

Task-based occupational exposure assessment and particle number concentration:

*Two important data resources to perform risk
assessment for occupational exposure to
particles*

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BACKGROUND



- ✓ Environment monitoring has an important role in occupational exposure assessment.
- ✓ Due to several factors is done with insufficient frequency and normally don't give the necessary information to choose the most adequate measures to avoid exposure.
- ✓ Identifying all the tasks developed in each workplace and conducting a task-based exposure assessment help to refine the exposure characterization and reduce assessment errors.
- ✓ A task-based assessment can provide a better evaluation of exposure variability, instead of assessing personal exposures using continuous 8-hour time weighted average measurements.

Wijnand and Bakke, 1999

Bello et al. 2010; Ham et al., 2012

BACKGROUND

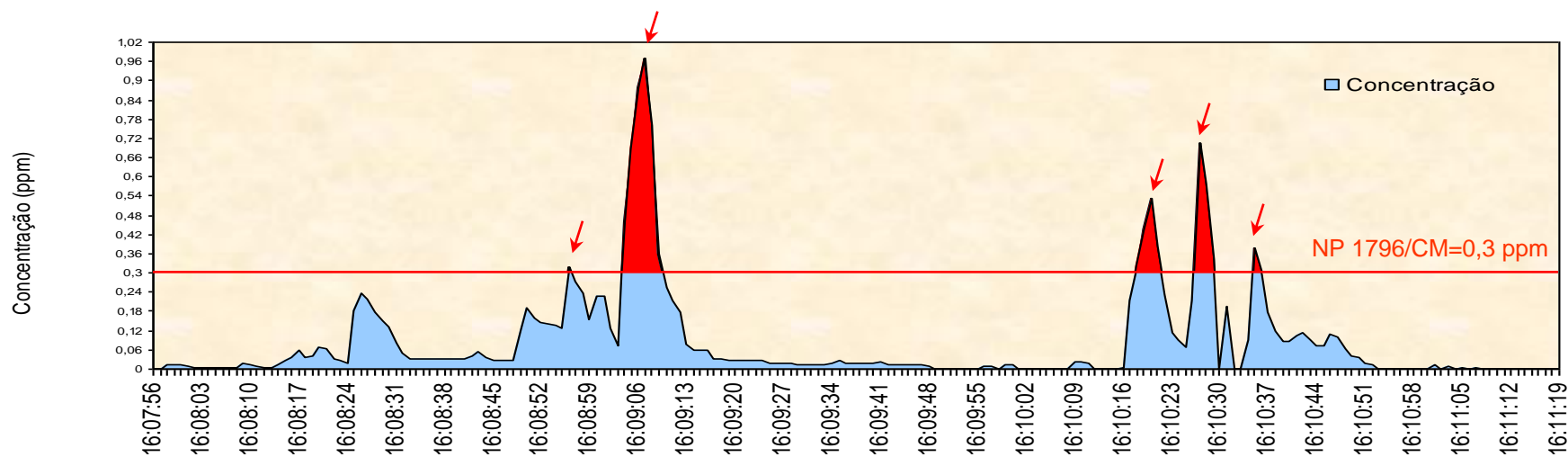
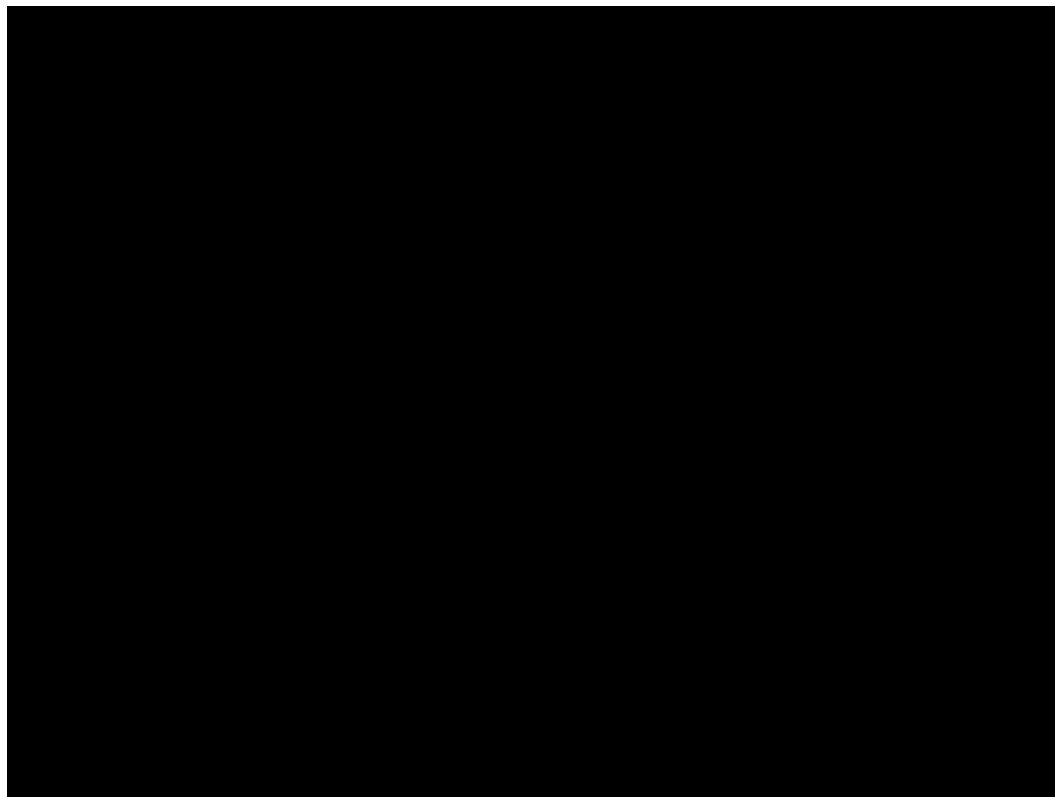
Direct-reading instruments

Using direct-reading instruments to perform task-based exposure assessment allow:

- ✓ To identify more easily tasks that may present a hazard.
- ✓ To determine which tasks to focus traditional sampling and desired control measures.

Verma et al., 2003; Viegas et al., 2010







BACKGROUND

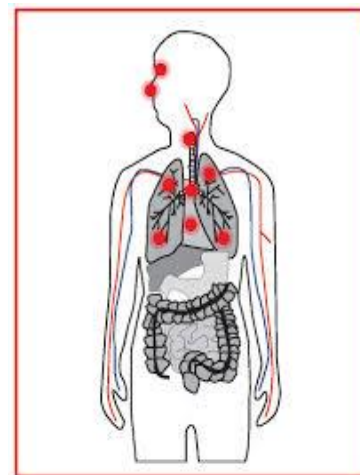
Particles and Health Effects

Health effects related with exposure to particles have mainly been investigated with mass-measuring instruments or gravimetric analysis.



There are some studies that support that size distribution and particle number concentration (PNC) may have advantages over only particle mass concentration (PMC) for assessing the health effects of particles.

Wichmann et al., 2000; Weijers et al., 2004



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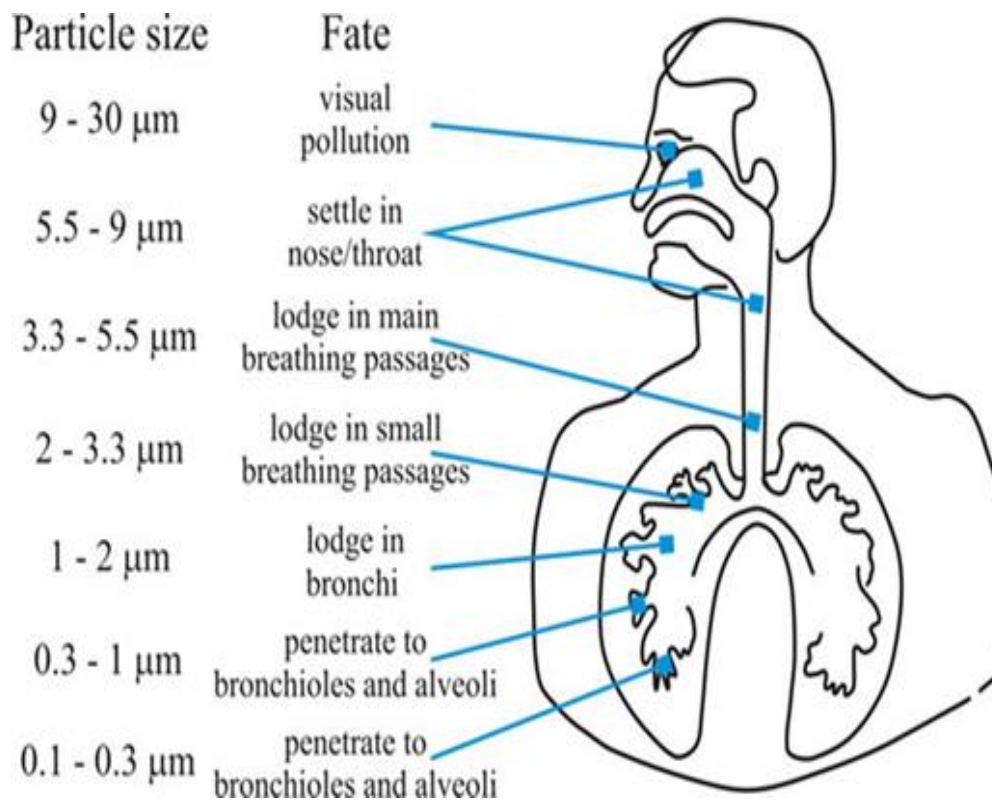


BACKGROUND

Particles and Health Effects



PNC can be an alternative metric that give more accurate information regarding the amount of particles that can reach and deposited onto the walls of the respiratory tract.



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STUDY DEVELOPED

Main Objectives

- ✓ Demonstrate the importance of task-based exposure assessment in occupational health interventions;
- ✓ Recognize the utility of the use of two different exposure metrics simultaneously: PMC and PNC.

Occupational Settings Studied

- ✓ Bakery
- ✓ Horsemanship
- ✓ Waste sorting
- ✓ Cork industry



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Materials and Methods



- ✓ Before starting the measurements, a flowchart for each setting was done to describe the production process, the different workplaces and the respective tasks developed in each one.



- ✓ The selection of tasks to evaluate in each workplace was based on:
 - visual observations of work practices on a task-by-task basis
 - in the time spend by workers in each task
 - in professional judgment (task that probably involves higher exposure)



- ✓ After detail visual observation of each task was decide to study 21 different tasks in all the occupational settings.
- ✓ It was used always the same methodology and measurements were done between the years of 2012 and 2014.



STUDY DEVELOPED - Assessed tasks in each setting LONDON 2015

Setting	Workplace	Task
Bakery	Galley	No activity – Preparing of raw materials
	Galley	Bakery dough mixer working
	Galley	Removing dough from the mixer and weight
	Galley	Cut the dough and put on trays
	Galley	Cleaning process
Horsemanship	Closed boxes	Changing litter and cleaning
	Closed boxes	Horse brushing
	Round pen	Training horses
	Uncovered arena	Training horses
	Covered arena	Training horses
Waste	Waste sorting bag	Waste sorting bag
	Discharge	Waste discharge
	Sorting	Sorting
Cork Industry	Baking	Cork baking
	Selection	Cork selection
	Cutting	Production of cork discs
	Rectification	Rectification
	Selection	Automatic selection
	Crushing	Crushing near the reception
	Crushing	Gridding mills



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Particulate Matter Assessment

Direct-reading equipment that measured:

- **Mass: 5 different sizes**

PM0.5; PM1.0; PM2.5; PM5.0; PM10.

- **Particle Number Concentration (PNC): 6 diameter sizes**

0.3 μm ; 0.5 μm ; 1 μm ; 2.5 μm ; 5 μm ; 10 μm .

This data was also collected because might be more closely correlated with particles health effects .

Wichmann et al., 2000; Weijers et al., 2004

Other authors recommend the simultaneous measure of these two exposure metrics to ensure adequate risk assessment.

Tuch et al., 1997; Heitbrink et al., 2009

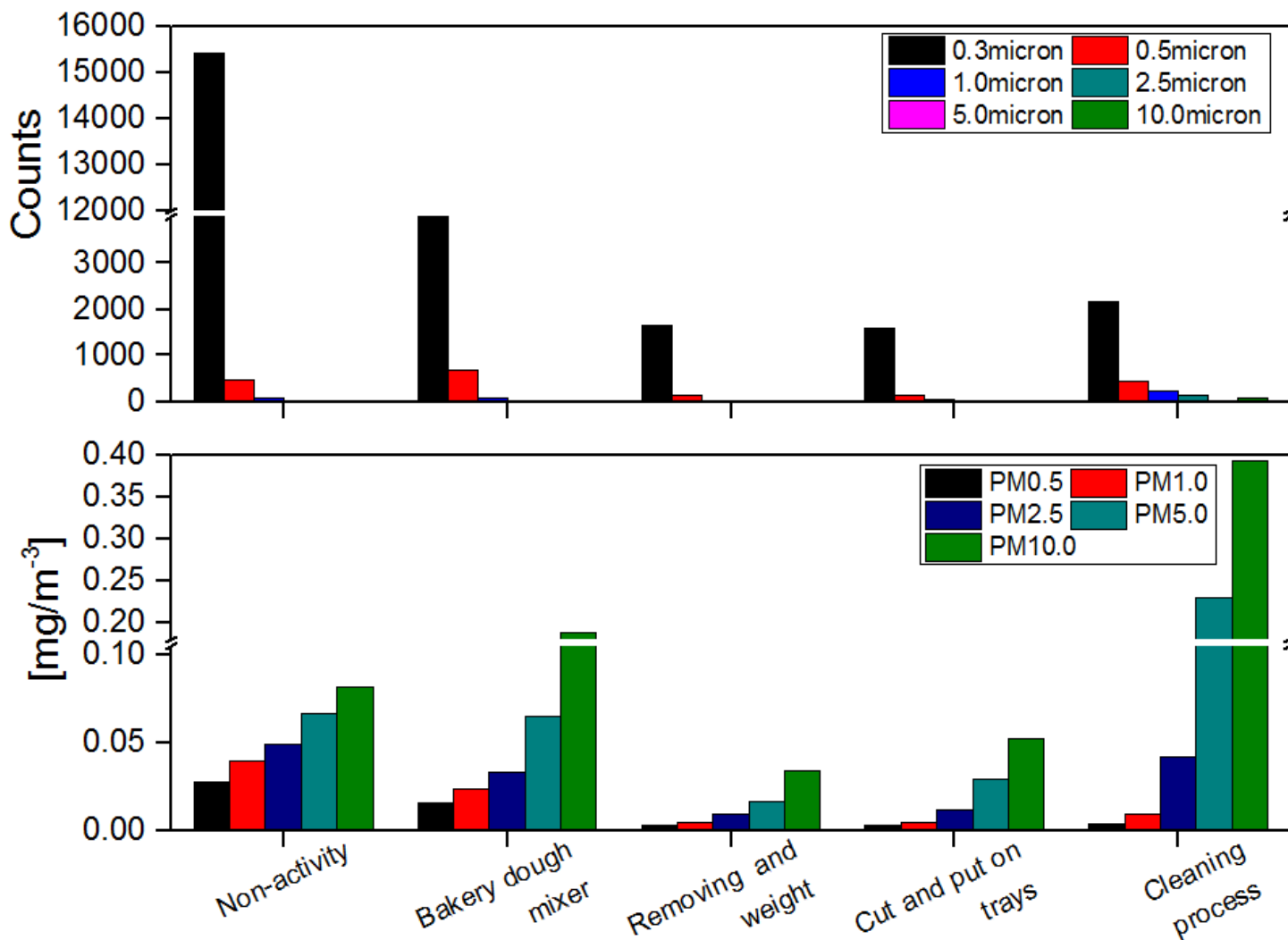




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Bakery results

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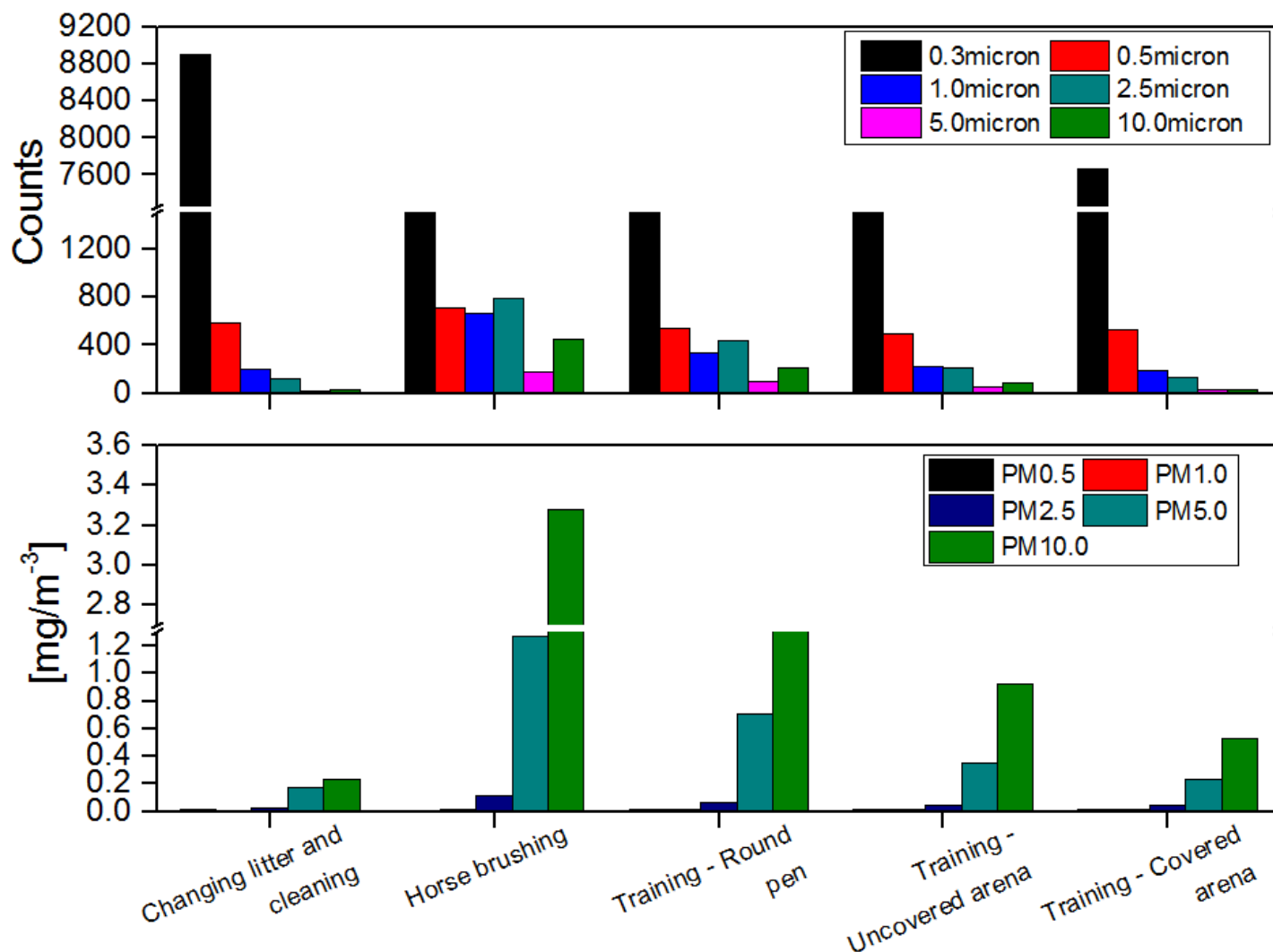




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Horsemanship results

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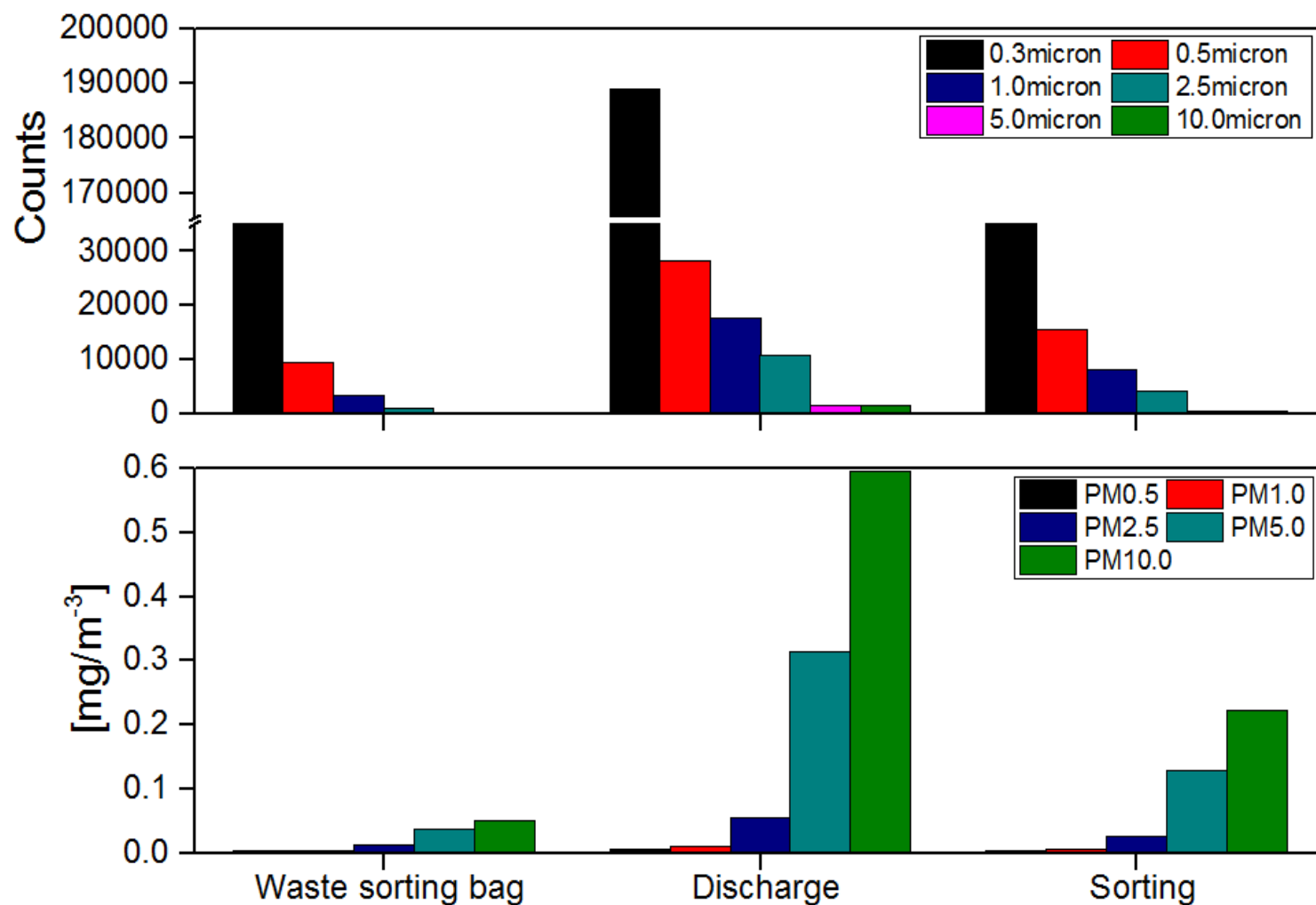




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Waste Sorting results

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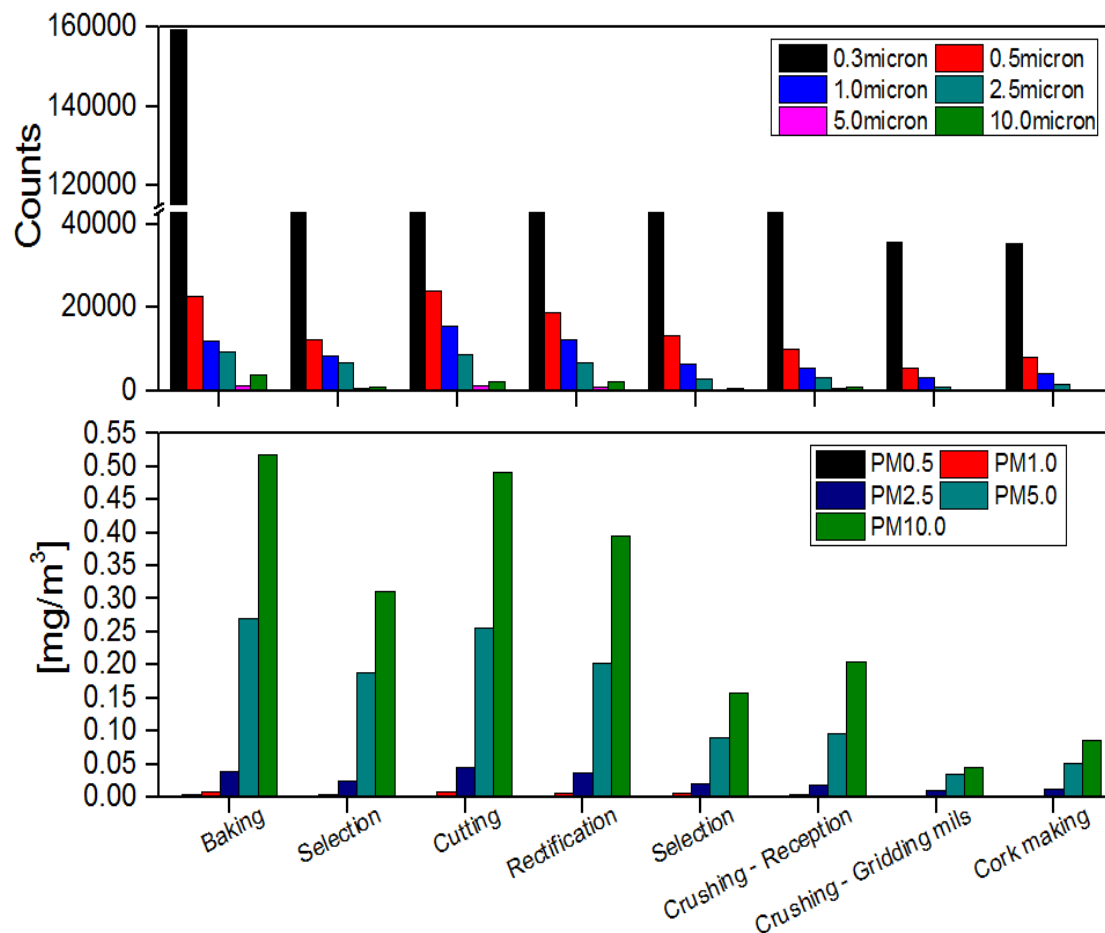


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Cork industry results

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Results discussion

- ✓ Results showed that some tasks influence significantly total exposure to particles. The same type of findings was obtained in recent published work developed in other settings.

Basinas et al., 2013; Thilsing et al., 2014

This was possible to observe due to task-based assessment.

Table 1 - Task with higher exposure in each setting

Settings	PMC (mg/m ³) PM10	PNC (counts) 0.3µm
Bakery	Cleaning process	Preparing of raw materials
Horsemanship	Horse brushing	Changing litter and cleaning the box
Waste sorting	Discharge	Discharge
Cork Industry	Baking	Baking



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Results discussion



- ✓ Probably preventive interventions on the tasks identified with higher exposure can have substantial impact on workers total exposure.
- ✓ In two of the settings there is a strong positive linear relation between the two exposure metrics (PMC and PNC).



Similar findings were obtain previously.

Tuch et al., 1997; Morawska et al., 1999





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Results discussion



- ✓ It seems of extreme importance the use of the two exposure metrics because gives more complete and accurate data to perform risk assessment.

Tuch et al., 1997; Heitbrink et al., 2009



- ✓ Knowing when and where the exposure to smaller particles occurs with higher intensity gives information regarding where the exposure can have more dramatic health effects because these particles can reach deeper in the respiratory system: besides local effects also systemic effects can be expected.

Nygaard et al., 2004





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Results discussion

Besides PMC and PNC there are other aspects that must be consider:

- ✓ the chemical proprieties
- ✓ the fact that particles may act as a carrier and a source of nutrients for fungi and bacteria

In **Horsemanship** and in the **Cork** and **Waste** industries it was well documented the significant fungal contamination present and probably particles presence can promote the contact with these microorganisms through the respiratory tract .

Viegas et al., 2014;Viegas et al., 2015 in press



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Results discussion

Particles can also be rich in endotoxins and mycotoxins.

Zock et al., 1995; Mayeux et al., 1997; Allermann et al., 2000; Viegas et al., 2013

In the **Waste** management industry considered it was found occupational exposure to aflatoxin B1 and probably particles presence is also promoting exposure to this chemical agent.

Viegas et al., 2014

Ann. Occup. Hyg., 2014, 1–9
doi:10.1093/annhyg/meu082

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Assessment of Workers' Exposure to Aflatoxin B1 in a Portuguese Waste Industry

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Elisabete Carolino¹ and Carla Viegas¹



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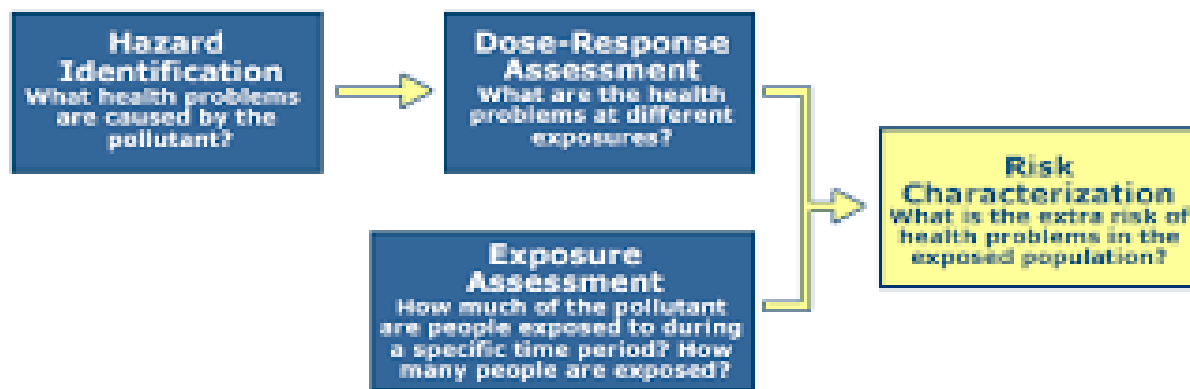


STUDY DEVELOPED

Results discussion

- ✓ Several contaminants can adhere to particles - exposure to mixtures and possible additive and synergistic health effects.
Von Essen et al., 1999
- ✓ These aspects are not considered for the exposure limits definition and can result in high risk even when exposure to particles is below the limits defined for occupational exposures.

The 4 Step Risk Assessment Process





MAIN CONCLUSIONS



- ✓ The settings studied are recognized as responsible for respiratory health effects and exposure to particles is probably the main cause.
- ✓ Is recommended a complete exposure characterization to identify the best and more usefulness preventive measures for each situation.
- ✓ The tools applied to perform exposure assessment can be a good way to:
 - define the tasks with highest priority for additional measurements
 - better understanding when and why workers have high exposures
 - allow designing efficient control strategies focusing on specific tasks.



REFERENCES

- ✓ Bello, A., Quinn, M.M., Perry, M.J., Milton, D.K. (2010). Quantitative assessment of airborne exposures generated during common cleaning tasks: a pilot study. *Environmental Health*, 9:76. <http://www.ehjournal.net/content/9/1/76>
- ✓ Ham, S., Yoon, C., Lee, E., Lee, K., Park, D., Kim, E.C.P., Lee, B. (2012) .Task-based exposure assessment of nanoparticles in the workplace. *Journal of Nanoparticle Research*, 14:1126. DOI 10.1007/s11051-012-1126-8
- ✓ Tuch, T., Brand, P., Wichmann, H.E., Heyder, J. (1997). Variation of particle number and mass concentration in various size ranges of ambient aerosols in Eastern Germany. *Atmospheric Environment*, 31, 4193–4197.
- ✓ Viegas, C., Carolino, E., Malta-Vacas, J., Sabino, R., Viegas, S., Veríssimo, C. (2012). Fungal contamination of poultry litter: a public health problem. *Journal of Toxicology and Environmental Health, Part A*, 75: 1341–1350. <http://www.tandfonline.com/doi/abs/10.1080/15287394.2012.721165>.
- ✓ Viegas, C., dos Santos, M., Meneses, M., Faria, T., (2014a). Exposure to fungi in cork industry – case study. *Proceedings from International Congress on Environmental Health 2014*.
- ✓ Viegas, S., Ladeira, C., Nunes, C., Malta-Vacas, J., Gomes, M., Brito, M., Mendonça, P., Prista, J. (2010). Genotoxic effects in occupational exposure to formaldehyde: A study in anatomy and pathology laboratories and formaldehyde-resins production. *Journal of Occupational Medicine and Toxicology*, 5: 25 <http://www.occup-med.com/content/5/1/25>
- ✓ Weijers, E.P., Khlystov, A.Y., Kos, G.P.A., Erisman, J.W. (2004). Variability of particulate matter concentrations along roads and motorways determined by a moving measurement unit. *Atmospheric Environment*, 38: 2993–3002.
- ✓ Wijnand, E., Bakke, B. (1999). Experiences with task-based exposure assessment in studies of farmers and tunnel workers. *Norsk Epidemiologi*, 9 (1): 65-70 65.

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