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Structural and Functional Characteristics of the Oral Cavity Organs and Tissues in Workers of the Petrochemical Industry of the Republic of Uzbekistan.

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Abstract

Purpose: The aim of the study was to determine the dental status, level, and structure of dental diseases, as well as to identify some clinical and functional deviations in the organs and tissues of the oral cavity among workers in certain industrial enterprises.

Methodology: A comprehensive dental examination was conducted on 1600 individuals, including 420 from the Fergana Oil Refinery Plant (FNPP - main group (MG)-1), 425 from the Almalyk Mining and Metallurgical Plant (AGMK - MG-2), and 605 from the Navoi Chemical Plant (NavCP - MG-3), as well as 150 patients as a control group (CG) who visited a dental clinic. Tooth sensitivity (TS), pain and discriminatory sensitivity (PS and DS) of the oral mucosa, taste perception threshold, and functional mobility of the taste receptors on the tongue, enamel resistance to caries, microhardness (MH) of enamel and dentin, and the condition of periodontal tissues and pH of mixed saliva were determined. The data obtained were processed using statistical methods.

Findings: It was determined that the levels and relative weights of the main dental diseases among workers in the studied industries remain quite high; carious and non-carious lesions of the tooth hard tissues, deformation and defects of teeth and dental rows (18.5%), periodontal tissue diseases (74.7%), diseases of the oral mucosa - 38.7%; the need for prosthetics (58.4%) and other pathologies. Additionally, almost all clinical and functional indicators and local non-specific reactivity of the tissues of the oral cavity in workers were disrupted.

Unique Contribution to Theory, Policy and Practice: The presence of the main dental diseases among those surveyed from the studied groups is quite high, with noted reductions in the excitability threshold of teeth, around tooth tissues and the oral mucosa, disruption of PS and DS of the oral mucosa, as well as deterioration of the condition of tooth hard tissues. Based on the obtained results, the authors suggest continuing in-depth scientific research with the aim of developing effective methods for the diagnosis and prevention of dental diseases among workers in these industries.

Keywords: *Dentistry, Oral Avity Pathology, Harmful Factors, Clinical and Functional Examination*

Introduction

Relevance. Today, in Uzbekistan, over a hundred thousand people work in mining and metallurgical, as well as petrochemical enterprises, with more than 30% of the workforce being women. Consequently, the issue of harmful factors affecting the health of workers, including the organs and tissues of the oral cavity (OC), is becoming increasingly significant. It is known that when the body is exposed to low-intensity chemical factors, compensatory reactions are triggered, leading to a state of non-specific heightened resistance.

The protective function of the organs and tissues of the oral cavity is formed as a reaction aimed at maintaining the normal functioning of the respiratory and digestive systems. Additionally, it retains its significance for other systems, as changes occurring in the organs and tissues of the oral cavity may serve as sources of pathological impulses, leading to the development of various systemic disorders.

Furthermore, the issue of dental diseases among workers in industrial enterprises is not fully explored, thus making it not only of scientific interest but also of considerable socio-economic importance in Uzbekistan.

Objective and tasks: The aim of the study was to determine the dental status, level, and structure of dental diseases, as well as to identify certain clinical and functional deviations in the organs and tissues of the oral cavity among workers in some industrial enterprises.

Materials and methods. A comprehensive dental examination was conducted on 1600 individuals, including 420 from the Fergana Oil Refinery Plant (FNPP - main group (MG)-1), 425 from the Almalyk Mining and Metallurgical Plant (AGMK - MG-2), and 605 from the Navoi Chemical Plant (NavCP - MG-3), as well as 150 patients as a control group (CG), who visited a dentist in the clinic.

The second stage involved prospective studies, with a total of 1600 subjects, including 1450 workers from 3 M/G of the studied enterprises; M/G-1 - 420; M/G-2 - 425, and M/G-3 - 605 workers, and 150 individuals not associated with such industries - the control group (C/G) seeking dental care at local dental clinics. Of the total number of subjects, men constituted 67.7% and women - 35.3%; the most numerous age group was those aged 30 and above - 72.2%; the most numerous in terms of experience were workers with 1 to 10 years of experience - 66%; the smallest were those with 16 years and above - 7.7% (Table 1).

Table №1.

Distribution of the examined individuals by age and gender.

№		Age and work experience	Number of examined individuals		Males		Females	
			Total individuals	T %	Total individuals	T %	Total individuals	T %
Total		Total	1600	100	1052	65,7	548	35,3
		O/H	1450	90,6	980	67,6	470	32,4
		K/G	150	9,4	72	48,0	78	52,0
Work experience (1450 individuals)	Age group	20-24 years	165	10,3	125	11,9	40	7,3
		25-29 years	280	17,5	175	16,6	105	19,2
		30-34 years	375	22,3	202	19,2	173	31,5
		35-44 years	400	25,0	200	19,0	200	36,5
		45 years and above	380	23,75	350	33,3	30	5,5
		1-5 years	425	29,3	270	27,5	155	32,9
		6-10 years	528	36,4	365	37,2	163	34,7
		11-15 years	385	26,5	250	25,5	135	28,7
		16 years and above	112	7,7	95	9,7	17	3,6

Dental examinations of M/G workers were conducted with the participation of employees of the MSCH enterprises, with standardized forms filled out according to a unified methodological principle. Attention was paid to subjective sensations in the oral cavity during history-taking; dental complaints were clarified during interviews, periodontal tissues, oral mucosa (OM), and lips were examined, noting the presence of fillings, dental prosthetics, and their condition. Tooth sensitivity (TS) (S.A. Gafforova, M.V. Bekmetova et al., 2002); pain and discriminatory sensitivity (PS and DS) of the OM (M.V. Sisneva, B.A. Khvatova (1974)); taste perception threshold and functional mobility of taste reception of the tongue (TPTFMT) ((M.V. Bekmetova (1983), N.S. Zaiko (1958)); resistance of tooth enamel to caries (V.R. Okushko, L.I. Kosareva (1983)), microhardness (MH) of

tooth enamel and dentin (S.M. Remizova (1965)); the condition of periodontal tissues ((Shiller-Pisarev tests, periodontopapillary-alveolar (PPA)) and the hygienic condition of the oral cavity (OC) (L.V. Fedorova (1982)); resistance of periodontal tissue capillaries (Kulazhenko (1960)), pH of mixed saliva; determination of the microelement composition of teeth, saliva, blood, and hair collected from workers of the studied enterprises using neutron activation methods [4]; biochemical composition of saliva was studied. The obtained materials were processed using the parametric t-Student criterion with the Excel MS Office 2017 software.

Results and Discussion. It is known that during oil processing, harmful substances such as phenol, ammonia, sulfur dioxide, nitrogen oxides, toluene, acetone, hydrogen sulfide, carbon monoxide, various hydrocarbons, and others are formed and released into the air of the workplace, which are harmful to the human body. Analysis of the obtained results from the documents of the sanitary and hygienic laboratory of production (norms for maximum permissible concentrations - MPC approved by the Ministry of Health of Uzbekistan were used); in M/G-1, average air indicators of the workplaces were noted: hydrogen sulfide - 10.0 mg/m3 (MPC = 0.008); benzene - 5.0 mg/m3 (MPC = 0.1); toluene - 65.0 mg/m3 (MPC = 0.8); gasoline - 105.0 mg/m3 (MPC = 1.5); phenol - 0.3 mg/m3 (MPC = 0.003); hydrocarbons - (total) - 358.0 (MPC - 0) and others: at the workplaces of M/G-2, also found, in the air of different points of workplaces and workshops, mainly sulfuric acid, furfuryl alcohol, hydrogen sulfide, benzene, phenol, and formaldehyde were detected, which belong to harmful substances of hazard class 2, as well as, stone and metal dust, sulfuric and acetic acids, methanol, tetrahydrofuran, formaldehyde, the content of which in some samples exceeds their MPC: at workplaces and certain points of production in M/G-3, where more than ten types of chemical fertilizers, synthetic detergents and cleaning agents are produced, NO2, NO3, HCN, Ce2, CH3OH, CO, HCN, MA, MEA, CH2COOH, acetone, ammonia were found, with the concentration of ammonia and CO exceeding the MPC by 1.5-2.0 times, CH3OH by 1.2-1.6 times; NO2, NH3, CO - in some samples exceeded the MPC by 1.2-1.3 times, the presence of which can have an adverse effect on the health of the factory workers.

Analysis of the dynamics of the incidence rates of temporary disability (TD) among workers in 2022 and 2023 showed that in M/G-1, respiratory diseases (RD) were at the top (correspondingly - 25.8%; -29.8%), followed by digestive system diseases (DSD) (correspondingly - 12.5%; -14.3%), and musculoskeletal system diseases (MSD) (correspondingly - 9.8%; -9.6%); in M/G-2, RD (correspondingly - 29.3%; -32.9%) were in the first place, followed by DSD (correspondingly - 9.8%; -9.6%), and MSD (correspondingly - 11.2%; -7.6%). Furthermore, in M/G-1 and M/G-3, kidney and urinary tract diseases were observed, while allergic pathologies were observed in M/G-2.

Our research results on the dental status of workers revealed that among the M/G workers, the prevalence rates of dental caries were very high, reaching 92.8% at FORP, 89.9% at AMMC, and 88.6% at NCP; similar indicators were obtained when studying the intensity of dental caries lesions (caries, fillings, extractions - CFE) - 11.8; -10.2; -10.4 respectively. When considering the prevalence rates of caries depending on the length of employment and age, it was found that both

among M/G workers and in the control group (C/G), these indicators increased in direct proportion - the longer the employment and the older the age, the higher the indicators. The highest caries prevalence rates in all M/Gs were found among workers with 11-15 years of employment, with the highest rates observed in workers at FORP (99.81+0.44%). A decrease in caries prevalence rates was observed among workers with 16 years of employment and more, especially pronounced among workers at AMMC (1.4 times). The levels of CFE indicators were generally higher among female workers in all plants compared to male workers: at FORP - 41.8%; -36.2%: at AMMC - 39.8%, -34.6: at NCP - 39.2 - 35.2% respectively. In M/Gs, the caries increase indicators were highest in the age group of 25-29 years (1.5; 1.4; and 1.1), as well as in workers with 10-15 years of employment (1.4; 1.3; 1.3 respectively).

It was found that the frequency of tooth damage by chemical necrosis (CN) among M/G workers was 15.23% at FORP, 17.64% at AMMC, and 22.64% at NCP; in the C/G - 7.69%. The frequency of tooth damage by CN among M/G workers increased with age and length of employment, except for M/G-2 workers, and the exception was the group of workers with 16 years of employment and more. It was also characteristic that with age and an increase in length of employment, an inversely proportional relationship was observed - a decrease in the frequency of localized form and an increase in the frequency of generalized form. CN of teeth occurred with approximately the same frequency in both genders, and it was less observed in molar teeth but always accompanied by necrosis of frontal teeth. In M/G-3 workers, the frequency of tooth CN varied - from 10.9% to 31.1%, after 34 years of age, the frequency of CN decreased; this trend was noted for AMMC workers (from 12.5 to -21.8% respectively) and FORP workers (from 8.3 to -21.0% respectively). With age and length of employment, the frequency of CN usually increased, however, in the age group of 45 years and older, a decrease in its frequency was observed.

Pathological tooth wear (PTW) among examined workers was detected in M/G-1 - 13.7%; M/G-2 - 15.8%, and M/G-3 - 25.8%. Also noted is an interesting pattern with 16 years or more of tenure and in the age group of 20-24 years - in 100% of cases; in terms of gender, it was found that in M/G-3, the pathology was more common in men than in women (66.1% and 33.9% respectively). According to the frequency of mechanical injuries to the hard tissues of the teeth (MIHTT), it was detected in M/G-3 (24.8%), M/G-2 (16.2%); M/G-1 (14.8%), and in the C/G - 8%. There were no significant differences between M/Gs by gender, and it was also found that among many young subjects (aged 20 to 30), the frequency of MIHTT was 1.5-3 times lower than among those aged 35 and older.

The frequency of dental calculus and deposits (DC and DD) among M/G workers is quite high; M/G - 13.3%; M/G-2 - 23.3%, and M/G-3 - 18.8%, while among examined C/G workers - 12.6%; typical features include - DC and DD were mainly found in the area of lower frontal and upper lateral teeth, and in M/G workers, they were also localized in the area of lower frontal teeth. Moreover, in terms of size, DC and DD in M/G workers were more massive, of different consistencies, and difficult to remove, and after removal, workers complained of tooth hypersensitivity.

The results indicated a fairly high frequency of periodontal tissue diseases (PTD); - M/G-70.0%; M/G-2 – 75.1%; M/G-3 – 79.0%, while among C/G individuals - 54%: among them, gingivitis was detected on average in M/G-1 - 17.8%; M/G-2 - 15.5%, and M/G - 21.5%, and among all M/G workers, a high frequency was noted in the group with 10 years of employment and more, and among workers aged 20-34 years. Gingivitis was characterized by swollen and edematous gums, which became spongy, easily detached from the teeth. Also, pronounced atrophic processes of the periodontal tissues were observed - pale gums, quite firmly attached to the teeth, but not to the tooth necks, but to their roots. The tooth necks were exposed, mainly on the buccal and lingual sides.

When studying the frequency of oral mucosa and soft palate diseases (OMSD), it was found in M/G-1 - 37.8%, in M/G-2 - 31.2%, in M/G-3 - 46.9%, and in C/G - 18% (table No. 5). At the same time, in M/G-1 workers aged 20-24 years, 45.8%, aged 25-29 years - 39.1%, and aged 45 and older - 44.7% were affected; M/G-2 - 20-24 years - 41.7%; also, among all M/G workers, a certain regularity was noted - the longer the employment, the more oral mucosa and soft palate lesions. In C/G as well, at the age of 20-24 (20%) and the age of 25-29 (30%), cases of OMSD were noted. Among M/G-3 workers, these pathologies were more often identified in the age groups of 35-44 years (56.8%) and 45 and older (54.3%). Also noteworthy is that the most frequent oral mucosa lesions were characterized by leukoplakia; - in M/G-1 - 17.4%; - M/G-2 - 14.6%; - M/G-3 - 19.3%, while in C/G - 6.7%. An interesting finding is the study of OMSD depending on gender, that is, in our research, the incidence of oral mucosa lesions was more common in women than in men. Also, the analysis of morbidity depending on age showed that OMSD affects older individuals more, although they also occur in young age.

Leukokeratosis was quite common - with them, the mosaic formations located on the entire surface of the palate ranged in size from a pinhead to a lentil, white, wart-like plaques protruded on the surface of the skin and had a recessed red dot in the center. Also, on all studied plants, a fairly common form of OMSD among workers were tongue diseases. At the beginning, a yellowish-white spot appeared on the back of the tongue ranging in size from a pinhead to a penny, round or oval, slightly protruding, with a sharp border.

Among all the surveyed plants, workers predominated who needed prosthetic treatment, among M/G-1 - 59.5%; M/G-2 - 59.05%; M/G-3 - 56.2%, among surveyed C/G individuals - 7.35%, as well as with the presence of dental prostheses - 8.8%; -9.41%; -10.1%; -42.3% respectively; the proportion of workers who did not need prosthetic treatment ranged from 7.62 to 24.9%; and in C/G - 58.8%; workers with occlusal anomalies - from 35.5% to 38.3%. In the obtained data, there was no single regularity or correlation between the indicators of workers who did not need prosthetic treatment, those with dental prostheses, the need for dental prostheses, and occlusal anomalies.

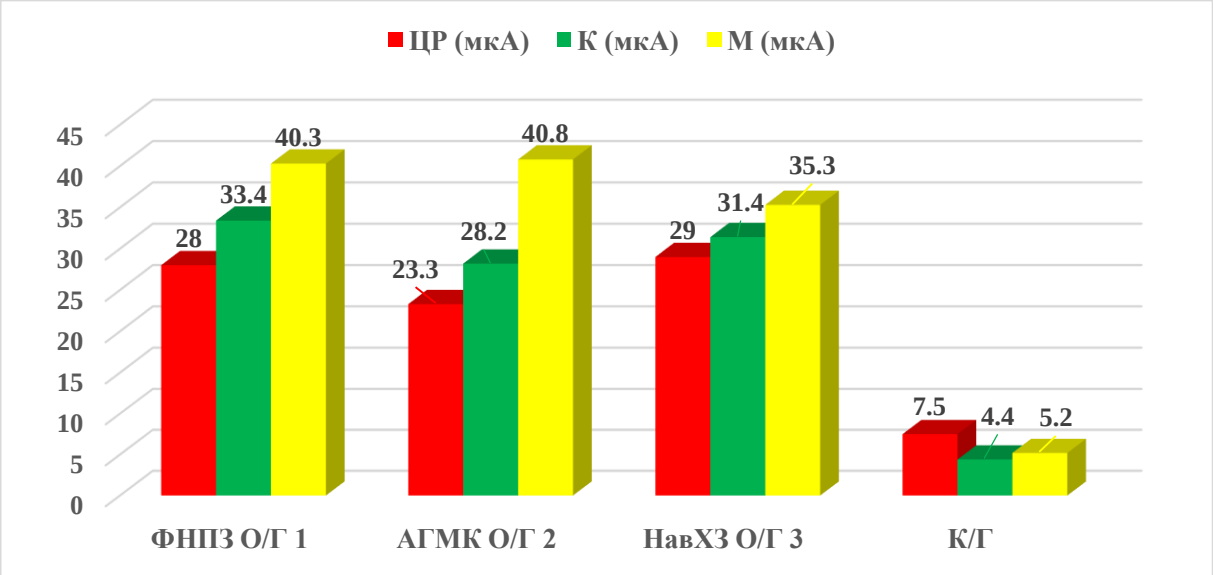
Electroodontometry (EOD) was performed on 126 individuals: 35 workers from each M/G and 31 individuals from C/G, for comparison; the objects of the study were central incisors (CI), canines (C), first molars (M) of the upper jaw (UJ), and the excitability threshold (ET) of 378 teeth was

determined: on CI UJ - 158, on C UJ - 145, on M UJ - 75. Results; among M/G-1 workers - a decrease in excitability threshold was noted - the maximum (max) value on CI - 52 μA, the minimum (min) - 3 μA: and on average 28+2.4 μA; on C - 75 μA, the upper threshold was 2 μA, on average 33.4+1.8 μA; on M decreased to 44 μA, min. was 6 μA, on average 40.3+2.4 μA: Among M/G-2 workers, the max. value on CI - 44 μA, min - 8 μA; on average - 23.3+1.2 μA; on C - 62 μA, the upper threshold was 6 μA, on average - 28.2+1.9 μA; on M decreased to 43 μA, min. was 8 μA, and on average 40.8+2.1 μA: Among M/G-3 workers, these indicators were; - 58 μA; - 4 μA; on average 29+1.4 μA; 85 μA; - 1 μA, on average 31.4+3.8 μA; 40 μA, 4 μA, on average 35.3+1.4 μA respectively. At the same time, the results of the studies in C/G individuals show that in individuals with intact teeth, the excitation threshold was within 5 to 9 μA, on average on CI - 7.5+1.2 μA, on C - 4.4+1.2 μA, on M - 5.2+2.2 μA. Moreover, the reaction of different functional groups of teeth was similar, only for M there was a tendency to decrease the excitation threshold. Its max. value in individual cases reached 16 μA, min - 2 μA. The analysis of the results characterizes a sharp decrease in the excitability threshold of all examined teeth in M/G-1, 2, and 3 workers compared to C/G ($P<0.001$). At the same time, the magnitude of the decrease was uneven for different functionally oriented groups of teeth, thus, a decrease in ET on M and C by 4-7 times was noted, and on CI - by 3.6 times.

The results of the study on the state of the sensitivity of the nerve receptor apparatus (SINRA) of the oral mucosa and soft palate region (OMSPR) in 120 examined individuals (30 from each group) revealed (fig. No. 1) a more pronounced SINRA on the vestibular surface (VS) of the alveolar process compared to its oral part ($P<0.001$). In the OMSPR, M/G workers in the 4th tooth had a tendency for the pain threshold to increase compared to the palatal surface of the 2nd and 6th teeth ($P>0.5$ - $P<0.05$). The pain threshold in the 2nd tooth of the palatal side in M/G was lower compared to the VS of the OMSPR ($P<0.05$), and the difference in indicators between the 2nd, 4th, and 6th teeth was insignificant ($P>0.05$). When determining the threshold of discomfort (TD) in C/G individuals, it was found that compared to the buccal mucosa, the most sensitive zone is the VS of the gums ($P<0.001$). In M/G workers, a statistically significant ($P<0.01$) decrease in TD was noted in all investigated areas (fig. 7.1.2). A comparison of the indicators of sensitivity of the tongue dorsum and gum OMSPR did not reveal a significant difference ($P>0.05$), however, a significant difference was noted between the indicators of gum OMSPR and cheek ($P<0.01$). The research results confirmed a decrease in the pain threshold and discomfort threshold in M/G workers.

Figure №1. Tooth excitability in surveyed individuals.

Additionally, to study taste sensitivity (TasteS) of the tongue, research was conducted on 75 individuals (20 workers from each M/G and 15 individuals from C/G). The results revealed that complaints about disturbances in taste sensations were reported by approximately 45 individuals: Among M/G workers, various TasteS disorders of the tongue were noted for all types of solutions used.



The increase in taste sensation threshold was most pronounced for sour - 31.2% and bitter - 25%, while the decrease was most pronounced for sweet - 53.1% and salty - 59.4%: in M/G workers - 45.2%; - 34.7%; 41.2%, and 39.2% respectively; in M/G-3 - 22.8%; - 28.9%; - 66.8%, and - 62.5% respectively. Additionally, when determining the threshold for sweet and salty, deviations were predominantly observed towards sour and sour-bitter taste in M/G-1 - 42.8%; - 34.6%; M/G-2 - 33.4%; - 33.2%; M/G-3 - 55%; - 44.8% cases respectively. When determining the threshold for sour and bitter, deviations were noted in the form of sour-bitter sensation in M/G-1 - 22.4%; - 31.1%; M/G-2 - 43.6%; - 48.2%; M/G-3 - 35%; - 24.8% cases respectively. The data obtained indicate a decrease in taste sensation for sour and bitter among M/G workers and a significant difference from C/G.

The study of microhardness (MH) of tooth enamel (55 molar teeth; 20 teeth from M/G-1, 20 teeth from M/G-2, 15 teeth from M/G-3) extracted due to severe periodontitis, with grade IV mobility, and 10 teeth from C/G individuals, revealed that enamel of the superficial layer possessed the highest hardness, significantly higher than in other layers ($P < 0.001$). The MH in the enamel thickness was significantly higher than in the dentino-enamel junction ($P < 0.001$) but lower than on its surface. In the teeth of M/G workers, MH of enamel was significantly increased in all studied layers compared to C/G ($P < 0.01$). Additionally, in the dentin of M/G workers, an increase in MH compared to C/G ($P < 0.01$) and a decrease compared to M/G-2 individuals ($P < 0.001$) were observed; in the dentin thickness, central part, and tooth cavity, there was a tendency for increased MH compared to C/G ($P > 0.05$); the results of the study show that in M/G-2 workers, there is an increase in MH in enamel and dentin, while in M/G-1 and 3 workers, there is a sharp decrease in MH of all investigated areas on the enamel surface and in its thickness.

When studying the results of the acid resistance test (ART) in M/G workers, it was found that the intensity of enamel etching ranged from 10 to 100% on the blue color scale. Depending on the intensity of staining, we conditionally distinguished 4 levels of tooth resistance to caries (table №2): level 1 from 10 to 30%, level 2 - 30-40%, level 3 - 40-50%, level 4 - above 50%.

Table №2.

Changes in the functional indicators of the oral cavity observed.

Examined Groups	TER Test	Enamel Resistance Level	DMFT (in scores)	Focal Demineralization of Enamel	pH of Mixed Saliva
FORP (W/G-1)	55,1+1,5^{x}	4^{x}	4,9+0,05^{x}	36,8+1,9^{x}	5,2+0,01^{x}
AMMC (W/G-2)	34,5+1,2^{x}	2^{x}	3,2+0,06^{x}	28,3+1,9^{x}	6,1+0,01^{x}
NCP (W/G-3)	52,9+0,9^{x}	4^{x}	4,9+0,05^{x}	33,4+ 2,2^{x}	5,4+0,01^{x}
Control	22,4+1,3	1	1,4+0,03	6,3+1,0	6,8+0,02

Among the surveyed M/G-1 workers, 23.2% were noted to have level 1 tooth resistance to caries, 21.8% had level 2, and many workers (55%) had level 3-4 enamel resistance. In M/G-2, the figures were 33.2%, 32.3%, and 34.5%, respectively, while in M/G-3 they were 21.2%, 27.7%, and 52.9%. In C/G, the corresponding percentages were 44.2%, 32.8%, and 22.4%. The results of the mixed saliva pH study in M/G workers indicate a shift towards acidity in M/G 1, 2, and 3, while in C/G individuals, the pH of mixed saliva was 6.8. In our opinion, the pH value of saliva changes because of exposure to acidic gases, vapors, micro-dust, and substances such as furfural, furan, tetrahydrofuran, tetrahydrofurfuryl alcohol, furfuryl alcohol, ethanol, xylitol, lacquers, nitrogen, copolymers, phenol-formaldehyde resins, catalysts, yeast feed, acetone, sulfuric acid aerosol, hydrocarbons, acetone, which have an acidic reaction. The microelement composition of enamel, dentin, cementum, hair, blood, and saliva was studied using the neutron activation method; 20 teeth and 12 hair, blood, and saliva samples were collected from M/G workers, while literary data [3] were used for control. According to the results (table №8), silver (Ag) was absent in the enamel of M/G-1 workers, while in M/G-2 and -3 workers, its content -1.45+0.02; -1.88+0.22* was closer to the norm. Conversely, in dentin, Ag content was not noted in M/G-2 and -3 workers, while in M/G-1 workers, it was 3-4 times higher than the norm. In tooth cementum, Ag content significantly differed, ranging from 2 to several hundred times higher than the comparison group's indicators.

Calcium (Ca) content in tooth enamel in all surveyed groups was slightly increased compared to its maximum content in the norm. Unlike enamel, in dentin, Ca content tended to decrease, especially in M/G-3 – 8-fold (4.5+0.91*).

Table №3.

The content of trace elements (Ca, Zn, Fe, Ag) in the teeth, saliva, and blood of workers at the FORP (Fergana Oil Refinery) to English.

Research	Object Trace Elements	Comparison Group	FORP (M/G-1)	AMMC (M/G-2)	NCP (M/G)
Enamel	Ca^{+2}	25,3+1,48	32,0+0,92*	30,8±1,36	29,5+1,13*
	Zn	185,0+11,3	136,0+16,7*	3763,0±131,0*	5361,0+261,0*
	Fe	32,0+1,41	62,0+0,44*	63,1±0,86*	14,4+0,33*
	Ag	2,2+0,01	-	1,45±0,02	1,88+0,22*
Dentin	Ca^{+2}	36,0+1,6	29,0+1,4*	29,8±1,4	4,5+0,91*
	Zn	368,0+19,4	3780,0+124,0**	3881,0±144,0*	5173,1+98,6*
	Fe	-	3,4+1,68**	-	<1,0
	Ag	0,56+0,01	2,45+0,098	-	-*
Cementum	Ca^{+2}	26,0+0,91	0,68+0,041*	24,8±0,84	2,99+0,32*
	Zn	92,0+3,6	28,4+0,42*	3036,2±131,4*	2351,0+49,0*
	Fe	0,1+0,001	1,9+0,44*	471,8±42,1*	0,98+0,01*
	Ag	0,27+0,01	9,0+0,28**	2,4±0,23*	0,51+0,013*
Cementum	Ca^{+2} мг/да	10,9+0,71	14,2+1,84	11,2±0,91	12,6+1,15
	Zn	112,0+10,6	86,8+3,5	76,4±3,21*	89,6+4,62*
	Fe	124,0+6,4	102,2+4,08*	96,0±3,19*	100,8+4,84*
	Ag	0,24+0,01	0,19+0,08	0,20±0,01*	0,22+0,08*
Saliva	Ca^{+2} мг/да	8.31+0.29	9,41+0,25	7,72±0,58	8.8+0.58
	Zn	30,8+1,46	36,4+1,94	74,6±3,76*	62,8+2,11*
	Fe	88,4+3,1	84,4+3,44	62,1±2,65	74,6+3,11*
	Ag	0,08+0,004	0,44+0,024*	0,06±0,003	0,09+0,054*
Hair	Ca^{+2} мг/да	1060+174	3480+420*	6080+17,44	5044+8,44
	Zn	225+8,5	210+30	180+4,54	140+4,5
	Fe	18+1,6	44,4+1,8*	48+1,64	38,4+1,45
	Ag	0,04+0,06	1,8+0,23	4,88+0,98	1,48+0,44

Note: *-P<0.05 indicates the significance of the results compared to the control group.

Iron (Fe) content in enamel was twice as high in M/G-1 and M/G-2 as in the control, while in M/G-3 workers, it was reduced almost 2.5 times. Although Fe is usually not detected in dentin, our studies found its presence in M/G-1 workers (3.4+1.68**), in a significantly higher quantity. In tooth cementum, Fe content in M/G-1 was 18 times higher than the control, nearly 450 times higher in M/G-2, and 8 times higher in M/G-3.

Zinc (Zn) content in tooth enamel was 1.4 times lower in M/G-1, 20 times higher in M/G-2, and 37-40 times higher in M/G-3 compared to the control. In dentin, Zn content significantly exceeded the control in all groups by 10 to 16 times, respectively. While there was a 3-4-fold decrease in Zn content in tooth cementum of M/G-1 workers, an increase of 250-300 times was observed in M/G-2 and -3 (2351.0+49.0*; 3036.2+131.4*).

The results of spectral analysis of microelements detected in the hard tissues of workers' teeth from various industries differ both quantitatively and qualitatively, apparently due to the influence of different production environments.

Calcium (Ca) content in workers' blood tended to increase in all M/G groups compared to the control ($P>0.05$) and was within the upper limit of the norm. In saliva, Ca levels slightly decreased in M/G-2, barely increased in M/G-1 and -3. Iron (Fe) content in blood and saliva noticeably decreased in all M/G groups compared to the control ($P<0.05$).

Moreover, an increase in the content of essential elements - significant increases in concentrations of Cr, Fe, Mn in hair in M/G 1 and 2 were observed. Practically in all groups, there were significant increases in Co, Ca, Sn, and Sb and decreased Cl content in hair; an increase in antimony and uranium concentrations and a decrease in copper in hair, which collectively may ultimately cause serious health issues throughout the body.

Furthermore, the results of the conducted studies revealed that individuals working in M/G-1, 2, and 3 showed an increase in acid phosphatase (ACP) activity (27.1+1.3; 29.6+1.2; 21.2+1.4) compared to the control group (26.8+1.2) ($P<0.01$), attributed to lysosomal membrane destabilization and a shift in saliva pH towards acidity. The decrease in alkaline phosphatase (ALP) activity (6.2+0.61; - 6.4+0.72; 7.2+0.54) compared to the control group (9.1+0.88) ($P<0.01$) can also be associated with salivary acidification. Based on the above, it can be concluded that changes in the enzymatic spectrum of saliva in M/G workers are primarily due to the impact of harmful production factors.

Analyzing the results of the studies, it can be concluded that under the influence of occupational hazards in the workshops of the mentioned productions M/G, there occur disruptions in the function of the taste analyzer, a shift in the pH of mixed saliva towards acidity, deterioration of GI, PI, and RMA in PR, a decrease in microhardness and resistance degree of tooth enamel, as well as negative clinical conditions of OM and periodontal tissues. Moreover, with an increase in workers' professional experience, these disturbances worsen and are accompanied by deviations in the macro and microelement composition of tissues from the norm.

Conclusions. The main unfavorable factor of the production environment in the M/G-1 and M/G-3 enterprises is phenol, formaldehyde, furfural, benzene, hydrogen sulfide, and sodium hypochlorite; in M/G-2, it is sulfuric acid, benzene, stone and metal dust, acetic acid, tetrahydrofuran exceeding MPC, which negatively affect the health of workers, including the PR organs.

In the main workshops and workplaces of the studied productions (FORP, AMMC, and NCP), the air in the working area is polluted with a complex of harmful chemical substances, including mixtures of substances of hazard classes 1 and 2; pollution levels and the proportion of air samples exceeding MPC depend on the nature of the production, the technology used, and the presence and effectiveness of existing sanitary-technical devices. At the same time, the levels and proportion of major dental diseases among workers in the studied productions remain relatively high, with a

tendency towards a decrease in morbidity rates in recent years; respiratory diseases have the highest proportion; the frequency of diseases of other classes is determined by the nature and levels of air pollution in the working area in the main workshops, the reduction of which remains the main task of the administration and health authorities.

The levels and proportion of major dental diseases among workers in the studied productions remain relatively high: on average, the prevalence of caries is 90.43; caries increment - 0.89; chemical necrosis of teeth - 18.43%; pathological tooth abrasion - 33.2%; mechanical enamel damage - 19.9%; tooth and dental arch deformities and defects - 18.5%; periodontal tissue disease - 74.7%; OM diseases - 38.7%; need for prosthetics - 58.4%, and pathology and anomalies of dental arches and joints - 36.6%, compared to the examined individuals in the control group, all types of dental pathologies are determined to be 1.5-5.5 times more.

The functional indicators and nonspecific reactivity of PR tissues in workers are disturbed, with a decrease in the excitability threshold of teeth and peri-tooth tissues (by 4-6 times), as well as the threshold of BCH, VCH, and DCH (by 25-59.4%), changes in the microhardness of tooth enamel and dentin, which are most noticeable in the superficial layer (by 13%), and then spread deeper into the teeth (by 11.8% in enamel thickness, by 1.2% in dentin-enamel junction). Thus, the data obtained from the study of electrometry indicators of tooth hard tissues, TER test, KPU, GI, PI, RMA, tooth enamel microhardness, and pH of mixed saliva in PR workers from the studied productions convincingly demonstrate the need for in-depth scientific research to determine the etiological factors of pathological processes in PR organs and tissues. This is necessary for improving the quality of dental services and expanding the methodology of specialized medical dental care for this category of workers.

The spectrum of trace elements detectable in the hard tissues of the teeth of workers from the studied productions, using the neutron activation method, differs both qualitatively and quantitatively, which is associated with the influence of various production environments and depends on their length of service. Additionally, the enzyme spectrum of saliva in workers is altered towards increased alkaline phosphatase (AP) activity and decreased acid phosphatase (ACP) activity, which is attributed to the impact of harmful production factors on the phosphate, carbonate, and protein buffer systems, leading to disruption of saliva homeostasis.

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