Design guidelines for capture devices on wood working machines

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Content

- Need of efficient capture devices
- Design methodology
- Method of assessment
- European standardisation
- Application to a CNC router
- Conclusion
Why an efficient dust removal?

- Wood dust = hazardous substance
  - Health related risks
  - Fire and explosion
- Regulatory exposure limit value in France from July 1st 2005 $1 \text{ mg/m}^3$
- Inherently safe design better than reconditioning
- Crucial problem for hand held machines
Guidebook for proper design

- Intended for manufacturers, designers, users
- Method for design, logic diagram
- Application to 7 usual machines
  - vertical panel, radial arm, bench saws, router...
- Published by INRS : ED 841
  - brochure in French
  - downloadable on www.inrs.fr
Design analytical method

- Observation of dust source and characterisation of the emission during a specified machining operation
- Selection of type of capture device and location
- Layout of capture device
- Sizing of aerodynamic characteristics
Design process (1)

- Emission source: fixed
- Direction of ejection: constant
- Capture device: fixed
- Mobility: fixed

Moving with source and direction
Design process (2)

- exhaust / ejection
- in front of
- ejection span
- kinetic energy

cover elementary ejection span
cover elementary ejection span
cover overall ejection span

obstacles to
- deviate particles
- reduce capture velocity ($E_k$)

collect as close as possible to the source
Assessment criterion

- Evaluation of capture efficiency
- Decontamination index
- Method described in standard EN 1093-11

\[ I_a = \frac{C_a - C_m}{C_a - C_f} \]

- gain achieved by dust capture
- based on relative wood dust concentrations
Standardisation work

- European machine directive 98/37/CE
  - Essential Safety Requirements
  - Annex 1, article 1.5.13 Emission of dust...
  - No strong requirements

- Technical aspects dealt with in standards
  - Ad hoc group of CEN/TC142 wrote a checklist of requirements to help standard writers
  - In line with guidebook
Application to a DC router
Existing capture device

- Low capture performance
- High exhaust flow rate
- High dust exposure
- Time consuming cleaning
- Reduction of visual space
Observation of the source

Movement

Existing capture device

Piece
Use of logic diagram

Direction of projection

Emission source of particles

Capture device

Capture in front of the direction of projection

Cover instantaneous variation in the angles of projection (radial and axial)

Choice of type of capture device...
New design

Movement

Piece

Movement

Movement
New capture device (a)
New capture device (b)
Results in test house

![Graph showing decontamination index vs. air flow rate (m³.h⁻¹)]

- **Decontamination index**
- **Air flow rate (m³.h⁻¹)**

- **Prototype**
- **Existing device**
Results on site (a)
## Results on site (b)

<table>
<thead>
<tr>
<th>Capture device</th>
<th>Flow rate m${}^3$.h$^{-1}$</th>
<th>Performance</th>
<th>Exposure mg.m$^{-3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing device</td>
<td>5 000</td>
<td>0.35</td>
<td>2.0</td>
</tr>
<tr>
<td>New device</td>
<td>1 000</td>
<td>0.95</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Conclusion

- Operating conditions
  - Energy savings for fresh air heating
  - Quicker cleaning of machines and workshop
- Investment cost
  - More money on capture devices
  - Less on fans and air cleaning equipment
- Satisfaction of user
  - Safer and healthier working conditions
  - Better quality of final product