Societal – Occupational Health and Safety

Current challenges for joining and cutting processes

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ABICOR BINZEL

• Founded in Gießen, Germany in 1945
• 500 employees in Germany, 1,000 employees worldwide
• 34 Subsidiaries and more than 20 exclusive partners
• Production sites in:
  – Germany (2)
  – China
  – India
  – Brazil
  – USA
  – Russia
• Distribution companies in:
  – Europe
  – North and South America
  – Asia
  – Africa
  – Australia
• Turnover in 2014: 140 million EUR
• Total number of welding torches in 2014 (worldwide): 540,000
## Importance of welding and cutting in EU27

### Welding and cutting equipment and systems
- 2,900 million EUR added value
- 47,800 employees

### Welding and cutting processes over all – incl. use and complementary goods
- 66,100 million EUR added value
- 1,220,000 employees out of which 850,000 welders and operators are in direct or close contact to the processes.

DVS Research Association on Welding and Allied Processes: Added value and jobs by joining technology in Germany and Europe. Data base: 2010, DVS 2013

### Harmful effects on physical health by joining and cutting processes
- Electrical hazard
- Fumes
- Gases
- Noise
- Machine movement
- Physical load (e.g. torches, esp. in positional welding)
- Radiation

⇒ **Hazards occur in all joining and cutting processes – arc and laser processes as well as adhesive bonding and mechanical joining.**
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- Radiation

⇒ Main challenge for most processes are emissions of aerosols and/or gases (respirable and toxic).

<table>
<thead>
<tr>
<th>Country</th>
<th>Exposure limit 2007</th>
<th>Up-to-date exposure limit</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>3 mg/m³</td>
<td>1.25 mg/m³ (2014)</td>
<td>- 58 %</td>
</tr>
<tr>
<td>Netherlands</td>
<td>5 mg/m³</td>
<td>1 mg/m³ (2010)</td>
<td>- 80 %</td>
</tr>
</tbody>
</table>

⇒ Challenge: Causal process emission rates cannot be estimated because they highly depend on specific application and boundary conditions (process parameters, welding equipment, material, extractions systems, ceiling height, ...).
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<th>Country</th>
<th>Up-to-date exposure limit</th>
<th>Recommendation</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>5 ppm (currently suspended)</td>
<td>0.5 ppm (evaluation criterion)</td>
<td>- 90 %</td>
</tr>
<tr>
<td>France</td>
<td>3 ppm</td>
<td>0.5 ppm</td>
<td>- 83 %</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>3 ppm</td>
<td>0.5 ppm</td>
<td>- 83 %</td>
</tr>
</tbody>
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⇒ Challenge: Regulations will lead to mandatory use of activated carbon filter in almost every joining and cutting application – but effectiveness of extraction is unknown.
Effects on technology users

- Constantly increased demands on occupational health and safety lead to uncertainty of machine investments in Europe especially for manual workplaces.
- Occupational Exposure Limits are lowered without regarding technical feasibility and test reliability.

⇒ Demands for research:
  - Validation and demonstration of new low-emission processes and materials
  - Support in designing efficient extraction systems
  - Practicable measurement and documentation systems for fumes and gases

Effects on technology providers

- Increasing demand for easy-to-handle equipment (e.g. lightweight extraction torches)
- Increasing demand for low-emission processes.
- Complex and expensive measurements of emissions – only random measurements by authorities

⇒ No predictive statements about real-world fume concentrations at work places currently possible

⇒ Demands for research:
  - Effective, close-to-process extraction systems
  - Low-emission processes
  - Practicable measurement systems for fumes and gases
Approaches to fulfill demands in OHS

1. Development of low-emission processes and materials

- Optimized process control can reduce fume emissions by up to 75%.

- Hazardous fume components can be reduced to almost zero.

⇒ Many research results do not reach end users because technologies are not market-ready yet.
⇒ Projects are needed to validate and demonstrate research results of innovative, low-emission processes and materials in relevant environments – esp. in manual use for SME applications.
2. Development of extraction systems

- Fume extraction torches can reach capture efficiencies of up to 90% but depend on process parameter setting welding and welding position.

- Modern process cabins are currently designed specifically for applications, e.g. for laser remote cutting.
- Special equipment is needed for certain applications, e.g. when using nanoparticles.

⇒ Many users, esp. SMEs, are often overstrained by current demands and different approaches of extraction.
⇒ Projects are needed to design effective and efficient extraction systems for aerosols, gases and nanoparticles.
3. Measurement and documentation

- Ultrafine particles / nanoparticles are hard to measure in an industrial environment.
- Very expensive equipment, not ideal for welding and cutting processes due to wide variation of particle size distribution and chemical composition.

- Exposure limits are currently checked in industrial environments in test series of max. 2 h duration with uncertain boundary conditions.

⇒ Today only fractions of air can be analyzed with many uncertainties about boundary conditions.
⇒ Projects for emission measurement and documentation in industrial environments are needed.
Starting point:
1. Exposure limits are constantly lowered all over Europe – e.g. respirable fume and nitrogen oxides.
2. Most joining and cutting process are highly emissive – especially in aerosols and gases.
⇒ High demands for low-emission processes and materials, especially for manual use.

Current problems:
1. Occupational exposure limits are lowered without regarding technical feasibility and test reliability.
2. Innovative technical solutions are not ready – esp. for manual use in SME applications.
3. Most measurement devices are not suitable for joining and cutting processes in industrial environment.
⇒ Uncertainties about sustainability of investments lead to questions on investments in Europe.

Approaches:
1. Development of low-emission processes and materials – validation and demonstration in relevant environment, especially for manual use in SMEs.
2. Development of extraction systems – support for technology users to create design efficiently.
3. Measurement and documentation – provide reliable, secured and repeatable measurements which can be documented.

Goals:
1. Companies have to be enabled to comply with health and safety demands.
2. Exposure limits have to be measurable and verifiable in industrial environments.
3. Low-emission processes and suitable, efficient extractions have to be ready for market to reach the goals in occupational health and safety.
Thank you for your kind attention!

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Burt & Rose: S&S 4/2015

IGF-Nr. 18.179 B

IGF-Nr. 18.149 BG/2
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