Exposure limits in different countries

John Cherrie
Outline...

- The purpose(s) of exposure limits
- Asbestos causes cancer
- Workplace limits
- Limits in non-occupational
  - indoor and outdoor environments
- A limit for asbestos in water
- Limits for asbestos in solid materials
  - soil and indoor settled dust
- A rational approach?
Exposure Limits...

- *Exposure Limits* are a simple tool to assist in managing risks
- They must:
  - protect health
  - be achievable in practice
  - be associated with a valid measurement method
- They may:
  - reflect national socio-economic conditions
  - administrative arrangements
Contamination Limits...

- Secondary to *Exposure Limits*
  - measurement in media or situations where there is no direct risk to health
- Achieving a *Contamination Limit* should generally mean that an *Exposure Limit* is not exceeded
- Must be practicable and associated with a valid measurement method
Asbestos and health...

- Asbestosis, lung cancer, mesothelioma
- Laryngeal cancer ?
- Gastrointestinal cancer ?
  - Stomach cancer
  - Colon cancer
Collection of information about limits...

- Questionnaire sent to:
  - Participants of the AFRICA fibre counting exchange
  - EU Senior Labour Inspectors Committee
- Responses from:

  Australia, Austria, Belgium, Brazil, Canada, Colombia, Czech Republic, Estonia, Finland, France, Germany, Ireland, Italy, Poland, Portugal, South Africa, Spain, Switzerland, UK and USA
### Workplace limits...

<table>
<thead>
<tr>
<th></th>
<th>Long-term limit (fibres/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Crocidolite/Amosite</td>
<td>20</td>
</tr>
<tr>
<td>Chrysotile</td>
<td>20</td>
</tr>
</tbody>
</table>
Workplace limits...

- Six out of 20 countries have short-term limits (i.e. less than 1 hour)
- Most countries long-term limits are over 8 hours
  - France 1 hour
  - UK 4 hours
- Germany has no limits and Poland only has a short-term limit
Published information from Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>OEL (Fibers/mL)</th>
<th>Medical Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>China, People’s Republic of</td>
<td>2 mg/m³</td>
<td>Yes</td>
</tr>
<tr>
<td>Indonesia, Republic of</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Japan</td>
<td>2.0</td>
<td>Yes</td>
</tr>
<tr>
<td>Korea, Republic of</td>
<td>2.0</td>
<td>Yes</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Philippines, Republic of</td>
<td>2.0</td>
<td>Yes</td>
</tr>
<tr>
<td>Singapore, Republic of</td>
<td>0.1</td>
<td>Yes</td>
</tr>
<tr>
<td>Taiwan (R.O.C.)</td>
<td>1.0</td>
<td>Yes</td>
</tr>
<tr>
<td>Thailand, Kingdom of</td>
<td>5.0</td>
<td>No</td>
</tr>
<tr>
<td>Vietnam, Socialist Republic of</td>
<td>1.0</td>
<td>No</td>
</tr>
</tbody>
</table>

*Information not available.

Clearance values...

- All asbestos (fibres)
- Lower values by electron microscopy

<table>
<thead>
<tr>
<th>Clearance (fibres/ml)</th>
<th>N</th>
<th>0.0005</th>
<th>0.001</th>
<th>0.002</th>
<th>0.005</th>
<th>0.01</th>
<th>0.1</th>
<th>none</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>
Environment, water and soil...

- Only one country reported environmental air limit
  - 0.00235 fibres/ml (1 hour)
  - 0.00025 fibres/ml (year)
- Three countries had water limits
  - 1 to 600 million fibres/L
- Four countries with soil limits/guidance
  - 100 to 10,000 mg/kg
A rational approach?

- **Exposure Limits for:**
  - Workplace inhalation
  - Air “clearance”
  - Non-occupational inhalation
  - Ingestion

- **Contamination Limits for:**
  - Soil and other solids
  - Surface water/ waste
Inhalation Exposure Limits...

- Health-based use predicted risk
  - Hodgson and Darnton (2000)
- For a maximum predicted “very low” lifetime risk (1 in 10,000) you need a cumulative exposure of 0.01 fibre/ml.yrs.
- Over 10 years this would correspond to an exposure limit of 0.001 fibres/ml, annual average.

Clearance Exposure Limit...

- Assume 0.01 fibres/ml after work, declining to “background” over one year
- Cumulative exposure 0.005 fibres/ml.yrs
- Maximum predicted lifetime risk about 3 per 10,000
- This is a “minimal” risk over a lifetime
Non-occupational exposure...

- Risks proportionately higher than for occupational exposure
  - Children
  - 24 hours per day
  - “lifetime” exposure

- If the Exposure Limit was based on cumulative lifetime exposure of 0.001 fibres/ml.years

- Limit is then 0.000001 fibres/ml, as an annual average
Water Exposure Limit...

- Risks identified in Norwegian cohort with exposure between $10^9$ and $10^{11}$ fibres/L
- Assuming a “safety factor” of 100
- Exposure Limit for drinking water is $10^7$ fibres/L, long-term average

Soil Contamination Limit...

- Laboratory tests on the release of asbestos from soil showed:
  - 100 mg/kg produced exposures about 0.1 fibres/ml, if respirable dust levels less than 5 mg/m³
- For Occupational Exposure Limit not to be exceeded Contamination Limit probably needs to be about 0.01 mg/kg

Water Contamination Limit

- Based on ensuring soil does not become contaminated above limit
- However, I have no suggestion about what the limit should be
### Summary...

<table>
<thead>
<tr>
<th></th>
<th>Health-based</th>
<th>Pragmatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>OEL</td>
<td>0.001 f/ml</td>
<td>0.1 f/ml</td>
</tr>
<tr>
<td>Clearance</td>
<td>0.01 f/ml</td>
<td>0.01 f/ml</td>
</tr>
<tr>
<td>Non-occupational</td>
<td>0.000001 f/ml</td>
<td>0.0001 f/ml</td>
</tr>
<tr>
<td>Drinking water</td>
<td>$10^7$ f/L</td>
<td>$10^7$ f/L</td>
</tr>
<tr>
<td>Soil</td>
<td>0.01mg/kg</td>
<td>1mg/kg</td>
</tr>
<tr>
<td>Waste water</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>
Thanks to...

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