MERCURY VALUES IN URINE

Annually, in St. Petersburg there are registered about 200 mercury spillages, 10–20 of them major (of over 1 kilo) resulting in damage to both industrial structures and housing. Therefore, important is the timely selection and curing the victims of mercury vapor inhalation.
Due to the simplicity of sampling and preparation urinalysis is the most common means of evaluating the exposure effects of person to mercury pollution of the environment and work place. In common medical practice, total mercury content in urine, up to 10 μg/l is considered normal in Russia. Although, the additional research has shown that even though there are no explicit signs of poisoning, changes in the immune system and others adversely affects take place among workers regularly contacting with mercury, despite allowable mercury levels in urine – less than 5 μg/l. There is no consensus on safe mercury contents in urine. Systematic investigations dealing with mercury levels in urine for St. Petersburg region are still lacking.

At LUMEX Ltd, Russia, a portable, multipurpose atomic absorption mercury spectrometer **RA–915+** has been developed for mercury measurement in ambient air and any gas media, as well as in solid and liquid samples of complex composition. Original scheme of the application of the direct Zeeman effect provides very high selective determinations. The distinguishing feature of this newly developed method is that it allows making direct measurements without any preconcentration accumulation of mercury in a sorbent with simultaneous controls for non–selective absorption in dynamic regimes. In order to analyze liquid and solid samples, the device has appendages working on the cold vapor and pyrolize principles to select atomic mercury from samples. The instrument's parameters make it possible to simplify sample preparations, to detect mercury at rather low levels in samples of complex compositions, and to improve substantially the reproducibility and accuracy of analysis.
Strong basic stannous dichloride solution is used to reduce mercury compounds in urine. The detection limit is on the range of 0.01 μg/l for the 5 ml samples. The accuracy of measurements is less than 10 per cent. The pyrolysis method has been applied to be certain that all amount of mercury is analyzed. In pyrolysis process all mercury compounds that may occur in the sample are bound to be broken up by high temperature and provide the determination of total mercury. Correlation of the parallel results, obtained by these two methods for 25 urine samples with different mercury content, does not show an increase of the mercury exit in the pyrolysis case in comparison with figures received by the cold vapor method. Tested samples were taken from people suffered from breathing the air polluted by mercury vapour. We have not disposed of samples connected with input by contaminated food.

DISCUSSION OF RESULTS

We present the results of urine analyses of about 3000 samples from St. Petersburg (Russia) obtained during three last years.
The background (reference) group (380 people) was taken from valid school children and adults. Mercury content in the samples varies between less than 0.1 μg/l and 40 μg/l, although in 90 per cent of the samples mercury concentration is not exceed 2 μg/l, and 70 per cent – 0.5 μg/l. Histogram of background allocation is displayed in the **Fig.1**. Based on this allocation we determined a background mercury value in urine for St. Petersburg region as 0.5 μg/l. For example, this level for inhabitants of European community is 3.5 μg/l.
With the help of the Zeeman atomic absorption mercury spectrometer, analyses of urine samples from 5 studied groups (real mercury accidents – above 100 patients) were conducted in the manner described above. Histogram of mercury concentrations in samples taken from studied groups is represented on the **Fig.2.** For example, we will concern in some detail the allocations of mercury content in urine from two groups (group1 and group5). The first group (210 people) was taken from school children, and the study was conducted in connection with the appearance of mercury contamination in their school. It was established that mercury content in the samples varied from less than

0.08 μg/l to 10 μg/l, although in 137 of the samples (65 per cent), mercury concentrations did not exceed 0.8 μg/l that is close to the background allocation. The second group (170 people) was comprised from dwellers of an apartment building where metallic mercury had been accidentally spilled in front of the building entrance. For second group in 75 per cent of the samples mercury concentrations exceed 2 μg/l, and only in 10 per cent cases the content is less than 0.5 μg/l (a background mercury value in urine).
Histograms of allocations of mercury concentrations in samples taken from all studied groups differ considerably in shape, and indicate widely different effects of mercury contamination. The data obtained permit to determine risk group (subjects with mercury content in urine more than 1 μg/l) that need further medical treatment. This conclusion was subsequently confirmed by detailed clinical study.

Figure 1
Histogram of allocations of mercury in urine for background (reference) group.
The background group (380 people) was taken from valid school children and adults. Mercury content in the samples varies between less than 0.1 μg/l and 40 μg/l, although in 90 per cent of the samples mercury concentration is not exceed 2 μg/l, and 70 per cent – 0.5 μg/l. Based on this allocation we determined a background mercury value in urine – 0.5 μg/l for St. Petersburg region.

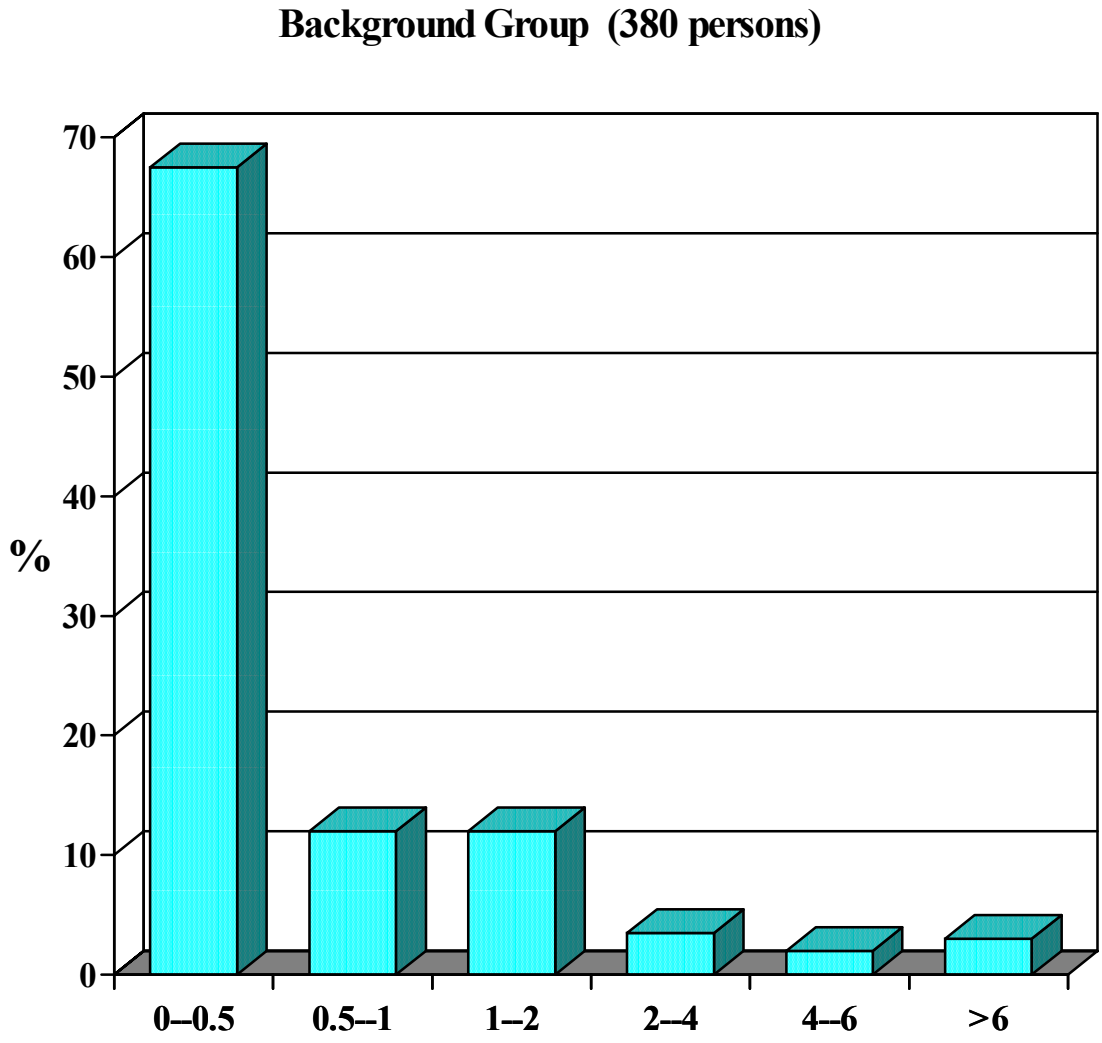
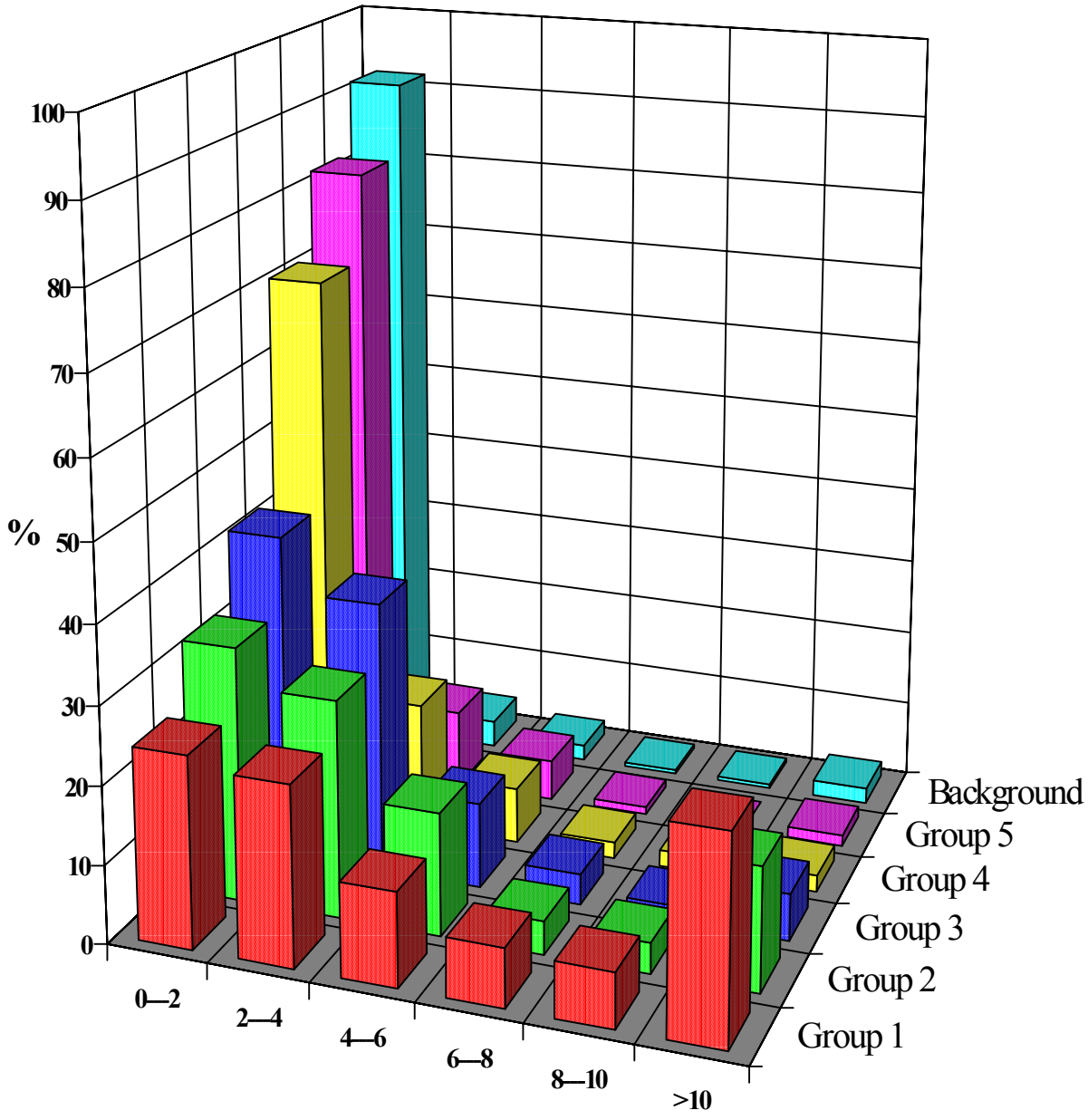


Figure 2
Histogram of allocations of mercury in urine from sample groups 1–5; they were comprised from dwellers of an apartment building where metallic mercury had been accidentally spilled.
Group 1 (170 person, Apr. 95) – Accident I
Group 2 (230 person, Apr. 96) – Accident II
Group 3 (107 person, May 95) – Accident III
Group 4 (97 person, Feb. 96) – Accident IV
Group 5 (210 person, Mar. 95) – Accident V
Group 6 (380 person, Sept. 94) – Background (reference)



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