The struggle against occupational exposure to noise and vibrations : the Belgian experience

- industrial noise : a slow progress
- industrial vibrations : still a long way to go …
- occupational health issues

Dr. Katrien Mattan
Occupational Physician/Safety Expert

Ir. Jan Van Peteghem
Director of the Risk Management division

I. The occupational exposure to noise

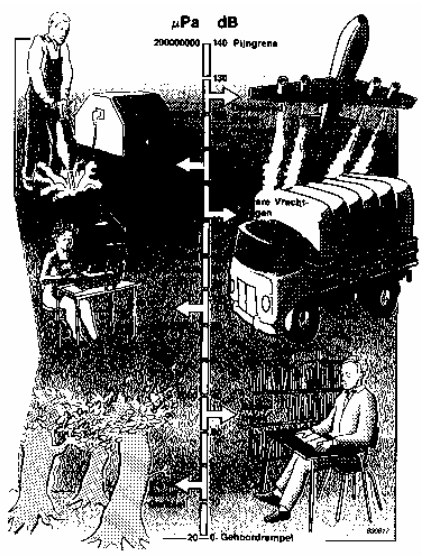
1. Unit for noise exposure

- Unit of noise level : decibel

$$Lp = 10\log(\frac{p^2}{p_0^2})$$

$waarbij$

$$p_0 = 20\,\mu Pa$$



1. Unit for noise exposure (2)

- Unit of acoustic capacity : decibel

$$L_W = 10\log(\frac{W}{W_0})$$

$waarbij$

$$W_0 = 10^{-12}\,W$$

2. The Belgian regulatory framework

- 2.1. Standards (codes of good practice)

- international standards, like EN 458:2005 “Hearing protectors - Recommendations for selection, use, care and maintenance - Guidance document”
- national standards, like NBN S1-401 on comfort criteria

Comfort criteria

Limit values for noise exposure in different environments $L_{(A)eq}$ (norm NBN S1-401)

Environment	I	II	III	IV
Offices				
- upper management	30	35	40	45
- lower management	35	40	45	50
- employees	40	45	50	55
Typing room	45	45	50	55
Computer room	55	55	60	65
College room	35	40	45	50
Meeting room	40	45	50	55
Restaurant	45	50	55	60
Laboratories	55	55	60	60
Shops	40	45	60	60
Production areas	50 à 75			

I : residential areas, more than 500 m away from busy traffic routes
II : urban residential areas, less than 500 m away from busy traffic routes
III : shopping or light industry areas
IV : city centres, heavy industry, proximity of a motor way or an airport

2. The Belgian regulatory framework (2)

- 2.2. Legislation not related to wellbeing at the work place

- with respect to to environmental issues
- with respect to to product safety

2. The Belgian regulatory framework (3)

Emission standards

Within the framework of the Machinery Directive, the E.U. defines the acoustic capacity L_w of :

- tower cranes
- lawn mowers
- ...

2. The Belgian regulatory framework (4)

- 2.3. Actual exposure limits at the workplace

  Tolerable mean values (Leq)

  - action level 85 dB(A)
  - peak level 90 dB(A)*

  Tolerable peak values

  - impact noise (max) 140 dB

  * Companies exceeding this limit should apply for a special permit

2. The Belgian regulatory framework (5)

- 2.4. The E.U. Directive 2003/10/EU : what's new ?

- (theoretical) lowering of the limit value with respect to the general exposure to continuous noise ?
- measuring impact noise with a C-filter ?
- Leq(8h) may be replaced by Leq(week)
- for the general exposure limit : how to take into account the effect of hearing protection ?

3. Industrial noise reduction in practice

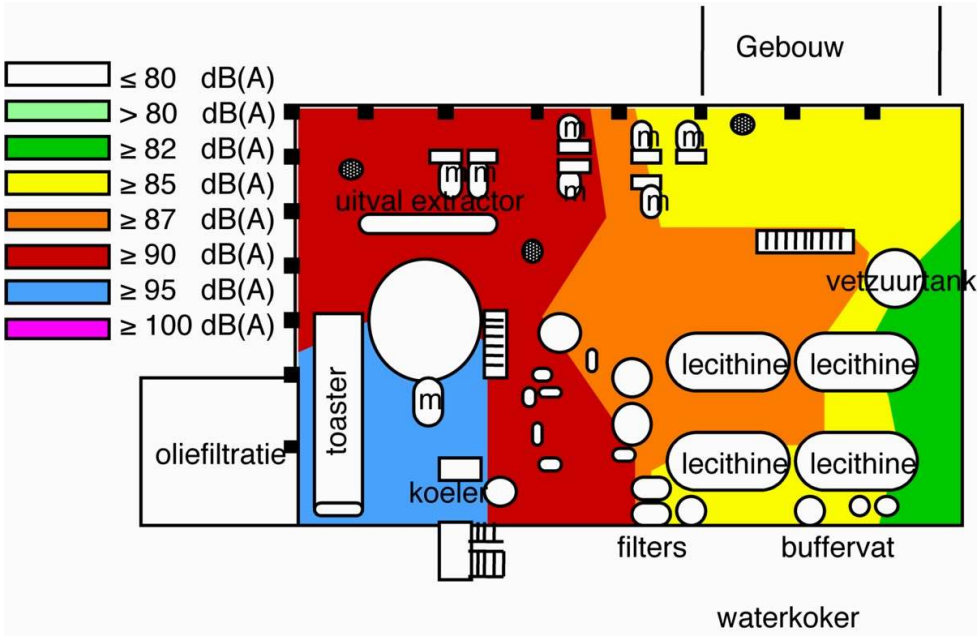
- Combination of:
  - To begin with : a simple dB)A) measurement
  - Dose measurements (personal sampling with dose meter)
  - Source specific measurements (e.g. frequency related measurements)
  - Measurement of the acoustic quality of the environment (e.g. reverberation time)
  - Noise map: the distribution of noise through the production hall

3. Industrial noise reduction in practice (2)

- Noise map
  - arrangement of the hall into grid points (e.g. in function of the roof pillars)
  - Leq measurements (1min.) at each grid point
  - colour coding of the various zones (connecting the points representing the same noise level)

idewe

Noise map of a diary production hall



idewe

II. The occupational exposure to vibrations

1. Transposition of the directive

- The E.U. Directive 2002/44/EC has been translated into the Belgian regulatory system by the Royal Decree of July 7th, 2005
- Nearly literal transposition

2. Main problems for implementation in Belgium

1. Limited measuring capabilities

⇒ expensive equipment
⇒ measuring expertise is rare

2. Measuring problems

⇒ 8 h ?
⇒ Interference with impacts (shocks) ?
⇒ clumpsy equipment

III. Occupational health issues with respect to noise and vibrations

1. Occupational Illnesses in general

Top 10 in Belgium (2002)

1. Illnesses realted to vibration exposure (incl. back injuries)
2. Deafness
3. Neuroparalysis due to pressure
4. Dermatosis
5. Silicosis
6. Allergy to natural latex
7. Mesothelioma
8. Asbestosis
9. Lung cancer due to asbestos exposure
10. Farinosis

2. Exposure to noise/vibration : the big picture

Objective of the Belgian regulations

- prevention and early diagnostic of any damage associated with the exposure to noise and vibrations.

Medical examinations (Royal Decree 28/05/2003 health supervision)

- who needs to be medically surveilled?
  "Cat 3 : activities with a definite risk : exposure to fysical agents
  > noise, vibrations"

Exposure ?

- The employer should determine whether there is exposure or not
- The employer should measure the exposure levels

3. Noise exposure and occupational medical surveillance

1.1. Actual situation

Health surveillance, including audiometry, is mandatory for noise exposure levels above 85 dB(A) Leq :

- during the pre-employment exam
- after 12 months
- afterwards : every 1 to 3 year

For workers exposed to above 90 dB(A) Leq :

- during the pre-employment exam
- periodically : once per year

3. Noise exposure and occupational medical surveillance (2)

1.2. The future situation after the implementation of the directive 2003/10/EC

<u>If exposure >new lower action level (80 dB(A))</u>

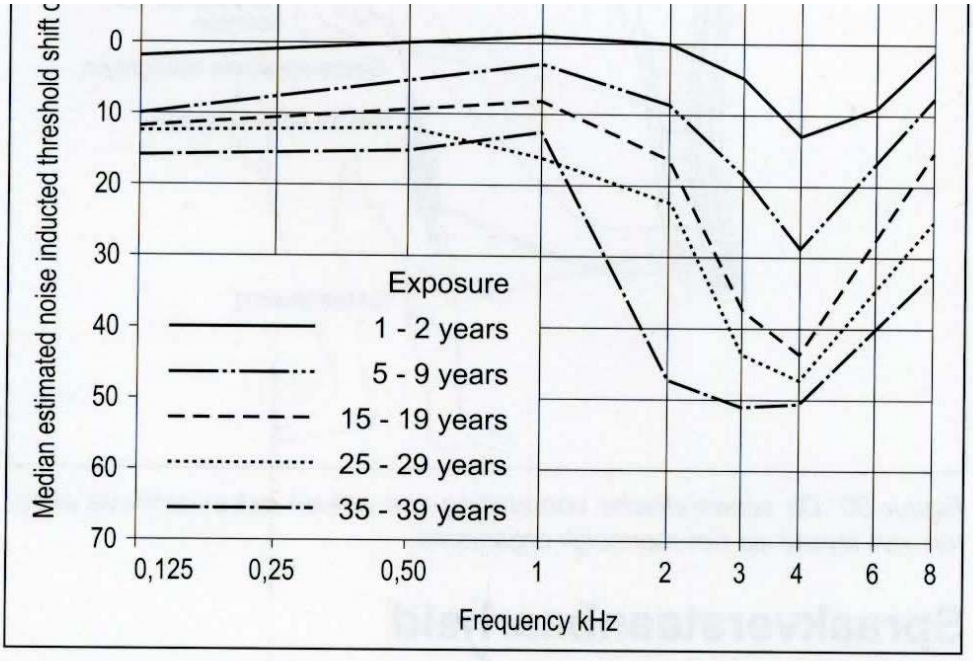
- health surveillance will most probably be mandatory
- frequency ?

<u>If exposure > new upper action level 85 dB(A))</u>

- health surveillance will be mandatory
- periodicity : once per year

3. Noise exposure and occupational medical surveillance (3)

audiogram



Figuur 28. Voorbeelden van audiogrammen bij normaal gehoor, bij ouder-

4. Noise exposure and occupational illnesses

Deafness due to occupational exposure to noise is considered in Belgium as an occupational illness. It figures on the limitative list of professional

Condition

Standard for recognition : minimum hearing loss = 50 dB on the best ear, after having applied to following formula :

$$\frac{\text{Hearing loss on 1000 Hz + loss on 2000 Hz + loss on 3000 Hz}}{3}$$

In 2003 : 25% of the recognised occupational illnesses where due to occupational noise and vibrations exposure, good for 7,4 mil. Euro

4. Noise exposure and occupational illnesses (2)

If hearing loss is identified, the employer must :

- revise the evaluation of the exposure
- revise the prevention programme
- propose job rotation to the employee, leading to an alternative job post without further exposure to noise

4. Noise exposure and occupational illnesses (3)

Practical drawbacks with respect to prevention programmes

- occupational deafness advances stealthily : workers are hard to convince wearing PPE
- PPE's are often uncomfortable
- PPE's are often improperly used
- at high noise levels : efficiency of PPE's is greatly reduced when not worn constantly
- Communication difficulties

  > ! Safetyrisk

The employer has to make a considerable effort to ensure the correct use of the PPE's.

5. Vibration exposure and occupational medical surveillance

1.1. Actual situation (1998)

No action levels
The employer must determine whether there is exposure
If yes,
- evaluate on the basis of the work practices
- data provided by the manifacture (fabrikant)
- and when necessary, measure the exposure levels

Health Surveillance:
When exposure > 7 days / year : annual exam
- Hand arm < 100 Hz : RX upper limbs
- Hand arm > 100 Hz : finger temperature
- WBV < 20 Hz : RX spine

5. Vibration exposure and occupational medical surveillance (2)

1.2. The future situation after the implementation of the directive 2002/44 /EU

- Limits :
  Hand arm : 2,5 action level (5 exposure limit value)
  WBV : 0,5 action level (1,15 exposure limit value).

- Health surveillance if :
  exposure > action level
  including :
  - WBV < 20 Hz : RX spine
  - Hand arm V < 100 Hz : RX upper limbs
  - Hand arm V > 100 Hz : finger temperature

6. Vibrations : health effects

Important characteristics in assessing the risks :

- the type of vibrations : hand-arm whole body
- the frequency : low to high
- the amplitude (acceleration m/s2)
- the duration off exposure
- working at low temperatures

6. Vibrations : health effects (2)

Hand-arm vibrations

- vibrating machines and tools
- entering the body through the hands and arms
- associated health effects :
  - > vasculair
  - > osteo-articulair
  - > neurological

6. Vibrations : health effects (3)

Hand-arm vibrations

The pathology depends on the vibration frequency :
1. Vibrations in low frequency bands (< 60 Hz) :
ex. pneumatic hammer
osteo-articulary :
- bone and joint disorders at shoulders, elbows, wrists (artrosis, vacuoles,..)
- Kienböch desease (necrose os lunatum)
- Köhler desease (pseudo-artrose os scaphoïdeum)

Symptoms : pain and limitations of the joints.

6. Vibrations : health effects (4)

Hand-arm vibrations

2. Vibrations in medium frequency bands (60 – 200 Hz)

Ex. vertical grinding machine

Vascular : Raynoud phenomenon (white fingers)

Stage	Degree	Description of the crisis
0		No fits
1	Light	Occasional fits, limited to the extremities of the phalanxes of one of more fingers
2	Moderate	Occasional fits in the second and third phalanxes of one or more fingers
3	Severe	Repeated fits in all phalanxes of several fingers
4	Very severe	Like 3, with tropical changes of the skin at the finger tips

6. Vibrations : health effects (5)

Hand-arm vibrations

3. Vibrations in high frequency bands (> 200 Hz)

Ex. smoothing machines

Neurological effects : pathologies nerves in the hands and fingers :

Stage	Symptoms
0	Exposure to vibrations, without symptoms
1	Intermittent paresthesies, with our without pain
2	Intermittent or continuous paresthesies, lessening of the sensory capacities
3	Intermittent or continuous paresthesies, lessening of the touch perception and/or finger dexterity

6. Vibrations : health effects (6)

Whole Body Vibrations

- produced by vehicles (ex. driving a fork lift truck) and machines (ex. standing on platforms)
- entering the body through the feet and seat
- associated health effects :
  - low back pain
  - spine problems

6. Vibrations : health effects (7)

Osteo-articular and angioneurotic diseases caused by vibrating tools
= recognised as professional illness

Objectified radicular pathology caused by whole body vibrations
= recognised as professional illness.

To be found in the building and transport industry