

Work safety conditions analysis

Analiza warunków bezpieczeństwa pracy

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Abstract: Work safety conditions are one of the most important issue that affects the product quality and manufacturing processes organization. The aim of the study is the analysis of chosen enterprise in terms of work safety conditions and identification of improvement actions. Study presented in the paper was conducted for the selected work position involved in the production process rolled steel bar. Owing to analysis of work safety conditions in the chosen enterprise factors of production process improvement were determined in the presented research findings.

Streszczenie: Warunki bezpieczeństwa i higieny pracy są jednym z najważniejszych kwestii, które mają wpływ na jakość produktu oraz organizację procesów produkcyjnych. Celem badań jest analiza wybranego przedsiębiorstwa pod względem warunków bezpieczeństwa i higieny pracy oraz identyfikacja działań doskonalących. Badania przedstawione w artykule zostały przeprowadzone dla wybranego stanowiska pracy związanego z procesem produkcji pręta walcowanego. Dzięki analizie warunków bezpieczeństwa i higieny pracy w wybranym przedsiębiorstwie ustalono czynniki doskonalenia procesu produkcji.

Key words: production, work safety, improvement

Słowa kluczowe: produkcja, bezpieczeństwo pracy, doskonalenie

1. Introduction

The competitiveness which exists in any manufacturing industry and services increases the importance of the customer in the product manufacturing process. This effect does not apply, however, only the final product delivered to the buyer, as well as the method of manufacturing. Proper organization of the production process increases the production efficiency and the product quality so the process improvement shouldn't be limited only to product improvement but also to enterprise functioning improvement. Field for improvement activities, which is often ignored by entrepreneurs, is connected with work safety conditions at the production positions. Creating employees properly organized position improves their work, increases its safety and it can improve the product quality.

In the case of work position improvement it is necessary to know all kinds of standards and regulations relating to it, on the basis of which work position can be re-designed. The introduction of improvements at the workplace is affected mostly by workers who are able to define important factors [1]. The analytical process for a particular work position is the original and thus complex and demanding carrying out a series of different tests. Improvement proposals of the specific factor is often presented by a number of solutions that bring benefits in theory.

The analysis of possible solutions is aimed at choice of options based on a cost, a time period intended for the implementation, the safety of workers and the impact on product quality. Ideas that do not meet expectations and the implementation of which may be impossible are rejected. During designing improvements related to the work organization including materials and devices available at the workplace it is advisable to follow general guidelines [3]:

- the improvement project at every stage of its implementation should be carried out by a research team composed of competent personnel familiar with the specific industry and production company;
- in the case of project cooperation taking place between two or more departments, it is advisable to ensure the most efficient cooperation possible,
- organization of activities for process improvement has been to precisely-defined;
- responsibility in the implementation of the project improvements was not a burden only for the research team. The management should also ensure the smooth conducting the evaluation work.

The aim of the study concerns the analysis of chosen enterprise in terms of work safety conditions in proposals of improvement actions. Study presented in the paper was conducted for the selected work position involved in the production process of rolled steel bar. The adopted study aim is determined by thesis that concerns analysis of work safety conditions which allows identifying factors of production process improvement. The subject of the research was an enterprise operating in the market of production and distribution of semi-finished products manufacturing by the machining. A sample item is an element performed on the turning machine.

2. Experimental

The ongoing diploma thesis research was based on the results of observations of the company engaged in the production technology characteristic for deficit treatments. The body responsible for determining the detailed standards enabling the generation and distribution activities is the Technical Committee 207 located

under the Polish Committee for Standardization. The area they formulated the subject is related to the definition of basic definitions concerning particleboard, erosion and abrasive treatments. The Technical Committee for the machining industry also deals with issues of incremental treatment, time-consuming devices and machine parts preparation, machining using automatic control system of digital and issues-ing for machining operations on a scale "micro" and "nano-"[5].

Machining in terms of quality performance material removal operations are divided into initial (roughing), forming a correct shape and the execution of final amendments machined surfaces (finishing). Cutting involves removing material mechanically at the surface and at a certain depth by chip formation [2]. It consists of operations involving shaping of action by cavities. They consist of removing unnecessary layers of material from the work piece while receiving the appropriate parameters of surface roughness [4]. Cutting operations be mediated by one or more blades having good properties to fulfil the type of machining on the work piece made of material with a specific hardness. Conducting a specific machining operation is possible if it is applied machine designed to perform a particular type of treatment, which is equipped with a blade made of a material with appropriate physical and chemical properties. The used blade is selected for specific work piece. In order to reduce the consumption of material and acid-increasing level of quality of machining they are often used various kinds of lubricants or coolants.

Machining processes carried out in the an inappropriate manner may produce nonconformities, and in extreme cases, it leads to an accident at the operator. The priority therefore is to create working conditions that minimize the risk of unwanted situations. For this purpose, the general methodology of the preparatory actions should be carried out a number of preparatory steps to ensure the comfort and safety of the work involving land use right jobs, e.g. removing unnecessary waste, addition of production materials to carry out the processing. After adapting the workstation to work machining operator familiar with the handling of machine cutting and manufacturing technology of the object is involved in the preparation of each item belonging to the cutting. It includes placing the proper working tool and the work piece material in designated places and the introduction of appropriate machine settings. In the case of conventional machines manual operation the operator determines the zero point and planned moves through a series of levers and knobs. Machines controlled automatically require the introduction of a system of program activities prepared algorithm to produce a given subject. The work project preparation for the automated machine tool requires the use of appropriate computer programs, in which it is possible to determine the succession of tasks including spatial orientation, with the end result will produce in accordance with the assumptions of the product.

After completing work preparation steps for cutting the operator performs operations to ensure the maximum level of safety. At this stage of preparation consist of action, the use of which is not necessary to carry out processing, but for reasons of fulfilment of legislation on Safety and Health at Work is necessary to preserve the safety of the operator. It concerns supporting the operator with elements of protective clothing, among other things in the ear or goggles and secure workspace. In modern machines, e.g. CNC machine, the guards are necessary before working due to automatic locking action having the function of preventing the use of improper practices to operations carried out.

In order to analyse the potential for the assessment of work safety conditions and the implementation of improvement activities in this field it is necessary to carry out research of the work stations.

As a part of the research work the analysis was limited to the work station characterized as the "bottleneck" of the process. Decisions been conditioned with the greatest level of relevance for positions performing this role in the overall structure of the process. In the case of the analysed enterprise and technological assumptions for the process of forming the object of study as a "bottleneck", the CNC lathes work position was characterized. Illustrative image used to be automated lathe machining work pieces with the same parameters for the study presented in the paper was shown in Figure 1.



Fig. 1. Example of CNC lathe for processing elements of a "a snail" (<http://www.afm.com.pl/tod.htm> (dostęp z dnia 30.03.2016))

Adapting the workplace for the employee should be based on the basic ergonomics and safety principles. The selection of appropriate tools is significant to create an easy and effective range of tasks at the same time meeting the requirements for the job. Lathes used for machining create a lot of potential possibility of an accident at work. Modern solutions to prevent them significantly cancel, however, the probability of its occurrence. It is required, however, compliance with health and safety procedures.

Operation of CNC lathes, despite automates operations still require the operator to fulfil a number of requirements. Operator supports automatic lathe organisations area in which performs tasks assigned to him, maintains the purity of position, document the course of their work, using the prepared documents that describe how the operation and the required parameters of the work piece after the treatment. It also deals with basic maintenance work, the preparation of details for processing and further transport.

The staff member at the lathe should meet the requirements specified range. Examined company expects that a worker employed as a provider of equipment designed for machining cutting addition to the basic requirements of the qualifying him for this type of work, e.g. the ability to use a lathe distinguish will be a good vision, proper coordination of the movements during the work, holding divisible attention, perception, the ability to react quickly to unforeseen situations during the execution of the tasks entrusted necessarily should have the ability of spatial imagination, working with technical drawing and perform the necessary design calculations or execution of production models in the programs that supports automated CNC lathes. The work station of the lathe operator should meet a number of requirements for safety and convenience. While performing their tasks at the workplace is essential to ensure the worker appropriate microclimate conditions for the type of work. It is necessary to maintain optimum temperature and humidity, frequent exchanges of air through the ventilation to maintain its composition possibly close to a normal adopted state.

Lathe operating also requires adequate lighting, reducing noise level and vibrations of the machine by, among others, the use of shock absorbers or frequent lubrication or exercise on a loose screws tightening operations, eliminating any adverse effect (oil mist and dust formed during machining). The problem of oil mist

produced during the processing of a negative impact on both the environment by settling it on the machine and the area around it creating a slippery surface or directly to the operator, which exposes the allergic reactions or other diseases [6].

Equally important is the negative impact on the operator of factors characterized as a nuisance in the implementation work. This group of factors includes, among others, fatigue due to frequent lifting and moving the work piece standing working position or the stress caused by the need to meet the quantitative production plan. Performing tasks for tested operator work position requires compliance activities within the ranks of health and safety associated with minimizing the risk of an accident by guidelines. It is necessary to use the machine ground and shielding to protect the operator and their appropriate use, proper start working knife on a work piece involving the exercise of the slow movement of the knife in the direction of the blank until you start working, check the technical condition and that there are no occurrence of unnecessary objects in the work area elements lathes, and when work is forbidden to interfere in the operator indicated zone.

3. Results and discussion

In the discussion on the obtained study interview results, six groups (determinants of work safety conditions at lathe work station) were identified with using Ishikawa diagram. Ishikawa diagram is one of the quality management problems identifying tool. Actions taken by the workers, which were included in the determinants' group called "Man" have been divided into four subgroups. The first subgroup was related to the physical and mental health worker refers to: the malaise, a fatigue, frequent diseases decreasing the efficiency of the operator, a decrease of concentration at work, as well as the stress caused by, among others, the need to produce a given day standards compliant products. The second subgroup identifying work safety conditions as factors threatening the operator reported the monotony of supervision of the work of processing performed mainly in the standing position. In the absence of precise tasks, the operator is negatively affected by an inattention during a clamping tools, routine activities carried out or ill of the operation, repair and maintenance. Due to the lack of consideration biggest threat is failure to maintain security by interfering with the operator in carrying out elements of the movement.

The determinants' group "Management" identified causes that were divided into two subsets, and an additional factor related to ignoring training. For the organizational safety-related factors, the risk has been identified due to the use of inadequate quality protective clothing, and even its absence, the lack of application security electric current through the grounding of the machine and protect electrical wiring, improper securing jobs against interference factors outside positions or sharp or heated machine parts, the tools placed at the analysed work station. The risk was also related to the work organization, which consists of the lack of order regular inspections machines and other equipment, incorrect guidelines for devices, tools and materials storage, caused by its improper layout station.

Determinants' group "Method" allowed the creation of two main subgroups reasons for carrying the risk of the accidents occurrence at the analysed work station. The first was related to the procedures associated with the provisions of ignoring safety instructions or other documents used in operations at the wrong position and completion of the procedure fixing the semi-product in the machine. The subject of the second determinants' subset was related to the order maintenance at the work station. It highlights a lack of application regulate, repeated systematically cleaning, ignoring oil stains caused, among others, by depositing oil mist and

the shoulder of standards for the storage of materials and tools, combined with a momentary inattention can result in an accident.

Factors determining "Material" group consists of two main subgroups. First subgroup is related to the use of tools and instruments forming a potential risk of accident by using of defective or worn parts or tools. Association of factors, which are assigned to the group "Environment" with the occurrence at the workplace was determined by the negative impact of the use of low light, contact with oil mist and the lack of use of air exchange. Cause of the accident for a set of "Machine" is defined for the lack of screens, excessive use of machines turning, crash sensor system security, transfer of a log without instruments to support this process and the use of temporary repairs.

4. Conclusions

Causes of the accident at the CNC lathes work positions, despite its modernity is still a phenomenon quite common for the organization of work and positions do not meet safety standards. Lack of adherence to the guidelines and recommendations dramatically increases the possibility of injury to the operator, and in extreme cases, cause death. Identified reasons depending on whether there singly or in combination with other risks can cause a variety of injuries include fractures, sprains, amputations, electric shock, burns, cuts, creases.

In order to minimize the likelihood of an accident while working on a lathe machines it is necessary to use a range of measures. The most important in ensuring the safety of the compliance procedures stored in the documentation and sober thinking operator backed by knowledge gained during the training, which significantly minimize the risk of a problem. The use of accurate and systematic control of the equipment, the use of systematic location of tools and instruments to guarantee the position of the respective airflow and lighting can help with avoiding the accident.

The proposed solutions correction are associated with:

- the introduction of the tool box for a set of keys - so far all tools were on the worktop in disarray;
- using multilevel boxes equipment lathes;
- equipping work positions in the container for used cutting blades - blades used during the processing time lose their properties;
- providing security solutions documentation - minimizing the risk of contamination or damage to the documentation has to rely on securing it through the use of t-shirts and binders;

Proposals presented as the conclusions lead to a delimitation for all elements equipment of a particular place, in which the object should be in when it is not used and minimize the risk of damage. The introduction of proposals for the system cleaning the position will improve the working conditions in terms of safety and production efficiency.

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