Workplace Measurements and Studies of Physiological Responses of Welding Fume Exposure

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40) Workplace measurements and studies of physiological responses of welding fume exposure.

C. Isaxon[1], I. Hagerman[4], U.B.K. Andersson[2], E. Assarsson[2], M. Berglund[4], K. Broberg[2], A. Dahl[1], K. Dierschke[2], A. Gudmundsson[1],J.E. Karlsson[2], M.H. Kristiansson[2], B.A,G. Jönsson[2], L.S. Jönsson[2], J. Pagels[1], E. Swietlicki[3], H. Tinnerberg[2], A. Wierzbicka[1], J. Nielsen[2], M. Bohgard[1]

[1]*Division of Ergonomics and Aerosol Technology, Lund University, Sweden*
[2]*Division of Occupational and Environmental Medicine, Lund University, Sweden*
[3]*Division of Nuclear Physics, Lund University, Sweden*
[4]*Department of Cardiology, Karolinska University Hospital, Huddinge, Sweden*

Nano sized particles, often enriched in health relevant species, for example metals, occur at high concentrations in many industrial work places. Important sources are thermal processes as welding, which is associated with for example an increased prevalence of bronchitis and other respiratory illnesses.

Three different industrial welding work shops were examined in detail using a wide range of aerosol characterization techniques. At each workshop samples were taken both of the background and of the plume. From the in-plume measurements the signature of welding fume was determined and by using detailed notes of activities the signature size distributions of other processes were identified from the background measurements.

MAG welding fume with the same characteristics as in the workshops was generated and supplied to a 21.6 m^3 exposure chamber. The aerosol flow was diluted with clean air prior to entering the exposure chamber. A series of chamber exposure experiments were conducted, where thirty healthy male test subjects, normally working in mechanical workshops, were exposed to welding fume in the chamber for six hours. Concentrations were in the range of what was found in the real environments. Particle sizes ranged from a few to several hundreds of nanometers. The exposures were conducted according to a double blind protocol. Prior to the provocations, test subjects underwent a physical examination Medical and work history was registered. Before and after exposure, samples were taken for analysis of biological markers (oxidative stress and inflammation). Lung function and nasal patency were measured by spirometry and acoustic rhinometry. Several ten minute series of ECG were regularly registered during the exposure event. Effects on cardiac autonomic control were studied by heart rate variability spectral analysis

Welding fume induced a significant change of the variability in low frequency (LF) spectral band ($p<0,05$) while no effects were seen in the high frequency (HF) spectral band. The opposite phenomena was seen during clean air, with a significant change of the variability in the HF spectral band ($p<0,001$). Exposure to nano-sized particles from welding fume seem to have an impact on heart rate variability, mediated by different aspects of autonomic cardiovascular control.

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