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EVALUATION OF TECHNICAL CONDITION AND ORGANIZATIONAL ACTIVITIES IN THE PRODUCTION DEPARTMENT OF THE COMPANY

Abstract. Technical equipment and machinery used in the production halls of companies largely determine work safety. Ensuring efficient production can be achieved by exercising control over the technical condition of machines and industrial equipment or the gradual modernization of the machinery in the continuous improvement process. A very important factor, due to which it is possible to improve actions of the effective production continuity maintenance, is the involvement of employees, both maintenance staff and production operators. The article presents the evaluation of the technical and organizational activities in the production department of the company. It also introduces results obtained from the quantitative survey among employees of the selected production line.

Keywords: company, production department, manufacturing process, maintenance of machines and devices, safety.

OCENA STANU TECHNICZNEGO I DZIAŁAŃ ORGANIZACYJNYCH W DZIALE PRODUKCYJNYM WYBRANEGO PRZEDSIĘBIORSTWA

Streszczenie. Urządzenia techniczne oraz maszyny wykorzystywane w halach produkcyjnych przedsiębiorstw w dużym stopniu decydują o bezpieczeństwie pracy. Zapewnienie sprawnej produkcji uzyskać można poprzez sprawowanie kontroli nad stanem technicznym maszyn i urządzeń przemysłowych czy też sukcesywną modernizację parku maszynowego w ramach procesu ciągłego doskonalenia. Bardzo ważnym czynnikiem dla usprawnienia działań efektywnego utrzymania ciągłości produkcyjnej jest zaangażowanie pracowników, zarówno służb utrzymania ruchu, jak i samych operato-

rów produkcji. Artykuł przedstawia ocenę stanu technicznego i działań organizacyjnych w dziale produkcyjnym badanego przedsiębiorstwa oraz prezentację uzyskanych wyników badań ilościowych z przeprowadzonej ankiety wśród pracowników wybranej linii produkcyjnej.

Słowa kluczowe: przedsiębiorstwo, dział produkcyjny, proces produkcyjny, eksploatacja maszyn i urządzeń, bezpieczeństwo.

Introduction

Efficient operation of enterprises is mainly based on the technical and organizational structure of production department. The production department in all enterprises is one of the most important. Its proper operation ensures production of finished products on time, in the required quantity and quality at the lowest possible cost. Smooth production process is a joint venture of operation and maintenance, and efficient and effective maintenance of the production department is crucial for manufacturing companies.

Main condition for success of any business enterprise is honouring commitments. In order to achieve this goal it is necessary to ensure reliability of the production department, which means having full control over the technical condition of machinery, equipment and facilities. This in turn requires the ability to predict the damage and possibilities of its corrective maintenance to normal operable state [1].

Machinery, equipment and other fixed assets are one of the most important factors in the production process. The quantity, quality and modernity of machines and devices affect the production capacity of the company, production volume, structure and quality of production [2]. Failures and downtime of machines, equipment and installations generate additional costs for production undertaking. Their reliability directly affects company's productivity and efficient production department. The more often failures and downtime occur, the lower number of finished products, and at the same time, the lower earnings of the organization. Therefore, a priority action of the organization should be machinery maintenance, because only reliable infrastructure and professional services responsible for the removal of possible failures allow avoiding additional financial burdens. Order realization cycles depend on the indicators of productivity, efficiency and so-called 'bottlenecks'. Technical infrastructure state of production department determines the degree of compliance with the product quality requirements. For this reason, each production unit should know the actual status of its machinery. This is important in a highly competitive environment, where even a minimal advantage over other market players can influence the fate of an undertaking [3].

The aim of this paper is to present the evaluation of the technical and organizational activities in the production department of the company and to present the results obtained from the survey among employees of the selected production line. In order to evaluate the technical condition of the production department, theoretical research tools, i.e. the analysis, synthesis, generalization, comparison and practical research tools in the form of survey are used.

Technical condition and operational safety of machinery and equipment

In many companies, technical condition of the production department determines efficiency of the production process. Production quality and reliability of production systems depend on many factors, mainly the condition of the machinery park [4]. Maintaining technical condition of machines and equipment in operation means to perform ongoing operations aiming at correct operation of machinery and equipment as well as taking preventive measures that reduce the risk of damage to the machinery. These activities are implemented through periodic and scheduled servicing, maintenance of machines as well as measures aimed at failure-free operation of the company. Efficient machinery maintenance helps to increase company effectiveness [5].

Technical system of any enterprise is an important part of the manufacturing process. Its task is to maintain the production capacity on the highest possible level [6]. Technical condition of machinery and equipment is usually described with values of measured symptoms. Therefore, not only effective methods and means of technical diagnostics are taken into account, but also appropriately trained technical personnel [7]. Methods and means of modern technical diagnostics are a tool for diagnosing technical condition of machinery and equipment, which enables rational and safe exploitation [8]. While taking into consideration quality of the system and/or the technical condition of machinery and equipment, their durability should also be regarded. The service life of machinery and equipment can be defined as the ability to maintain the required (normative) operation values in standard operation time. It is the time period, in which the operated machines and equipment maintain their ability to work (also after repair) efficiently in order to fulfil their objective functions that were specified in the design and construction process [9]. Management of machinery and equipment is a set of activities covering planning, organization, management, control and decision-making focused on system resources (human, financial, material and information) in order to achieve efficient use and maintenance of machinery/production department. In this context, the machinery and equipment technical operation effectiveness is evaluated by the usage of

two indicators, which are efficiency (describing the degree of objective achievement) and cost effectiveness (defining the relationship between benefits and expenditures) [10]. The main aspiration criterion in machinery and equipment exploitation is ensuring the longest proper and safe operation. Long term use of machinery and equipment leads to their deterioration. Therefore, there is a need to restore them periodically during the renewal process [11].

In production processes in order to facilitate, accelerate and improve working conditions, properly working machinery and equipment are indispensable. Reliability of these machines is very important in the production process, but its achievement is extremely difficult. Machine failure can be caused by many factors such as inaccurate repairs or improper use. As a rule, in relation to the machinery operation, their load and information on technical failure are usually stored. It is also possible to find information about downtime related to the occurrence of the failure. All the collected information is usually used on regular basis. Information about the failure results in a decision on the actions in respect of repairs to the machine, and sometimes additional control of products manufactured on it, as well as the purchase of spare parts. Rarely, the information is analysed in a broader time period to determine, for example, the cost of downtime associated with failures or for supervision planning [12].

Inspection of technical condition of machines and equipment in production lines is an important element related to enhancing their performance and reliability. For this purpose, among others, are used integrated systems designed for monitoring and machine diagnostics cooperating with software supporting prediction of their technical condition. The use of these system improves safety, increases operational reliability and decreases maintenance costs [13]. In addition, in accordance with Polish regulations, all currently used machinery and equipment at the enterprises must meet minimum requirements related to safety and occupational health in the field of their use. Every employer is obliged to comply with the rules related to operation of machinery, technical equipment and working tools used in his company [14]. It is also worth remembering that safety in the operation of machinery and equipment is strongly influenced by employees. People employed at different positions are responsible for their work and are exposed to certain risks associated with the performance of this work. In this regard, the security also depends on each individual employee the quality of his work. Together with the development of technology it is important to provide adequate security. Therefore, an important element of a good and safe operation of machinery and equipment is the acquisition of new knowledge by their machine operator [15].

Production department characteristics of the enterprise

The analysed manufacturing company was founded 1993. It employs over 250 people. The company specializes in the production of food additives, flavourings, essential oils and food colouring. Work in the manufacturing department is carried out in several shifts. The production process in the is conducted in accordance with the requirements of GMP - Good Manufacturing Practice, which introduces a set of actions defined in order to ensure the proper production process. The company, in which the research was conducted, works in accordance with the principles of Quality Management System ISO 9001, Food Safety Management System (compliance of the implemented system with the ISO 22000: 2005), Environmental Management System ISO 14001 and the Health Safety Assurance System HACCP. The company meets all the requirements of the EU standards in terms of production safety, environmental protection and fire safety.

The company with such a wide range of products must have a well-developed production department. Technical equipment of the production department in the company includes a wide range of machinery equipped with, among others, the station for obtaining flavour (group of devices for restoring fruit flavours), flavour micro dispensers, ploughshare mixers or machinery and equipment for packaging. The production process in the company is the manufacturing process, so it represents a material, energy and information system. It consists of main, auxiliary and adjacent processes. In main production process (connected with the manufacture of the product) machinery, equipment and production workers, who operate them, play an important role, because it is a machine – manual process. Auxiliary processes involve the movement of finished goods to the warehouse. Adjacent processes relate primarily to the health and safety requirements and administrative management. The production process is cyclical, which means that the production of goods takes place in a certain order, maintaining a constant interval between the production start-up and completion of a particular product series.

Technical condition of the production department analysis

Technical condition of the production department examination was carried out visually. During the analysis, special attention was paid to the operation of the production department, technical equipment and all aspects of safety.

Analysing the technical condition of the production department, it was noted that the company has modern automated machinery that meets the strictest technical and organizational requirements. The company over the past five years, thanks to a grant from the European Union, purchased new machinery

and equipment. All newly purchased machinery and equipment are ISO 9001:2000 certified. Therefore, the technical condition of the machinery is at a high level. In the production department there are 7 machines and 5 devices of the so-called old type that, in accordance with the Machinery Directive 2006/42 / EC, have been adapted to the minimum requirements of occupational health and safety with respect to their use. Customized machines and devices have so-called declaration of conformity. All machines and devices are equipped with manuals in Polish. They are the most important source of information about the correct use of a machine or device. Proper functioning of the production department, and in particular its machinery and equipment, ensures the maintenance department. Its main task is to maintain machinery and equipment in good technical condition, ensure the production continuity, make repairs in the event of a machine breakdown as well as execute current repairs and planned maintenance.

While analysing technical state of the production department, it was noted that the positions connected with team operation of machinery and equipment are equipped with warning lights (easily perceptible and understandable for employees). Multi-station machines are equipped with audible and/or light warnings, which automatically emit signals when the machine is about to start working. Moving parts and other machine parts (which in the case of contact with them pose a threat) are covered (with accordance with the law regulations) to a height of at least 2.5 m from the floor level of a workstation. In specific workstations Active Opto-Electronic Protective Devices (AOPD) is installed – it is a system for safe stopping of machinery and/or equipment. It was also noted that the machines and tools as well as their protective equipment are maintained in a state of top technical performance and cleanliness ensuring their use without impairment to workers' safety and health.

During the analysis of the technical production department it was noted that the production hall has the required lighting (also in all workstations) and it is equipped with industrial ventilation ensuring the exchange of air. Moreover, workstations, where there are groups of devices for production of different aromas and flavouring substances (in liquid and solid state), are also equipped with fans and filters to protect workers against the effects of inhaling harmful substances. Furthermore, the personnel operating machines for acquisition of flavours is equipped with personal protective equipment.

Analysing the traffic organization in the production department, it was noted that all possible technical security systems were applied. Traffic and evacuation routes in the production department have been marked in accordance with the required regulations. Rules for the movement of vehicles in the production hall were established. The movement speed of the vehicles was restricted and appropriate signs in the passageways were installed. In places, which are poorly or completely invisible to the operator of the machine (e.g. forklift)

safety mirrors, improving visibility of both machine operators and other workers in the communication routes, were used. In addition, it was observed that in the production department there are so-called contactless security systems like RFID (Radio Frequency Identification) that use radio frequency radiation to detect the presence of people in the working area of a particular vehicle, e.g. forklift.

The analysis of technical condition of the production department in the company clearly showed a very high functional level. The production department is equipped with modern machinery, equipment and collective protective equipment. The personnel are equipped with personal protective equipment. The analysis indicated that the production department has a technical security system. All the traffic routes are appropriately marked and contactless security system is used. In addition, appropriate condition of the machinery is secured by the maintenance department, whose employees constantly monitor the technical condition of machinery and equipment, eliminating failures and downtimes. To summarize, we can conclude that the entire production process in the production department is realized in safe conditions for people, as well as raw materials and finished products.

Research methodology

Analysis of the technical condition of the production department was followed by a survey conducted among employees of a selected production line. The chosen production line manufactures finished products weighing 500 g. The quantitative research methods were implemented by the usage of a standardized paper questionnaire. The survey was completely anonymous and it was carried out in order to obtain the employees' opinion regarding the general technical state of the production department, hazards occurring in the workplace as well as compliance with safety regulations. The respondents are women and men of different ages. All those who took part in the study were over 18 years of age.

Results of the survey

The study involved 32 employees. However, the analysis includes 29 correctly filled questionnaires. 3 of the questionnaires were rejected and not taken into consideration, because they were not properly filled. Age range of the respondents includes people from 18 to over 50 years old, fig. 1. The questionnaire, apart from respondent's particulars, contained 7 multiple choice questions. The questions in the questionnaire concerned the following areas:

- technical state of the production department,
- frequency of breakdowns and stoppages,
- knowledge concerning the hazards existing at particular workstations,
- maintaining order and cleanliness at the workplace,
- use of personal protective equipment,
- equipment of machinery and technical devices with emergency shutdown systems,
- equipment of machinery and technical devices with audible warning systems.

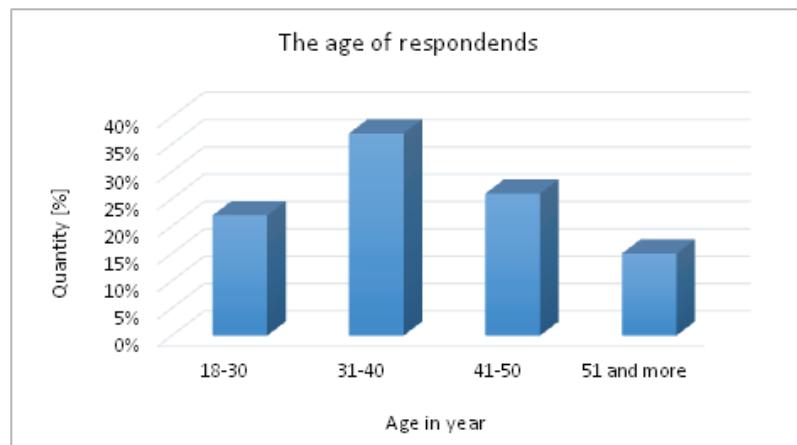


Fig. 1. Age of responders taking part in the survey
Source: Own elaboration.

Analysing the age of the respondents participating in the survey, most people working in the selected production line are between the ages of 31 and 40 years old, another age group is represented by respondents in the group of 41-50 year-olds. Large group is also represented by respondents in the aged 18-30. The rest of the surveyed people, aged 51 and older, create a group of not more than 20 % of respondents.

The surveyed group is dominated by persons with secondary education 43%. In second place there are people with vocational education 34%. Respondents with higher education represent the group of 23%. Considering the professional experience of the employees, the largest percentage of respondents has worked from 10 to 20 years (42%). With experience ranging from 5 to 10 years there are 27% of the respondents, 19% of respondents are employees with experience of more than 20 years, and 12% of the respondents are employees with professional experience up to 5 years.

The first question in the survey is related to the overall assessment of the technical production department, fig. 2.

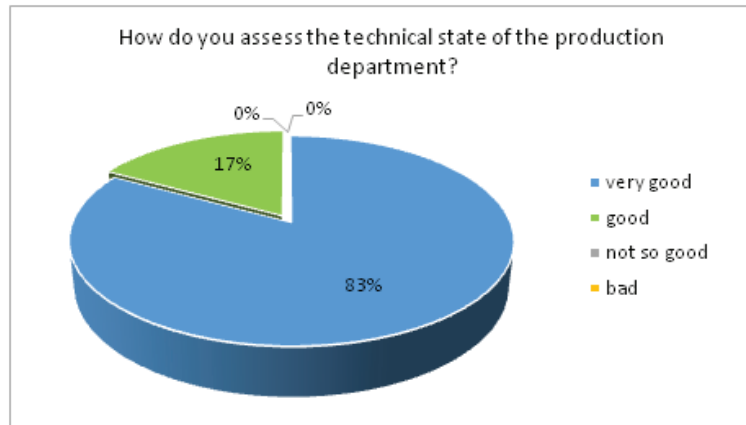


Fig. 2. Technical state of the company's production department
Source: Own elaboration.

Analysing the results concerning technical state of the production department, it can be seen that all respondents (100 % of them) indicated a positive response. None of the respondents chose a negative response, which means that the respondents evaluate the technical condition of the production department at a very high level. The reason for this may be new automated machinery, safe performance of work at the workplace or general feeling of security among the workers. In summary, it can be stated that the technical condition of the production department not only fulfils high organizational and technical requirements, but also meets expectations of employees in terms of security.

The second question in the survey is connected with the frequency of breakdowns and stoppages, fig. 3.

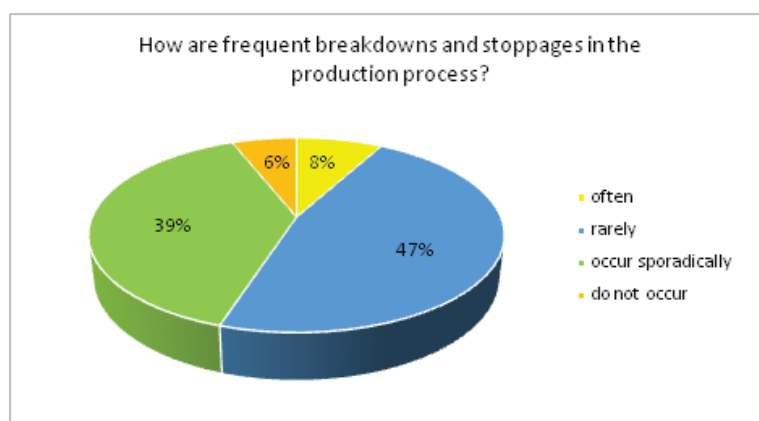


Fig. 3. Frequency of breakdowns and stoppages
Source: Own elaboration.

Analysing the results obtained for the frequency of failure or downtime, it can be seen that in total 86 % of respondents marked the answers: ‘seldom’ – 47 % or ‘occasionally’ – 39 %. Only a small number of respondents indicated answers: ‘often’ – 8 % or ‘do not occur’ – 6 %. In summary, it can be stated that failures and downtime occur sporadically or once in a while. Their occurrence on production lines is normal in the operation process of machines and equipment. From the results it is clear that machine breakdowns and stoppages happen rarely.

The third question in the survey is related to the knowledge of hazards that may occur at particular workstations, fig. 4.

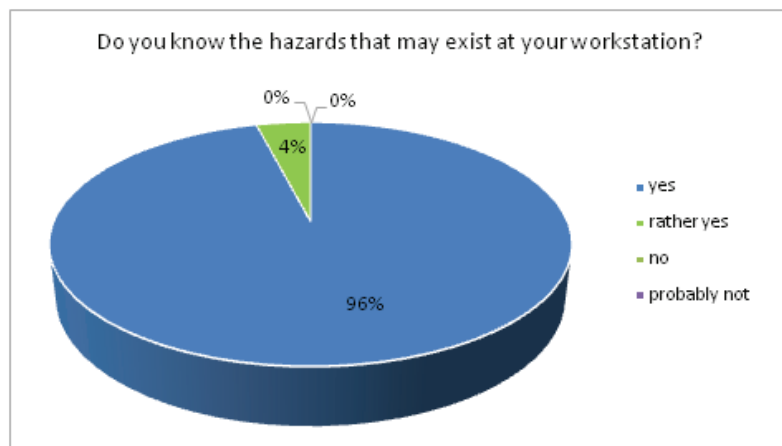


Fig. 4. Personnel knowledge on the hazards occurring at particular workstations
Source: Own elaboration.

While analysing results concerning the knowledge of the hazards at particular workstations, it can be noted that all the respondents (100 %) marked positive answers. None of them chose a negative response. Therefore, it can be concluded that employees are aware of the hazards occurring at particular workstations. None of the respondents selected answer ‘no’ or ‘probably not’. To sum up, it can be stated that the personnel operating the machinery and equipment is very well informed of the dangers that may occur during the use of machinery and equipment. It has to be also underlined that specialized training is of great importance in this matter, because without it the employees would not be able to perform their duties at the workstation.

The fourth question in the survey refers to the maintenance of order in the workstation, fig. 5.

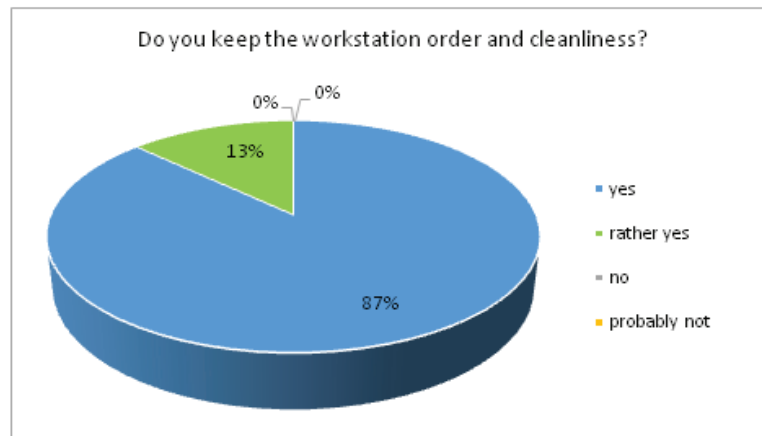


Fig. 5. Maintaining order and cleanliness at the workstation
Source: Own elaboration.

The results concerning the maintenance of order and cleanliness at the workplace show that virtually 100 % of the respondents chose the answer 'yes' – 87 % or 'rather yes' – 13 % . None of the respondents indicated a negative response, which means that the respondents are aware of the huge benefits that can be gained by keeping their workstations in order. In summary, it can be said that employees are aware of the hazards that may be caused by disorder at the workplace. Workstations, which are kept clean, contribute to increased safety and better quality of work.

The fifth question in the questionnaire applies to the use of personal protective equipment, fig. 6.

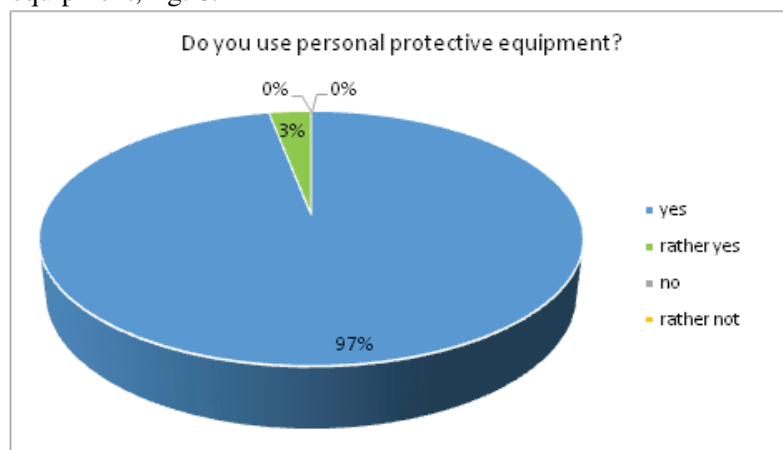


Fig. 6. The use of personal protective equipment
Source: Own elaboration.

Analysing the results concerning the use of personal protective equipment, it can be noticed that 97% of respondents use personal protective equipment. Only 3% of respondents chose the answer 'rather yes'. None of the respondents noted a negative response. In general, we can conclude that the whole personnel (100% of respondents) in the workplace use personal protective equipment, which protects their life and health. In addition, it can be concluded that respondents are aware of the risks arising in the workplace, as well as consequences of not using personal protective equipment and non-compliance with the safety regulations.

The sixth question in the questionnaire is related to equipping machines and technical devices with emergency stop systems, fig. 7.

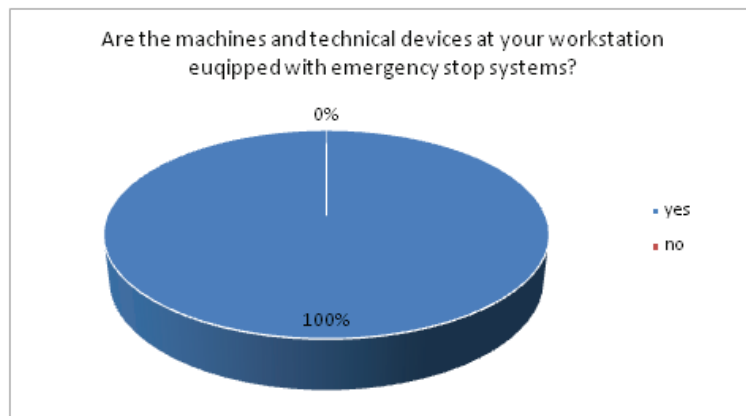


Fig. 7. Machinery and technical devices with emergency stop systems
Source: Own elaboration.

Results of the research prove that machinery and technical devices used in the enterprise are equipped with emergency stop – 100% of the responders answered 'yes' to this question. This means that each workstation using machines and devices has emergency shutdown system. None of the respondents chose a negative response, which means that in the company there are no workstations without emergency stop system. All in all, it should be concluded that employees' security is very important for the company. The use of technical systems of emergency stop certainly helps to minimize the number of adverse events.

The seventh question in the questionnaire gives the answer if the machines and technical devices in the company are equipped with audible warning systems, fig. 8.

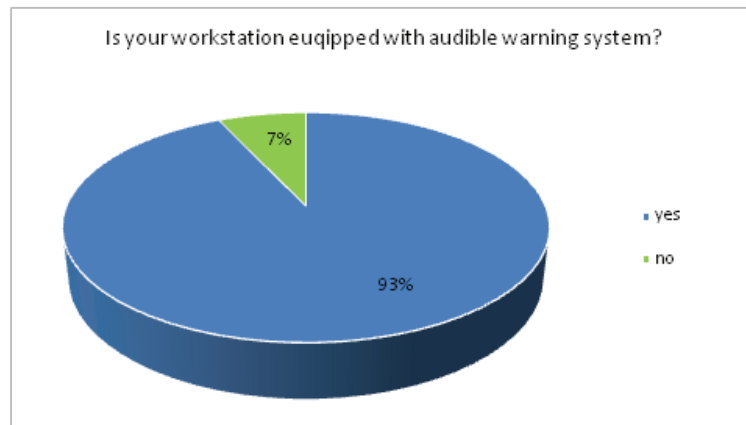


Fig. 8. Equipment of machines and technical devices with audible warning systems
Source: Own elaboration.

Obtained results show that 97% of respondents confirm that machinery and technical devices used in the company are equipped with audible warning systems. Only a small group of respondents (7%) answered 'no'. Thus, we can conclude that the audible warning systems are present in the most of the workstations. It is not clear why 7% of respondents chose a negative answer. It can be only assumed that workstations of these respondents do not have audible warning systems, because there are no risks requiring the sound signal. To summarize, we can conclude that audible warning systems are one of the main elements ensuring safety in the workplace. Thanks to the audible warning system, it is possible to provide quick transmission of information about the threat and effectively manage evacuation of people from dangerous areas.

Analysis of accident rate – results of the research

The analysis covers accidents, which happened in the production department over the period 2005–2015. Accidents taken into account were directly associated with the operation of machinery and equipment in the workplace. Moreover, they caused injuries to workers, fig. 9.

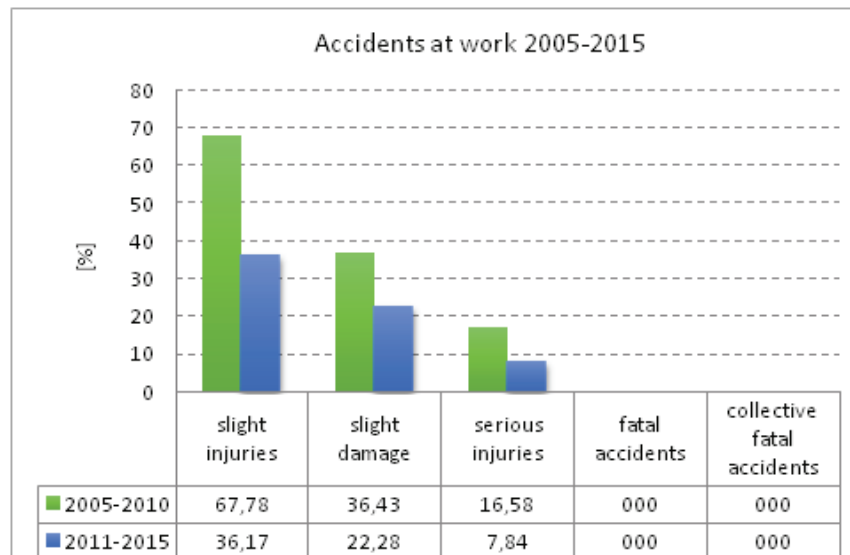


Fig. 9. Comparison of the total number of accidents occurring in 2005–2010 and 2011–2015
Source: Own elaboration.

Analysing the list (in %) of accidents at work illustrated in fig. 9, it is easy to notice that there is a large decrease of accidents in the studied years. Comparison of the period 2005–2010 with the period 2011–2015 clearly shows the difference in the amount of accidents. Some accidents still occur in the workplace causing slight injuries, slight damage or serious injuries to employees. However, when we compare years 2011–2015 with the period 2005–2010, it becomes obvious that the number of accidents at work dropped significantly. Such a visible reduction in the number of accidents at work is mainly due to modern automated machinery that meets the most stringent technical and organizational requirements. High safety standards are also very important. Final key factor is awareness, knowledge and experience of the employees. In the analysed period in the workplace, there were no fatal accidents or collective fatal accidents.

In summary, it should be noted that an important element in the safe operation of machinery and equipment is complying with safety regulations. Being aware that a hazardous event may happen is an important part of the continuous improvement process. Security at every workstation should be a priority for every enterprise.

Conclusions

The aim of the research was to assess the technical condition of the production department in the chosen company and to present the results obtained from the survey among personnel of the selected production line.

Visual analysis of the technical condition of the production department clearly showed that the department has modern automated production machinery that meets the strictest technical and organizational requirements. Security in the researched department is at a very high level. All the machines and equipment are certified according to ISO 9001:2000 or comply with the minimum requirements for the use of work equipment in accordance with the Machinery Directive 2006/42 / EC. Technical condition analysis of the production department also proved that it possesses technical security system and required lighting. Furthermore, it is equipped with industrial ventilation system ensuring air exchange.

Quantitative research was conducted in the form of a survey among employees of the selected production line. Its aim was to obtain their opinion on the general technical condition of the production department, hazards that may occur in the workplace and compliance with safety rules. Analysing the obtained results, it can be concluded that all respondents (a total of 100 % of respondents) were satisfied with the quality of the technical condition of production department, its equipment and the overall safety level at work. Results of the survey among employees clearly showed that incidents of failure or downtime on production lines are sporadic. It also demonstrates that maintenance department effectively supervises technical condition of machinery and equipment, which ensures smooth and trouble-free operation of the production department. Employees are well aware of the risks that may occur at the workplace. Employees also know what substantial benefits derive from the use of personal protective equipment. Moreover, they are well informed why it is crucial to maintain their workstations in order. Research results also inform us that emergency stop and audible warning systems are widely used in the workplace. While analysing the results concerning the frequency of accidents at work over the period 2005–2015 it was noticed that since 2011 there was a large decrease in the number of accidents at work. It can be concluded that key factors, having crucial impact on the current condition of the enterprise, are modern machinery, technical security systems of machines and equipment as well as the experience and knowledge of the employees.

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