The background of the slide features a dark, textured surface, possibly a leaf or a piece of fabric, with numerous water droplets of various sizes. The droplets are illuminated from the side, creating bright highlights and deep shadows, giving them a three-dimensional appearance. The overall color palette is dark with some highlights from the light reflecting off the water.

**EXPOSURE  
TO  
MERCURY  
AND ITS COMPOUNDS**

**Table 1. The Major Clinical Toxicologic Features of Mercury.\***

Variable	Mercury Vapor	Inorganic Divalent Mercury	Methyl Mercury	Ethyl Mercury
Route of exposure	Inhalation	Oral	Oral (from fish consumption)	Parenteral (through vaccines)
Target organ	Central nervous system, peripheral nervous system, kidney	Kidney	Central nervous system	Central nervous system, kidney
Local clinical signs				
Lungs	Bronchial irritation, pneumonitis (>1000 µg/m <sup>3</sup> of air)			
Gastrointestinal tract	Metallic taste, stomatitis, gingivitis, increased salivation (>1000 µg/m <sup>3</sup> of air)		Metallic taste, stomatitis, gastroenteritis	
Skin	Urticaria, vesication			
Systemic clinical signs				
Kidney	Proteinuria (>500 µg/m <sup>3</sup> of air)	Proteinuria, tubular necrosis		Tubular necrosis
Peripheral nervous system	Peripheral neuropathy (>500 µg/m <sup>3</sup> of air)	Acrodynia		Acrodynia
Central nervous system	Erethism (>500 µg/m <sup>3</sup> of air), tremor		Paresthesia, ataxia, visual and hearing loss (>200 µg/liter of blood)	Paresthesia, ataxia, visual and hearing loss
Approximate half-life (whole body) (days)	60	40	70	20†
Treatment‡	Meso-2,3-dimercaptosuccinic acid	Meso-2,3-dimercaptosuccinic acid	Chelators not effective§	Chelators not effective§

\* Data were adapted from Gossel and Bricker.<sup>4</sup> Clinical manifestations vary with the degree and length of exposure. The values in parentheses are the approximate range of mercury concentration in air (expressed as micrograms per cubic meter) and in blood (expressed as micrograms per liter) associated with the onset of clinical signs and symptoms. Epidemiologic studies that did not use specific end points such as IQ score indicate a risk of adverse effects (approximately 5 percent) at lower concentrations (e.g., 25 to 50 µg of mercury vapor per cubic meter and 40 µg of methyl mercury per liter of blood are associated with an increased risk of prenatal damage to the developing central nervous system).<sup>3,5</sup> In general, the atmospheric concentration of mercury vapor equals the urinary concentration. The mean urinary concentration in the U.S. general population is 0.72 µg per liter (95 percent confidence interval, 0.6 to 0.8), and the mean blood concentration is 0.34 µg per liter (95 percent confidence interval, 0.3 to 0.4).<sup>6</sup> In Europe<sup>7</sup> and other parts of the world,<sup>8</sup> blood concentrations appear to be somewhat higher. The mean urinary concentrations increase according to the number of dental amalgam surfaces, and blood concentrations increase according to the level of fish consumption.<sup>6</sup> No reliable data are available on the concentration of inorganic divalent mercury associated with adverse effects.

† The half-life in blood is about 20 days in adults but may be as short as 7 days in infants.

‡ Details of meso-2,3-dimercaptosuccinic acid treatment have been published.<sup>9-11</sup>

§ Chelators can remove methyl and ethyl mercury from the body; they cannot reverse the damage to the central nervous system. They may, however, prevent further deterioration.<sup>12</sup>



AMA 254 MERCURY ANALYZER

4

Jednotlivý atomový absorpční spektrofotometr pro stanovení Hg<sup>0</sup> v pevných nebo kapalných vzorcích

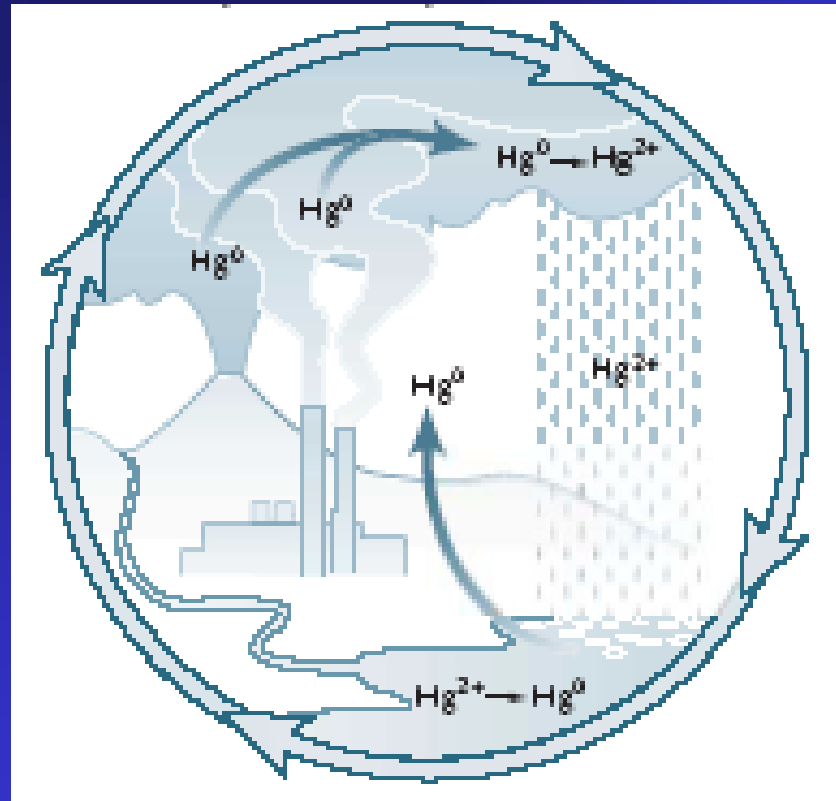
## Daily intake of mercury in mcg (WHO):

air	0.05 - 0.20
food - fish products	2.34
food - except fish products	0.25
drinking water	0.005
mercury amalgam	1,00 - 21.60
<b>SUM</b>	<b>7.70 - 24.70</b>

*ADI 40 mcg (methylmercury 30 mcg) = retention 30 mcg*

Natural sources : release 3000 - 6000 tons/year

## THE GLOBAL CYCLE OF MERCURY



WORLD PRODUCTION 1650 tons mercury/year (2000)

## 20 workers poisoned by mercury

Twenty workers were exposed to dangerous levels of mercury at a recycling plant at Kirkheaton in Huddersfield between October 2007 and August 2008. The mercury came from fluorescent light bulbs.

Ventilation problems at the plant meant that workers breathed in toxic mercury fumes, as well as lead from recycling televisions and computer monitors. They complained of ill health, with one woman alarmed about the risk to her unborn baby.

An investigation by HSE and the Environment Agency found that 20 workers had levels of mercury in their bodies above recommended safety limits. Five of them were said by HSE to have "extremely high levels" of the poison.

"This is a shocking case involving a large number of employees, many of them young and vulnerable, who were suddenly faced with the worrying possibility of damage to their long-term health," said HSE Inspector Jeanne Morton.

"The risks associated with handling toxic substances like mercury have been known for generations, so it is all the more unacceptable that something like this has happened. The company failed to see the risks created by their recycling work and failed to develop effective plans for safe working."

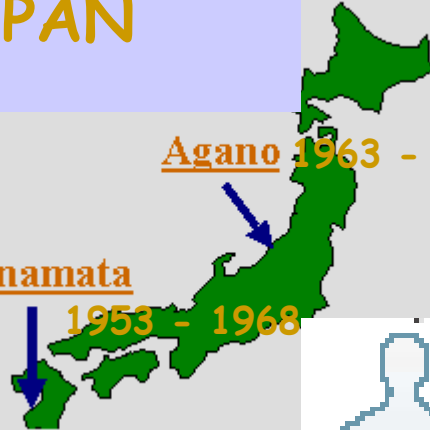
The company, Electrical Recycling Group, pleaded guilty to breaching health and safety law, as well as rules governing hazardous substances at Bradford Crown Court on 5 February 2010. It was fined £140 000 (170 000 euros), while its director, Craig Thompson, was fined £5 000 (6 000 euros).

# MERCURY INTOXICATIONS

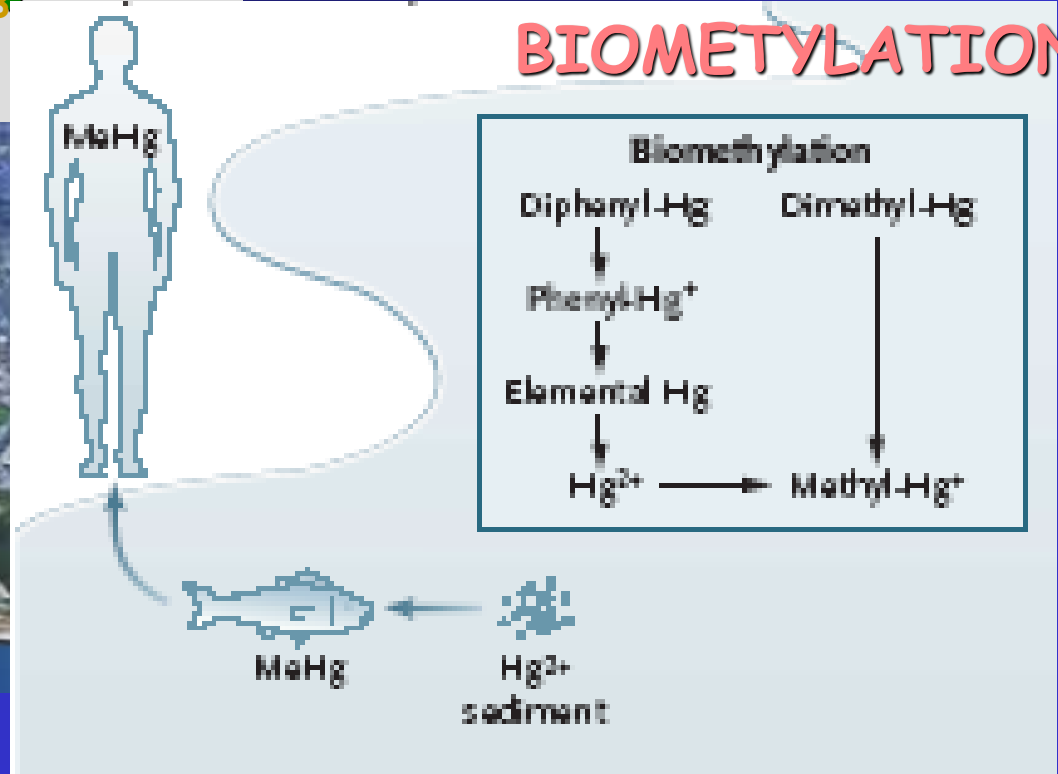
JAPAN

Minamata  
1953 - 1968

Agano 1963 - 1965



## BIOMETYLATION



# Mercury use in agriculture (1)



## Fungicide intoxications:

Pakistan, Guatemala, Iraq (1971-1972)....

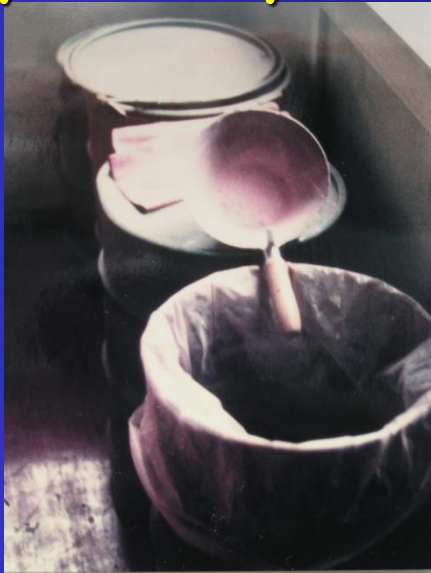
Czech preparation

AGRONAL Super

5.4% Hg

(phenylmercury chloride)

Handling with dangerous waste

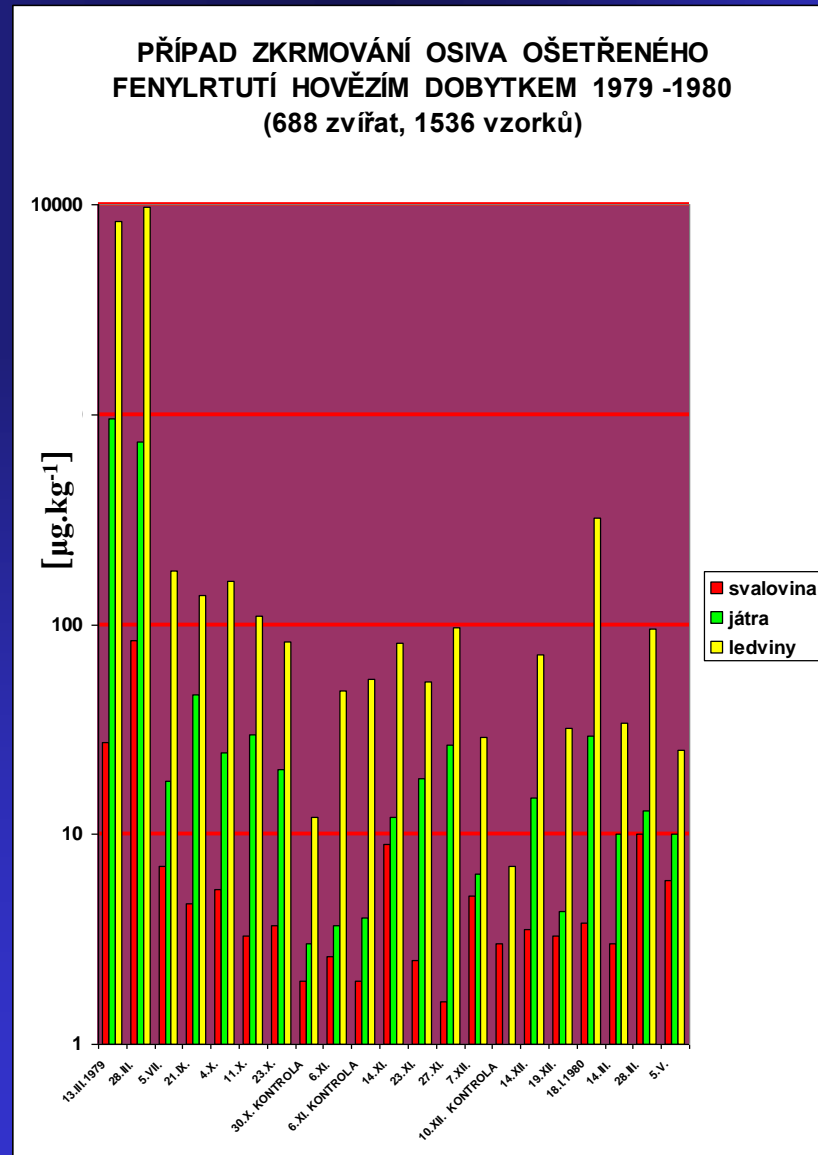




# Mercury use in agriculture (2)

*In 1979 first reported case of livestock mercury overexposure (1054 head of cattle received during a 3-week feeding period a total amount of 18 tons of grain treated with AGRONAL H)*

*TUČEK, J., TUČEK, M.  
Contribution to the Problem of  
Environmental Contamination  
with Mercury.  
J.Hyg.Epid.Microb.Immunol.,  
1981, vol.25, p.354 - 363.*

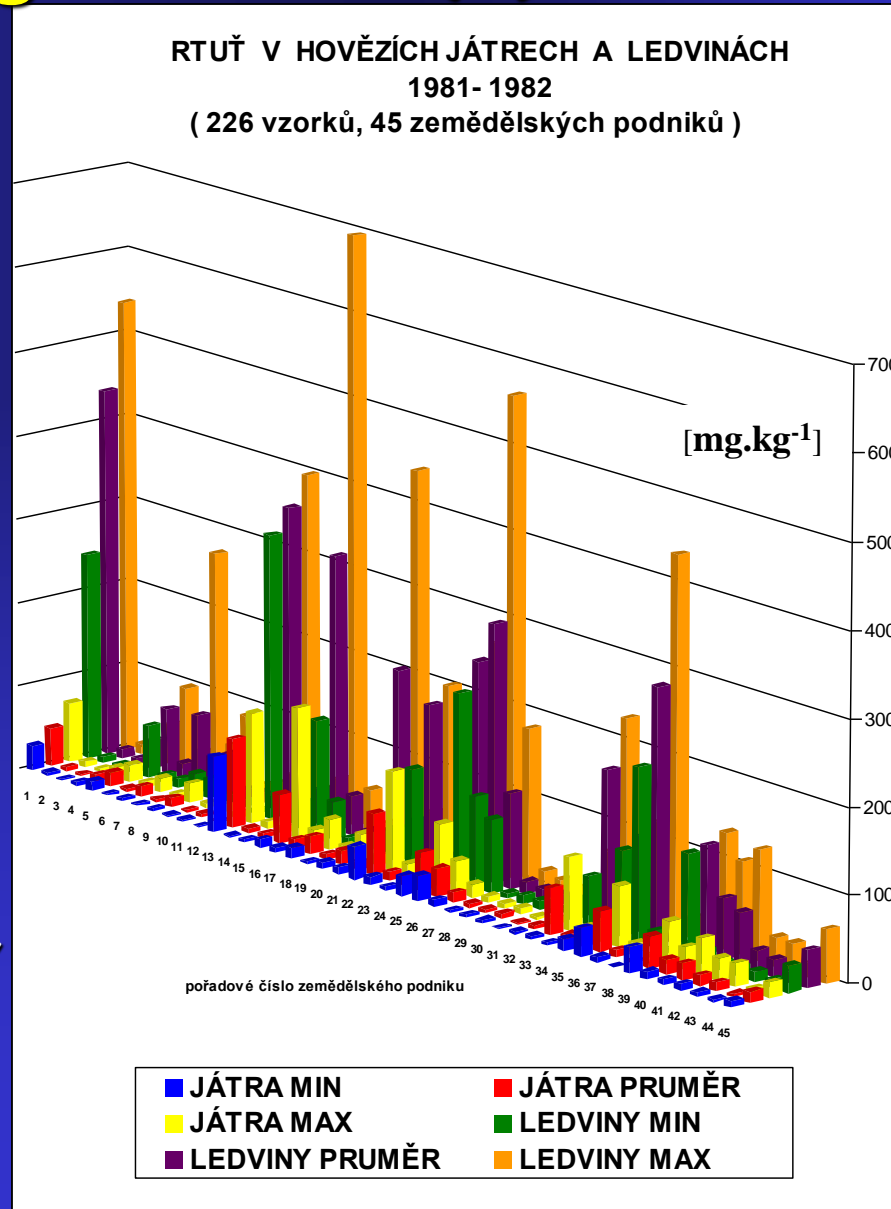


# Mercury use in agriculture (3)

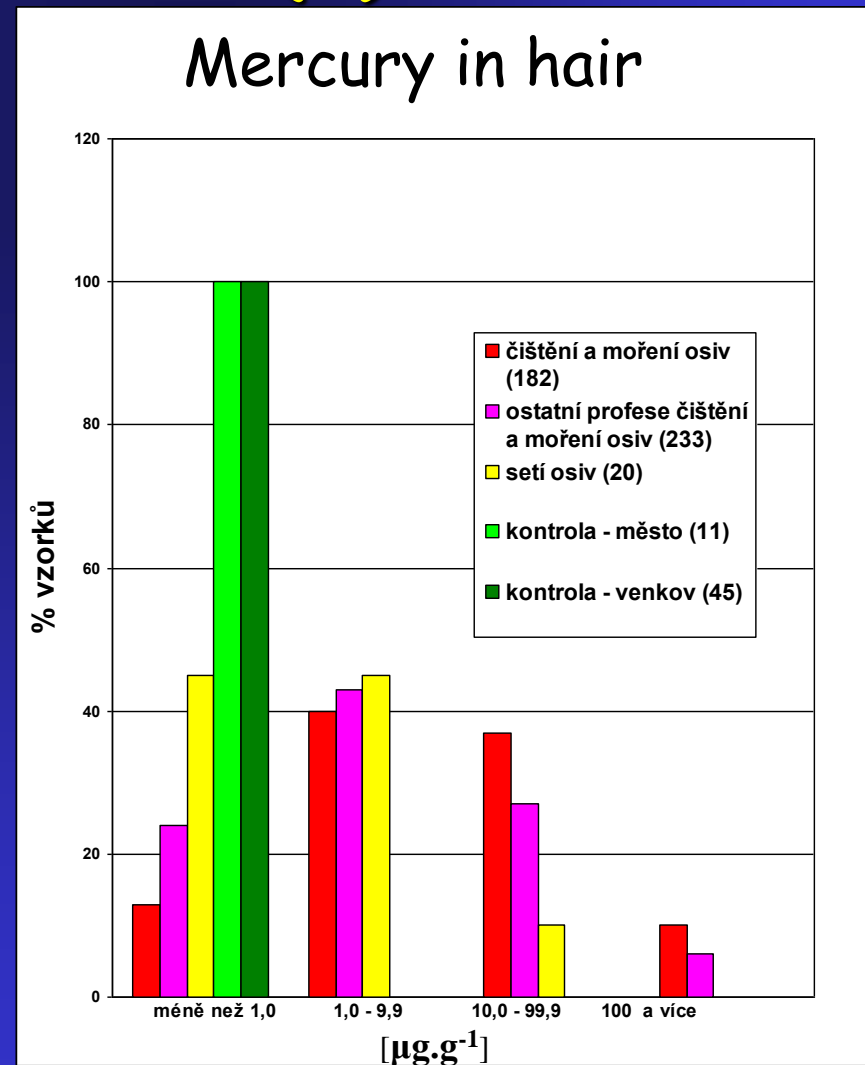
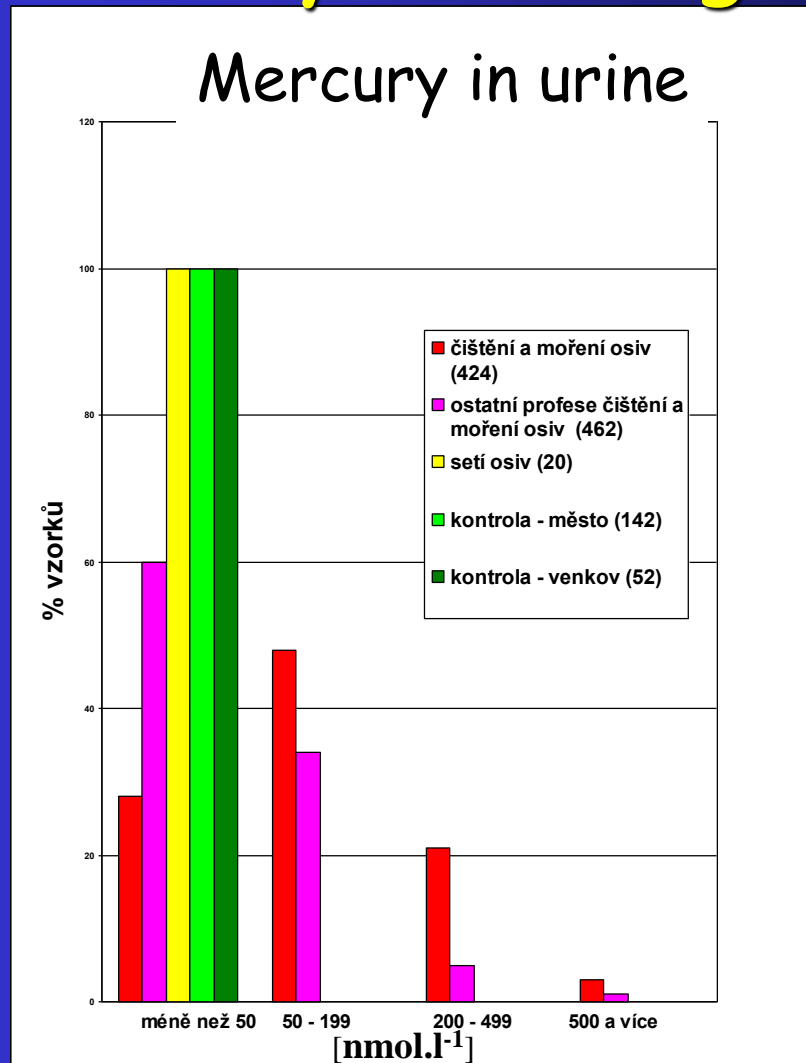
*In 1981-1982 about 40% of all farms of the suspected district with higher total mercury content in the liver and kidney of cattle*

TUČEK, M., TUČEK, J., KRÝSL, S., NOVÁKOVÁ, M., ČERVENÝ, V., DUDÁČEK, K. Průnik rtuti do potravinového řetězce. Čs. hyg., 1982, vol. 27, p.445 - 449.

KRÝSL, S., TUČEK, J., HLAVSOVÁ, D., NOVÁKOVÁ, M., TUČEK, M. Hygienická problematika rtuti v potravinách. Čs. hyg. , 1986, vol.31, p. 434 - 440.

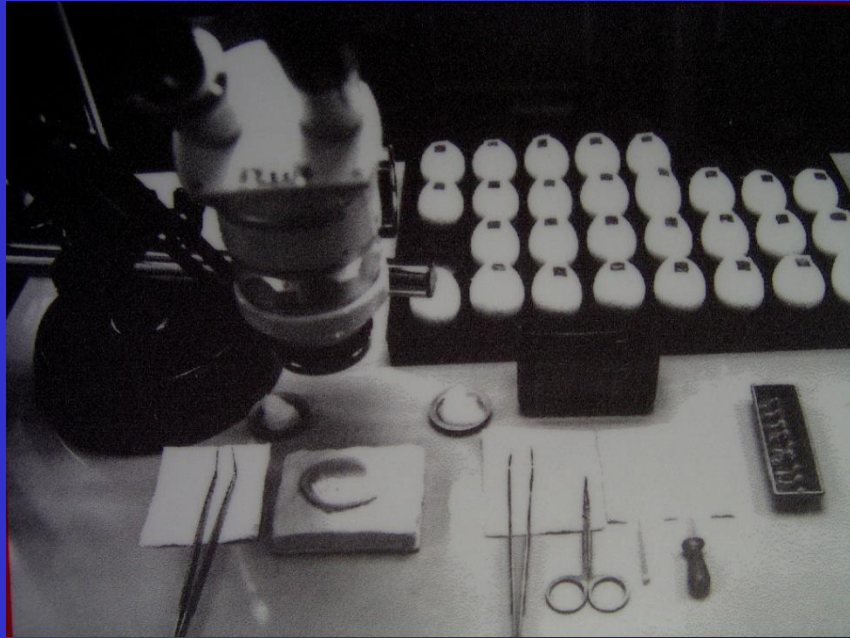


# Mercury use in agriculture (4)



TUČEK, M., TUČEK, J., KRÝSL, S., NOVÁKOVÁ, M. Stanovení rtuti v moči a ve vlasech při použití Agronalu. Expoziční testy 1982, Sborník z konzultačních dnů o expozičních testech, 1982, Staré Splavy, 1. sv. Acta Hyg., 1985, příl. 3, p. 79 - 86.

# Mercury use in agriculture (5)

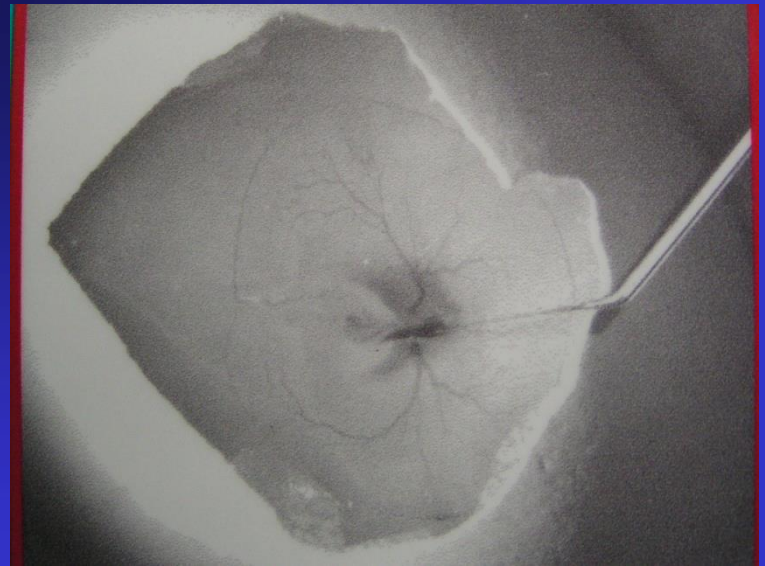


Structural malformations in living embryos caused by phenylmercurichloride (Agronal Super) are:

are:

syndrome of caudal regression  
reduction deformity of lower  
extremities  
exencephaly  
cleft beak  
coloboma iridis  
microphthalmia

PETERKA, M., TUČEK, M. ,  
Veselý, D.  
*Embryotoxicity of Nine Seed Mordants  
in the Chick Embryo-the CHEST  
Method. Acta vet.Brno, 1996, vol.65,  
p.213-217.*



# Mercury use in agriculture (6)

ESTIMATION OF THE EMBRYOTOXIC EFFECT 50% (ED 50%) - CHEST II

PREPARATION	DOSES ( $\mu\text{g}/\text{embryo}$ )
Agronal Super	3
Quinolate 15 F	5
Baytan Universal 19,5 WS	7
Wolfen Thiuram 85	10
Fundazol 50 WP	30
Baytan Combi 10,5 WS	40
Novozir MN 80	50
Sibutol WS 39,8	100 - 200
Vincit F	> 100

PETERKA, M., TUČEK, M., Veselý, D. Embryotoxicity of Nine Seed Mordants in the Chick Embryo-the CHEST Method. Acta vet.Brno, 1996, vol.65, p.213-217.

# CONCLUSIONS

Reasons of mercury contamination of animal food were irregular treated seed handling in agricultural plants and irregular technology in seed mordant processing plants (cleaning stations).

In 1995 the last stores of preparation AGRONAL have been consumed. Last signs of irregular treated seed handling were noted in 1996.

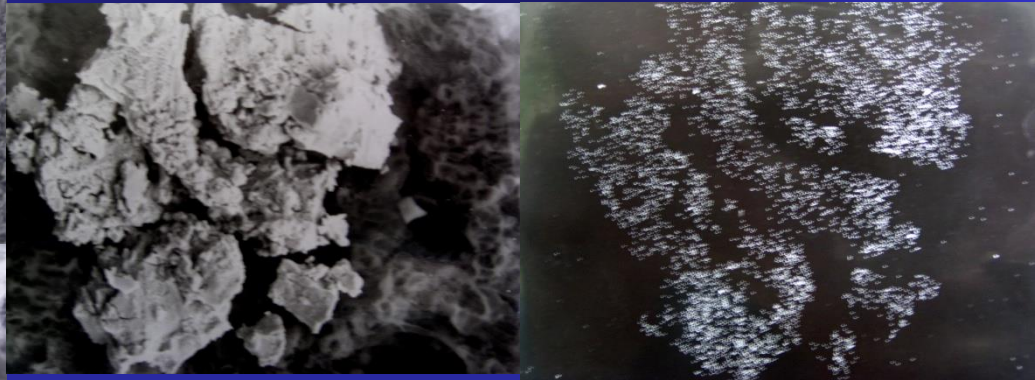
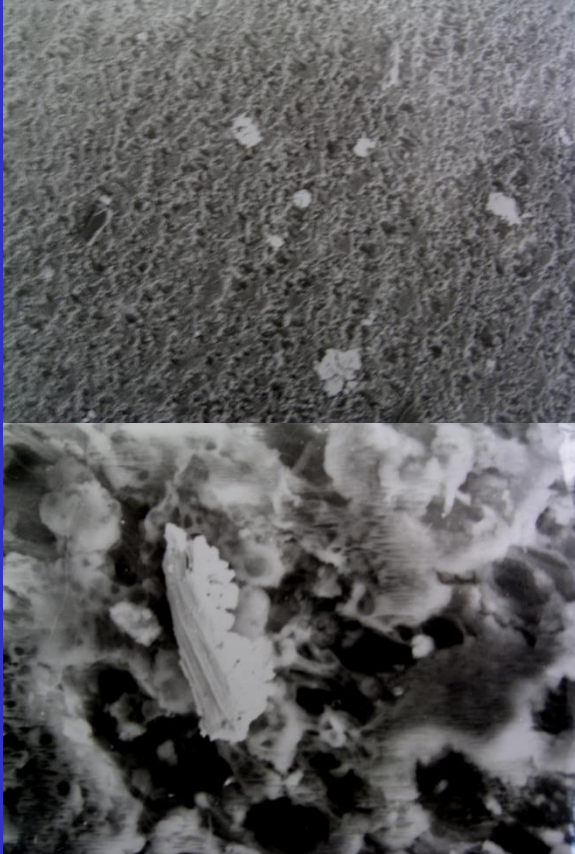
Agronal Super containing 5.4% of phenylmercuri-chloride exhibited the highest embryotoxic effect in range 1 - 10 mgkg<sup>-1</sup> ( this range occurs in human necropsy organ samples ).

All of the tested seed mordants without mercury were surely less embryotoxic than Agronal Super .

The possible embryotoxic potential of seed mordants should be taken into consideration. Seed mordants containing organic mercury should be replaced by new ones with minimal or no toxic effect in eucaryotic organisms .

# Dental amalgam use in stomatology (1)

*In amalgam particles were always silver and mercury*



*ŠKODA VÝZKUM s.r.o., Plzeň, el. microscope  
JEOL JXA 840*

*Amalgam particles  
originated by drilling and  
grinding of amalgam  
(1 - 7  $\mu\text{m}$ ).*



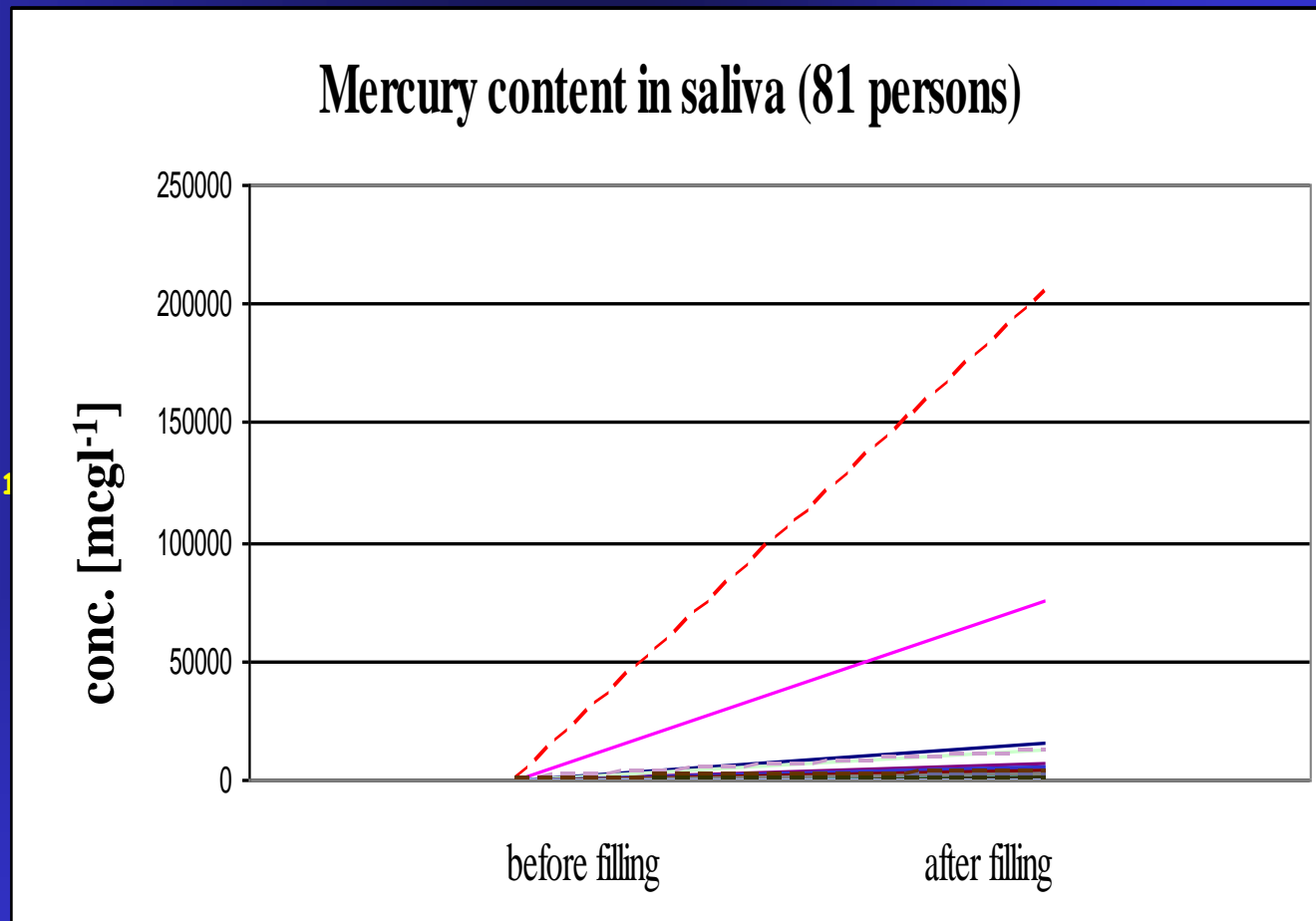
**Mercury analyzer  
AMA 254**

# Dental amalgam use in stomatology (2)

Before amalgam filling

a.m.  $40.8 \text{ mcgl}^{-1}$   
95% CI  $11.3\text{-}19.4 \text{ mcgl}^{-1}$

g.m.  $14.8 \text{ mcgl}^{-1}$



TUČEK, M. *Současná zdravotní rizika expozice rtuti a jejím sloučeninám. České prac.lék., 2006, vol.7, no.1, p. 26-37.*

Závěrečná zpráva o řešení grantového projektu IGA MZ ČR 3523-3 : Zhodnocení zdravotních rizik při užívání rtuti ve stomatologii.



# Dental amalgam use in stomatology (3)

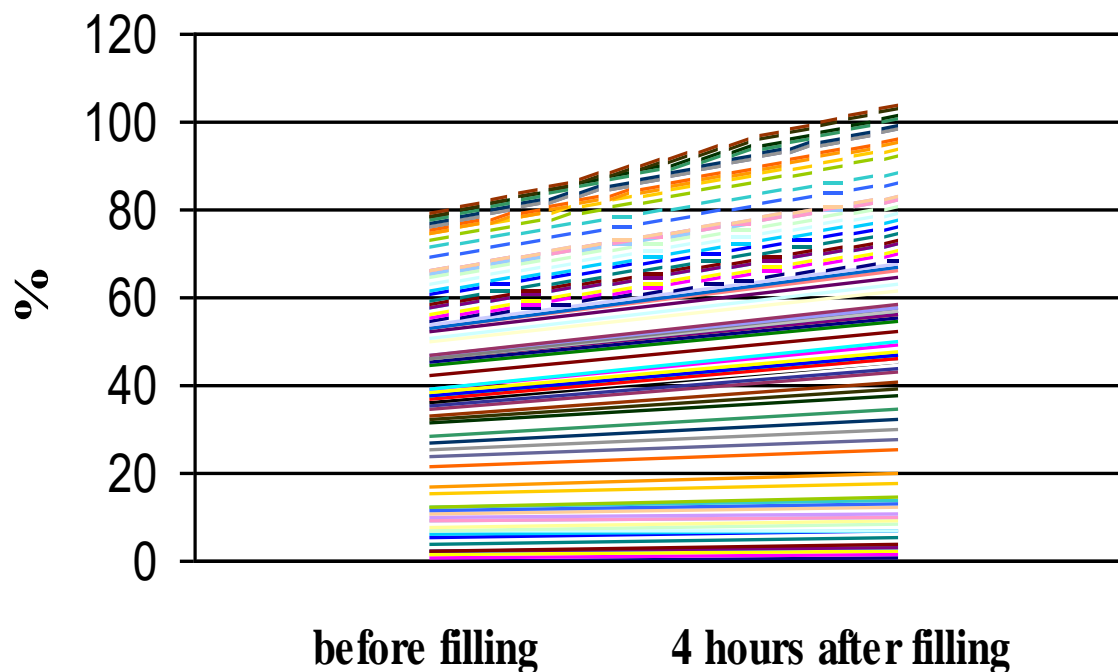
nonexposed  
population  
below  $5 \text{ mcgl}^{-1}$

before amalgam  
filling

a.m.  $0.97 \text{ mcgl}^{-1}$   
95% CI  $0.59\text{-}0.88 \text{ mcgl}^{-1}$

g.m.  $0.72 \text{ mcgl}^{-1}$

Relative changes of mercury content in blood [ $\text{mcgl}^{-1}$ ]  
(81 persons)



TUČEK, M. *Současná zdravotní rizika expozice rtuti a jejím sloučeninám. České prac.lék., 2006, vol.7, no.1, p. 26-37.*

Závěrečná zpráva o řešení grantového projektu IGA MZ ČR 3523-3 : Zhodnocení zdravotních rizik při užívání rtuti ve stomatologii.

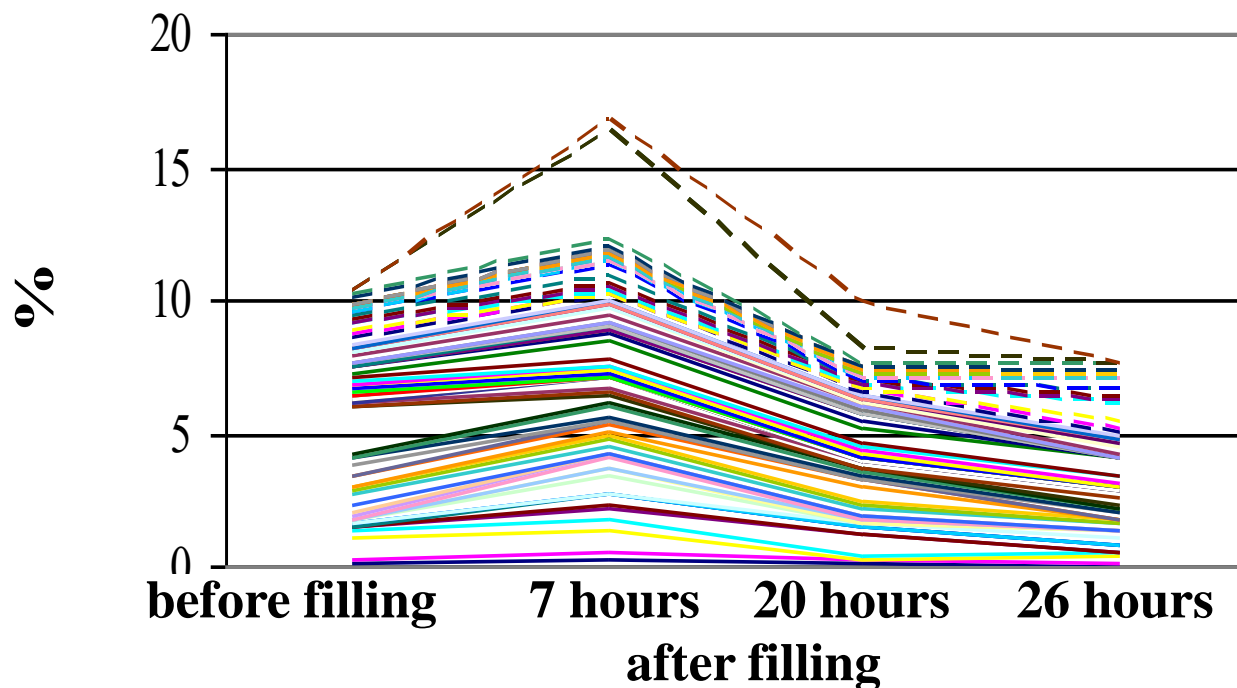
# Dental amalgam use in stomatology (4)

before amalgam  
filling

a.m.  $0.12 \text{ mcgh}^{-1}$   
95% CI  $0.05-0.08 \text{ mcgh}^{-1}$

g.m.  $0.06 \text{ mcgh}^{-1}$

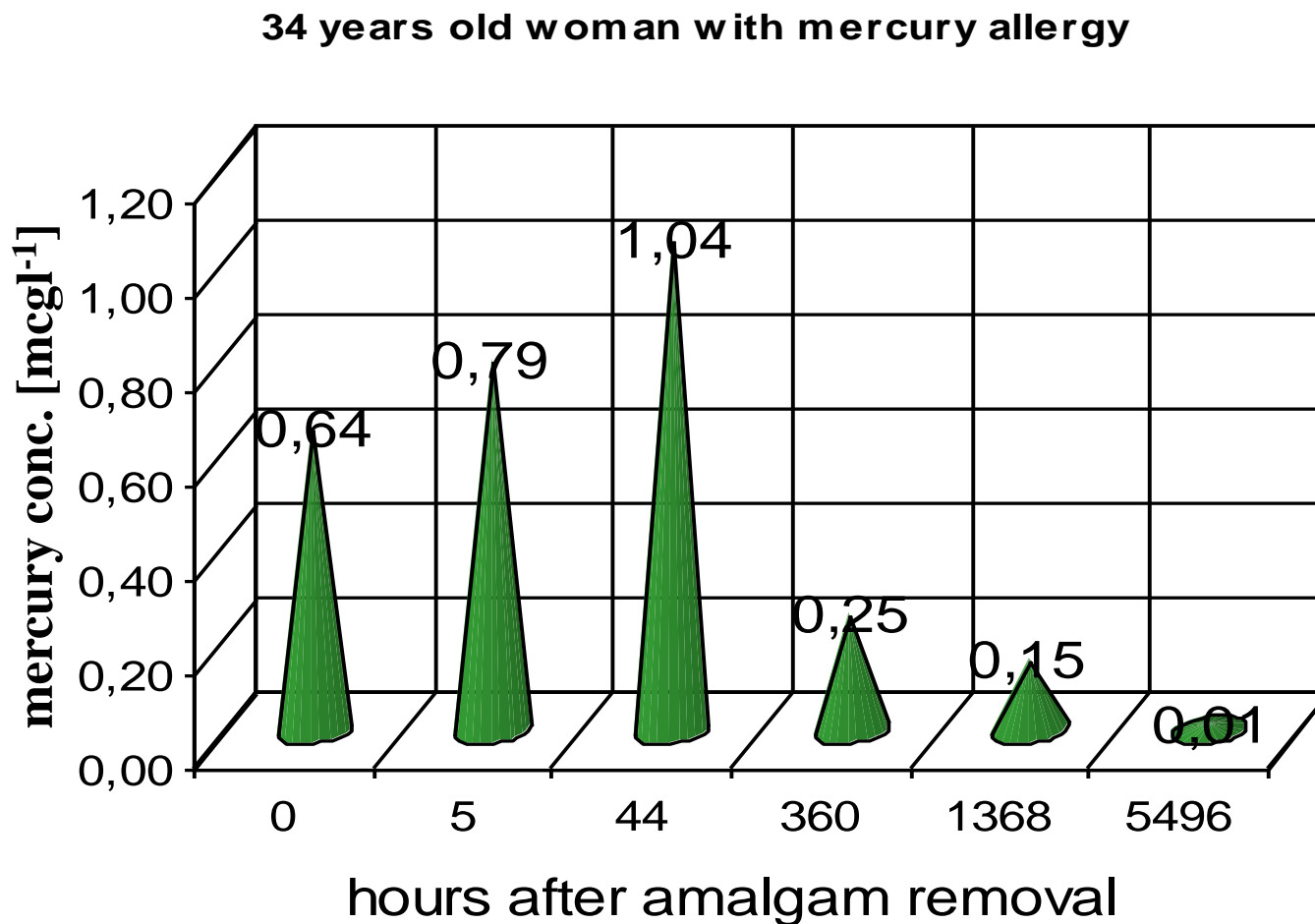
Relative change of urine excretion speed of mercury  
[ $\text{mcgh}^{-1}$ ] (82 persons)



TUČEK, M. *Současná zdravotní rizika expozice rtuti a jejím sloučeninám. České prac.lék., 2006, vol.7, no.1, p. 26-37.*

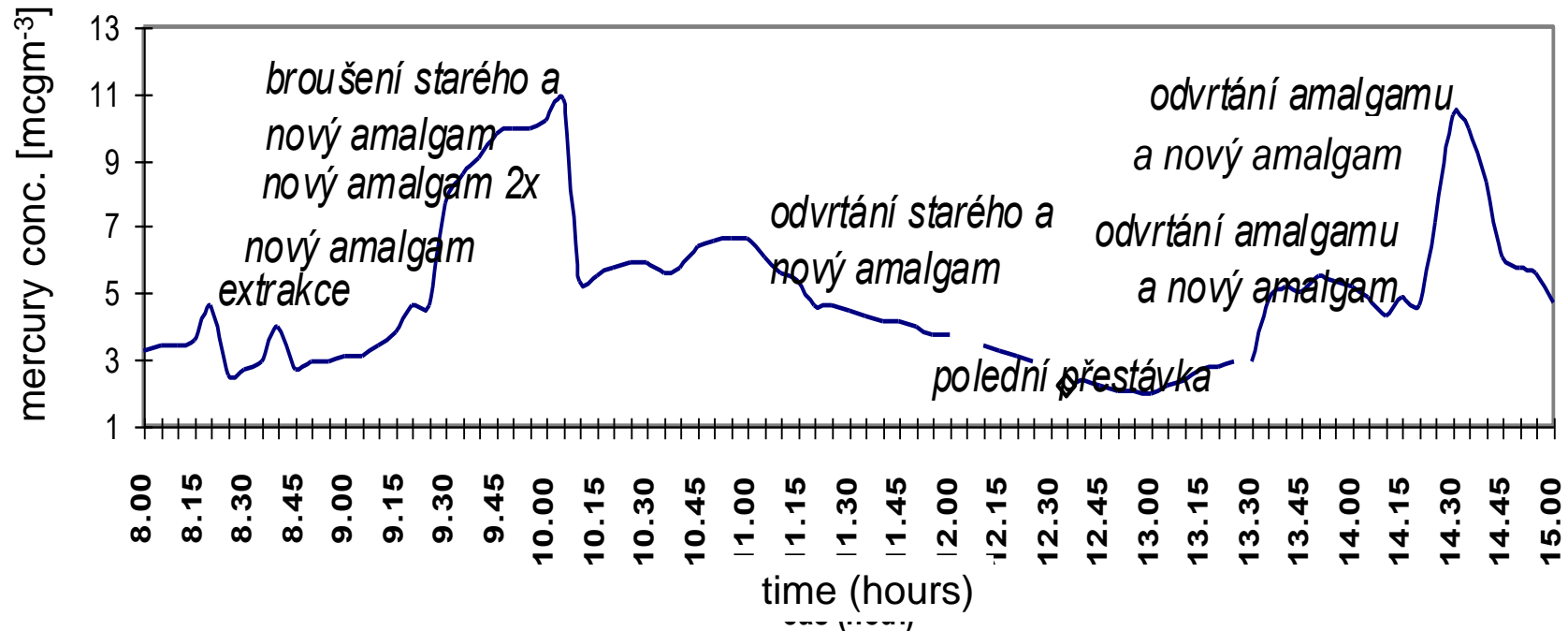
*Závěrečná zpráva o řešení grantového projektu IGA MZ ČR 3523-3 : Zhodnocení zdravotních rizik při užívání rtuti ve stomatologii.*

# Dental amalgam use in stomatology (5)



# Dental amalgam use in stomatology (6)

Mercury vapour content in atmosphere of dental surgery during work with amalgam

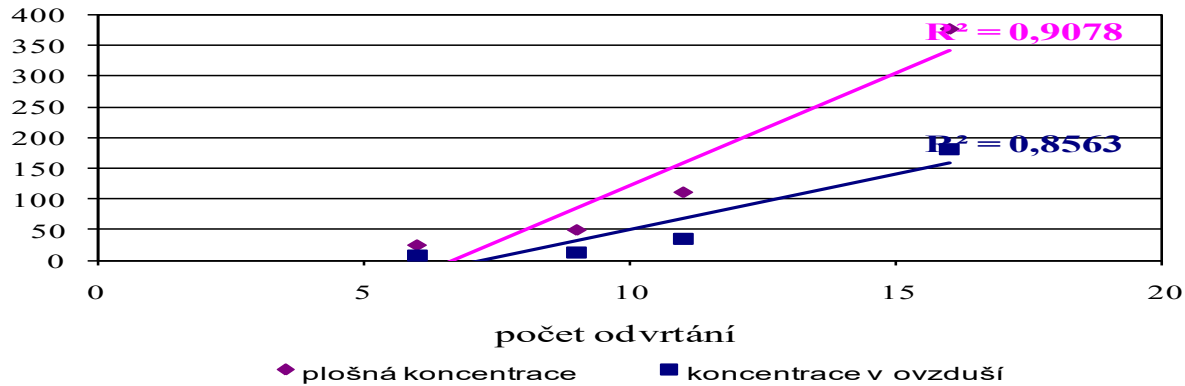


Av. conc. of total Hg (18 days): stomatologist **25.1**  $\text{mcgm}^{-3}$ , nurse **20.5**  $\text{mcgm}^{-3}$ , respectively **2.2 - 3.0**  $\text{mcgm}^{-3}$  (11 fillings, 2005).  
Peak concentrations - **hundreds**  $\text{mcgm}^{-3}$ .

# Dental amalgam use in stomatology (7)

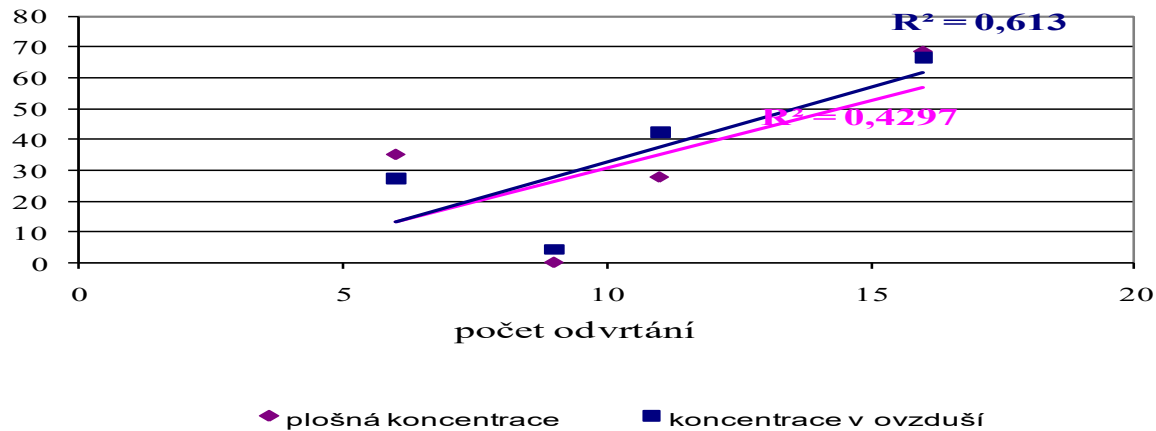
Shift exposure in correlation with number of drilled amalgam filling - stomatologist

Mercury surface conc. [ $\text{mcgm}^{-2}$ ]



Shift exposure in correlation with number of drilled amalgam filling - nurse

Mercury air conc [ $\text{mcgm}^{-3}$ ]



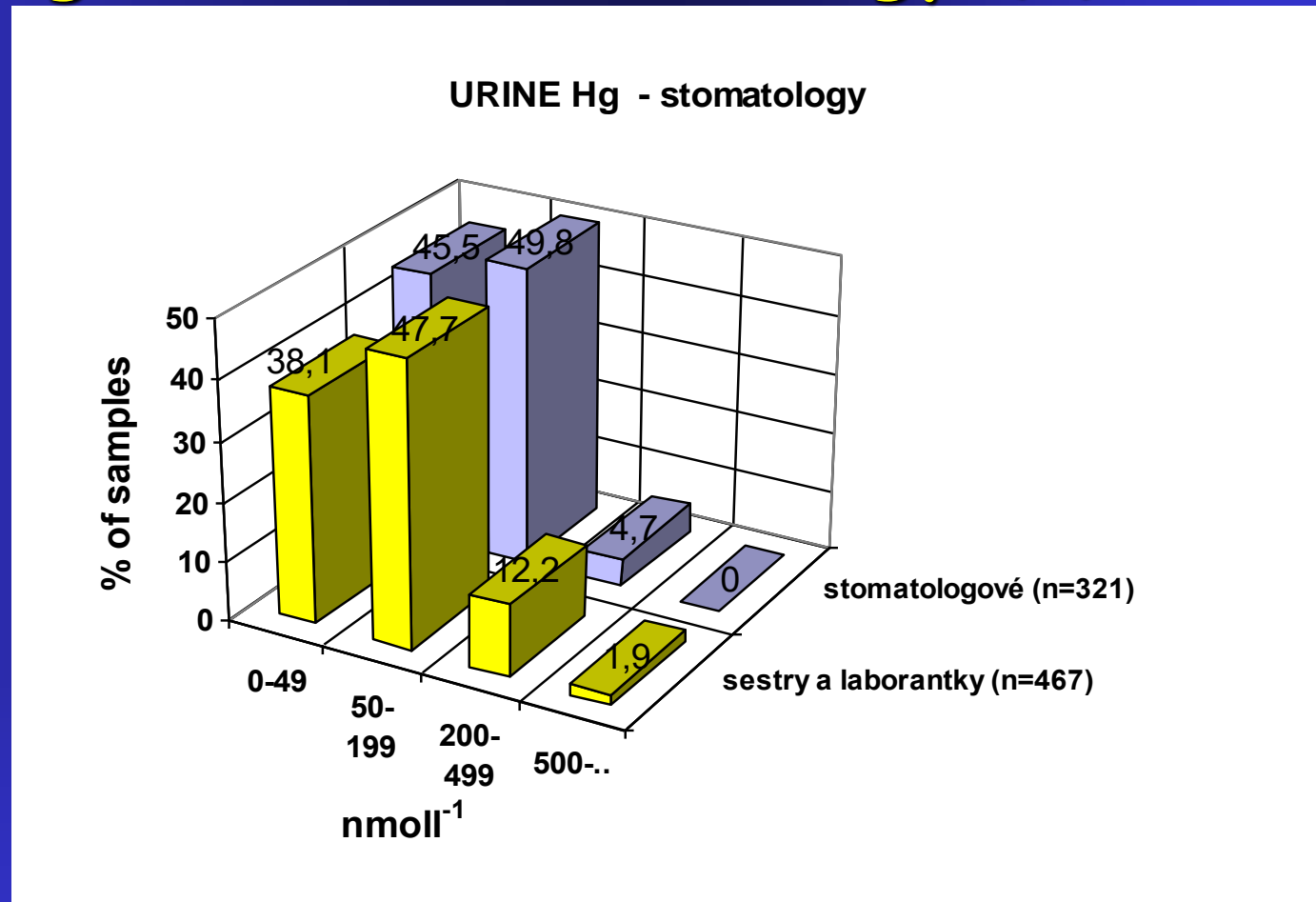
# Dental amalgam use in stomatology (8)

nonexposed  
population  
below  
 $10 \text{ mcgl}^{-1}$

limits

$100 \text{ mcg/g creatinine} =$   
 $0.056 \text{ mmol/mmol}$   
creatinine

$100 \text{ mcgl}^{-1} =$   
 $500 \text{ nmoll}^{-1}$

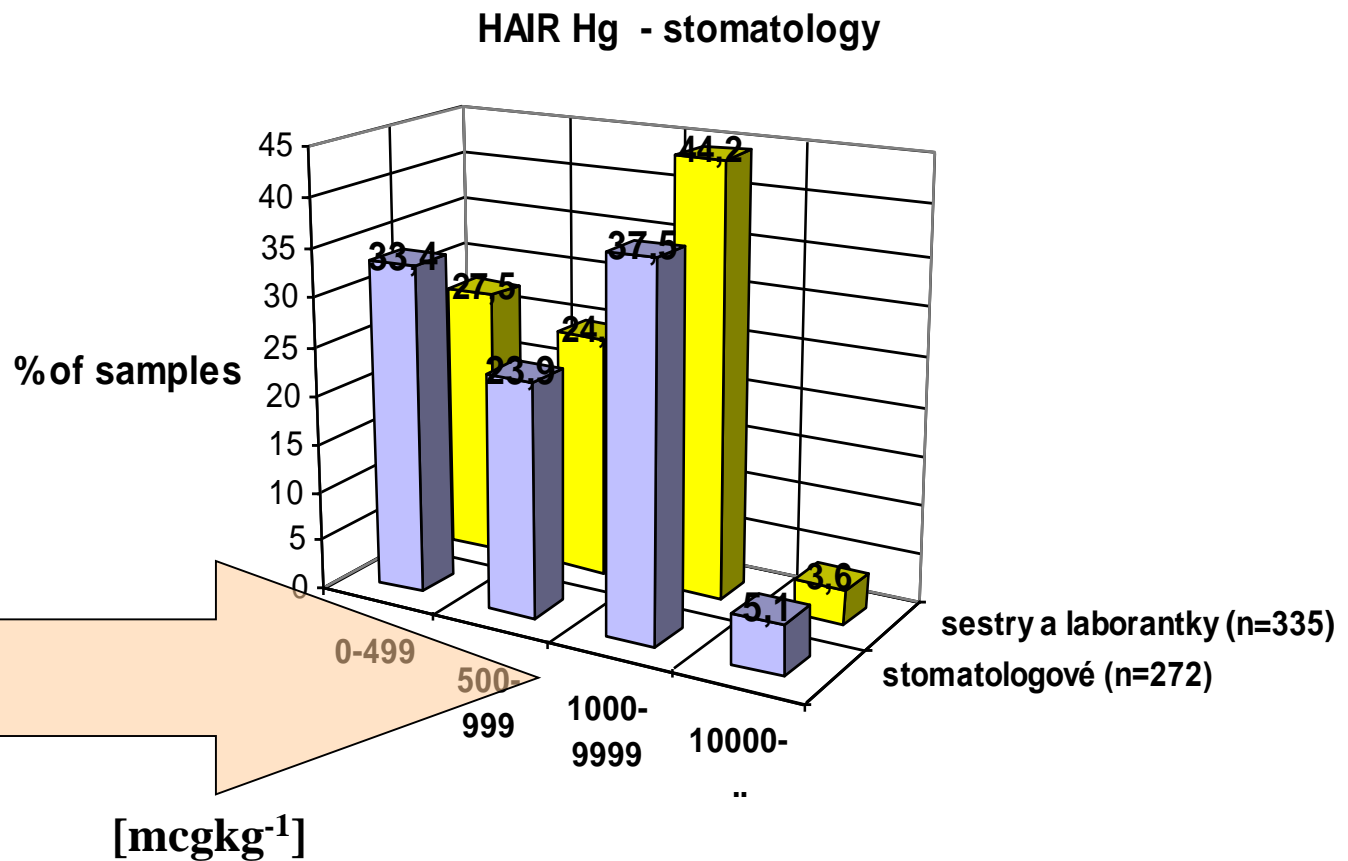
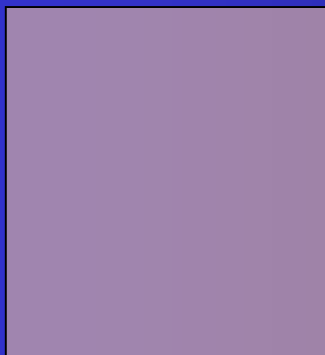


TUČEK, M. *Současná zdravotní rizika expozice rtuti a jejím sloučeninám. České prac.lék., 2006, vol.7, no.1, p. 26-37.*

CIKRT, M., ČÁBELKOVÁ, Z., SOUČKOVÁ, B., TUČEK, M., VOLF, J. *Expozice rtuti ve stomatologických ordinacích. Pracov.Lék., 1992, vol. 44, no.4, p.162-164.*

# Dental amalgam use in stomatology (9)

nonexposed  
population  
below  
1000  $\text{mcgkg}^{-1}$



TUČEK, M. *Současná zdravotní rizika expozice rtuti a jejím sloučeninám. České prac.lék., 2006, vol.7, no.1, p. 26-37.*

CIKRT, M., ČÁBELKOVÁ, Z., SOUČKOVÁ, B., TUČEK, M., VOLF, J. *Expozice rtuti ve stomatologických ordinacích. Pracov.Lék., 1992, vol. 44, no.4, p.162-164.*

# Dental amalgam use in stomatology (10)

## Personal protection effects (štít, rouška)

SHIELD				MASK		
PD before the shield		PD behind the shield		PD before the mask	PD in the mask*	PD behind the mask
$c_{(Hg^0)}$ mcgm <sup>-3</sup>	$c_{(Hg)}$ mcgm <sup>-2</sup>	$c_{(Hg^0)}$ mcgm <sup>-3</sup>	$c_{(Hg)}$ mcgm <sup>-2</sup>	$c_{(Hg^0)}$ mcgm <sup>-3</sup>	$c_{(Hg)}$ mcgm <sup>-2</sup>	$c_{(Hg^0)}$ mcgm <sup>-3</sup>
10,6	301	5,2	15,0	10,6	1000-6000	1,57

\*after 8 hours shift  
PD – passive dosimeter

$c_{(Hg^0)}$  metallic mercury  $Hg^0$   
 $c_{(Hg)}$  aerosol with mercury content



# CONCLUSIONS (1)

Mercury always is one of main components in dental fillings.

Discussion about influence of dental amalgams on human health was reopened in EU.

The concentration of mercury in the working atmosphere depends on the phase of the amalgame preparation and treatment, but occupational exposure is acceptable as a whole (only 2 % of urine samples exceeded the biological limit for Hg in urine).

Application of amalgam fillings showed up by enormous growth of mercury content in saliva and by unmistakable growth in blood.

# CONCLUSIONS (2)

It is relevant to discuss possibility of mercury alkylation in oral cavity and successive absorption in gastrointestinal tract.

Present mercury exposures of dental staff in Czech Republic don't exceed acceptable risk rate. Safety regulations for dental personnel must be accepted because the raised urinary mercury concentration after mobilization suggest that there is a mercury depot in the organism of exposed subject.

# CONCLUSIONS (3)

It is necessary to weight up all the pros and cons before the amalgam treatment and where possible to avoid the mercury amalgam treatment of persons with

*neurological diseases*

*renal diseases*

*pregnant women*

*women thinking about pregnancy*

*All amalgam fillings must be burnished (minimizing of corrosion in oral cavity)*

# REGULATION (EU) 2017/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2017 on mercury, and repealing Regulation (EC) No 1102/2008

Mercury is a very toxic substance which represents a global and major threat to human health, including in the form of methylmercury in fish and seafood resources, ecosystems and wildlife. Due to the transboundary nature of mercury pollution, between 40 % and 80 % of total mercury deposition in the Union originates from outside the Union. Action is therefore warranted at local, regional, national and international levels.

# REGULATION (EU) 2017/852 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2017 on mercury, and repealing Regulation (EC) No 1102/2008

Most mercury emissions and associated exposure risks result from anthropogenic activities such as primary mercury mining and processing, the use of mercury in products and industrial processes, artisanal and small-scale gold mining and processing, coal combustion and the management of mercury waste.

The use of mercury in dental amalgam is the largest use of mercury in the Union and a significant source of pollution. The use of dental amalgam should therefore be phased down... The Commission should assess and report on the feasibility of a phase out of the use of dental amalgam in the long term, and preferably by 2030, taking into account the national plans required by this Regulation and whilst fully respecting Member States' competence for the organisation and delivery of health services and medical care.

Furthermore, particular preventive health protection measures should be taken for vulnerable members of the population, such as children and pregnant or breastfeeding women.

Only pre-dosed encapsulated dental amalgam should be allowed for use, and the use of amalgam separators in dental facilities in which dental amalgam is used or dental amalgam fillings or teeth containing such fillings are removed should be made mandatory, in order to protect dental practitioners and patients from mercury exposure and to ensure that the resulting waste is collected and disposed of in accordance with sound waste management and under no circumstances released into the environment.

In this respect, the use of mercury in bulk form by dental practitioners should be prohibited.

## Article 10

### Dental amalgam

From 1 January 2019, dental amalgam shall only be used in pre-dosed encapsulated form. The use of mercury in bulk form by dental practitioners shall be prohibited.

From 1 July 2018, dental amalgam shall not be used for dental treatment of deciduous teeth, of children under 15 years and of pregnant or breastfeeding women, except when deemed strictly necessary by the dental practitioner based on the specific medical needs of the patient.

By 1 July 2019, each Member State shall set out a national plan concerning the measures it intends to implement to phase down the use of dental amalgam.<sup>32</sup>



From 1 January 2019, operators of dental facilities in which dental amalgam is used or dental amalgam fillings or teeth containing such fillings are removed, shall ensure that their facilities are equipped with amalgam separators for the retention and collection of amalgam particles, including those contained in used water.

Such operators shall ensure that:

- a) amalgam separators put into service from 1 January 2018 provide a retention level of at least 95 % of amalgam particles;
- b) from 1 January 2021, all amalgam separators in use provide the retention level specified in point (a).

Amalgam separators shall be maintained in accordance with the manufacturer's instructions to ensure the highest practicable level of retention.