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JOB SAFETY ANALYSIS IN THE CONTEXT OF THE RISK MANAGEMENT PROCESS

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Abstract: The article presents the Job Safety Analysis for a Glass Production Line Operator's Workstation in the context of the Risk Management Process. The main tasks performed by the worker have been defined, and then risks associated with each activity and preventive actions have been identified. On this basis, for the Health & Safety risk analysis and assessment, criteria have been established, which take into account the actual exposure to risks and their probability and results.
Keywords: risk management, job safety, risks

1. INTRODUCTION

The Job Safety Analysis consists of three steps: defining the objectives of the tasks performed by the workers, and then establishing a list of activities to be carried out and determining the risks associated with carrying out each of these activities. The analysis accurately fits into the assumptions of the Risk Management System that undertakes the work safety issues in a holistic manner. Above all, it takes into account all work process aspects, such as the context (determinants), the accurate identification of risks for specific tasks, risk analysis and assessment, and the implementation of control mechanisms to improve the employee's work conditions (Marcatto et al., 2016). Taking the above assumptions into considerations, it was assumed, therefore, that the basic purpose of the study would be to put forward a proposal for occupational risk assessment including Job Safety Analysis and the Risk Management Process in accordance with the new ISO 45001:2018 (PN-ISO 45001:2018) Health & Safety Management System standard, and to indicate the benefits gained from a more accurate and reliable assessment of risks occurring at the workstation. With respect to the presented problem situation it can be noted that the current occupational risk assessment relates largely to the workstation rather than specific tasks and activities performed by the worker, which could considerably distort the actual picture of existing risks and general work safety assessment. Moreover, for risk analysis and assessment, available and recommended methods are used, which do not always reflect the existing probability, frequency or definition of the effects in a specific organization and on an actual workstation (Romanowska-Słomka, 2015; Szklarzyk et al., 2016). Therefore, the present article proposes that, in conjunction with the adopted risk assessment method for the tasks, our own assessment criteria, relevant to the work conditions, should be established. To this end, it is furthermore postulated to make and attempt to identify individual Risk Management Process steps for a specific case (establishing the context, identifying the risks, risk analysis, risk assessment, responding to risk, and monitoring and control). Research on the employee work process and occupational risk assessment has carried out in the article for an employee performing job, and then the choice of the adopted risk assessment methodology for the job has been justified. To better understand and achieve its objective, the study has taken the Risk Management Process guidelines resulting from the new ISO 31000:2018 whose framework is compatible with standard ISO 45001:2018 (Risk Management Process steps), while constituting its complement for the entire organization (PN- ISO 31000:2018, PN-ISO 45001:2018).

2. RESEARCH METHODOLOGY

To achieve the objective of the study, research on the job risk assessment was undertaken using different research methods, techniques and tools (Wojtyto and Rydz, 2018; Wojtyto, 2018). The research was carried out in November 2018 and concerned an employee performing work activities at the workstations of the Glass Production Line Operator (the first working shift). The number of the employee's working days in the entire month was 20-22. For this purpose, work measurement methods, such as Time Study and the Job Inventory, as well as the survey and the Risk Identification Checklist were used (Martyniak, 1996). The process of work assessment was carried out on the first shift of an eight-hour system, spanned from 5.40 to 14.20 hours, at the Glass Production Line Operator's Workstation operated by a 33-year-old employee in a good health condition, with a three-years' work experience in the company and using all the necessary personal and collective protection equipment, and allowing for breaks for meeting the employee's physiological needs. The research was carried out for a glass production plant active in the Silesian Province and employing 400 workers. The enterprise is part of a foreign corporation and specializes mainly in the production of construction glass.

3. RESULTS

As has already been mentioned in the introduction to this article, the Risk Management Process consists of the following stages: establishing the context, identifying the risks, risk analysis, risk assessment, responding to risk, and monitoring and control (Kaczmarek, 2010; PN-ISO 31000:2018, PN-ISO 45001:2018). The identification of risks along with preventive actions and control mechanisms, is shown using a Time Study Record Sheet and the Job Inventory for the Glass Production Line Operator (Table1).

Table 1
The Time Study Record Sheet and the Job Inventory at the Glass Production Line Operator's Workstation

No.	Duration [min]	Subject of observation (activity)	Position*	Level of difficulty **	Potential risks	Preventive actions-control mechanisms
1.	10	Putting on Personal Protective Equipment and going to the workstation	1,2, 4,5, 6	1	Slip, tripping, fall	Keeping traffic paths in appropriate order
2.	25	Shift take-over, obtaining information on glass production process conditions	1,4, 5,6	2	Disinformation, strain	Detailed reporting on the whole day and a detailed communication of information between shifts, control by superiors
3.	45	Tin Tank and Glass Annealing Furnace inspection - visual, tactile, temperature. Control of the flow of process-aiding gases (nitrogen, hydrogen, sulphur, oxygen).	1,4, 5,6	3	Burns, hot microclimate, cuts and abrasions, noise, dustiness, mechanical hazards (machines in motion, radiation, energy sources: steam, water, hydraulic systems, infrared radiation, contact with suffocating gases	Safe work procedure, Personal Protective Equipment, i.e. protective glasses, long-sleeved incombustible cotton clothing, leather gloves and long fire-resistant aramid gloves, fire-resistant balaclava helmet, ear stoppers, gas leak detectors, training.
4.	20	Filling out Tin Tank and Glass Annealing Furnace inspection Control Cards	1	2	Disinformation	Detailed communication of information to the next shift and the Engineering Department, and data archiving.

5.	80	Glass production process supervision and optimization in the Control Room.	1	4	Production loss, strain	Properly trained staff, round-the-clock Engineering Department support
6.	60	Temperature inspection of the Tank Furnace bottom using a laser pyrometer	5.6	3	Hot microclimate, noise, energy sources: steam, water, hydraulic systems	Safe work procedure, Personal Protective Equipment, i.e. protective glasses, long-sleeved incombustible cotton clothing, leather gloves and long fire-resistant aramid gloves, fire-resistant balaclava helmet, ear stoppers, training.
7.	20	Filling out Tin Tank and Glass Annealing Furnace inspection Control Cards	1	2	Disinformation	Detailed communication of information to the next shift and the Engineering Department, and data archiving.
8.	120	Fulfilling the Engineering Department's orders, i.e. replacing tin coolers, tightening the Tank Furnace, cleaning glass coolers, cleaning and tidying up, etc.	1,2, 3,4, 5,6	4	Burns, hot microclimate, noise, cuts and abrasions, dustiness, mechanical hazards (machines in motion), radiation, energy sources: steam, water, hydraulic systems; infrared radiation; slip, tripping, fall; compressed air, dynamic loads (manual transport work), cut, fire, static loads.	Safe work procedure, Personal Protective Equipment, i.e. protective glasses, long-sleeved incombustible cotton clothing, leather gloves and long fire-resistant aramid gloves, fire-resistant balaclava helmet, dust mask, training.

9.	20	Filling out Tin Tank and Glass Annealing Furnace inspection Control Cards	1	2	Disinformation	Detailed communication of information to the next shift and the Engineering Department, and data archiving.
10.	20	Control of cooling nitrogen flow over the Tin Tank	4,5, 6		Hot microclimate, slip, tripping, fall, contact with suffocating gases.	Safe work procedure, Personal Protective Equipment, i.e. protective glasses, long-sleeved incombustible cotton clothing, leather gloves and long fire-resistant aramid gloves, fire-resistant balaclava helmet, gas flow and leak detectors, training.
11.	70	Glass production process supervision and optimization in the Control Room	1	4	Production loss, strain	Properly trained staff, round-the-clock Engineering Department support
12.	10	Communication of information of the process to the next shift.	1,4, 5	2	Disinformation, strain	Detailed reporting on the whole day, detailed communication of information between shifts, and data archiving.
13.	20	Leaving the Workstation. Return to the dressing room. Handing over working clothing to the laundry.	6	1	Slip, tripping, fall	Keeping traffic paths in appropriate order

* – (1) sitting, (2) kneeling, (3) squatting, (4) standing, (5) bent standing, (6) walking, (7) other nonergonomic (e.g. lying) positions
**1-Very easy, 2- easy, 3- average, 4-harder than the other, 5- very difficult)

The table lists 13 activities that are performed during a working shift. Two additional tasks are performed irregularly. The first of them involves cleaning all glass coolers and exit curtains once a month by a team of several persons for a duration of about 4 hours, and the second one is carried out upon an order by the Planning Department

and may take place as often as up to several times a week (depending on the Production's needs). This is a glass thickness changing activity. The duration of particular activities can be shorter or longer, depending on the process conditions. The saved time is used then for a breakfast break and for meeting physiological needs. The highest level of difficulty occurs in tasks, such as cleaning all glass coolers and exit curtains, exchanging tin coolers, Tank Furnace tightening, cleaning glass coolers, tin melting, glass production process supervision and optimization in the Control Room, as well as glass thickness changing. Body positions most often taken during the working day include a sitting, standing, bent standing and a walking positions; additionally, for work activities with the highest level of difficulty, a kneeling and a squatting positions are also assumed. Activities, such as glass production process supervision and optimization in the Control Room, occur two times during a working shift; a similar is true for filling out Tin Tank and Glass Annealing Furnace inspection Control Cards. Tasks that are distinguished by the occurrence of the largest number of risks are: Tin Tank and Glass Annealing Furnace inspection - visual, tactile, temperature; control of the flow of process-aiding gases (nitrogen, hydrogen, sulphur, oxygen); replacement of tin coolers; cleaning the Tank Furnace; cleaning glass coolers; melting tin; cleaning and tidying up all glass coolers and exit curtains; and changing glass thickness.
Summing up the investigation results contained in Table 1, criteria for occupational risk analysis and assessment (Yao, 2018) can thereby be established, taking into account the actual frequency of the occurrence of those risks, exposure to them and their effects, as shown in Table 2. The proposed probability criterion is derived from the number (multiplicity) of repeating risks occurring when particular work activities are performed during a working shift (the number of repeating activities equals to the frequency of occurring risks to those activities, which is subject to summation). Exposure, on the other hand, results from the duration of an employee's exposure to a given risk arising from the performance of that activity (the duration of the performance of an activity equals to the duration of the employee's exposure to a given risk; e.g. 10 minutes of performing an activity = 10 minutes of exposure to the risk during a working day; so, 10 min./520 min.= 0.02 working day). If a risk occurs with several performed activities, then the duration of exposure to that risk is subject to summation, just like the multiplicity of its occurrence (probability).

Table 2
Criteria for occupational risk analysis and assessment at the Glass Production Line Operator's Workstation (probability, effects, exposure)

Probability - P	**Scale**	**Description**	**Effects- S**	**Scale**	**Description**
Rare	1	Occurs once in a working shift	Negligible	1	Small injuries, sick absenteeism up to 1 week
Little probable	2	Occurs 2 - 4 times in a working shift	Small	2	Small injuries, sick absenteeism up to a month
Medium	3	Occurs 5-6 times	Medium	3	Considerable injuries, sick absenteeism up to half a year
Probable	4	Occurs 7-8 times in a	Serious	4	Serious bodily injury, sick absenteeism over half a

		working shift			year
Almost certain	5	Occurs more than 8 times in a working shift	Very serious	5	Death
Exposure- E	**Scale**	**Description**			
Very frequent	1	Above 0.75 (above 390 minutes)			
Frequent	2	0.75 >E<0.5 working day (between 260 and 390 minutes)			
Occasional	3	0.5 >E<0.2 working day (between 260 and 104 minutes)			
Minimal	4	0.2 >E<0.06 working day (between 104 and 31 minutes)			
Negligible	5	E<0.06 working day (less than 31 minutes)			

To calculate the value of occupational risk at the Glass Production Line Operator's Workstation, the values of exposure, probability and effects need to be multiplied by themselves (R= PxExS). The results of this calculation, together with substantiation, are presented in Table 3.

Table 3
The results of risk calculation, together with substantiation

No	Risk	Substantiation	P	E	S	R	Risk level
1.	Slip, tripping, fall	Occurs 4 times in a working shift; exposure to these risks is 170 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
2.	Cut by sharp protruding parts	Occurs 2 times in a working shift; exposure to the risks is 165 minutes. Minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
3.	Burns	Occurs 2 times in a working shift; exposure to these risks is 165 minutes. Considerable injuries, sick absenteeism up to half a year	2	3	3	12	acceptable
	Hot microclimat e	Occurs 4 times in a working shift; exposure to these risks is 245 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
4.	Dustiness	Occurs 2 times in a working shift; exposure to these risks is 165 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
5.	Noise	Occurs 3 times in a working shift; exposure to these risks is 225 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
6.	Infrared radiation	Occurs 2 times in a working shift; exposure to these risks is 165 minutes; minor injuries, sick absenteeism up to 1 week	2	3	1	6	acceptable
7.	Contact with suffocating	Occurs once in a working shift; exposure to these risks is 45 minutes; serious bodily injury, sick absenteeism above	2	2	4	16	acceptable

	gases	half a year					
8.	Dynamic loads	Occurs once in a working shift; exposure to these risks is 120 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
9.	Static loads	Occurs once in a working shift; exposure to these risks is 120 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable
10.	Cuts and abrasions	Occurs 2 times in a working shift; exposure to these risks is 165 minutes; considerable injuries, sick absenteeism up to half a year	2	3	3	18	acceptable
11.	Compresse d air	Occurs once in a working shift; exposure to these risks is 120 minutes; considerable injuries, sick absenteeism up to half a year	2	3	3	18	acceptable
12.	Fire	Occurs once in a working shift; exposure to these risk is 120 minutes; possible death	2	3	5	30	acceptable
13.	Other mechanical risks	Occurs 2 times in a working shift; exposure to these risks is 165 minutes; serious bodily injury, sick absenteeism above half a year	2	3	4	24	acceptable
14.	Energy sources: steam, water, hydraulic systems	Occurs 3 times in a working shift; exposure to these risks is 225 minutes; serious bodily injury, sick absenteeism above half a year	2	3	4	24	acceptable
15.	Production loss	Occurs once in a working shift; exposure to these risks is 80 minutes; minor injuries, sick absenteeism up to 1 week	2	2	1	2	acceptable
16.	Disinformati on	Occurs 3 times in a working shift; exposure to these risks is 95 minutes; minor injuries, sick absenteeism up to 1 week	2	2	1	2	acceptable
17.	Strain	Occurs 3 times in a working shift; exposure to these risks is 185 minutes; possible minor injuries, sick absenteeism up to one month	2	3	2	12	acceptable

Risk assessment can be made on three levels, namely (Romanowska-Słomka, 2015): unacceptable risk- immediately discontinue the work, improve the working conditions, 125>R>99; partly acceptable risk- eliminate the causes and mitigate the risk effects, implement new control mechanisms, assess the effectiveness of the currently used control mechanisms, 99>R>51; acceptable risk- control and carry out the currently used preventive actions, 51>R>1.
Based on the Time Study and the Checklist, 17 main risks occurring at the Glass Production Line Operator's Workstation have been identified. The risk analysis and assessment has found that all of them are at an acceptable level. The greatest risk

concerns fire hazards (30), mechanical hazards (24) and energy source hazards (24). These are associated with activities, such as replacing tin coolers, tightening the Tank Furnace, cleaning glass coolers, melting tin, cleaning, temperature inspection of the Tank Furnace bottom, Tin Tank and Glass Annealing Furnace inspection, control of the flow of process-aiding gases (nitrogen, hydrogen, sulphur, oxygen). Only three risks, namely production loss, disinformation and strain, were characterized by a lower exposure level; the remaining risks showed an occasional exposure. The greatest effects were associated with a fire, contact with suffocating gases, mechanical hazards and energy sources. The probability of all identified risk was low. Moreover, when looking at the Glass Production Line Operator's Workstation, it is also worth considering risk assessment for risks associated with irregular activities; in that case, however, the Time Study will change.

4. CONCLUSION

To sum up the discussion in the present article the following conclusions can be drawn. First a worker employed in the enterprise under discussion may perform different tasks and work at several workstations; therefore, in order to make the picture of his/her work process more credible, it is worth of using risk assessment for specific tasks and activities performed by them. Working days may differ from one another due to various operating changes, the prevailing microclimate, and the scope of additional or irregular tasks; hence, the parameter of probability and exposure to risks will not be identical, so it is advisable, therefore, to adopt risk analysis and assessment criteria that will correspond to the working conditions and, on this basis, to conduct occupational risk assessment activities. Risk assessment should take into account all work aspects, such as the task duration, difficulty level, working position (ergonomic and nonergonomic), the number of tasks most often repeating themselves, break time, work dynamic, work type, workstation multiplicity, branch specificity, the number of workstations per worker, irregular activities, the worker's health condition, etc. Occupational risk for the same workstation will be different, when performed activities differ (in duration, shift, the number of auxiliary staff, etc.); Available and recommended risk analysis and assessment methods can be helpful, but, at the same time, may be too general for more complex workstations and not represent the actual risk level. Risk assessment for a task enables the selection of risk assessment criteria, whereby it is more reliable and adjusted to given workstations.

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