THE RISK MANAGEMENT METHODOLOGY IN THE METALLURGICAL ENTERPRISE

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Abstract

The article presents a risk management process implemented by the machine manufacturer and the user in metallurgical enterprise. The paper discusses the requirements of Directives 2006/42/CE, 2009/104/CE addressed under the law of the European Union Member States. The aim of the article is to present the risk reduction methodology during the usage of machinery in metallurgical enterprise.

Keywords: Hazard, risk management, metallurgical enterprise

1. INTRODUCTION

The issue of limiting the risks associated with the operation of machinery in the steel companies plays an important role. Used equipment is one of the sources of accidents at work, generating significant social and economic costs. The European Union strongly engages in the activities aimed at improving safety associated with the use of machines. The process to minimize accidents due to the use of machines began in the nineties (Directive 89/391/EEC, Directive 89/392/EEC) and continues.

Currently, in terms of machinery security requirements are valid Directive: 2009/104/CE - concerning the minimum requirements for the health and safety of use of work equipment and 2006/42/CE on machinery. These directives apply to safety in the design and use of equipment, pointing to the entity that is responsible for ensuring its i.e. the employer and producer. On these directives is based the concept of ensuring safety in the design and use of machinery, which involves the interaction of these entities. The common goal of designers and users of machines comes down to limiting the risks associated with the use of machines, and can be achieved only with their mutual cooperation.

The fulfillment of legal requirements described in the New Approach Directives allows you to provide employees metallurgical enterprises of safe working conditions. Therefore, the article a methodology for the risk reduction during the usage of the wire drawing machine as a tool for methodical approach to risk mitigation was presented.

2. SAFETY REQUIREMENTS FOR MACHINERY IN THE EUROPEAN UNION

The requirements of machine safety in the European Union are described in the New Approach Directives 2006/42/CE and 2009/104/CE. Machinery Directive [1] is addressed to machine operators who place on the EU market. The EU legislator committed Member States to effectively implement the content of the directive to ensure the essential requirements. Committing thus manufacturer or his authorized representative to carry out risk assessment of machine, which intends to market or return to use.

The manufacturer or his authorized representative must ensure a risk assessment to determine the requirements for the protection of health and safety. Consequently, he defines limitations on the machine, identifies a risk rates and assess the risk to eliminate or reduce the risks. According to the Machinery Directive, the manufacturer must apply the principles relating to complex security, which includes [1]:

- design and execution of the machine in such a way that it is fitted for its function, without putting persons

at risk when working in accordance with its intended purpose, but also taking into account any reasonably foreseeable misuse thereof;
- the use of security triad (three-step method);
- a consideration during the design, construction and drafting the instructions intended use of the machinery and foreseeable misuse. Instructions should include information about how to use the illegal machines and restrictions on movements of the operator as well as the ability to use protective measures;
- providing the machine with all the special equipment and accessories essential to enable it safe adjustment, maintenance and use.

In terms of the minimum requirements apply Directive 2009/104/EC [2]. It is addressed to employers who are commitment to take all necessary measures to ensure that the work equipment made available to workers is competent to do the job.

Operated equipment should also not be a source of harm to their health and safety. Where it is not possible to ensure that the equipment can be used by workers without risk to their safety, the employer shall take all measures aimed at minimizing risks. Used in the Directive [2] the concept of work equipment refers both to technological machines, technological installations, tools and objects work.

The legislator of EU also points to the need for control of work equipment, in the case of equipment, which poses a particular risk to the safety and health of workers, the need for the employer [2] limiting use of work equipment is restricted to those persons given the task of usage and repairs, modifications, maintenance or servicing, the workers who are specifically designated to carry out such work.

In Directives [1, 2] EU legislator draws attention to the need to reduce, eliminate risks associated with the use of machines in the enterprise. It also imposes an obligation on the parties its reduction through the implementation of protective measures. Therefore, the main objective for the safe use of machinery in the steel industry is to ensure the rational management of risks associated with the use of machines. This objective can be achieved through mutual cooperation between designers of machines and their users, where he producer manages the risk by designing the machine, while the employer makes the management of specific conditions, in which the machines are operated.

In the literature [3, 4] often draws attention to the need to ensure safety in the use of machines, and also indicate to them as one of the basic pillars of World Class Manufacturing. In this respect it is a part of one of the four pillars, which include Autonomous Maintenance, Maintenance and Professional Early Equipment Management [5]. Rational risk management in engineering metallurgical enterprises effect on reducing the cost of accidents at work and occupational diseases, and thus improves work safety culture.

3. RISK MANAGEMENT OF MACHINERY BY THE MANUFACTURER AND USER

Risk management in the design and use of machinery is dependent on the manufacturer and the user's machine. In the case of machines that meet the requirements of Directive 2006/42 / EC [1], the manufacturer is responsible for their product, so it should take measures that the manufactured machine is secure. The legislator EU imposes on manufacturers the obligation to apply the security triad, which includes: the use of structural solutions inherently safe, the use of guards or protective devices and to inform the user of the remaining residual risks. At this stage, the producer manages the risk of primary and residual use of the funds resulting from the triad of security. The use of solutions provided by the manufacturer does not make machines safe, because there is still the risk resulting from the conditions in which the machine will be operated. Other risk limits employer using technical and organizational measures, which is consistent with Directive 2009/104/EC [2]. Acceptable risks are obtainable only with mutual cooperation of manufacturers and users of machines. Manufacturers implementing technical solutions inform about the risks, and users of machines

taking into account the specifics of the technological profile, follow the established procedures for the correct use of machines.

4. METHODOLOGY OF RISK MANAGEMENT IN THE METALLURGICAL ENTERPRISE

Risk management methodology described in the example of the machinery for wire drawing machine, which is usage in the metallurgical enterprise. Puller reel is used in the processing of plastic wire with a diameter of 3.2 mm to 1.8 mm in diameter. In order to carry out the process of managing the risks associated with the use of machines for processing of plastic: specify the limits of the machinery, identify emerging threats, assess risks, carry out the process of risk evaluation, implement solutions provided triad of security (including these steps, which apply to the analyzed machine).

Methodology of the risk management process requires engineering activities carried out in the order indicated, for each of these stages that affects the next stage of the process of reducing the risk of machine. In determining the limits of the pulling machine should take into account restrictions on the user space of time. After determining the limits of the machinery is an important step in the process of risk identification (existing constantly and those that may arise in an unexpected way), and risk assessment for each emergency. After estimating the risk process is carried out its evaluation in order to determine whether it is necessary to reduce it. In the case of the need to reduce, you must select and apply safeguard measures. Minimizing risk can only be achieved by eliminating risks or reducing them. By implementing the steps provided in the triad of security should make use standard [6], which indicates that the technical aspects should be taken into account.

The triad of security applied by the manufacturer in accordance with Directive [1], but also can apply it the employer in the process of risk reduction. The use by employers of the risk reduction with regard to the triad of security simplifies the process of meeting the requirements set out in the legislation.

The way a methodical approach to risk management process engineering are presented in **Table 1**. In the first stage, set restrictions on the use of the machine, time interval inspections are carried out and the limitations arising from the behavior of the order in the workplace, the type of workpiece material (wire rod with a diameter of 3.2 mm). Based on preliminary analysis obtains information allowing an initial analysis of safety associated with the use puller machine. This stage allows you to gather basic information that can be useful when carrying out further work.

In the second stage of the risk management process followed hazard identification. It is an important step in the whole process, the absence of an identified hazard can contribute to an accident at work. The threat, which are analyzed are the moving parts of the pulling machine. The source of the identified hazards is rotating drum of pulling machine.

In the third stage of the methodology described in the risk components are used in accordance with standard [6, 7], i.e. the probability of loss (P) and the severity of injury (S). The severity of the damage refers to injury or deterioration of health, and the likelihood of the possibility of avoiding or limiting the damage. The risk was estimated according to the method described in the standard matrix [7], where after determining the risk parameters follows his estimate. For risks moving parts of machines specified contractual values of parameters characterizing the risk. Serious injury, catching and pulling that may contribute to the death of the employee. Following method is described in the document [7] as a high severity of consequences. In the case of estimating the probabilities into account the need for access to the danger zone, the frequency of access, and the ability to avoid the damage. There are no statistical data concerning the possibility of an accident without the use of screens does not allow for an accurate estimate of probability. Taking into account the need for technical solutions (covers) assumes that the probability of an incident is greater than their application. On the basis of the estimated likelihood to be highly probable. The parameters by which describes the risk enabled the determination of its acceptability. After estimating the likelihood and impact of risks associated with this

threat it is unacceptable, which is why you need to implement measures aimed at improving working conditions.

Based on the initial analysis (stage 1 - 3) conducted the evaluation process of risk on the basis of which it was found that it is necessary to reduce the risks associated with the analyzed machine.

To reduce the risk, use the next stage - the process of reducing it (step 5). It becomes possible to achieve through the implementation of the method of three steps based on the use of: safe design, application of technical and user information. Each of the solutions adopted by the manufacturer in varying degrees affects the likelihood of an accident.

Table 1 Stages of risk management on example of the metallurgical enterprise

1. Definition of limitations related to the machine: - limitations related to the usage: industrial machine, trained workers, who are aware of the risk - limitations related to time: time interval between service - others limitations - related to maintenance of cleanliness - the required level of fineness
2. Hazard identification: Moving parts of the machine
3. Elements of risk and its estimating: Moving parts of the machine: - probability of loss (P): 3 (high probability) - severity of injury (S): 3 (high) - risk (R): 3 (high)
4. Evaluation of the risk: Unacceptable risk - necessary to reduce of the risk
5. Reducing of the risk: Producer: Step 1 - the use of structural inherently safe - the proper location of the danger zone; Step 2 - the use of quads or protective devices - the use of a movable guards Step 3 - inform the user of the remaining residua risk - the information pictograms
6. The risk estimation after the implementation of the manufacturer's solutions: - probability of loss (P): 1.5 (probably) Step 1 - the probability of events reducing about 0.50 Step 2 - the probability of events reducing about 0.80 Step 3 - the probability of events reducing about 0.20 } P < 1.5 against P = 3 - severity of injury (S): 3 (high) - risk (R): 2 (average)
7. Evaluation of the risk: Acceptable risks after the application of the manufacturer solutions
8. Reducing of the risk: Employer: - periodic checks guards - observing safe work procedures - increased caution

9. The risk estimation after the implementation of the employer's solutions: - probability of lost (P): 1 (improbable) - periodic checks guards - the probability of events reducing about 0.20 - observing safe work procedures - the probability of events reducing about 0.10 } P < 0.5 against P = 1.5 - increased caution - the probability of events reducing about 0.20 - severity of injury (S): 3 (high) - risk: 2 (average)
10. Evaluation of the risk: Acceptable risks after the application of the manufacturer and employer solutions

In step 6, indicated as the implementation of the three steps also affects the likelihood of an accident. The use of design solution for safe assumption involving the location of the drum machine, so that the employee does not have direct access to them reduces the likelihood of an accident of 0.50. The use of a movable guard constituting a physical barrier between the worker and the moving parts reduces the risk of an accident of 0.80. Information in the form of pictograms on the machine and in the operating instructions reduces the probability of 0.20. Each of the solutions adopted by the manufacturer, to varying degrees reduces the likelihood of accident and implemented solutions limit the risk of an accident with high (R = 3) to the average (R = 2).

Acceptable risk after applying the solutions provided by three steps (step 7), despite its acceptance requires the implementation of solutions resulting from the specific profile of the process, place of use of the machine. In step 8 - dedicated to reducing the risk, the employer shall take actions to carry out periodic checks guards, observing safe work procedures and to inform the employee about the risks, drawing his attention to especially careful. The use of the solutions provided by the employer (stage - 9) finally reduces the likelihood of an accident by 0.5. The application of solutions manufacturer and employer reduces the probability of 2 (P = 1.5 - producer + P = 0.5 - the employer) and P = 1.

The last step in the process of managing the risks associated with the use of the machines is a re-evaluation of its - stage 10. Based on the analysis, it was found that the implementation of solutions manufacturer and employer influence the improvement of safety at work, and thus reduce the likelihood of an accident. It was therefore concluded that providing safe and healthy working conditions is dependent on the mutual interaction between these entities.

The methodical approach to the risk reduction can be applied to each of the identified threats in the metallurgical industry. This methodology can be also used to the reducing risk for example in the rolling process, where the employee is also subject to the influence of many threats.

5. CONCLUSION

Methodical approach to risk management enables machinery to the effective actions to meet the requirements set by law and contributes to the improvement of working conditions. Within each of the steps undertaken actions aimed at reducing the risks associated with the use of machinery, and the process of its evaluation provides confirmation that the intended target was successfully achieved.

Reduce the risk of machines is an important element in the functioning of the metallurgical company, since it effectively reduces the number of accidents at work, which are the cause of the costs incurred by the company. For the analyzed risks associated with moving parts, methodical approach to risk management allowed us to effectively reduce the risk of an accident at work unacceptable R = 3 to acceptable R = 2.

REFERENCES

[1] Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery.

[2] Directive 2009/104/EC of the European Parliament and of the Council of 16 September 2009 concerning the minimum safety and health requirements for the use of work equipment by workers at work.

[3] MAŁYSA T., NOWACKI K., LIS T., *The review of the safety usage of machinery in industrial enterprises*, Hutnik - Wiadomości Hutnicze, 2015, vol. 82, no 6, p. 409-415.

[4] ŁABANOWSKI W., Safety usage of machinery a guide for the employers (in Polish), PIP, 2010, p. 8.

[5] GAJDZIK B., *World Class Manufacturing in metallurgical enterprises*, Metalurgija, 2013, vol. 52 (1), pp. 131-134.

[6] PN-EN ISO 12100:2012 Safety of machinery - General principles for design - Risk assessment and risk reduction.

[7] PN-N 18002:2011 Work safety management systems - General guidelines for occupational risk assessment (in Polish).