

Study and evaluation of negative factors affecting employees' health of glass manufacturing enterprises in Ferghana Region

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Abstract. The article describes the measures aimed at studying and eliminating negative factors that affect the health of employees in the glass production enterprise located in Kuvasoy city of Ferghana region. The results of the study showed that the concentration of dust, vapor, gas, aerosols from chemicals in the air of the working area is higher than the AC in all workplaces at the enterprise. In the hot period of the year, the microclimate indicators in the workplace did not meet the hygienic requirements, and the content of dolomite and quartz dust, nitrogen oxides, carbon and sulfur in the emissions of atmospheric air was higher than normal. These conditions have a negative impact on the health of employees, leading to stress in the thermoregulatory process and changes in the functional state of the cardiovascular system.

1 Introduction

Today, the protection of the health of the working population in Uzbekistan is one of the most important social issues. Factors of production that negatively affect the health of employees are still present in many sectors of the economy. These are associated with the use of low-quality technological processes that do not provide safe hygienic conditions in production, the use of obsolete machinery and equipment [1-3]. An analysis of the literature shows that negative factors such as hazardous silicose dust, lead dust, noise, and unfavorable microclimate have a place in glass production enterprises [4-6]. The impact of adverse factors on the health of employees in glass factories has been studied by scientists in European countries. In Sweden, the role of chemical factors in this production in the development of malignant tumors of the nasal cavity has been studied [7]. A number of authors have argued for the importance of chemicals, along with other types of pollutants, in the occurrence of pyelonephritis in the population: the average duration of treatment of patients in such contaminated areas was $16,49 \pm 0.14$, and in the control group $14,11 \pm 0,21$ days ($R \leq 0.001$) [7-12].

In recent years, numerous studies on occupational hygiene have been conducted in our country, assessing the impact of chemical, physical and psycho-physiological factors on the body of employees [13-15]. This kind of interest in occupational health issues is explained

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by the need to conduct health measures in many manufacturing enterprises, the lack of a normative and methodological framework for calculating occupational risks and determining the level of negative impact on production. The problems shown are significantly implausible to both glass products and glass manufacturing enterprises. The study of technological processes in the glass production enterprises operating in the Republic by the present period, hygienic conditions of labor, and the absence of work on temporary incapacity of employees determines the controversy of the research work [8-12].

The Purpose of the Study. To study and evaluate the factors that adversely affect the health of employees in enterprises engaged in the production of glassware and glass.

2 Methods

The object of research was the enterprise of JSC "Quartz", a glass manufacturer in the city of Kuvasoy, Fergana region, and employees of this enterprise. Hygienic, chemical, instrumental, computational and statistical research methods were used in the study.

In this case, the location of the main buildings, their location in relation to the green area and production areas was assessed hygienically. The area of the main shop buildings in the production area, their location, sanitary protection zone was studied. The area of administrative and residential buildings, their condition, and the number of rooms in accordance with sanitary and hygienic requirements was considered.

The situation of the glass factory, technological characteristics of production, sanitary and hygienic description of harmful and hazardous production factors, microclimate of the enterprise air, lighting indicators, noise level in the shops were studied and hygienic description was given.

The total number of employees at the enterprise is 3103, of which 1126 are women. The total production area is 46.6 hectares. Of this, the production zone - 10.66 hectares, the administrative zone - 0.09 hectares, the green zone - 7.16 hectares, the hard surface - 14.4 hectares, the natural zone - 14.39 hectares. The main shops are SPPG - 1.03, GJMW - 1 - 0.59, GJMW - 2 - 0.49, GJMW - 3 - 0.41, DCS - 0.73.

Thus, the production zone accounts for 22.8% of the total area, the administrative zone for 0.19%, and the green zone for 15.36%. From a hygienic point of view, the pollution of the air in the working area with harmful substances is of paramount importance. Toxic chemicals were detected at all stages of production in the region. Fig. 1 shows the quantitative indicators of chemical factors in warehouses for transportation of finished products and storage of raw materials.

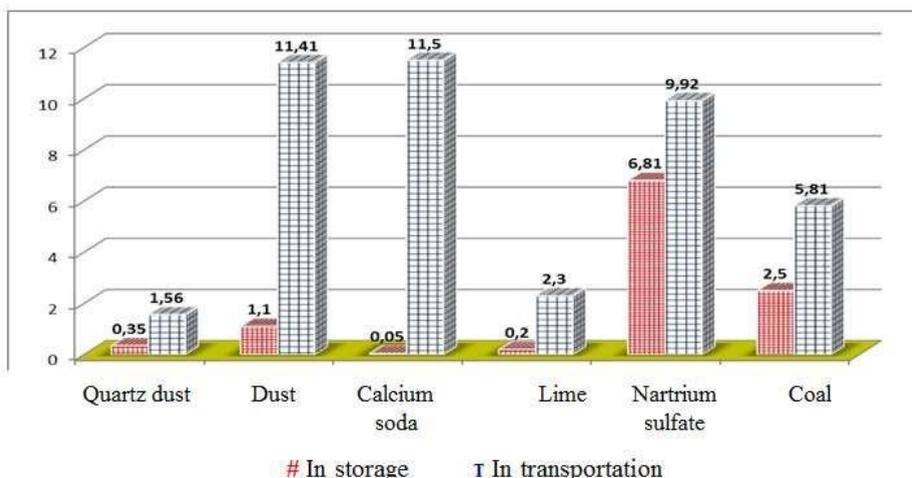


Fig. 1. Quantitative Indicators of Chemicals in the Raw Material Warehouse of the Glass Production Enterprise.

It was noted that the process of transporting the product is accompanied by high levels of air pollution, often due to excessive FN, the use of shovels in transportation and the release of bags of raw materials in the working area, which increases the concentration of chemical factors by 10-35%. In all cases studied, the sum of the quantities of the permissible quantities and the quantitative indicators of the detected substances was comparable to the magnitude greater than 1, which testifies to the unfavorable hygienic situation in the studied regions of production.

Exceeding the permissible concentration of substances in the air of workplaces was also noted at other points. The amount of harmful factor indicators in the respiratory zone of employees during the preparation of the shaft is given in Table 1.

Table 1. Quantitative Indicators of Harmful Factors in the Working Respiratory Zone during the Preparation of Slag.

| Indicators | Number of examples | Main points | Checkpoints | R | The fixed amount is mg / m ³ |
|-----------------|--------------------|-------------|-------------|--------|---|
| Dust | 10 | 10,5±2,1 | 1,50±0,31 | <0,001 | 10,0 |
| Quartz dust | 10 | 1,80± 0,2 | 0,11±0,03 | <0,001 | 1,0 |
| Soda dust | 10 | 6,30±1,0 | 1,20±0,21 | <0,001 | 5,0 |
| Natrium sulfate | 10 | 11,60±2,5 | 0,51±0,1 | <0,001 | 10,0 |
| Dalomite | 10 | 8,32±1,04 | 1,22±0,33 | <0,001 | 6,0 |
| Lime dust | 10 | 2,1±0,7 | 1,4±0,3 | >0,05 | 2,0 |

The data in Table 1 show that the most hazardous substance in the preparation of the slag is silica (containing quartz powder), which was 80% higher than the established hygienic norm and amounted to 1,8 mg/m³. The amount of dust in the air of the working zone is 10,5 mg / m³.

The reliability coefficient was R≤0.001 compared to the samples at the control points. The level of soda dust in the main shops was above the hygienic norms and was 6,30 ± 1,0 mg / m³, and at the checkpoints it was 1,20±0,21 mg / m³ (R≤0.001).

The amount of sodium sulfate at the main points was 11.60±2.5 mg / m³, and at the control points it was 0,51±0,1 mg / m³. The concentration of dolomite dust in the main bunkers was 8,32±1,04 mg / m³, and at the checkpoints it was 1,22±0,33 mg / m³ (R≤0.001).

Quantitative examples of microclimate (air temperature, relative humidity, air velocity) in the enterprise are given in Table 2.

Table 2. Microclimate Indicators in the Working Air Zone of the Glass Production Plant.

| Technological process | Air, Grade ° C | Relative humidity,% | Air velocity, m/s |
|------------------------------|----------------|---------------------|-------------------|
| | M±m | M±m | M±m |
| Cold period | | | |
| Warehouse | 13,5±1,5 | 58,1±1,4 | 0,08±0,01 |
| Preparation of raw materials | 10,5±1,0 | 54,0±7,2 | 0,10±0,01 |
| Preparation of slate | 12,2±0,3 | 64,2±0,8 | 1,08±0,02 |
| Boil the glass mass | 15,1±1,5 | 54,5±2,6 | 0,51±0,2 |
| Shaping in form | 17,8±1,4 | 29,5±0,9 | 0,7±0,03 |
| Window cutting | 12,1±1,0 | 71,5±1,2 | 0,9±0,02 |
| Packing | 19,5±1,2 | 72,5±1,1 | 0,17±0,02 |
| Warm period | | | |
| Warehouse | 26,4±1,70*** | 46,7±0,5*** | 0,05±0,01* |
| Preparation of raw materials | 26,9±3,4*** | 36,2±0,5* | 0,06±0,01** |
| Preparation of slate | 26,0±2,4*** | 26,7±1,5*** | 0,12±0,01*** |
| Boil the glass mass | 26,0±1,6*** | 26,4±1,2*** | 0,7±0,03*** |
| Shaping in form | 32,9±3,4*** | 25,8±0,7** | 0,06±0,01*** |
| Window cutting | 26,0±2,4*** | 25,3±0,7*** | 0,09±0,02** |
| Packing | 22,9±1,2 | 17,5±0,5*** | 0,14±0,02 |

The differences in the cold period group data are significant (* - R <0.05, ** - R <0.01, *** - R <0.001)

In the cold period of the year, the air temperature in the main shops and raw material warehouses was 13,5±1.50 ° C, relative humidity was 58,1±1,40%, and air velocity was - 0.08±0.001 m/sec. In the hot period of the year, the temperature was 26,4±1,70 ° C (maximum-33 ° C), relative humidity was 46,7±0,50%, and air velocity was 0,05±0,001 m/sec; this differs significantly from the hygienic requirements. In the process of preparing raw materials for the cold period of the year, the microclimate indicators comply with hygienic standards. For the cold period of the year, the air temperature was 26,9±3,40 ° C, the relative humidity was 36,2±0,50%, and the air velocity was 0,06 ± 0,01 m/sec. During the preparation of the frost for the cold period of the year, the air temperature was 12,2±0,30 ° C, relative humidity was 64,2±0,80%, and air velocity was 1,08±0,02 m/sec. In the hot period of the year, the air temperature rose to 26,0±2,40 ° C (maximum 32,0 ° C), relative humidity was 26,70±1,50%, and air velocity was 0,12±0.01 m/sec. In the process of boiling is hardest working glass mass, the air temperature for the cold period of the year was 25,10±1,50 ° C, the relative humidity was 54,50±2,60%, and the air velocity was 0,51±0,02 m/sec. During the warm period of the year, the air temperature rose to 26,01±1,60 ° C, the relative humidity was 26,40±1,20%, and the air velocity was 0,70±0,03 m/sec.

Analysis of air temperature, relative humidity, and air velocity indicators showed that at different stages of the technology, microclimate indicators differed significantly, with non-hygienic requirements recorded in all surveyed workplaces (especially in hot weather). This underscores the need to take measures to improve the microclimate in the production process.

The next stage was a functional study of the state of the working organism during the hot period of the year. The study involved 110 employees with work experience ranging from 1 to 7 years, ranging in age from 33 to 44 years. According to the classification sanitary rules and norms №0141-03, their labor was rated as average weight labor (II b), energy consumption was 200-250 kcal / h, and in heavier areas of work, mostly men were

employed. The results of the assessment of the impact of microclimate factors on the physiological parameters of the body of employees in the enterprise are presented in Table 3. The surveys were conducted before, during, and at the end of the work day.

Table 3. Influence of Microclimate Factors on Physiological Parameters of Employees.

| Indicators | Background | Between shifts | | End of shift | |
|---------------------------|------------|--------------------|-------------------|--------------------|-------------------|
| | | Before the measure | After the measure | Before the measure | After the measure |
| Body temperature, degrees | 36,6±0,004 | 37,2±0,05 | 36,1±0,12*** | 37,4±0,03 | 36,6±0,06**^^^ |
| Heat sensation score | 4,0±0,27 | 7,0±1,0 | 6,20±0,20*** | 7,0±0,11 | 6,40±0,07*** |
| SCT, °C | 35,9±0,13 | 36,7±0,17 | 36,0±0,14** | 36,8±0,50 | 36,10±0,17 |
| Sweating% weak | 0 | 10 | 25 | 0 | 0 |
| Medium | 0 | 28 | 50 | 2 | 42 |
| Strong | 0 | 92 | 57 | 120 | 57 |
| Systolic pressure | 120,2±1,40 | 125±1,82 | 120±1,40 | 130±2,20 | 125±1,82^ |
| Diastolic pressure | 84,2±1,40 | 82,4±1,71 | 80,3±1,40 | 84,9±1,50 | 80,3±1,40*** |
| Heart rate per minute | 72,8±0,70 | 103±1,54 | 89,2±1,2 | 130±3,02 | 91,1±1,40*** |
| Respiratory rate | 24±2,10 | 28±1,40 | 25±1,70 | 29,0±1,30 | 26±1,30 |

Significant differences in group data before the event (* - P < 0.05, ** - P < 0.01, *** - P < 0.001), ^ - differences in data between shifts are significant (^ - P < 0,05, ^^ - P < 0,001).

From the data given in Table 3, it can be seen that the body temperature of the worker between work shifts is 37,2 °C, and at the end of the work shift is 37,4 °C; heat sensitivity was 2-3 points higher in the middle and at the end of the work shift than the results obtained before the start of work, the temperature of the skin coating was 2,6 °C between work shifts and 2,8 °C at the end of work shift. Sweating indicators 28% of employees between work shifts were assessed as weak in sweating status, 62% were assessed as strong in employees, while 100% were noted to be strongly sweating in employees who were observed after work shifts.

Preoperative (background) blood pressure readings were as follows: systolic pressure 120,2±1,40, diastolic pressure 84,2±1,40. Two hours after the start of the work shift, systolic and diastolic blood pressure rose by an average of 5 mercury units to 125±1,82, while at the end of the work shift, systolic pressure rose by 10 mercury units to 130±2,20. The number of heartbeats before work was 72,8±0,70 beats per minute. At the beginning of the work shift, the number of heartbeats before the start of work increased by 31 beats and amounted to 103±1,54. At the end of the work shift, the number of heartbeats was 58 beats more than the background and was 130 ± 3,02.

3 Conclusion

1. Working conditions in a glass factory are characterized by the formation of a complex of negative factors affecting the body of the employee; the degree of influence of these factors often depends on the nature of the technological process, the location and quality of devices, equipment and the efficiency of ventilation in production.

2. The main negative factors in the air of the working area at the glass industrial plant are chemical factors, which are in the form of dust, vapor, gas, aerosols; the concentration of these substances is higher than the AC in all workplaces at the plant.

3. In the hot period of the year, the microclimate indicators in the workplace do not meet the hygienic requirements, which lead to stress in the thermoregulatory process in employees and changes in the functional state of the cardiovascular system.

4. The glass factory must ensure the purification of dolomite and quartz dust, nitrogen oxides, carbon and sulfur from the emissions into the atmosphere during its operation; it is necessary to organize constant monitoring of the amount of these substances at a distance of 100 meters around the plant.

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