

Occupational risk assessment in the process of continuous steel casting

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ABSTRACT

Purpose: of the presented paper aimed at motivating the necessity of the implementation of Occupational Health and Safety Management System and showing the possibility of usage the estimation of threats to occupational health and safety and results of threats; in this case in the process of continuous steel casting.

Design/methodology/approach: used for the research has covered the occupational health and safety risk assessment including the identification and classification of the threats, occupational risk assessment as well as calculation of its acceptability

Findings: of the carried out researches are as follows: the realization of occupational health and safety policy using the occupational health and safety risk assessment leads to the improvement of the analyzed processes by the preventive actions, and in consequence - lowering of the occupational risk to the acceptable level.

Practical implications: can refer to continuous steel casting processes and to the usage of occupational health and safety risk assessment, identification of the threats connected with physical factors in the sudden manner acting on worker as well as recommendation of the preventive actions in the form of the means of collective and individual protection and organizational and procedural means.

Originality/value: of the presented paper has the meaning both for the employees from the point of view of work in the safe and hygienic conditions, as well as for employers from the point of view of creation the proper work background and possibilities of legal and normative requirements fulfilling.

Keywords: Safety and health management; Technological process analysis; Risk assessment

1. Introduction

Safety and hygiene of work it is one of the basic requirements stated for every company because of the need of health protection and safety of the workers.

Ensuring the required level of the health and life protection against the threats occurring at the work environment, and at the same time, fulfilling by the employers all the legal requirements being in force, that is difficult and time-consuming task.

Implementing of the occupational health and safety management system, which is supportive factor for organizing all necessary actions, into the company can be helpful in that range.

One of the key tools of that system, strongly influencing on creating and smooth functioning, is occupational risk assessment. It is systematized and constant estimation of meaning and probability of health damages among the workers, due to occupational threats in work environment; therefore, it supplies the basis for taking up activities aiming at improvement of the existing conditions.

Applying of the occupational risk assessment has crucial meaning, especially in the process of continuous steel casting because of accompanying factors of that process, which create threat for the safety of the workers' health.

2. Occupational health and safety management and the guidelines for the occupational risk assessment

management functions, which is the crucial one in the estimation and incorporation process of the safety policy in the workplace, and aims at taking up the preventive measures tending to improvement of working conditions at the workplace [1-4].

Safety of work, defined set of conditions which should be fulfilled at the workplace, in order to ensure to the workers performance of work safely and without any harm for the health. Safety of work covers all the technical, organizational and economic activities aiming at preventing from the risk of accident [5-10].

From the organizational point of view management of safety and hygiene of work is possible due to the management system based on the requirements of the PN-N 18001 standard. This system is a part of the general management system of the organization, which comprises the organizational structure, planning, and responsibility, code of conduct, procedures and resources necessary for working out, implementing, realizing, revising and supporting the policy of safety and hygiene of work [4-10].

The standard hasn't stated the absolute requirements concerning the effects of work in the range of safety and hygiene of work; it is only requested to take up the commitment of acting accordingly to adequate legal regulations and the constant advancement. It should be pointed out that the norm is based on the common points of the quality management system and the environmental management system, which can be used in some cases by adapting the existing, common elements of the general management system for occupational health and safety management system [1-3,6,11-14].

Constant improvement of the occupational health and safety management system is achieved due to the constant estimating of the effect of the actions taken, in order to identification of the possibilities of improvement in the range of the system functioning. And constant estimation of the effect of the activities is led by monitoring the information, which is necessary to plan the corrective and preventive actions against the incompatibilities identified in this process. The crucial role in the process of monitoring is assigned to the occupational risk assessment [1,2,6,10].

The risk may be defined as the function of probability of occurrence of the particular dangerous accidents and steaming from them consequences [1,2,4,15].

The assessment of the occupational risk relies on the comparison of the real risk level with the acceptable risk level [1,3,4,16].

This estimation is a multi-stage process, however, there may be distinguished two main areas; the analysis of the occupational hazard and its exact estimation during which the decision concerning acceptability of the estimated risk is taken [1,3,4,16].

The procedures taken during the occupational risk assessment process, and steaming from them actions being

in accordance with the PN-N 18002 standard, have been presented as [16]:

- collecting of the data necessary for the occupational risk assessment,
- identification of threats,
- estimation of occupational risk,
- estimation of acceptability of occupational risk,
- answering the question if the corrective and/or preventive actions are necessary,
- preparation of the plan of the corrective and/or preventive actions,
- realization of the plan,
- analysis of occupational risk,
- estimation of occupational risk,
- periodical estimation of occupational risk.

3. Own research

The research have been led in the steel plant company, having been present on the Polish market since over twenty years, not having implemented occupational health and safety management system compatible with the requirements of the PN-N 18001 standard.

The aim of the research was to estimate the occupational risk at the work stand of continuous steel casting, as well as to point out the preventive and corrective actions in the range of safety and hygiene of work in this branch.

Furnace charge in the process is mainly steel scrap of the trade and the company's origin, and in a small amount - the iron and the pig iron. Moreover, the calx is added, as well as the fluorite and coke. The fluorite and the coke is initially incandesced out in the range of temperature from 400°C to 700°C in order to remove the moisture. The scrap is segregated due to the size and purity of the scrap-pieces. The process of selecting and weighting of the individual materials is done by computer. Steel of the appropriate chemical composition from the tun is transported by the gantry to the continuous steel casting work stand (CSC).

After reaching the stage of the full readiness by the casting machine, CSC operator contacts the furnace-tun operator and confirms the readiness for acceptance the main tun with the liquid steel, and reports the temperature of the liquid steel at the moment of transportation to CSC.

After the transportation of the main tun to the rotational tower of the CSC machine, the main tun is located in the "pending" position. After preparing all the technical parameters by the CSC machine's operator, the casting process starts. Steel starts to flow into the tundish, and next to the crystalissoirs. The process of casting in the CSC machine starts. The continuous castings are passed to the cutting zone.

While estimating the risk, the algorithm concerning:

- identification of the threats occurring at particular work stand, together with the sources of their origin,
- estimating the risk concerns mainly setting the probability of the threats occurrence (low probable - lp, probable - mp, high probable - hp) and the severity of the results (low severity - ls, medium severity - ms, high severity - hs),
- pointing out the actions eliminating or limiting the occurring risk, was used.

Record of the occupational risk estimation for the continuous steel casting process has been shown in the table 1.

Table 1.

Record of the chosen occupational risk estimation results done at the stand of continuous steel casting machine; s - severity of the results of threats, p - probability of the threats occurrence, r - risk level.

Identified threat	Source of threat	Possible effects of threat	s	p	r	Corrective and preventive actions lowering the risk level
Fall during motion on the footways, stumble, slip on the surface.	Haste during work performance, complicated system of ways on the casting platform and in the area of the CSC machine, as well as near the main tuns and in the area of filling the dich of inlet tuns to the release.	Contusion, fracture.	ms	lp	m	Maintaining the right technical condition and order on the horizontal and vertical footways, and the ones near the work stands.
Stroke or crush by mechanically or manually transported materials.	Bad cooperation with the crane operator, incomprehensible and contradictory orders given to the crane operator during the cristallisoirs' covers, casings and cristallisoirs themselves transportation process.	Contusion, crushing, fracture, death.	hs	lp	m	Removal of such threats as: disorder on the horizontal footways before transportation of materials; supervision of the team, manual transportation of the load with the parameters accepted by law; aid and protective equipment for workers.
Stroke or crush by falling materials.	Loss of balance of the stored materials, overloading of the stored materials, badly prepared ground, fall of the wrongly stored or wrongly put aside tools	Contusion, fracture, serious injuries, death.	hs	lp	m	Safekeeping of the products, semi-finished products, materials, tools, during their storage time, in stable way and accordingly with the law regulations; preventing from an uncontrolled displacement, in the place designed for that purpose, safety helmet usage.
Hot working conditions.	Not using or lack of the proper protective clothing eliminating the effect of working in a high temperature.	Faints lost of consciousness, overheating of the body.	ls	mp	l	Usage of the proper protective clothing – heat-proof working clothes, which at the same time should be respiring ones.
Contact with extremely high temperature objects.	Exposure to the direct effect of the steel stream floating into the tundish during the casting process; steel splinters during casting; contact with equipment and materials, having high temperature due to the technological processes - covers of the main tun and the tundish, covers of the heaters	Death due to first, second and third degree of skin burns, skin burn due to the burnt clothing, temporary or permanent eyesight injury.	hs	mp	h	Heat-proof working clothes for workers, anti infrared-radiation covers and glasses, life-saving equipment (showers) and fire equipment at the work stand, systematic eyesight check-up of workers especially exposed to radiation.

4. Conclusions

Systematization of all actions taken in the company, aiming ensuring safe and hygienic work conditions to the workers, is able by implementing of the occupational health and safety management system, based on the requirements of the PN-N 18001 standard.

The basic tool used in the range of that system is occupational risk assessment, covering identification and classification of the threats, defining of the occupational risk, and estimating its acceptability. The basic criteria are always legal and normative requirements.

Results of the occupational risk assessment are the basis of taking up of the preventive actions, and are taken into account while equipping the work stands and while organizing the work.

The carried out analysis of the continuous steel casting, covering the safety and hygiene of work issues, enabled the identification of the threats occurring simultaneously with this process.

The identified threats were concerned with physical factors, having the instant impact on the worker. The following threats were stated:

- probable threat of the burn causing serious consequences,
- highly probable threat of the movable and immovable elements, as well as the threat of the fall, with the medium consequences.

Taking up of the preventive actions in form of the mass and individual protection measures, as well as the organizational and procedural measurements, enabled estimation of the occupational risk as acceptable one.

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