IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

The indirect evaluation of asbestos exposure – the approach in Germany

Curso internacional de verano de la UPV de seguridad y salud laboral

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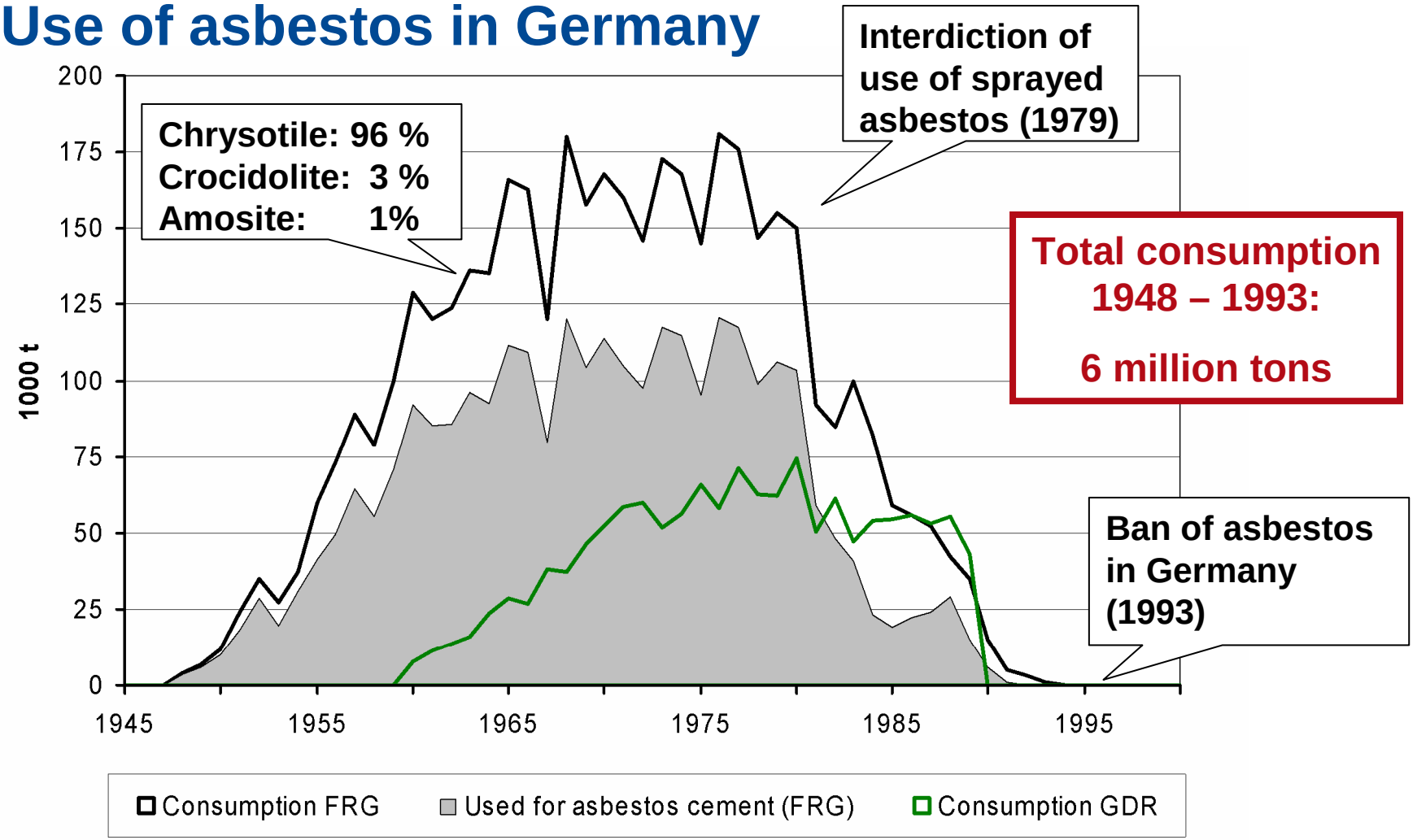
Dr. Markus Mattenklott
IFA - Institute for Occupational Safety and Health of the German Social Accident Insurance Germany

Topics

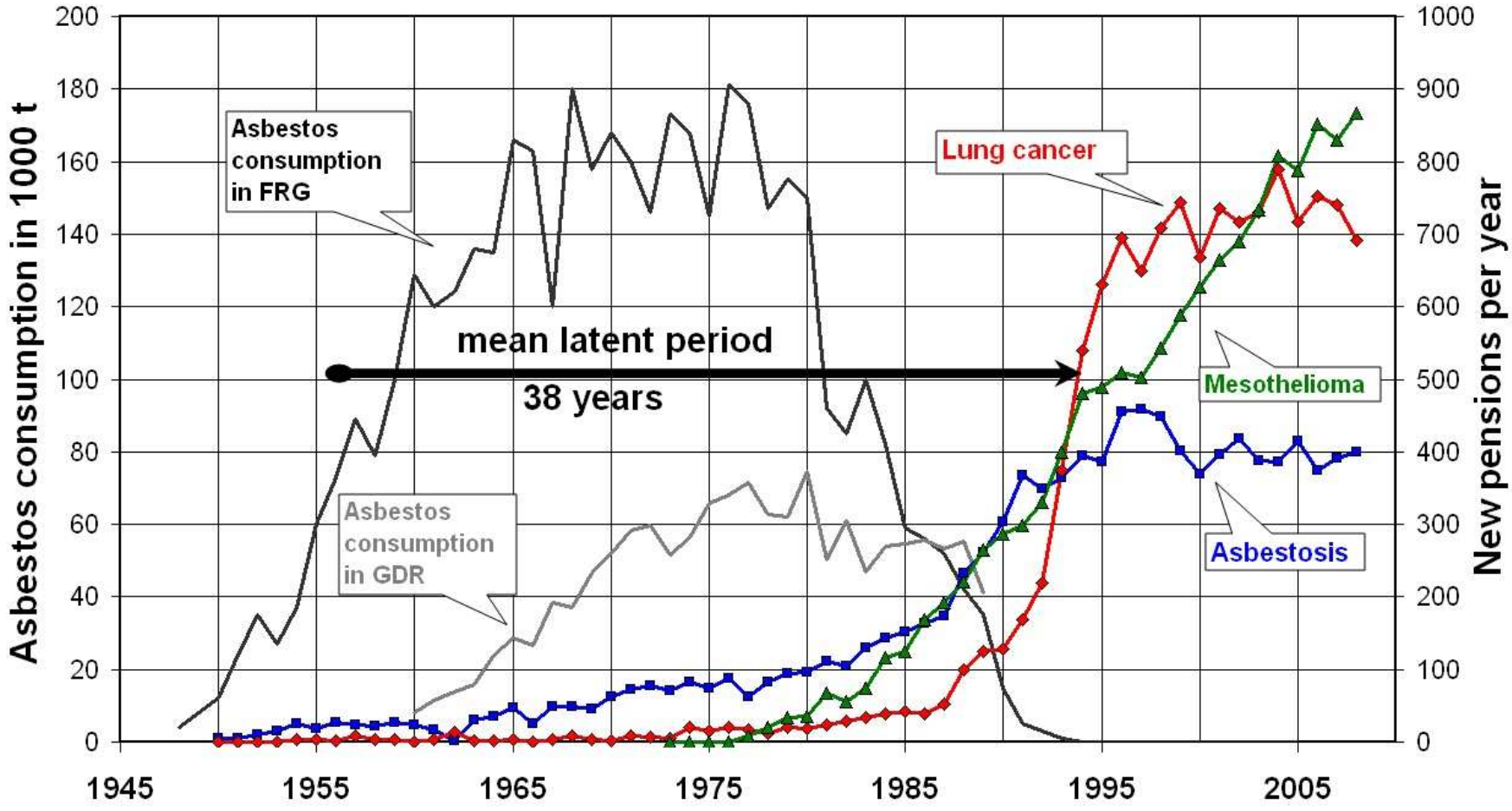
- Asbestos in Germany – a brief summary

- Retrospective exposure assessment
  - Sampling and analytical technics in Germany
  - Conversion factors
  - Consolidated exposure data
  - Lack of exposure data
  - Estimation of exposure

Use of asbestos in Germany



Asbestos related occup. diseases in Germany



Development of legislation (main steps)

Since 1940: Guidelines and recommendations by the German social accident insurance

1979: Prohibition of use of sprayed asbestos

1981 - 1993: Prohibition of marketing, fabrication, use of most asbestos products step by step

1993: General prohibition of marketing, fabrication and use of asbestos and asbestos containing products (with few special exceptions)

1995: Interdiction of asbestos exposure at workplaces
(except for asbestos removal, controlled by special rules, exposure **< 0,015 F/cm³**;
except use or reuse of naturally occurring mineral substances ≤ 0.1 mass-% asb.) *)

2005: Ban of asbestos in the countries of the European Union by a binding guideline

2008: Recommendation for an exposure-risk relationship in activities involving asbestos (acceptable risk: **0,01 f/m³** (2018: 0,01 f/m³; tolerable risk: 0,1 f/m³) **)

*) Technical Rule for Hazardous Substances „Asbestos: Demolition, reconstruction or maintenance work„ (TRGS 519).
**) Announcement on Hazardous Substances "Risk figures and exposure-risk relationships in activities involving carcinogenic hazardous substances" (Announcement 910)
Both Available in English → www.baua.de, topic "Gefahrstoffe", subtopic "TRGS"

Development of exposure limits in Germany

	kind of LV		Technical Limit Value							ERR
			Long term				Shift related			
		1960	1973	1976	1979 - 1982	1979 new plants	1985	1990	1995	2008
Chrys.	mg/m³ (AFD)	Recommended values (concerning conimetric data)	0,15	0,1			0,05	-		
	mg/m³ (FD)		4,0	4,0			2,0	-		
	f/m³		-	2			1	0, 25		
Amo.	mg/m³ (AFD)		-	0,1			0,05	-		
	mg/m³ (FD)		-	4,0			2,0	-		
	f/m³		-	2			1	-		
Croc.	mg/m³ (AFD)		-	-			0,025	-		
	mg/m³ (FD)		-	-			2,0	-		
	f/m³		-	-			0,5	-		
Asbes-tos	mg/m³ (AFD)				0,1	0,05				
	mg/m³ (FD)				4,0	2,0				
	f/m³				2	1			(0,015)	(0,01)

Chrys.: chrysitile; Amo.: amosite; Croc.: crocidolite

Retrospective asbestos exposure assessment

Need for retrospectice assessments in Germany:

due to regulations for compensation of asbestos related occupational disease (lung cancer)

on the basis of cumulative asbestos exposure („Fibre Years“)

Main problems:

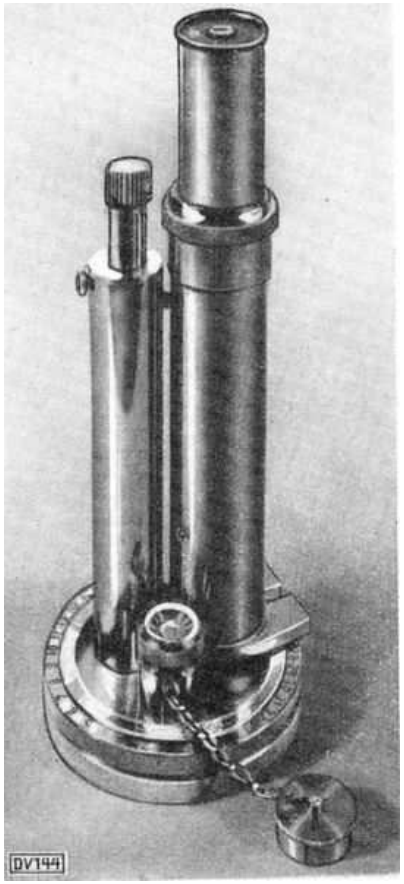
- different sampling and analytical technics

→ consolidation of available data

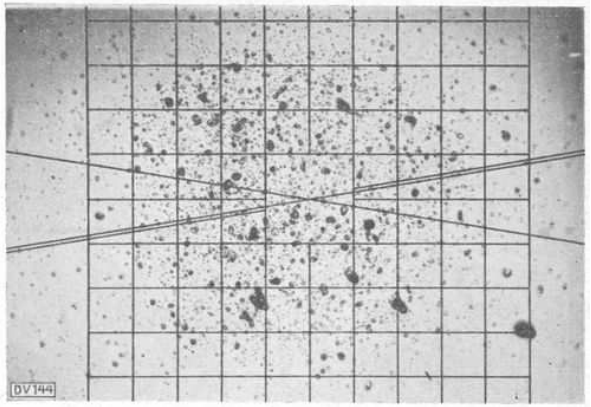
- lack of exposure data for different tasks

→ relation to comparable tasks

Conimetric measurements: ca. 1950 – 1973 / 1989



- Sampling time: < 1 sec
- Sampling volume: e.g. 2,5 cm³
- Analysis by integrated light microscopy
- Counting or estimation of **particles/cm³** or **f/cm³**
- Usually up to 30 samples to assess shift exposure



Source: D. Hasenclever, Staub, Heft 28, p. 235-242, 1952

Gravimetric exposure data: 1973 - 1990

- Stationary sampling
- Asbestos mass concentration (**mg/m³**) determined by IR-method

- Depending on kind of task
  - overestimation (sampler placed aside emisssion point)
  - underestimation (sampler placed beneath working area)

  of personal related exposure

Source: Berufsgenossenschaft Rohstoffe und Chemische Industrie

Microscopic Methods: since 1976

- **Phase-contrast microscopy („PhaKo“)**
  - In Germany in use since about 1976
  - Up to now: Standard method for the determination of asbestos fibre concentration (directive 83/477/EEC*) / 2009/148/EC (cod. version))

Article 7, 6. Fibre counting shall be carried out wherever possible by phase-contrast microscope (PCM) … or any other method giving equivalent results.

- **SEM-EDX-Analysis**
  - In Germany in use since about 1983
  - Defined parameters to achieve comparable results with PhaKo
  - Nevertheless: published comparisons support differences to PhaKo results, often SEM gives higher concentrations (often due to very thin fibres)

*) Council directive of 19 September 1983 on the protection of workers from the risks related to exposure to asbestos at work (second individual Directive within the meaning of Article 8 of Directive 80/1107/EEC) (83/477/EEC)

Conversion factor: Conimetric data → PhaKo

- **Great variation of conversion factors determined by side-by-side measurements in different work places and industries**

- **Mean conversion factors:** **0.3 – 0.6 (conimeter in FRG)**
  (1 Con. f/cm³ ~ 0.3 – 0.6 PhaKo f/cm³)
  ca. 2 (conimeter in GDR)
  (1 Con. f/cm³ ~ 2 PhaKo f/cm³)

- **Problems with conversion of conimetric data:**
  - **Different instrument modifications of conimeters**
  - **different counting rules**
  - **Beside fibre counting also estimation of particle concentration by comparison with sample pictures of different concentrations**
  - **big variation due to „snap-shot“ like sampling**

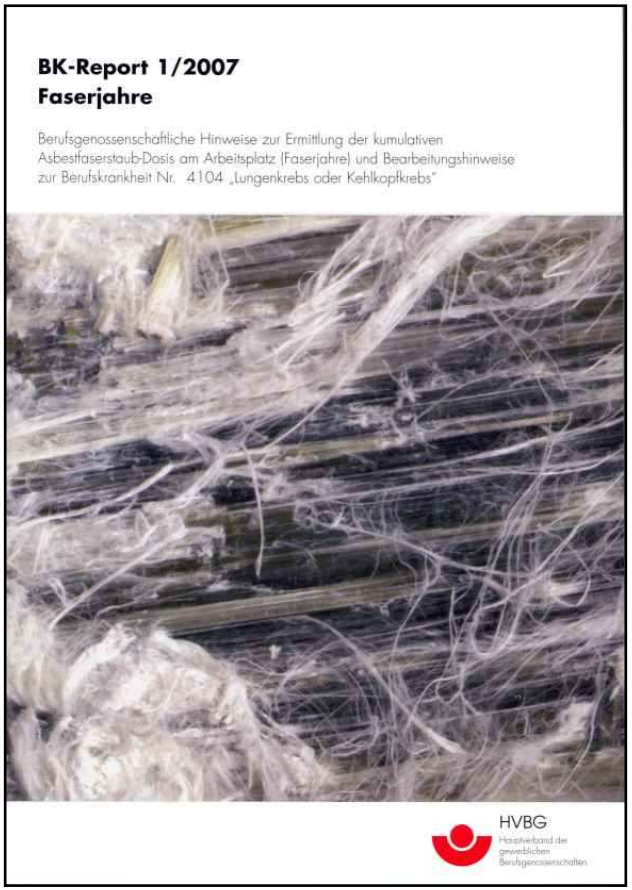
Conversion factor: Gravimetric data → PhaKo

- **Great variation of conversion factors determined by side-by-side measurements in different work places and industries**

- **Mean conversion factor:** **20**
  50th percentile: 12.5
  arithmet. mean: 21,3
  90th percentile: 51,4
  (1 mg/m³ ~ 20 PhaKo f/cm³)

- **Problems with conversion of gravimetric data:**
  - No general relation between mass and particle concentration
    - dependent on kind of asbestos product, used tools, working process, …
  - Varying correlation between stationary and personal sampling
    - dependent on kind of and distance to emission, flow of work, …

Consolidated exposure data (Report „Fibre Years“)



- Compilation of data recieved from different analytical technics:
  - 1.600 conimetric data
  - 15.315 mass concentrations
  - 9.974 fibre concentrations (PhaKo)
- Fibre concentrations are devided into
  - Shift related
  - Task related exposure data
- Only the 90th percentiles are documented
- Time trends for production in some branches

→ 5th edition of report in preparation

Report „Fibre Years“: documented applications/tasks

Production and use of products

- Textiles (heat protection, woven, fabrics, ribbons), paper / cardboard
- Seals, gaskets
- Asbestos cement
- Insulation / fireprotection panels
- Brake linings and clutches
- Insolation (thermal, acoustic, pipe covering, block insulation, shipbuilding, power plants, turbines)
- Plastics, filling materials
- Filters
- Bituminous and chemical produkts (plaster, etc.)
- Floor tile, flooring, floor underlayment
- Mineral resources (talkum etc.)

Other tasks

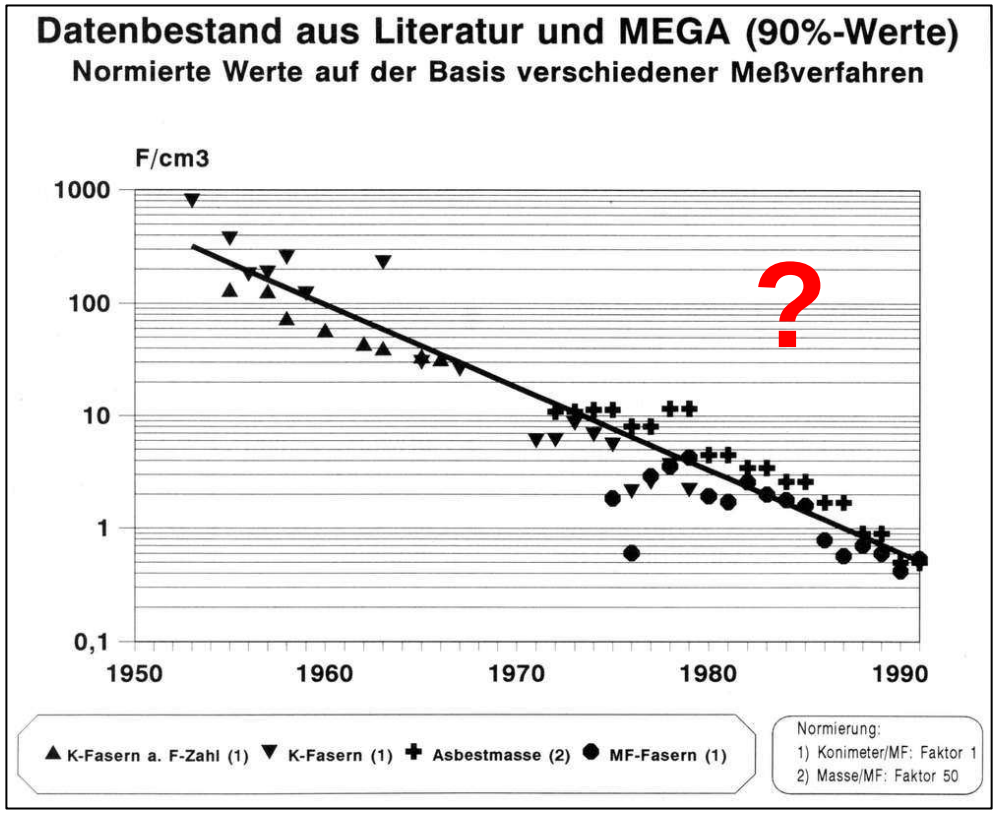
- shipbuilding
- Spray asbestos applications and removal
- Asbestos off-loading (harbour)
- Dumpsides
- Heat installation mechanics
- Car body shop
- Fireproof / furnace construction
- Glass production
- Power plant, pipework, container construction
- ...

Lack of exposure data for special tasks

Estimation of exposure by:

- Expert assessment ⟷ Different experts – different results?
- Use of exposure data from tasks with comparable exposure (depending on used product, tool, processes, etc.) ⟷ Applied for some tasks in the report Fibre Years“ as a convention
- Extrapolation by time trend ⟷ What time trend?

Is there a time trend of exposure?



Source: BK-Report „Faserjahre“, 4th edition, 2007

- **Decline of exposure** is typical for workplaces in the production industry
- Often **no distinct time trend** for typical manual tasks of mechanics (e.g. exchange of gaskets)
- **Escalate increase of exposure** by technological changes (e.g. cutting of asbestos cement, use of - hand saw: 0,5 F/cm³ - angle grinder: 60 F/cm³)

general time trend allows no conclusion to exposure of a single task

Alternative use of task / shift related exposure data

Task		Fibre concentration 90th percentile [F/cm³]	Typical duration at a shift	Type of exposure
Use of undulated Panels on roofs	Cutting with angle grinder (since 1956)	60	6 % cutting	Task
		4	6 % cutting 94 % installation and drilling	Shift
	Installation and drilling on the roof (without cutting)	1,2	Bystander position at 6 % cutting	Shift
Cutting with hand saw		0,5		Shift

Preference of shift related exposure data, because of high uncertainty in estimation of duration of separate job operations

Source: BK-Report „Faserjahre“, 4th edition, 2007


Thank you
for your attention