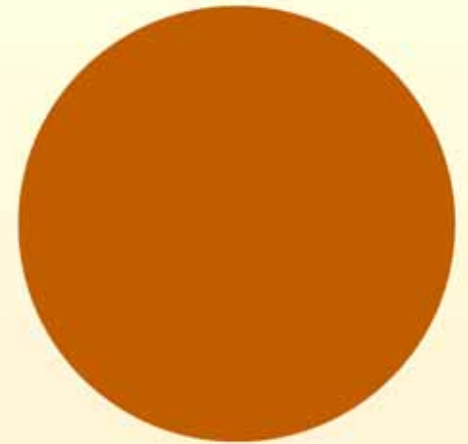


# Occupational exposure to Beryllium in France

R. VINCENT, M. GRZEBYK, B. SAVARY

Unit of Chemical Risk Characterization  
INRS

Centre de Lorraine  
F-54501 Vandoeuvre



# Outline

- Introduction
- Estimates of current workers potentially exposed to Be in France
- Occupational exposure data
- Assessment of exposures
- Perspectives

## France in figures

- Population 61,684,691
  
- Labour Force 26,759,000
  - Employed 24,355,000
  - Unemployed 2,404,000
  
- Firms 4,000,000

## France in figures

### Labour Force by activity sector

- Agriculture 336,000
- Industry 4,345,000
- Construction 1,362,000
- Wholesale 3,245,000
- Services 15,033,000

## Consumption of Beryllium in France

- No extraction or treatment of Be ore
- Importation of:
  - Pure Be
  - Be products
  - Wastes containing Be
- Annual consumption of these Be materials ranged from 40 to 60\* tons.

\* *From EUROSTAT statistics*

## Be Occupational disease

- During the period 2000-2002, 10 cases of disease due to an occupational exposure to Be have been officially recognized by the Social Security Insurance (MP-33)
- Exposure was due to :
  - Beryllium for 6 cases
  - Inorganic Beryllium for 4 cases
- Type of disease was:
  - Conjunctivitis for 3 cases
  - Pulmonary Fibrosis for 6 cases
  - COPD for 1 case

## Be occupational disease

- Related industrial activities (2000-2003)
  - Jewelry (2 fibrosis)
  - Research and development (2 fibrosis)
  - Casting of metals (1 fibrosis, 1 conjunctivitis)
  - Dental laboratory (1 COPD)
  - Other non-ferrous metal production (1 fibrosis)
  - General mechanical engineering (1 conjunctivitis)
  - Manufacture of weapons and munitions(1 conjunctivitis)

## Populations occupationally exposed to Be

- Two questionnaire surveys were conducted in 2003 and 2004 in order to :
- estimate :
  - Use of Be alloys and number of workers potentially exposed in dental laboratories
  - Use of Be and Be compounds in Industry and number of workers potentially exposed
- Identify industrial establishments where an exposure measurement survey could be conducted

## Survey methodology

- After validation, the questionnaire has been sent to a representative sample of firms, selected by stratified random sampling from the database of the French national statistics board (INSEE)
- 410 dental laboratories over 5300 were selected (22,000 workers)
- 4500 industrial firms over 26000 were selected (420,000 workers) from 22 industrial sectors

## Survey Methodology

- Industrial sectors were selected after a review of literature and interviews with experts from industry and organizations
- For the two surveys, and before analysis of data, comparison of responding and no-responding populations was conducted
  - Selection of a representative sample of non responding firm
  - Questionnaires were filled during phone call interviews
  - Comparison of populations by using logistic regression

## Results - Dental laboratories

- Response rate : 54 %
  - (210/408 questionnaires)
- No significant difference between responding and non-responding laboratories
  - Representative sample of 30 dental laboratories
  - Current use of Be alloys ( $p=0.7666^*$ )
  - Past use of Be alloys ( $p=0.6446^*$ )

*Logistic regression\**

## Results-Dental Laboratories

- One dental laboratory over Two declares to have used Be alloys by the end of the 80s
- By the end of 2003, only One dental laboratory over Seven declares to currently use Be alloys
- 80 % of laboratories answered that they have been contacted by suppliers for using Be free alloys

## Results-Dental Laboratories

Estimates of current workers potentially exposed

- In 1990 : 7,641-9,689
- In 2003 : 2,547-3,285

## Results- Industry

- 262 Manufacture of non-refractory ceramic goods
- 274 Manufacture of basic precious and non-ferrous metals
- 275 Casting of metals
- 283 Manufacture of steam generators
- 285 Treatment and coating of metals; general mechanical engineering
- 287 Manufacture of other fabricated metal products
- 295 Manufacture of other special purpose machinery
- 321 Manufacture of electronic valves and tubes and other electronic components
- 322 Manufacture of radio, television and communication equipment and apparatus
- 331 Manufacture of medical and surgical equipment
- 332 Manufacture of instruments and appliances for measuring
- 334 Manufacture of optical instruments and photographic equipment
- 362 Manufacture of jewellery and related articles
- 364 Manufacture of sports goods
- 371 Recycling of metal waste and scrap

## Results-Industry

- Response rate : 33 %
  - (1485/4500 questionnaires)
- Significant difference between responding and non-responding laboratories
  - Representative sample of 300 firms
  - This significant difference was taken into account for calculation of estimates

## Results- Industry

- About 10% of firms answers that they currently use:
  - Be alloys: Cu/Be-98/2; Al/Be-2%; 10%...
  - BeO
- Be alloys are often used for manufacture of aerospace equipments, molds, springs...
- BeO is used for manufacture of electronic devices : transistors, thyristors...

## Results - Industry

- The largest populations potentially exposed belong mainly to these industrial activities :
  - 285 Treatment and coating of metals; general mechanical engineering
  - 295 Manufacture of other special purpose machinery  
Molds for plastics industry
  - 274 Manufacture of basic precious and non-ferrous metals
- Based on results issued from this survey it could be estimated that the number of workers potentially exposed in industry ranged :  
**from 6,820 to 11,114**

## Estimates of current workers potentially exposed in France

- Industry 6,820-11,114
- Dental laboratories 2,547-3,285
- Total
- Range 9,367-14,399
- Mean 11,931
  
- Carex\* estimates for France in 1995 11,620

\*(<http://www.occuphealth.fi/internet/suomi/haku/>)

## Occupational exposure data to Be

- In France all exposure measurements (air sampling) made by the 8 laboratories of CRAM and INRS are stored since 1986 in the COLCHIC database
- During the period 1986-2004, 1500 exposure measurements to Be have been collected during 237 surveys conducted in 190 firms

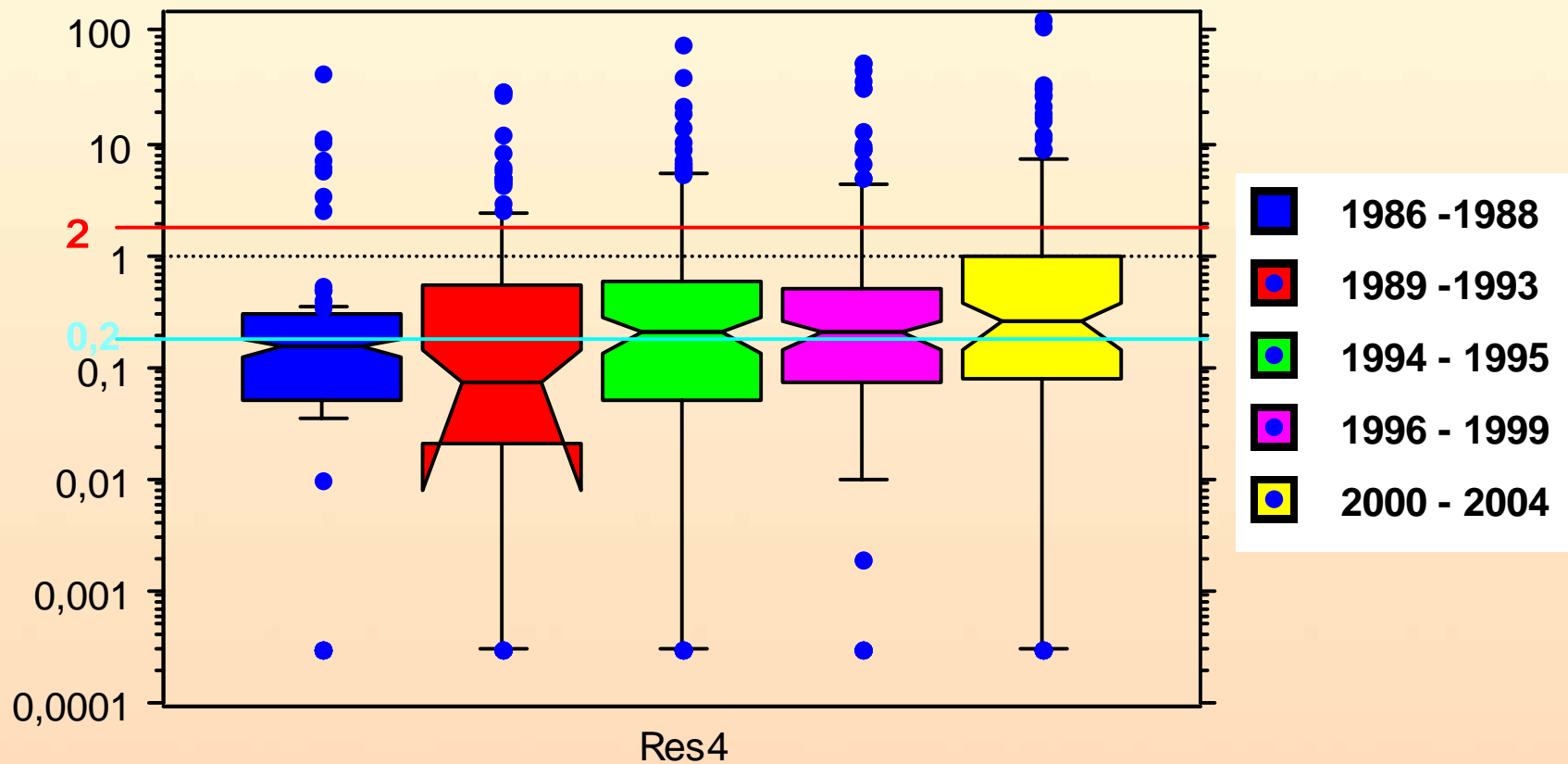
## Be-Exposure measurement method

- Personal or area sampling
- 37mm cassette , 4mm hole, equipped with a quartz fibre filter
- Sampling flow rate 1L/min
- Analysis by ICP-AES

(INRS-METROPOL Method 003- <http://www.inrs.fr/>)

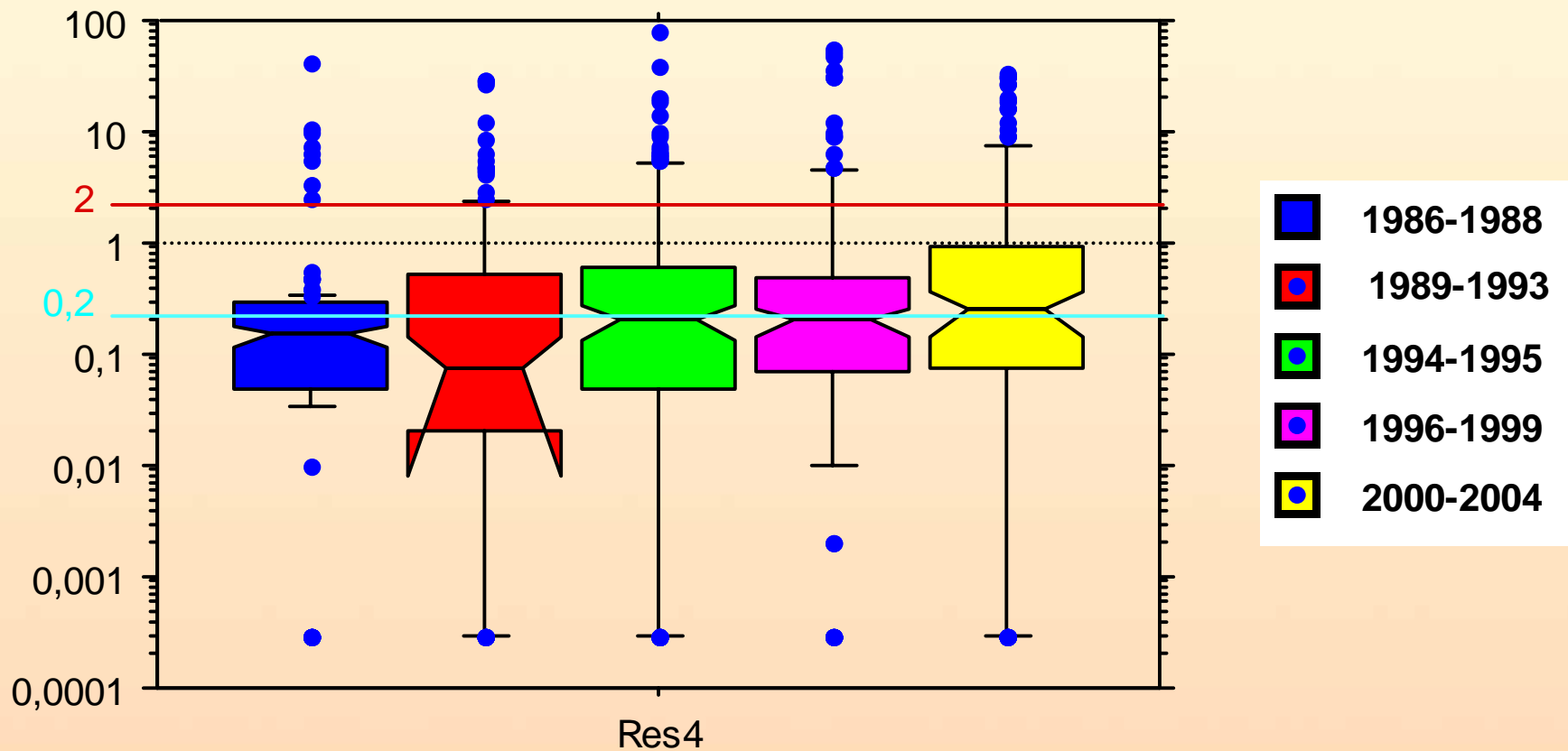
# Results of exposure measurements

## Personal samples (sampling time 1-8 hours)

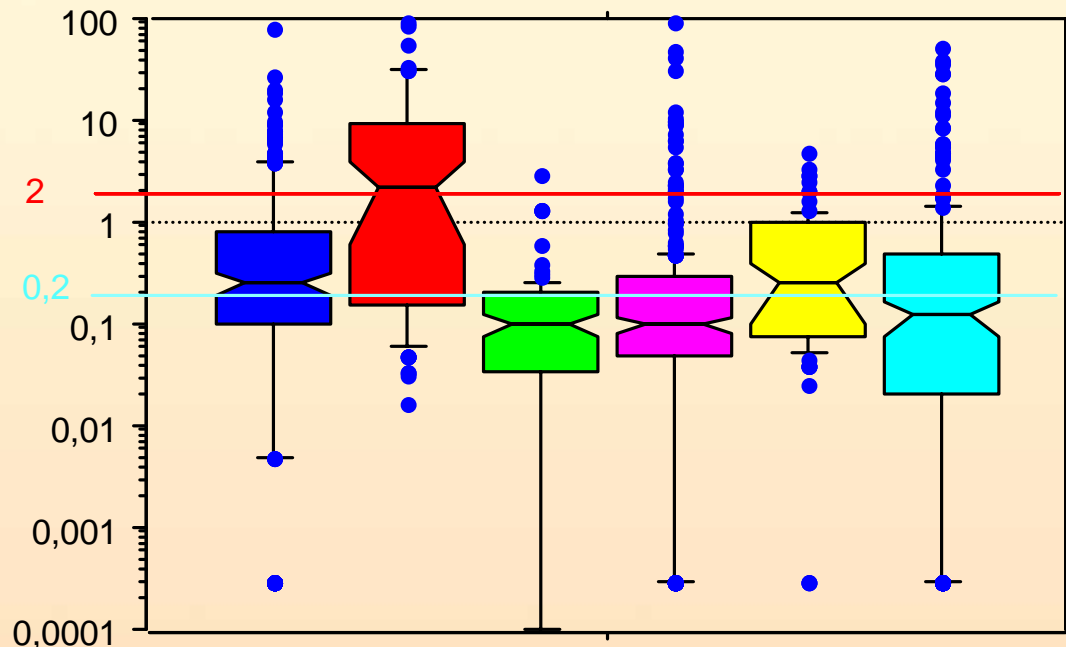


# Results of exposure measurements

## Area samples (sampling time 1-8 hours)



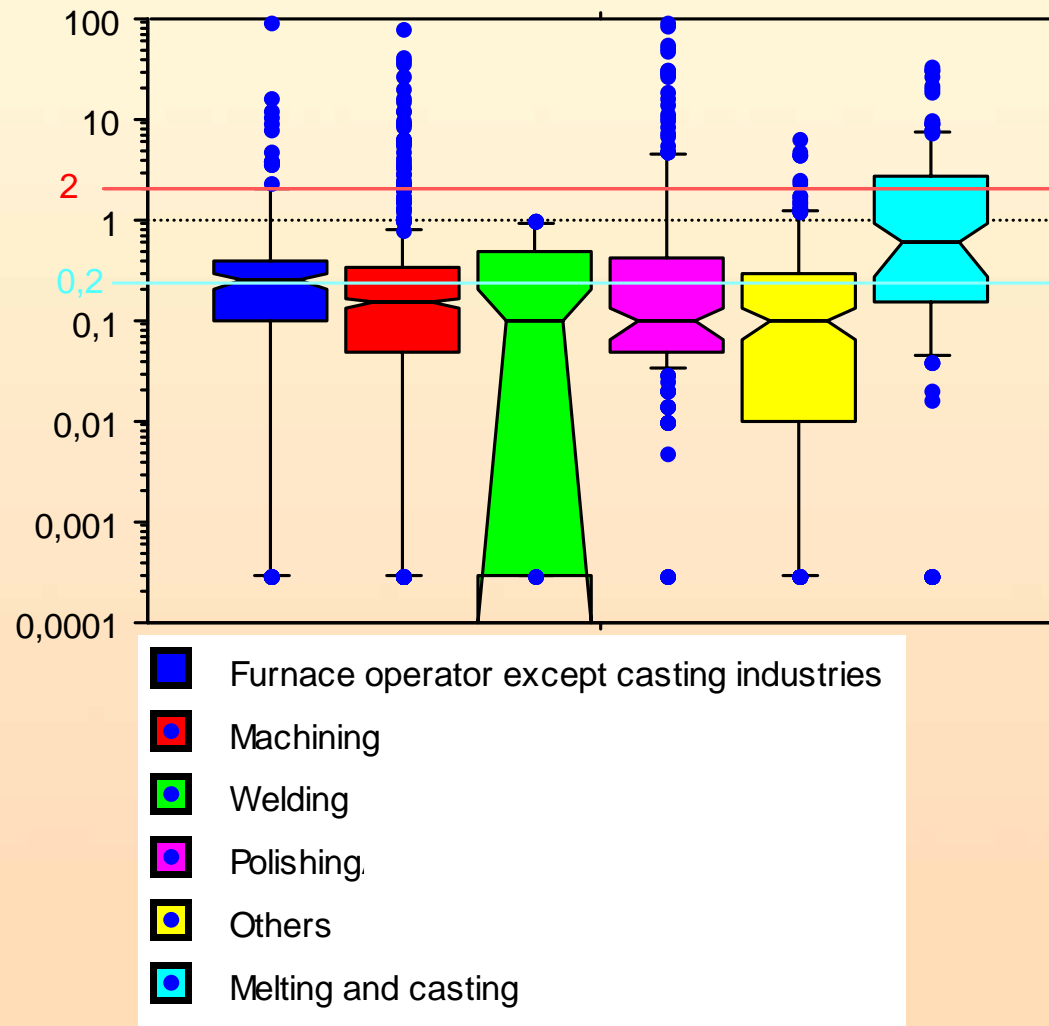
# Results of exposure measurements Industrial Activities (Area + personal samples)



- 274-Manufacture of basic precious and non-ferrous metals
- 275-Casting of metals
- 285-Treatment and coating of metals; general mechanical engineering
- 331-Manufacture of medical and surgical equipment and orthopaedic appliances
- 362-Manufacture of jewellery and related articles
- All others activities

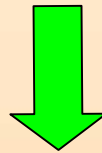
# Results of exposure measurements

## Type of task (Area + personal samples)



## Assessment of exposure to Be in France

- Estimates of the number of current workers potentially exposed to Be
- COLCHIC exposure data
- Monte-Carlo simulation



Numbers of workers by level of exposure

## Workers potentially exposed by level of Be concentration

Be in $\mu\text{g}/\text{m}^3$	0,1<	0,1-2<	0,2-0,5<	0,5-1<	1-2<	> 2
Number of workers	5574	1275	1639	974	811	1658

## Perspectives

- An exposure survey is currently conducted by the 8 CRAM's laboratories
- Representative sample of firms
  - Industrial activity
  - Size
  - Location
- Exposure (air sampling) and surface contamination (Wipe sampling) measurements will be conducted in 100 firms during 2004-2005

## Perspectives

- Ultrafine aerosols, worker exposure will also been studied in several firms by particle number measurements
- Contamination surface, mass and particle number exposure measurements could be conducted in firms who have stopped to used Be and Be compounds in the last years