Analysis of Working Postures in Tire Production Sector by OWAS Method

Hatice ESEN, Tuğçen HATİPOĞLU, and Nilgün FIĞLALI

***Abstract*— There are several methods to identify the poor working postures that cause Musculoskeletal Disorders (MSDs) and financial burdens to the economies along with serious health problems for workers. OWAS (Ovako Working Posture Analysing System), one of these methods, depends on the observational analysis of work movements especially in physically demanding works. In this study, the working postures in tire raw materials production process are analyzed with OWAS method and some suggestions are made about the possible improvements to eliminate the poor working postures.**

***Index Terms*— Automotive Subsidiary Industry, OWAS, Working Posture Analysis**

I. Introduction

Musculoskeletal Disorders (MSDs), as defined by ICOH (International Commission on Occupational Health), are illnesses or disorders in musculoskeletal system due to the work conditions [1]. MSDs cause serious health problems in workers and also bring financial burdens to countries' economies. 30% of MSDs identified in the world are due to the work conditions. MSDs represent 34% of work losses resulting from occupational illnesses, and work accidents [2]. In Germany, the lost days due to MSDs represent 30% of all lost days due to illnesses whereas this rate is 46% in Holland. In England, each year 10 million work days are lost due to MSDs and among these, 50% is due to back pains, 30% due to neck and arm pains and 20% is due to leg problems [3].

Musculoskeletal Disorders (MSDs) that lead to important health problems and the depletion of social resources are the most common drawbacks affecting the working population. MSDs that are at the top of the list showing the expenditures for all disorders, and affecting the job efficiency, life quality and physical and social functions of a worker in a negative way, is generally due to the poor working postures.

There are also numerous methods in the literature to be able to detect inappropriate working postures that lead to MSDs and their risk levels, and to shed light on improvement and development plans to be made on these problems. These methods can be categorized into three classes: Load lifting-related methods (Snook's Table, Revised NIOSH Lifting Equation, Putting Down, Pushing, Pulling and the Carrying model and so forth), observation or survey-based methods (OWAS - Ovako Working Posture Analyzing System, RULA - Rapid Upper Limb Assessment, REBA - Rapid Entire Body Assessment, Job Strain Index, Quick Exposure Check and etc.) and ergonomic checklists (ACGIH-Hand/arm Vibration Threshold Limit Value, Risk Factor Checklist and etc.) [4].

In this study, OWAS methodology is used which has many applications in the literature and is used to analyze the problems in musculoskeletal systems at standing and dynamic working postures on physically demanding works. By using this method, working postures in tire raw materials production are analyzed. At the end of the study, some suggestions are made to improve the poor working postures.

In the second part of the study, the methodology, OWAS, is explained. The details of application are presented in the third section. Finally the conclusion is drawn in Section 4.

II. Ovako Working Posture Analysing System

OWAS is a working postures analysis method based on observation to identify the poor working postures which causes musculoskeletal disorders. OWAS method, designed to help the work analysts, is a work sampling method based on the analysis of working postures examples collected in certain time periods [5]. The method which was first used in steel industry is now in use in many sectors [6]. Although, the first applications of the method were made by using special printed forms and hand calculations, half-computerized systems are developed for its applications now [7]. Nowadays, during the recording step of the working postures, video-camera can be used and images can be analyzed in different time intervals in different works [8].

In the analysis, the working postures of workers are standardized as 'OWAS working postures'. Back, arm and leg postures classified by using OWAS method are shown in Fig. 1. OWAS method helps to identify the poor postures and actions, to determine how much the repeating system forces a worker and to find the optimum work methods. Besides, it allows to evaluate the work place in terms of efficiency, comfort and occupational health and to examine the human machine segment systematically. The postures are classified according to the method and systematic improvements are suggested through the design of work place to eliminate the uncomfortable factors for workers [5].

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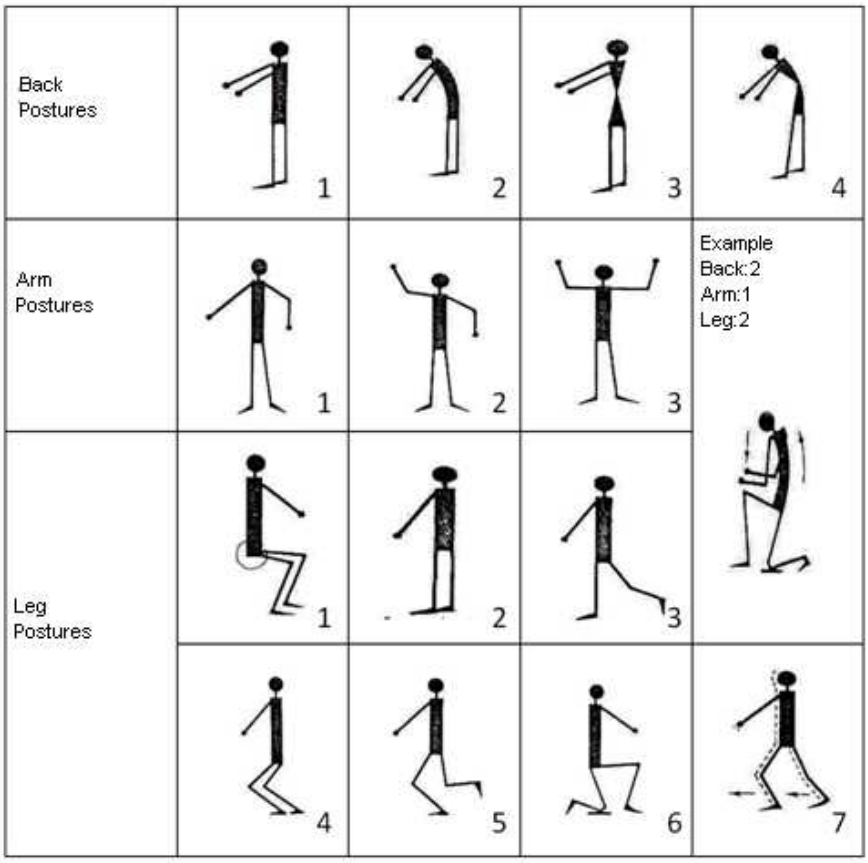

Fig.1. Standard working postures with the OWAS method [6]

OWAS method, applied successfully in different industrial areas, is used for [8];

- Evaluation of postural weight ergonomically and decrease the loading in musculoskeletal system,
- Improvement and planning of working environment, methods, machines and equipment,
- Occupational health investigations,
- Ensuring the security and efficiency

In this method, the analyst makes a qualitative analysis of worker movements during working processes by evaluating the working postures of back, arms, legs and the loaded weight. The body postures of workers are classified according to the power consumption during the work. Because OWAS method is conducted by direct observations, it can be time consuming sometimes [9].

We get 252 standard postures and weight combinations considering 4 back, 3 arm, 7 leg and 3 different weight levels by using OWAS method. During the analysis step of the method, the time spent for each work and the frequency of postures are evaluated [7].During the application of that method, the postures are stored according to the 4 digit coding system shown in Fig. 2. A large cod number represents an undesired working posture [10].

The observed posture combinations are classified according to the 4 risk categories. This classification depends on the health risks of each working postures and posture combinations on the musculoskeletal system predicted by professionals. The risk categories that determine the priority of risky postures are mentioned below;

Category 1: working postures don't have any harmful effect on musculoskeletal system. There is no need of ergonomic regulations for these postures.

Category 2: There are some harmful effects of working postures on the musculoskeletal system. Necessary ergonomic regulations should be planned in the future.

Category 3: Working postures have some harmful effects on the musculoskeletal system. Necessary ergonomic regulations should be planned as soon as possible.

Category 4: Working postures have very harmful effects on the musculoskeletal system. Necessary ergonomic regulations should be implemented urgently [8].

One of the several methods aiming to analyze the working postures in the literature, OWAS, is a successful methodology that considers the postures at all parts of a body. In the literature, there are many successful examples of OWAS application in very different sectors. These applications range from construction sector to automotive sector, from maintenance works to household works, from health services to livestock sector. OWAS method is applied to a tire production factory working for automotive subsidiary industry.

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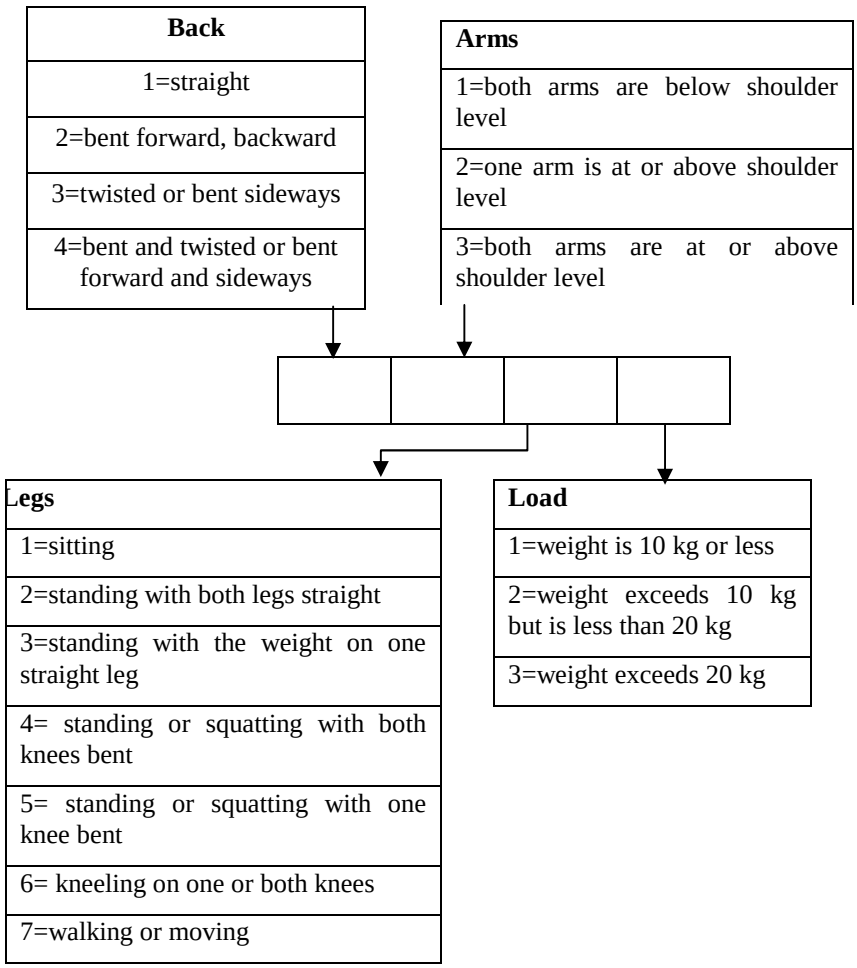

Fig. 2. Illustration of posture coding in the OWAS technique [10]

III. An Application of Working Posture Analysing

Due to the nature of the works in tire production factories, poor working postures and overloading to body are encountered quite often. This study is conducted in a tire production factory working for automotive subsidiary industry in Kocaeli. All physical works in the considered department are done in standing posture. Many workers on the department take breaks and medical reports due to musculoskeletal disorders. To identify and improve the working postures that cause these problems, the working postures of tire raw materials preparation job are analyzed with OWAS.

Tire raw materials preperation job has production prescriptions for each differnt type of tire. Worker gets the materials written in the prescription from the corresponding stands, carries them to the mixing boiler, and unload them after weighting. The related data is also entered by worker into the computer at control pane. After that, worker makes the loading of the prepared boiler into the machine. The boiler that contains mixed raw material is carried manually from the machine to the related storage areas by worker. Worker also does the cleaning of mixture preparing machine manually if it is necessary.

A worker is recorded for 45 minutes to be able to make OWAS analysis. 45 minutes include 8 job cycles which is found to be enough to represent the whole job. The postures recorded with video are stopped for each second and the working posture at that time is coded according to OWAS method. The observation period is taken as 1 second to increase the observational sensitivity. WinOwas package software is used during the analysis of the postures. 2564 working postures are collected and the risk categories of these postures are shown in Fig. 3.

The distribution of working postures in risk categories and the frequency of each posture within the whole work can be found with WinOwas software. As it can be seen from figure 3, 10% of working postures fall in 3. and 4. risk categories. The postures in 3. and 4. categories urgently need modifications from an ergonomic perspective. When we consider whole working postures, 10% of them create a danger for musculoskeletal system.

When we analyze the working postures in 3. and 4. categories, we see that they generally occur in processes of carrying full boiler, cleaning the machine and taking the packages from the stands. These working postures can be eliminated by making some changes in the working process and work place.

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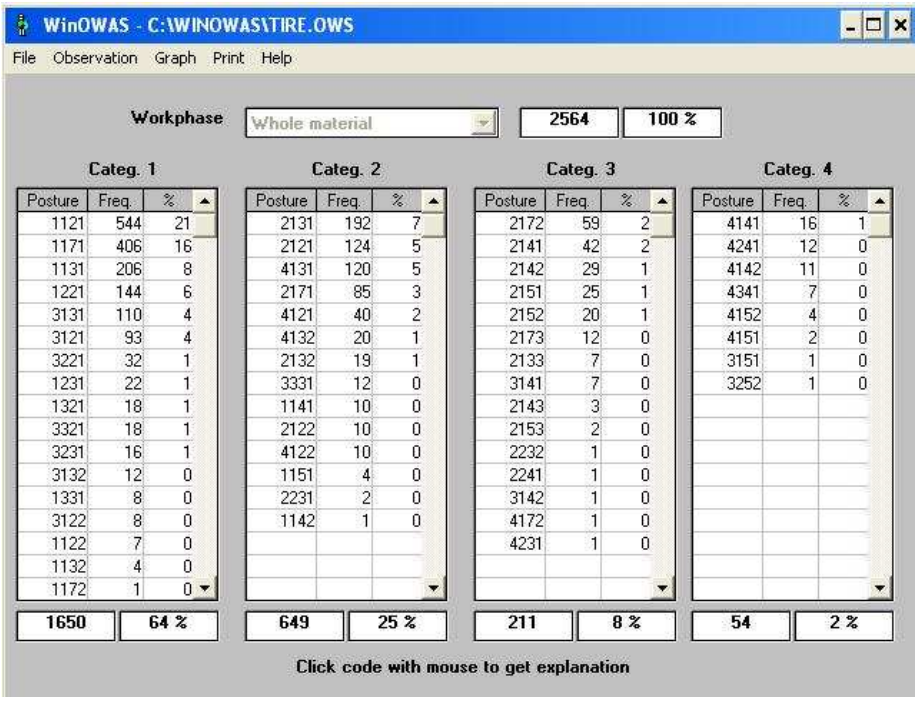

Fig. 3. OWAS results in tire raw materials preparation job

Even though the boiler has wheels under it, worker has to work in poor postures due to the load in the boiler. If the carriage of filled boiler is done with another carrier like a forklift, then these poor postures can be eliminated. Worker does the cleaning of mixer machine manually with a brush. During that process, s/he has to work by bent and twisted postures. That is why these postures fall under 4th risk category. If the cleaning is done with mechanical cleaning system instead of a brush, then these working postures can be eliminated. The other postures in 3th and 4th categories occur during taking of the materials in the prescription from the corresponding stands. During taking materials from the ground shelf of a two shelves stand, workers bend and twist. Raising up these stands by considering the average waist height of workers would resolve these poor postures. Also designing a new stand system with multiple shelves that will prevent the overlapping of materials would be convenient.

In the improvement of working postures, the trainings of workers are important. Workers should be informed about the importance of moving in line with work flow. This is because workers generally work with some steps that are not actually in work flow due to the habituation and the purpose of making it easier for themselves. Additionally, giving necessary trainings to workers about the right usage of their bodies and equipment will make the ergonomic improvements less required.

The suggestions made to the company managers according to the results of the analysis are evaluated as implementable suggestions and required improvements studies are started. After the suggestions are implemented, a further study for the same worker and job can prove how the suggestions improved the situation.

IV. CONCLUSION

Although important technological advancements are occurring today, the need for human force is still present. Identification of overloading into the workers due to working postures has an important role in building of a health and successful work life. Repetitions of inappropriate and poor body postures and movements result in musculoskeletal disorders and financial losses both for government and employer. The working postures in industry can be best evaluated by doing observations. In this study, working postures of tire raw materials preparation job are analyzed by using OWAS method, an analysis system for working postures that allows for identification of poor working postures and overloading in musculoskeletal system of workers. At the end of the analysis, some suggestions are made to eliminate the working postures that are identified as poor. In addition to the implementation of these suggestions, with a more comprehensive anthropometric study, work place design and/or ergonomic equipment design can also be made.

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