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MERCURY HAZARDS IN BREWERY FERMENTATION WORKERS

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A reported case of mercury poisoning in a fermentation worker at a brewery was followed by a countrywide survey on the unexpected mercury hazards in this occupation.

The mercury source in this connection is the usual bunging-apparatus on each tank used for storing the beer for after-fermentation. The U-shaped apparatus is filled with large amounts of mercury. The carbondioxyde escapes by bubbling freely through the mercury, sometimes with such violence that mercury is sprayed out.

High mercury air contamination, up to ten times the threshold limit value was measured, and urine analysis of mercury showed that 31% of the values were about 200 gamma/l urine and 3% over 1000 gamma/l. No further case of mercury poisoning was unveiled among 135 workers in 19 breweries.

The survey shows that mercury can be a real hazard, and is at least to be considered as a potential hazard in the after-fermentation cellars in breweries. High urine values of mercury can be tolerated for a considerable time without any clinical effect.

Preventive measures are mentioned.

In 1956 a 39-year-old worker was reported by his private practitioner to our Institute of Occupational Health as a possible case of mercury poisoning. The worker had for 6 years been employed in the fermentation cellar at a brewery. He had been hospitalized twice in the previous 6 months. No diagnosis of mercury poisoning had been established however.

Urine analysis at our Institute showed 980 gamma Hg/l urine.

Although clinically, at the time of hospitalization, he did not show the fully developed picture of the classical mercury poisoning, the working history, air analysis and the urine mercury values strongly indicated that mercury exposure was the cause of his disease. The main symptoms were: tremor manum, dysarthria, erethism, retarded movements, slight assymetrical abdominal and deep reflexes.

There were no definite pathological changes in air-encephalografy, E. E. G. or laboratory tests.

The symptoms gradually disappeared after removal from mercury exposure, thus supporting the diagnosis of mercury poisoning.

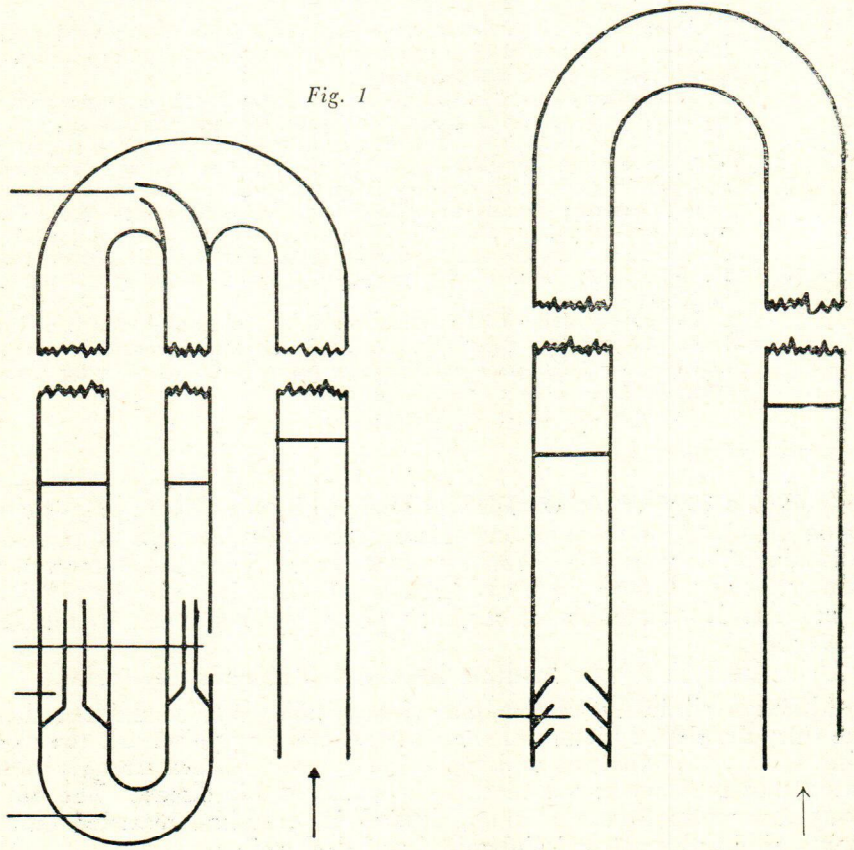
So far as we are informed no case of mercury poisoning in brewery workers has hitherto been described.

The working conditions in the cellars where the after-fermentation takes place, are as follows:

From some few up to hundreds of tanks of beer are found and the temperature must be kept at a level only few centigrades above zero.

The developed carbon-dioxyde in the tanks is causing a pressure in the tanks of 0,3–0,4 kg/cm². The carbon-dioxyde escapes by bubbling through the mercury filled bunging apparatus on each tank. There is usually more than 2 kg of mercury in each apparatus. Up to some few hundred kilos of mercury might thus be found in one cellar.

Fig. 1



The bubbling of CO_2 through the mercury is sometimes so violent that mercury is sprayed out.

The bunging apparatuses until recently in use were of two different types (see figure 1).

Some of the usual U-formed types have catches to avoid too much mercury to spray out. These catches have however a rather modest effect.

The other more complicated bunging apparatus has a return pipe for the smaller amount of mercury that might spray beyond the lock.

On visit to some breweries rather large amounts of mercury were found on the floors and in the sinks.

At a temperature of zero centigrades the mercury vapour pressure is equivalent to 1,94 mg/m³ air.

In the first brewery concerned where the patient mentioned was working, the mercury concentration in the air in the fermentation cellar showed values from 0,4–1,0 mg/m³ of air, i. e. up to ten times the usual threshold limit value.

In another brewery values from 0,1–1,0 mg/m³ were found.

Unfortunately no further investigation on air contamination could be done.

The ventilation problem of the fermentation cellar is a rather tricky one, especially during summer time as then all windows and openings have to be closed to avoid the heating effect of the outside air when let in. During winter the problem is a more simple one.

Based on the mentioned case a countrywide survey on urine excretion of mercury in all workers in the fermentation cellars in Norwegian breweries was started.

19 breweries were screened and urine samples of 138 workers were analysed, 82 of them before any change in the working conditions had taken place.

The following values were found:

Table 1.

Hg. gamma/l urine:	Number of samples:
—200	64
200— 400	7
400— 600	3
600— 800	1
800—1000	2
1000—	5
Total	82

About 22% had values above 200 gamma/l and more than 6% over 1000. One sample had over 3000 gamma/l urine.

A number of the workers, especially those with high urine values, were examined by local doctors, some by neurologists as well.

To our slight surprise no further case of mercury poisoning was unveiled during this survey.

However, all those with values above 200 gamma/l were recommended to change jobs until their urine levels were satisfactory. In most cases the values went down to below 100 in few weeks.

All new workers taking on the job were controlled in advance before being allowed to start on the job. In some cases the urine values went up to some hundreds gamma/l in less than 2 weeks.

Gradually at our recommendation, the mercury bunging apparatuses were exchanged by membrane manometers only filled with a water -glycerin mixture for control of the bubbling.

Floors, walls and sinks were thoroughly cleaned for all mercury contamination.

Due to shortage of personnel no further investigations in the breweries proper could be done.

One point might be mentioned especially. The more complicated bunging apparatus with return pipe might have had a reducing effect on the mercury hazard.

In the breweries using U-formed apparatus entirely, the average urine value was several time the average value in breweries using only the more complicated type. In breweries using both types, the average urine value was something in between. The number of observations in each group was rather small, however, and the differences cannot be considered as really significant.

One further problem turning up during the urine analysis programme should be mentioned.

Many of the first urine samples sent in were obviously very light in colour. The specific weight was rather low. Hence we started measuring the specific weight of all the following samples.

The specific weights showed a distribution as shown in table 2.

Table 2.

	% distribution	
Sp. w.	Brewery urines (106):	Lead, trichlorethylene and mercury urines (219):
—1005	15,1	0,9
1005—09	23,6	1,4
1010—14	16,9	1,8
1015—19	16,9	9,2
1020—24	16,0	36,9
1025—29	8,8	36,9
1030—34	2,7	10,2
1035—	0,0	2,7

The average for the brewery urines was 1015 compared to 1024 in the control group of lead, trichlorethylene and other mercury exposed workers.

The specific weight had the same average in all these 3 control groups.

The brewery urines seemed to have lower mercury values by low specific weight and higher values by high specific weight as shown in percentage distribution in table 3.

Table 3.

Sp. w.	Hg. gamma/l —100	100—499	500—
1020	16	30	70
1010	30	35	30
	54	35	0
Total	100	100	100

Most of the differences are statistically significant.

The cause of the light specific weight is probably clear:

A certain amount of light beer is offered free of charge to brewery workers. It was freely admitted, however, that the consumption often goes far beyond tle allowed amount. The cold working conditions does not stimulate much sweating (mostly sedentary work). Hence an increased diuresis to compensate for the heavy fluid intake occurs.

The low mercury values in the lighter urines are probably due to this diluting effect. In any case it seems to be reasonable to use some form of correction for the mercury values actually found in urines by different specific weights, especially when only spot samples, for practical reasons, are analysed and not 24-hour samples.

The distribution of the values actually found and corrected values in 106 urines where specific weight was measured, was as shown in table 4.

Table 4.

Gamma/l	200	400	600	800	1000	Total:
			Values observed:			
			Corrected values:			
1000	2	1		1	3	7
800	1	2	1	2		6
600	4	3	2	1	1	11
400	8	2	4			14
200	17	10				27
	41					41
Total	73	18	7	1	4	3	106

The correction used is proportional to the specific weight figures above 1000 and standardized to a specific weight of 1025.

The corrected values give a more even distribution all over the range. An increased percentage of higher values was to be expected, in fact twice as many urines have corrected values about 200 gamma/l.

Further studies must be done, however, to prove if this simple correction method is permissible or too simple for evaluating spot sample values.

Remembering that no further case of mercury poisoning was unveiled during this survey in spite of the high air contamination and rather high urine values, a probable profylactic effect of the high diuresis might be accounted for it.

Effective measures for prevention of mercury poisoning in brewery workers have already been introduced in most Norwegian breweries.

The mentioned membrane bunging apparatus has been widely taken into use.

The price of mercury nearly pays the costs of the new membrane apparatus.

Without such an exchange medical control of all fermentation workers including mercury urine analysis, is strongly recommended.

»Airing« of the personnel with high or suspect urine values, might be used.

On the technical side air analysis might be considered.

Sampling devices for mercury spoilage might reduce the air contamination.

Such devices might be simplified if all the bunging apparatuses are gathered on one spot and connected with the tanks by pipe lines and rubber hoses.

Effective and suitable room ventilation is instrumental but difficult, especially during summer time.

As always, good housekeeping and simple cleanliness is of importance.

Sadržaj

OŠTEĆENJA ŽIVOM KOD RADNIKA U PROIZVODNJI PIVA

U vezi s jednim objavljenim slučajem otrovanja živom kod radnika, koji je radio u pivovari na fermentaciji, počelo se opsežnim istraživanjima u cijeloj zemlji, da se ispitaju neočekivana oštećenja živom u toj grani industrije.

Izvor žive u produkciji piva su uobičajeni zaporni uređaji na tankovima, koji služe za pripremu piva naknadnom fermentacijom. Aparat u obliku slova U napunjen je velikom količinom žive. Ugljični dioksid izlazi u mjehurićima kroz živu napolje, i to katkada s takvom snagom, da se živa rasprskava naokolo. Utvrđene su visoke koncentracije žive u zraku, sve do deset puta veće od dopuštenih, a analiza urina je pokazala, da je 31% vrijednosti iznosilo 200 gama na litru urina, a 3% vrijednosti i preko 1000 gama/litru. Daljih slučajeva otrovanja živom kod 135 radnika u 19 pivovara nije bilo. Ispitivanja su pokazala, da živa može izazvati oštećenja u pivovarama kod naknadne fermentacije i da se prema tome može smatrati potencijalnom opasnošću pri toj vrsti posla. Visoke vrijednosti žive u urinu ne moraju kroz razmjerno dosta dugo vrijeme izazvati nikakav klinički defekt. Raspravljene su preventivne mjere.

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