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Characterization of Welding Aerosols at the PIXE-laboratory in Lund

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Characterization of welding aerosols are of major importance to be able to 1) obtain adequate hygienic standards, 2) develop good monitoring routines, 3) develop good elimination techniques and 4) take work environment into consideration in the development of new materials and new welding techniques.

The degree of health hazard that can be expected when inhaling welding fume is depending of the particle concentration, the particle size distribution and the chemical composition of the particles. PIXE - Particle Induced X-ray Emission - analysis offers a unique opportunity to perform an extensive study of the elemental composition of different size fractions of welding aerosols. In Lund such a study is performed with support from the Swedish Fund for Work Environment.

For several welding operations at different welding conditions (current, voltage) the generated aerosols have been sampled with a modified single-orifice, one litre per minute, Battelle impactor. The size-fractioned samples thus obtained have masses well below 100 µg. They have been analyzed with PIXE on a routine base (less than 4 minutes/sample), giving quantitative results for all elements heavier than potassium with mass detection limits in the order of 1 ng.

Fluorine, which is an element too light for PIXE, is found in high concentrations in the fume from some welding processes and then it is an important element in health hazard assessments. Fluorine is analyzed simultaneously with the PIXE-analysis by detecting the γ-rays from the $^{19}F(p,\alpha\gamma)\,^{16}O$-reaction. The detection limit is in the present arrangement about 50 ng.

The fume from stainless steel welding often contains a high chromium concentration. The health effects of airborne chromium are depending on the oxidation state of the chromium and the solubility of the chromium compounds. Today there is no satisfactory method giving this information, but we have developed a procedure, including PIXE, ESCA and TEM, which under certain conditions gives information about oxidation state and solubility.