



## Hygienic Estimation of Air Pollution in Workplaces of Polymer Products Production Enterprises

Ermatov J. Nizom<sup>1\*</sup>, Alimukhamedov Sh. Dilshod<sup>2</sup>, Rustamov A. Abbos<sup>3</sup>, Sadullaeva A. Khosiyat<sup>4</sup>, Rustamova T. Mamlakat<sup>5</sup>, Khayrullaeva S. Sanam<sup>6</sup>, Dadaboyeva K. Rano<sup>7</sup>, Saliyev R. Akromjon<sup>8</sup>

<sup>1</sup>Head of the Hygiene of Children, Teenagers and Nutrition Department, Tashkent Medical Academy, Tashkent, Uzbekistan. <https://orcid.org/0000-0002-9964-5962>

<sup>2</sup>Associate Professor, Hygiene of Children, Teenagers and Nutrition Department, Tashkent Medical Academy, Tashkent, Uzbekistan. <https://orcid.org/0000-0003-2824-3760>

<sup>3</sup>Lecturer at the Military Medical Academy of the Armed Forces of the Republic of Uzbekistan, Tashkent, Uzbekistan.

<sup>4</sup>Associate Professor, Department of Environmental Hygiene, Tashkent Medical Academy, Tashkent, Uzbekistan. <https://orcid.org/0000-0003-2798-6079>

<sup>5</sup>Professor, Department of propaedeutic of internal medicine No.1., Tashkent medical academy, Tashkent, Uzbekistan. <https://orcid.org/0000-0002-2363-5215>

<sup>6</sup>Assistant, Department of propaedeutic of internal medicine No.1., Tashkent medical academy, Tashkent, Uzbekistan. <https://orcid.org/0000-0003-3345-3244>

<sup>7</sup>Associate Professor, Head of Department of the continuing education for doctors., Tashkent medical academy, Tashkent, Uzbekistan. <https://orcid.org/0000-0002-6736-3434>

<sup>8</sup>PhD, researcher, Hygiene of Children, Teenagers and Nutrition Department, Tashkent Medical Academy, Tashkent, Uzbekistan

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### KEYWORDS

Benzene, Carbon monoxide (CO), Formaldehyde, Phenol, Ammonia, hygienic estimation, air pollution.

### Abstract

According to technological processes in production, the factors created by the operation of machines and equipment have various complex characteristics. We used sanitary-hygienic and laboratory-instrumental methods in our research to assess the harmful and dangerous factors in the highly generated production environment, and these data were reflected in this article. According to results of the technological processes of the consumer goods production workshop, benzene in the workplace air is 0.41 times higher, formaldehyde is 0.13 times higher, benzene is 0.83 times higher in the workplace of the casters, carbon monoxide is 1.3 times higher, formaldehyde is 0.36 times higher, phenol 0.13 times and ammonia increased by 2.3 times, carbon monoxide increased by 1.4 times in the master's workplace and benzene by 0.52 times, carbon monoxide by 1.6 times, formaldehyde by 0.03 times, phenol at the extrusion machine operator's workplace It was found that 0.18 times and ammonia exceeded REM by 1.6 times.

### Introduction

The chemical factor is the leader in determining the working conditions in the production of polymer materials. The complex of harmful substances

entering the air of the working area includes chemicals used as raw materials in the production of intermediate and final products. The effect of harmful substances on the body of workers has a



combined or intermittent character. It has been assessed that the combined effects of high-temperature harmful substances, noise intensity and work load, and other risk factors have their place on the health status and functional indicators of workers at polymer products production enterprises in a number of workplaces [3, 4, 6, 10, 12, 14, 16, 19, 20, 27].

Currently, the number of companies engaged in the production of polymers for various purposes is increasing day by day. This requires the existence of a large group of workers who are employed in this section of the labor market and who have contact with the harmful factors that characterize the conditions of this production. The principle of obtaining polymers is based on the polycondensation reaction of polyester isocyanides with the formation of urethane joints in the presence of water, catalyst, foaming agents, emulsifiers and a whole range of purpose additives (plasticizer, flame retardant, dye, stabilizer, etc.). The initial raw material appears as a 2-3 component system, component A is a mixture of polyesters with various targeted additives; B component – isocyanites or their mixture; Component C comes separately in the form of a catalyst, which can be mixed with component A under production conditions. In a number of large production enterprises, they prepare it themselves by mixing the raw materials according to the recipe [8, 9].

The specificity of working conditions in the production of PPU is determined in many cases by the toxicological description of the ingredients of PPU and the composition of the recipe. It was found in the research that harmful substances can be released at practically all stages of the technological process. These are: unreacted insulators - ethylene

and propylene oxides, thermally oxidizing destruction products (aldehydes, etc.), solvents (methylene chloride, toluene, dimethylformamide, etc.), catalysts (tertiary amines), flame retardants (trichloroethyl phosphate), foaming agents, synthetic products (polymer dust in secondary processing) and others have been cited in a number of scientific works [1, 5, 8, 9, 15, 18, 21, 22, 23, 24, 26].

Väisänen AJK, Hyttinen M, Ylönen S, Alonen L. (2019) The aim of the authors of this study is to measure concentrations of gaseous and solid pollutants resulting from post-processes and additive manufacturing operations in occupational settings where plastics are used as starting materials. A secondary objective is to propose means of reducing exposure to pollutants released during additive manufacturing processes and to assess concentration levels based on target markers and proposed exposure limits. Volatile organic compounds were obtained using Tenax TA adsorption equipment and analyzed using a thermodesorption gas chromatographic-mass spectrometric instrument. Carbonyl compounds were extracted using DNPH-Silica cartridges and analyzed using high-performance liquid chromatography, particulates were measured using a P-Trak instrument, and samples were taken using an IAQ-Calc instrument for indoor air quality. Dust mass concentrations were measured simultaneously using DustTrak DRX and IOM samplers. At the stage of preparing plastics for thermal processing, the dust concentration was the highest. The total concentration of volatile organic compounds, on the other hand, is low (113-317  $\mu\text{g}/\text{m}^3$ ) in photopolymerization of dust and preparation by such methods. However, the total concentration of



volatile organic compounds was high (1,114-2,496 µg/m) in bulk materials in multi-pour synthesis methods, probably due to dusting of material and binder, where part of the spray may be aerosol [7, 17, 25].

## Purpose of the research

To hygienic estimate of air pollution in workplaces of polymer products production enterprises.

## Materials and Methods

Four production workshops of the Jizzakh Plastics joint-stock company located in the Jizzakh industrial area, Jizzakh region, Tashkent street 5, Uzbekistan, were selected as the objects of scientific research.

The indicators of working conditions of workers in the main profession of this enterprise, harmful factors that characterize them (microclimate, noise, dustiness and gassiness, lighting) were taken as a research subject.

"Jizzakh plastic" enterprise, located in the Jizzakh industrial area of our country, was first built in 1972 and has been operating for half a century. Today, it consists of the following shops: 1<sup>st</sup> polyethylene film production shop, 2<sup>nd</sup> polyethylene pipe production shop, 3<sup>rd</sup> - it consists of the workshop for the production of consumer goods and the 4<sup>th</sup> workshop for the production of polyethylene components.

Research work was carried out in all seasons of the year 2020-2022. During the inspection, a total of 205 workers worked at the enterprise, of which 168 (81.9%) were men and 37 (18.1%) were women. The average age of workers was  $43.9 \pm 0.76$  years,  $44.2 \pm 0.84$  years for men,  $42.3 \pm 1.8$  years for women, their average work experience was  $13.9 \pm 0.66$  years, 12 years for women.  $4 \pm 1.4$  years, in men it was

$13.7 \pm 0.74$  years. The incidence rate among workers was estimated (HKT, 10, 1993).

Under the control, the microparticles indicators were evaluated using the AMT-3 analyzer in various shops and departments of Jizzakh Plastics Joint Stock Company. The obtained results were compared on the basis of sanitary standards and sanitary norms and regulations No. 0324-16 "Sanitary and hygienic standards of microclimate in production rooms".

The amount of chemicals in the air at the workplace is analyzed based on 0294-11 Hygienic standards. The permissible amount of harmful substances in the air of the working area (REM) was estimated based on DavST 12.1.005-88 "General sanitary and hygienic requirements for the air of workplaces". Evaluation of workplace microclimate indicators was carried out using the AMT-3 analyzer.

Hygienic assessment of industrial noise was carried out in accordance with Government 12.1.050-86 SSBT "Methods for measuring noise in workplaces". The noise level was measured directly in the production workshops several times during the working week. "Shumomer-003 MZ" equipment was used to measure the intensity and spectral composition of industrial noise.

Sound pressure levels were determined in Db in the frequency range of 31.5-8000 Hz at workplaces. The obtained results were evaluated by comparing the values with the maximum permissible level in accordance with Sanitary norms and regulations No.0325-16 "Sanitary standards for permissible noise levels in workplaces".

Lighting networks in the workshop were measured during the working day in order to check the state of lighting in the workplaces and in the non-workshop areas.



It was evaluated on the basis of methodological manuals on "Assessment of tension and severity of labor processes during certification of workplaces" (2016) [1, 2, 13].

The severity and intensity of work was evaluated based on SanNvaQ No. 0141-03 "Heaviness and intensity of the labor process in the production environment, hygienic classification of indicators of harmfulness and danger of working conditions" [11, 15].

In workshops, the concentration of chemical factors in the air of the working area in occupational groups was measured in accordance with the requirements of DavST 12.1.005-88 "General sanitary and hygienic requirements for the air of workplaces".

Sanitary norms and regulations No. 0294-11 was analyzed according to "Hygienic norms of permissible concentration of harmful substances in the air of workplaces".

Statistical processing of the research results was done using the "Statistica for Windows 7.0" personal computer application package.

## Results and Discussion

As a result of the study of the activities of the workshops of polymer products production enterprises, it was found that as a result of the technological process, various harmful factors are released into the atmosphere in the form of gas vapor.

Low-pressure consumer goods production workshop and polyethylene film production workshop, high-pressure workshops include polyethylene pipe production workshop and polyethylene fittings production workshop.

Polyethylene and polypropylene raw materials (cerio) were used in the low-pressure production

workshops, and polystyrene and polyvinyl chloride raw materials were used in the high-pressure ones, and the raw materials were sent to the injection molding machines-thermoplastautomat (TPA) through the pipe system.

Additives (plasticizers) dioctyl phthalate (DOP) and soapstock mixture are added to the raw materials in low and high pressure production shops, and come to the extruder device for complete melting at 182°C for 60 minutes, and in high pressure 185 °C for 80 minutes. In the process of melting, chemical substances are released into the air of the working area in the form of gas vapors.

The molten material is shaped under pressure by means of pressing molds, and its cooling and solidification is cooled by water in the pressing molds (water temperature  $t=15-20$  °C), cooling is carried out in freezer devices.

In the workplaces of casting machine operator No. 1, casting machine operator No. 3, and casting machine operator No. 5 of the low-pressure consumer goods production workshop of this enterprise, as well as film production machine No. 2, film producer No. 4 of the polyethylene film production workshop analysis was taken at the workplaces of the workshop, film production workshop No. 7.

ANT in order to assess the gasification of atmospheric air and its chemical composition in the workplaces of high-pressure workshops: thermoplast automatic equipment, grinding machine, granulator LGP-160 machine of the polyethylene pipe production workshop, thermoplastic automatic casting machine and granulator mixer equipment of the polyethylene components production workshop Analyzes were



performed on a 3M (analyzer-techesikatel) laboratory analyzer.

The results of the analysis of samples taken from the atmospheric air of workplaces were compared with sanitary norms and regulations No. 0294-11 "Hygienic norms of the permissible concentration of harmful substances in the air of workplaces" and the obtained results were given a hygienic evaluation in analytical order.

It was found that benzene, phenol, toluene, benzaldehyde, caprolactam, ethylene oxide, carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), acetic acid, formaldehyde, ammonia, acetaldehyde chemicals are formed at different stages of the technological process in the studied production units.

The first workshop is a workshop for the production of consumer goods. The workshop is located in a closed room with a 20-meter long and 10-meter wide concrete slab. Today, 31 workers work in this workshop in two shifts. produces household goods of different sizes, buckets, buckets, polyethylene containers and bags.

In this workshop, two rows of three thermoplastic machines are placed, each equipment is specialized in the production of different products on order, during the working period of this workshop, samples of 12 different chemicals were taken.

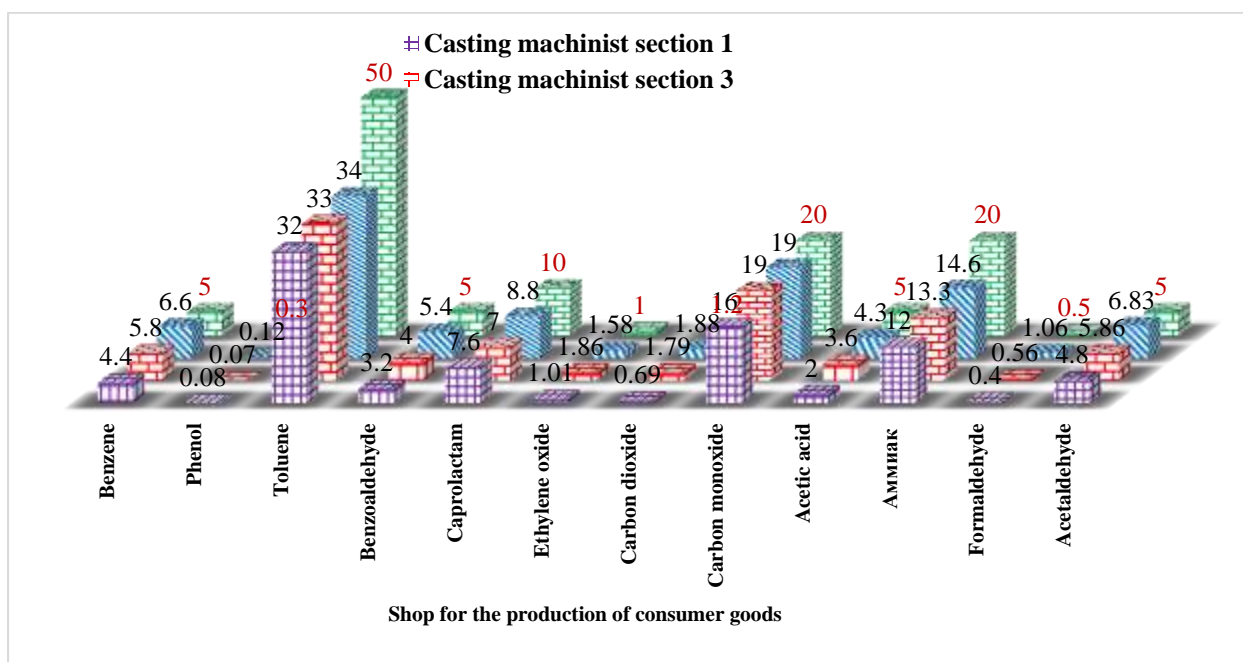
The first measuring point was selected near the caster section 1 machine, the second measuring point was near the caster section 3 machine, and the third measuring point was selected around 5 machines in the caster section. Five times analysis was taken at each point.

The first chemical substance is ethylene oxide, classified as a hazard class 2 substance (REM 1.0 mg/m<sup>3</sup>) at the first measurement point (1.01±0.74), which is (0.01 mg/m<sup>3</sup>), at the second measurement

point (1.86±0.38), which is (0.86 mg/m<sup>3</sup>) and the results obtained at the third measurement site (1.58±0.84), which is higher than REM (0.58 mg/m<sup>3</sup>) and according to the analysis result, the total The average amount of ethylene oxide by sex was (1.48±0.15) and it (0.48 mg/m<sup>3</sup>) was higher than REM (R<0.001) (Figure 1).

Benzene (class 2) REM 5.0 mg/m<sup>3</sup> substance, the result obtained at the first measurement point (4.4±0.18), is not higher than REM, at the second measurement point (5.8±0.21), it is (1.8 mg/m<sup>3</sup>), and at the third measurement site (6.6±0.06), this (1.6 mg/m<sup>3</sup>) results at all measurement points are higher than REM, the average amount of benzene for the total sex (5.6±0.15) and it was found to be higher than REM (1.6 mg/m<sup>3</sup>) (R<0.001) (Figure 1).

Carbon dioxide (CO<sub>2</sub>) (class 4) REM 1.2 mg/m<sup>3</sup> substance, the result obtained at the first measurement point (0.69±0.65) is lower than REM, at the second measurement point (1.79±0.45), which (0.59 mg/m<sup>3</sup>) and at the third point (1.88±0.02), this (0.68 mg/m<sup>3</sup>) is higher than REM, it was determined by the analysis, the average amount of carbon dioxide (CO<sub>2</sub>) for the general sex (1.45 ±0.08) and it was found to be higher than REM (R<0.05) on average (0.25 mg/m<sup>3</sup>) (Figure 1).



**Figure 1. Results of concentration of chemical substances in air samples, consumer goods production workshop.**

The next toxic substance is formaldehyde (class 2) REM  $0.5 \text{ mg/m}^3$ , at the first measurement point ( $0.40 \pm 0.33$ ), lower than REM, the result obtained at the second measurement point ( $0.56 \pm 0.74$ ), it ( $0.06 \text{ mg/m}^3$ ) the results obtained at the third measurement point ( $1.06 \pm 0.23$ ), which ( $1.06 \text{ mg/m}^3$ ) was found to be higher than REM, the average amount of formaldehyde in the general sex ( $0.67 \pm 0.20$ ) and it was found to be higher than REM on average ( $0.17 \text{ mg/m}^3$ ) (Figure 1).

Acetaldehyde (class 3) is a REM substance of  $5.0 \text{ mg/m}^3$ , the result obtained at the first measurement point ( $4.80 \pm 0.25$ ), lower than REM, the result obtained at the second measurement point ( $5.86 \pm 0.26$ ), it is ( $0.86 \text{ mg/m}^3$ ) and the result obtained at the third measurement point ( $6.83 \pm 0.08$ ), which is higher than REM ( $1.83 \text{ mg/m}^3$ ) was determined by the analysis, the average amount of acetaldehyde in the general sex was  $5.83 \pm 0.39$ ) and

it was found to be higher ( $R < 0.05$ ) than REM ( $0.83 \text{ mg/m}^3$ ) (Figure 1).

It was noted that the remaining chemical substances phenol, toluene, benzaldehyde, caprolactam, carbon monoxide, acetic acid, and ammonia did not exceed the permissible limit.

The second workshop is a polythene film production workshop, the workshop is located in a closed room with a concrete slab 25 meters long and 15 meters wide. It produces polyethylene films from 200 mm to 3000 mm in diameter for greenhouses and agricultural irrigation systems, and today there are 38 workers. leads

In this workshop, 12 lines of film production equipment were installed and samples were taken for 12 different chemicals, including: the first measurement location at 2 points around the film production equipment, the second measurement location at 4 measurement points around the film production equipment, and the third measurement



location around the film production equipment 7 digital measurement points were selected as measurement locations, and analyzes were taken five times at each point.

Benzene (class 2) REM  $5.0 \text{ mg/m}^3$  at the first measurement site ( $8.6 \pm 0.16$ ) is ( $3.6 \text{ mg/m}^3$ ) and at the second measurement site ( $8.1 \pm 0.23$ ) ( $3.1 \text{ mg/m}^3$ ) and the results obtained at the third measurement site ( $8.2 \pm 0.05$ ) are higher than REM ( $3.2 \text{ mg/m}^3$ ) and the average amount of benzene for the total sex ( $8.3 \pm 0.15$ ) and it was found to be higher ( $R < 0.001$ ) than REM ( $3.3 \text{ mg/m}^3$ ) (Figure 2).

Phenol (class 2) REM  $0.30 \text{ mg/m}^3$  at the first measurement point ( $1.148 \pm 0.48$ ) is ( $0.848 \text{ mg/m}^3$ ), from the second measurement point ( $0.59 \pm 0.25$ ) is ( $0.29 \text{ mg/m}^3$ ), the results obtained from the third measurement site ( $0.66 \pm 0.16$ ) are higher than REM ( $0.36 \text{ mg/m}^3$ ) according to the results of the analysis, the average amount of phenol ( $0.80 \pm 0.18$ ) for the total sex on average ( $0.5 \text{ mg/m}^3$ ) higher than REM ( $R < 0.05$ ) (Figure 2).

Benzaldehyde (class 3) REM  $5.0 \text{ mg/m}^3$  at the first measuring point ( $6.4 \pm 0.96$ ) is ( $1.4 \text{ mg/m}^3$ ) and at the second measuring point ( $6.3 \pm 0.18$ ) ( $1.3 \text{ mg/m}^3$ ), at the third measurement point ( $6.2 \pm 0.26$ ) it is higher than ( $1.2 \text{ mg/m}^3$ ) REM, and the average amount of benzaldehyde for the total sex ( $6.3 \pm 0.06$ ) and it is on average ( $1.3 \text{ mg/m}^3$ ) higher than REM ( $R < 0.001$ ) (Figure 2).

Coprolactam (class 3) REM  $10.0 \text{ mg/m}^3$  at the first measurement point ( $11.9 \pm 0.03$ ) is ( $1.9 \text{ mg/m}^3$ ) and at the second measurement point ( $11.8 \pm 0.36$ ) ( $1.8 \text{ mg/m}^3$ ), the result from the third measurement point ( $11.7 \pm 0.84$ ) is higher than REM ( $1.7 \text{ mg/m}^3$ ) and the average amount of coprolactam in the total sex ( $11.8 \pm 0.06$ ) and it was found to be higher ( $R < 0.001$ ) than REM by an average ( $1.8 \text{ mg/m}^3$ ) (Figure 2).

Ethylene oxide (class 2) REM  $1.0 \text{ mg/m}^3$  substance in the first measuring place ( $1.7 \pm 0.08$ ) is ( $0.7 \text{ mg/m}^3$ ), in the second measuring place ( $1.6 \pm 0.28$ ) ( $0.6 \text{ mg/m}^3$ ), at the third measurement site, the obtained results were ( $1.5 \pm 0.84$ ), which was found to be higher than ( $0.5 \text{ mg/m}^3$ ) REM, and the average amount of ethylene oxide ( $1.6 \pm 0.06$ ) and it was determined as a result of measurement ( $R < 0.001$ ) that it was higher than REM by an average ( $0.6 \text{ mg/m}^3$ ) (Figure 2).

Carbon dioxide ( $\text{CO}_2$ ) (class 4) REM  $1.2 \text{ mg/m}^3$  at the first measuring point ( $1.75 \pm 0.26$ ) is ( $0.55 \text{ mg/m}^3$ ), at the second measuring point is ( $65 \pm 0.56$ ) ( $0.45 \text{ mg/m}^3$ ), at the third measurement site, and the obtained results ( $1.55 \pm 0.07$ ) were found to be higher than ( $0.3 \text{ mg/m}^3$ ) REM, and the average amount of carbon dioxide ( $\text{CO}_2$ ) for the general sex ( $1.65 \pm 0.06$ ) and it was on average ( $0.4 \text{ mg/m}^3$ ) higher than REM ( $R < 0.001$ ) (Figure 2).

The next toxic substance is formaldehyde (class 2) REM  $0.5 \text{ mg/m}^3$ , at the first measurement point ( $0.40 \pm 0.33$ ), lower than REM, the result obtained at the second measurement point ( $0.56 \pm 0.74$ ), it ( $0.06 \text{ mg/m}^3$ ) the results obtained at the third measurement point ( $1.06 \pm 0.23$ ), which ( $1.06 \text{ mg/m}^3$ ) was found to be higher than REM, the average amount of formaldehyde in the general sex ( $0.67 \pm 0.20$ ) and it was found to be higher than REM on average ( $0.17 \text{ mg/m}^3$ ) (Figure 1).

Acetaldehyde (class 3) is a REM substance of  $5.0 \text{ mg/m}^3$ , the result obtained at the first measurement point ( $4.80 \pm 0.25$ ), lower than REM, the result obtained at the second measurement point ( $5.86 \pm 0.26$ ), it is ( $0.86 \text{ mg/m}^3$ ) and the result obtained at the third measurement point ( $6.83 \pm 0.08$ ), which is higher than REM ( $1.83 \text{ mg/m}^3$ ) was determined by the analysis, the average amount of



acetaldehyde in the general sex was  $5.83 \pm 0.39$ ) and it was found to be higher ( $R < 0.05$ ) than REM ( $0.83 \text{ mg/m}^3$ ) (Figure 1).

It was noted that the remaining chemical substances phenol, toluene, benzaldehyde, caprolactam, carbon monoxide, acetic acid, and ammonia did not exceed the permissible limit.

The second workshop is a polythene film production workshop, the workshop is located in a closed room with a concrete slab 25 meters long and 15 meters wide. It produces polyethylene films from 200 mm to 3000 mm in diameter for greenhouses and agricultural irrigation systems, and today there are 38 workers. Leads.

In this workshop, 12 lines of film production equipment were installed and samples were taken for 12 different chemicals, including: the first measurement location at 2 points around the film production equipment, the second measurement location at 4 measurement points around the film production equipment, and the third measurement location around the film production equipment 7 digital measurement points were selected as measurement locations, and analyzes were taken five times at each point.

Benzene (class 2) REM  $5.0 \text{ mg/m}^3$  at the first measurement site ( $8.6 \pm 0.16$ ) is ( $3.6 \text{ mg/m}^3$ ) and at the second measurement site ( $8.1 \pm 0.23$ ) ( $3.1 \text{ mg/m}^3$ ) and the results obtained at the third measurement site ( $8.2 \pm 0.05$ ) are higher than REM ( $3.2 \text{ mg/m}^3$ ) and the average amount of benzene for the total sex ( $8.3 \pm 0.15$ ) and it was found to be higher ( $R < 0.001$ ) than REM ( $3.3 \text{ mg/m}^3$ ) (Figure 2).

Phenol (class 2) REM  $0.30 \text{ mg/m}^3$  at the first measurement point ( $1.148 \pm 0.48$ ) is ( $0.848 \text{ mg/m}^3$ ), from the second measurement point ( $0.59 \pm 0.25$ ) is ( $0.29 \text{ mg/m}^3$ ), the results obtained from the third

measurement site ( $0.66 \pm 0.16$ ) are higher than REM ( $0.36 \text{ mg/m}^3$ ) according to the results of the analysis, the average amount of phenol ( $0.80 \pm 0.18$ ) for the total sex on average ( $0.5 \text{ mg/m}^3$ ) higher than REM ( $R < 0.05$ ) (Figure 2).

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Coprolactam (class 3) REM  $10.0 \text{ mg/m}^3$  at the first measurement point ( $11.9 \pm 0.03$ ) is ( $1.9 \text{ mg/m}^3$ ) and at the second measurement point ( $11.8 \pm 0.36$ ) ( $1.8 \text{ mg/m}^3$ ), the result from the third measurement point ( $11.7 \pm 0.84$ ) is higher than REM ( $1.7 \text{ mg/m}^3$ ) and the average amount of coprolactam in the total sex ( $11.8 \pm 0.06$ ) and it was found to be higher ( $R < 0.001$ ) than REM by an average ( $1.8 \text{ mg/m}^3$ ) (Figure 2).

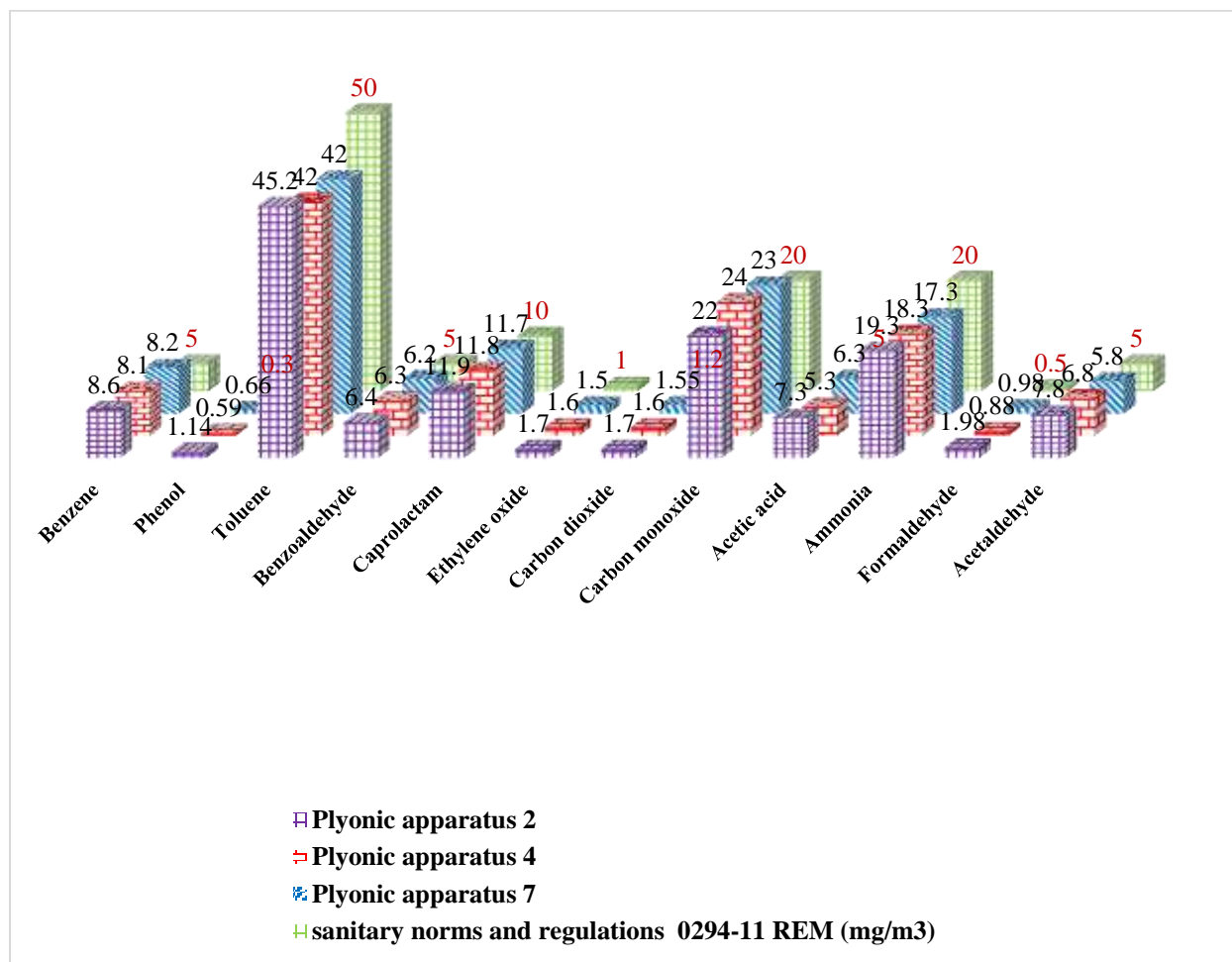
Ethylene oxide (class 2) REM  $1.0 \text{ mg/m}^3$  substance in the first measuring place ( $1.7 \pm 0.08$ ) is ( $0.7 \text{ mg/m}^3$ ), in the second measuring place ( $1.6 \pm 0.28$ ) ( $0.6 \text{ mg/m}^3$ ), at the third measurement site, the obtained results were ( $1.5 \pm 0.84$ ), which was found to be higher than ( $0.5 \text{ mg/m}^3$ ) REM, and the average amount of ethylene oxide ( $1.6 \pm 0.06$ ) and it was determined as a result of measurement ( $R < 0.001$ ) that it was higher than REM by an average ( $0.6 \text{ mg/m}^3$ ) (Figure 2).

Carbon dioxide ( $\text{CO}_2$ ) (class 4) REM  $1.2 \text{ mg/m}^3$  at the first measuring point ( $1.75 \pm 0.26$ ) is ( $0.55 \text{ mg/m}^3$ ), at the second measuring point is ( $65 \pm 0.56$ ) ( $0.45 \text{ mg/m}^3$ ), at the third measurement site, and the obtained results ( $1.55 \pm 0.07$ ) were found to be higher than ( $0.3 \text{ mg/m}^3$ ) REM, and the average amount of





carbon dioxide (CO<sub>2</sub>) for the general sex (1.65±0.06) and it was on average (0.4 mg/m<sup>3</sup>) higher than REM (R<0.001) (Figure 2).



**Figure 2. Results of concentration of chemicals in air samples of polyethylene film production plant**

The above two factories are producing polymer products under low pressure and at a temperature of 160-180 °C.

Production workshops for polymer products under high pressure production at a temperature of 185-218 °C include production workshops for polyethylene pipes and production workshops for components for polyethylene pipes.

Polyethylene pipe production workshop is included in the third production workshop, the workshop is 50

meters long and 20 meters wide, and the total covered area is 1250 sq/m<sup>2</sup>. It is one of the largest workshops in the enterprise.

This workshop produces polyethylene pipes for drinking water and sewerage and water-carrying devices for transmission pipes and conductors for electric wires, which can withstand high pressure from 0.32 MP to 20 MP according to the SDR indicator, with an outer diameter of 16 mm to 1200 mm. a granulator LGP-160 machine and a wood saw



machine have been installed to re-grind the pipes of poor quality and turn them into secondary raw materials. 58 workers are working today.

In this workshop, 6 lines of polyethylene pipe production equipment were installed, samples were taken for 12 different chemicals at three measurement points, the first measurement point was near the thermoplastic automatic pipe production equipment, the second measurement point was near the grinding machine saw, and the third measurement point was the granulator LGP-160 sorting machine. measurement points were selected, and analyzes were taken five times at each point.

In the analysis of samples taken in the air of the workplace for all sections of the enterprise, the highest amount of toxic substances is found in the following sections: benzene (REM 6.8 mg/m<sup>3</sup>), toluene (REM 8.0 mg/m<sup>3</sup>), benzaldehyde (REM 8.0 mg/m<sup>3</sup>), ethylene oxide (REM 0.76 mg/m<sup>3</sup>), carbon dioxide (CO<sub>2</sub>) (REM 0.49 mg/m<sup>3</sup>), carbon monoxide (CO) (REM 5.2 mg/m<sup>3</sup>), acetic acid (REM 1,78 mg/m<sup>3</sup>), ammonia (REM 2.3 mg/m<sup>3</sup>), coprolactam (REM 2.8 mg/m<sup>3</sup>) in the production workshop of polyethylene pipes, phenol (REM 0.5 mg/m<sup>3</sup>), acetaldehyde (REM 1.8 mg/m<sup>3</sup>) in the production workshop of polyethylene film, formaldehyde (REM 0.78 mg/m<sup>3</sup>), in the production workshops of polyethylene components higher than the permissible norm specified in sanitary norms and regulations No. 0294-2011 "Hygienic norms of the permissible concentration of harmful substances in the air of workplaces" determined (Table 1).



**Table 1**  
**Analysis of the highest concentration of chemicals in production facilities**

The composition of harmful chemicals in the workplace air	Production workshop name	The resulting sample mean (mg/m <sup>3</sup> )	Higher than REM mg/m <sup>3</sup>	Sanitary norms and regulations 0294-11 REM (mg/m <sup>3</sup> )
Benzene (Class 2)	Production of consumer goods	8,3±0,15	3,3±0,65	5,0±0,54
Phenol (Class 2)	Polyethylene film production	0,80±0,18	0,5±0,21	0,30±0,01
Toluene (Class 3)	Production of polyethylene pipes	58,0±1,5	8,0±0,12	50,0±1,7
Benzaldehyde (Class 3)	Production of polyethylene pipes	6,7±0,58	8,0±0,18	5,0±0,17
Caprolactam (Class 3)	Production of polyethylene pipes	12,8±0,55	2,8±0,4	10,0±0,37
Ethylene Oxide (Class 2)	Production of polyethylene pipes	1,76±0,06	0,76±0,7	1,0±0,04
Carbon Dioxide (CO <sub>2</sub> ) (Class 4)	Production of polyethylene pipes	1,69±0,06	0,49±0,32	1,2±0,04
Carbon monoxide (CO) (class 4)	Production of polyethylene pipes	25,2±0,60	5,2±0,24	20,0±0,70
Acetic Acid (Grade 3)	Production of polyethylene pipes	6,78±0,58	1,78±0,14	5,0±0,16
Ammonia (NH <sub>3</sub> ) (Class 4)	Production of polyethylene pipes	22,3±0,69	2,3±0,17	20,0±0,70
Formaldehyde (Class 2)	Production of polyethylene components	1,28±0,16	0,78±0,75	0,5±0,02
Acetaldehyde (Class 3)	Polyethylene film production	6,8±0,58	1,8±0,13	5,0±0,18

### Conclusion

Thus, as a result of the technological processes of the consumer goods production workshop, benzene in the workplace air is 0.41 times higher, formaldehyde is 0.13 times higher, benzene is 0.83 times higher in the workplace of the casters, carbon monoxide is 1.3 times higher, formaldehyde is 0.36 times higher, phenol 0.13 times and ammonia increased by 2.3 times, carbon monoxide increased by 1.4 times in the master's workplace and benzene by 0.52 times, carbon monoxide by 1.6 times, formaldehyde by 0.03 times, phenol at the extrusion

machine operator's workplace It was found that 0.18 times and ammonia exceeded REM by 1.6 times.

In the polyethylene film production workshop, benzene 0.69, formaldehyde 0.65, ammonia 1.4 times higher, benzene 1.83, carbon monoxide 2.3, formaldehyde 0.38, phenol 0.19 and ammonia 2, It was found that it increased by 3 times, and carbon monoxide increased by 1.6 times at the workplace of the master, and benzene by 0.62, carbon monoxide by 1.6 times, formaldehyde by 0.57 times, and phenol by 0.12 times at the workplace of the extrusion machine operator.



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