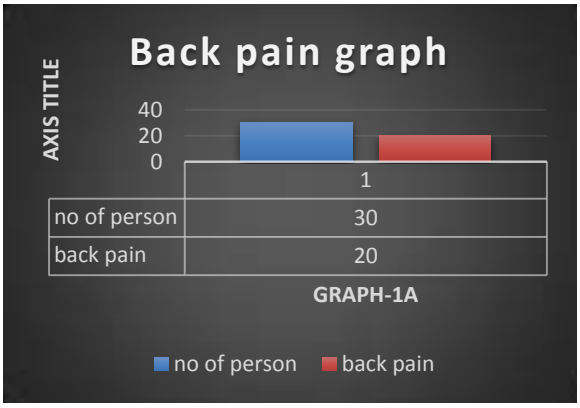
Fig. 7. working in a good posture but not wearing PPE

It is observed that in figure 6 and figure 7 that if the stand height is adjustable, then there is no need for bending the back and the welding is done in a straight posture. A good housekeeping practice will increase workers safety and also work efficiency. The importance of good housekeeping is best explained by the following statements [15], "Good order is linked to many production aspects", such as reduction of work, equipment and material costs, and savings of production times, better production quality, and better company image. It also means a better working environment, better safety, and better fire prevention. Thus, industrial housekeeping is a concrete area, which both the management and the welders would like to improve. The posture of the worker is good, but still, there is a problem in the work as the worker is holding the helmet and not wearing it. The PPE is used but not properly. It observed that during work, the worker also not wearing the dress and the hand gloves. It concluded that increase the number of accident inside the industry.

4. Results and Discussion

After accumulating all data from the survey in DEE piping system, several factors were found which create misunderstanding between workers, uncomfortable environment for workers, the large gap between machine and the workers, less number of safety precautions during the welding operation, excess working hours, less sleeping hours, etc. All these factors were found during my survey which creates so much problem during the manufacturing process. During the survey,their was also provision of an improvement in welding shop such as proper training to the worker, time to time methodology, improvement programme for supervisor and manager, etc. It observed that after implemented the provision of an improvement in the welding shop, the outcome of all the

parameters were shown with the help of below figure.



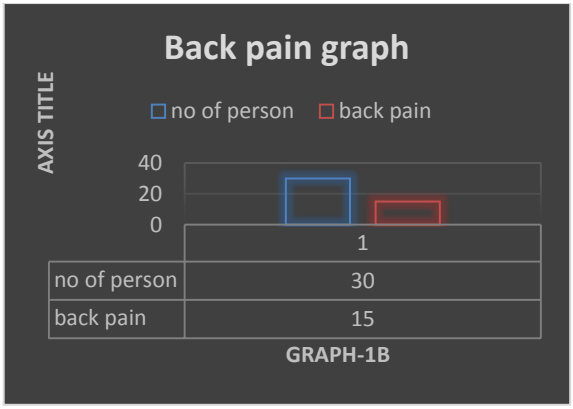
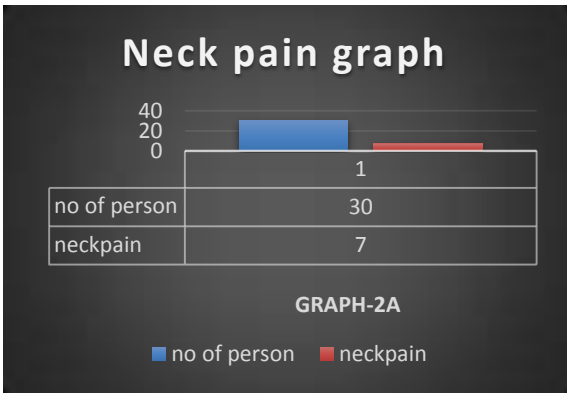


Fig. 8. comparison between back pains

In the figure 8, back pain was the measured problem found in survey, and the study proposed that to reduce the back-pain problem was to provide a good sitting arrangement for the welders and also avoid awkward posture by providing small rest break of 10 minutes in every two hours. This implementation reduced the back-pain problem by 25%.



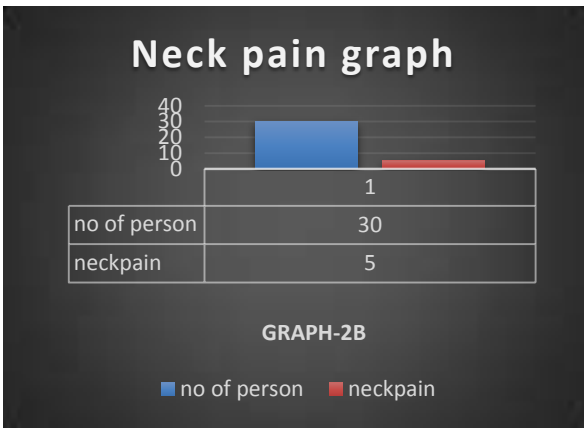
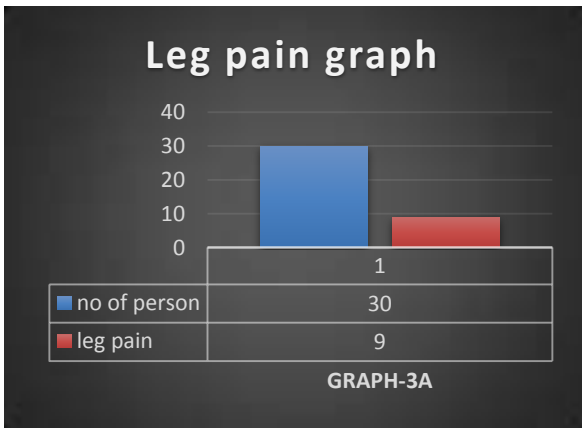


Fig. 9. Comparison between neck pains

In the figure 9, neck pain problem was detected to the movement of the neck for controlling the parameters of the welding machine and sometimes due to awkward postures. For reducing the neck pain problem, it observed to put all the controls in front of the welders and try to minimize the awkward posture by adjusting the position of the jobs. This implementation reduced the neck pain problem by 30%.



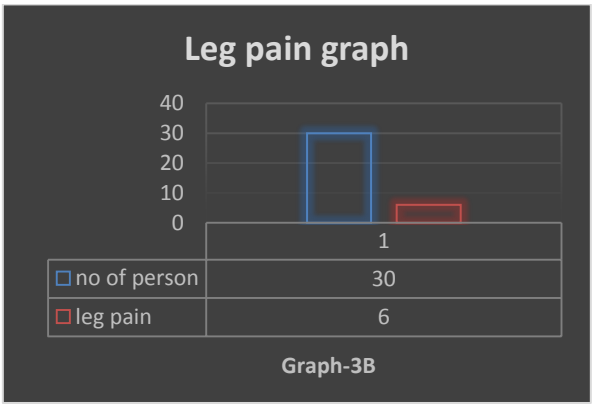
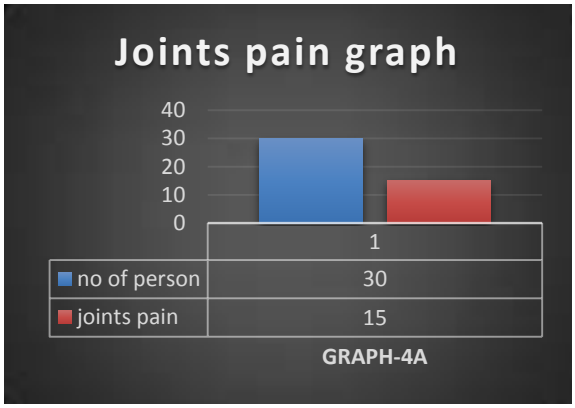


Fig. 10. Comparison between leg pains

In the study, it observed that the leg pain problem arises due to standing for a long time while doing their jobs. The study recommended providing a

good sitting arrangement and small rest breaks in every four hours. This implementation reduced the leg pain problem by 33% as shown in figure 10.



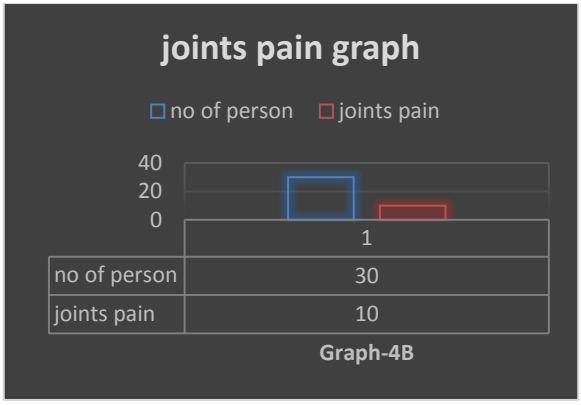
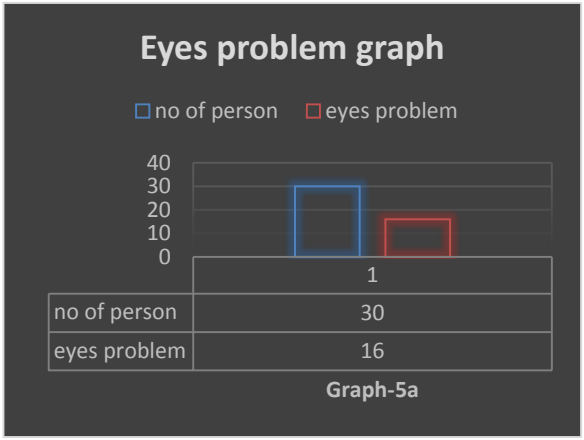


Fig. 11. Comparison between joints pain

It observed that half of the welders have joint pain problem due to continuous working for a long period and due to a repetitive task. As repetition and continuous working are the main reasons for the joints pain. To reduce this problem, the study proposed them to use rest breaks in every repetitive task and divided the task to other workers. It help reduced the joint pain problem by 33%. The comparison study, before proposed and after proposed is shown in figure 11.



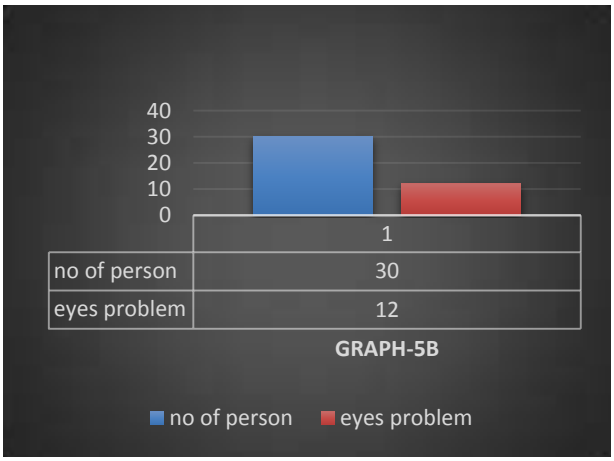


Fig. 12. Comparison between eye problems

In the figure 12 shown that the eye problem is the second major problem in the welding workshop. This problem arises due to the continuously use of corrupt eye protection glasses. To change the eye protection glasses time to time helps reduce the problems. This implementation reduced this problem by 25%.

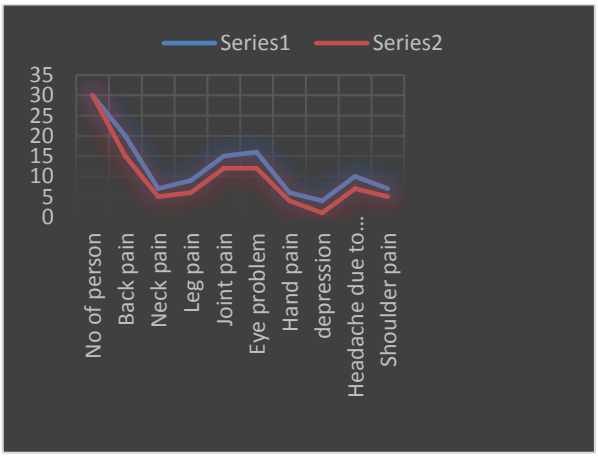


Fig.13. Assessment of the condition of welders before and after the implementation.

It observed in figure 13-line graph, series 1 lines show the problems before ergonomics evaluation, and the series 2 shows the decrease in problems after applying ergonomics guidelines. It is clear from the graph that the problems faced by welders reduced to some extent by using some general awareness about ergonomics. This ergonomic evaluation served as a preliminary assessment of potential risk factors. Wherever a risk factor was found, recommendations were given. These

recommendations can be applied immediately and with low cost to the employer. Further ergonomic analysis can be performed to detail specific concerns or issues. The first step in any ergonomics program is training to workers. Presently, it was observed a lack of education on the part of workers and managers on ergonomics risk factor recognition and control. Welders are skilled in performing their tasks and have consequently established work priorities. These priorities are based on high work efficiency, and minimization of the energy consumption needed in performing a task. Therefore, a very minimum use of personal protective equipment was seen throughout the evaluation. More to the point, the welders were not aware of ergonomics problems as exemplified in the work postures used in several workstations. Thus, welders need to be educated about ergonomics problems and how to avoid the risk of MSDs. Managers and supervisors also need to receive ergonomics training immediately. This training will educate them in recognizing risk factors and taking appropriate measure in controlling them. This project will further discuss ergonomics interventions that can be implemented in the welding workshop industry.

5. Conclusion and Recommendation

Ergonomic hazards are an important issue that affects worker at their place of work throughout the world. In the manufacturing industries, ergonomics related problems are extremely costly and affects a wide variety of workers. It can affect workers on the welding work shop, assembly line, office areas, and many other types of work. The ergonomics risk factors which considered for the research work were awkward postures, repetitive work, contact stress, and force. The consequences of these risk factors being present for a long period (weeks and months) can lead to cumulative trauma disorders or CTDs, as they are known. Examples of CTD are tendonitis, carpal tunnel syndrome, hand-arm vibration and bursitis.

With the graphs, it showed that the worker needs to follows these scheduling, the worker initiates maximum comfort with minimum occupational health hazards. occupational Health Hazards of the worker can be reduced by providing rest breaks between their sessions, but if increase the rest breaks after a certain limits, then total duration decreases and earnings of worker would reduced. Switching over alternate jobs within the organization can also reduce the occupational health hazards as well as earnings of the worker, so every worker would not agree with the changes. The drinking water arrangements near the working site to avoid dehydration problems. The worker should use eye-shield for the safety of his eyes from excessive heat. There should be a proper sitting arrangement for the welders for avoiding legs pain problems. Personal protective equipment must be checked properly time to time to avoid injuries like eye problem, skin burn, electric shock. The work station must be cleaned to avoid an accident.

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