Societal – Occupational Health and Safety

Current challenges for joining and cutting processes

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- **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**



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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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Challenge – Occupational Health and Safety

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



BGI 593



Weigl, Bayrisches Laserzentrum / DVS

Occupational Exposure Limits for respirable (non specific dust) / welding dust

Country	Exposure limit 2007	Up-to-date exposure limit	Reduction
Germany	3 mg/m³	1.25 mg/m³ (2014)	- 58 %
Netherlands	5 mg/m³	1 mg/m³ (2010)	- 80 %

⇒ **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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Weigl, Bayrisches Laserzentrum / DVS

Occupational Exposure Limits for nitrogen oxide NO_2

Country	Up-to-date exposure limit	Recommendation	Reduction
Germany	5 ppm (currently suspended)	0.5 ppm (evaluation criterion)	- 90 %
France	3 ppm	0.5 ppm	- 83 %
United Kingdom	3 ppm	0.5 ppm	- 83 %

⇒ **Challenge: Regulations will lead to mandatory use of activated carbon filter in almost every joining and cutting application – but effectiveness of extraction is unknown.**

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Effects on European industry and their demands

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**

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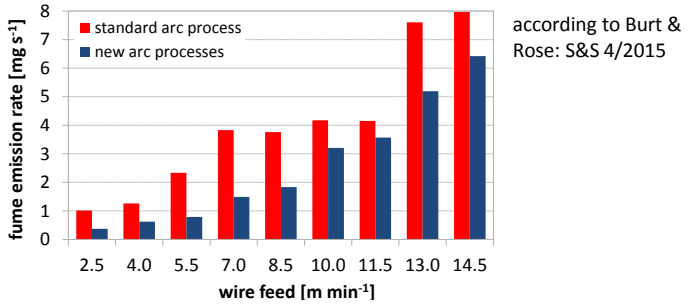
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Approaches to fulfill demands in OHS

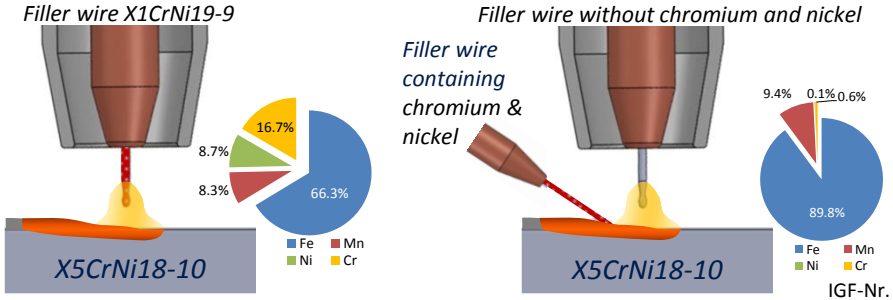
1. Development of low-emission processes and materials

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



according to Burt & Rose: S&S 4/2015

- Hazardous fume components can be reduced to almost zero.



IGF-Nr. 18.179 B

⇒ 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.**

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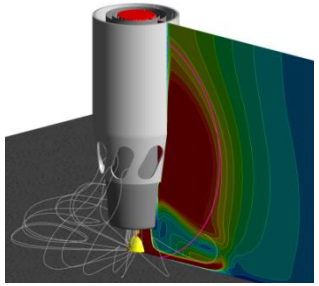
2. Development of extraction systems

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

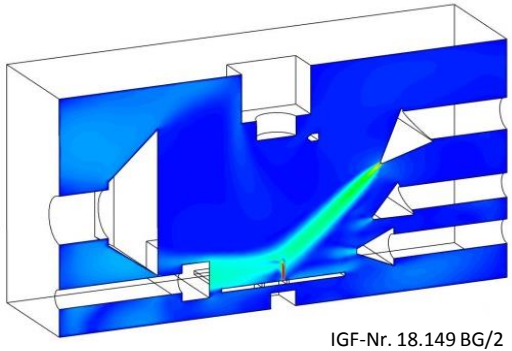




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- Modern process cabins are currently designed specifically for applications, e. g. for laser remote cutting.
- Special equipment is needed for certain applications, e.g. when using nanoparticles.



IGF-Nr. 18.149 BG/2

⇒ Many users, esp. SMEs, are often overstrained by current demands and different approaches of extraction.

⇒ **Projects are needed to design effective und efficient extraction systems for aerosols, gases and nanoparticles.**

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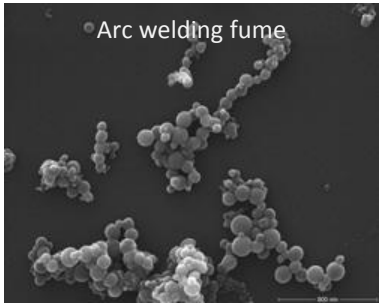
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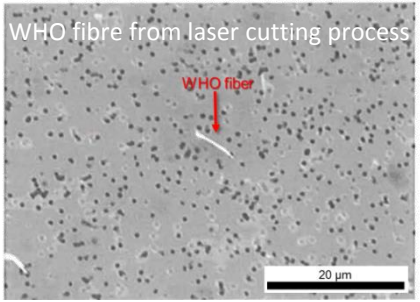
Approaches to fulfill demands in OHS

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.



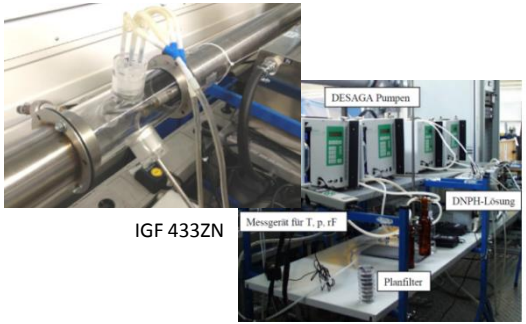
Plitzko, BauA



BMBF ELite (02PJ2090-2095)

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


Weiß, BGHM



IGF 433ZN

⇒ 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.**

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Summary

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.**

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Thank you for your kind attention!

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