Use of local ventilation in welding and solvent washing operations

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ABSTRACT

A local ventilation unit has been developed and tested by laboratory experiments in welding and solvent washing operations.

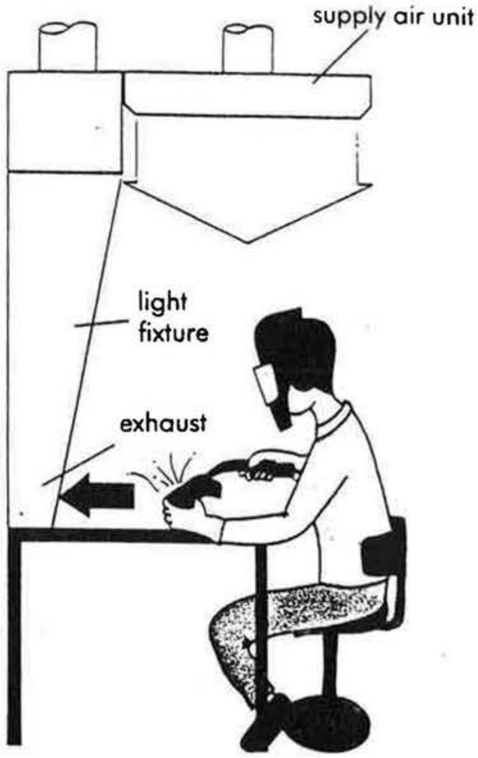
INTRODUCTION

Local ventilation is needed for extracting impurities, e.g. welding fumes and solvents, that are released into the immediate working area. A local ventilation unit, which is easy to install to different types of workplaces, has been developed in order to meet the requirements made on industrial working places.

The local ventilation unit (Fig. 1) incorporates a supply air unit which provides protection air with low velocity. This supply air is directed to the exhaust through the operator's breathing zone. The distribution of supply air can be changed by adjusting baffles inside the plenum box. The air is exhausted through a horizontal slot in front of the worker. The local ventilation unit includes built-in lighting to illuminate the working area.

The function of the unit was evaluated in the controlled laboratory conditions where welding and solvent washing were completed.

Fig. 1. Local ventilation unit system



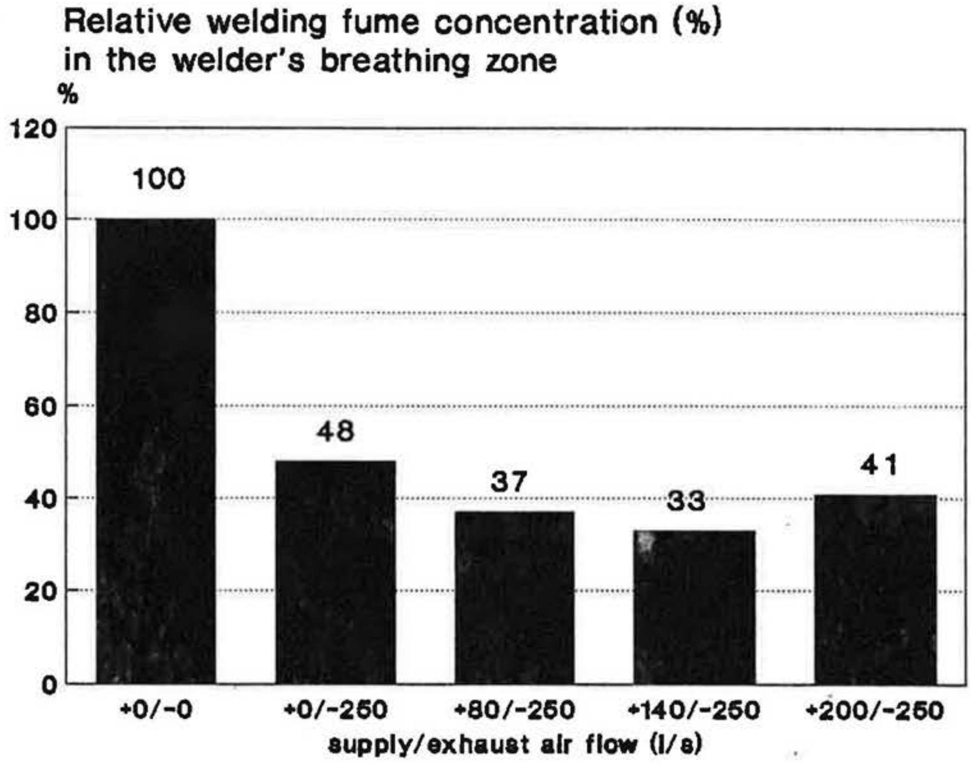
WELDING

The local ventilation unit was installed in the middle of the laboratory hall with a volume of 900 m^3 and with general ventilation flow rates of 500 l/s. The tests were carried out at four supply air flows of the local ventilation unit: 0, 80, 140 and 200 l/s respectively. The exhaust flow rate was constant, 250 l/s. The temperature of the supply air was 0,4 C lower than the room temperature. The MIG-welding process with 0,8 mm welding wire and water-cooled material lasted in each test about 20 minutes.

Our results by the filter method showed that fume emission was quite low. Without local ventilation unit the exposure of the sitting welder was low, 0,54 mg/m^3, and with the local ventilation unit all exposures were below 0,2 mg/m^3. According to our measurements 50-70 % reduction in the welding fume exposure was observed by the use of the local ventilation unit.

The influence of the exhaust flow was already so effective that 11-15 % extra reduction was attained by introducing the supply air flow rates of 80 and 140 l/s (Fig. 2). By the inlet air flow rate of 200 l/s the extra reduction was lower, 7 %.

Fig. 2. Relative welding fume concentration in the welder's breathing zone in relation to the supply and exhaust air flow rates



SOLVENT WASHING

The performance of the local ventilation unit for solvent control was evaluated by a washing container (400 mm x 600 mm x 300 mm) filled with White Spirit at temperatures 20, 30 and 40 C. The exposure to solvent was measured continuously by four point measurement system consisting IR-analyzer. The locations of the four measuring points were the breathing zone of the sitting and standing worker, the exhaust duct of the local ventilation unit, the ambient air and the supply air duct of the local ventilation unit. The amount of the supply air at the breathing zone of the sitting and standing worker was measured by tracer gas techniques.

The tests were carried out at two supply air flows of the local ventilation unit: 0 and 130 l/s respectively. The exhaust flow rate was constant, 240 l/s. The temperature of the supply air was 0,7 C higher than the room temperature.

In the best case (solvent temperature 21-22 C, supply air flow rate 130 l/s) the reduction of 90 % in the exposure of the standing worker was achieved by using the local ventilation unit (Fig. 3). The amount of supply air in the breathing zone was then 67 % (Fig. 4). The increase of solvent temperature by 10-20 C lowered the reduction to 30-60 %.

The reduction of 30 % in the exposure of the sitting worker was measured by the use of the local ventilation unit. The amount of the supply air in the breathing zone of the worker was then 32 %.

Fig.3. Relative solvent concentration in the worker's breathing zone in relation to the supply and exhaust air flow rates

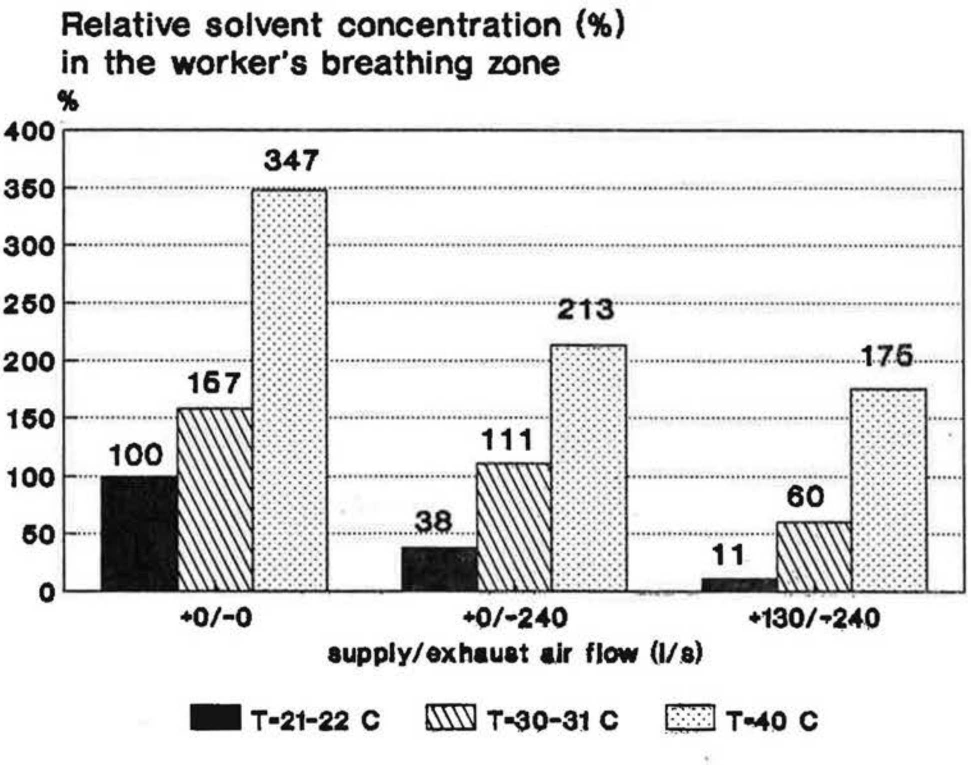
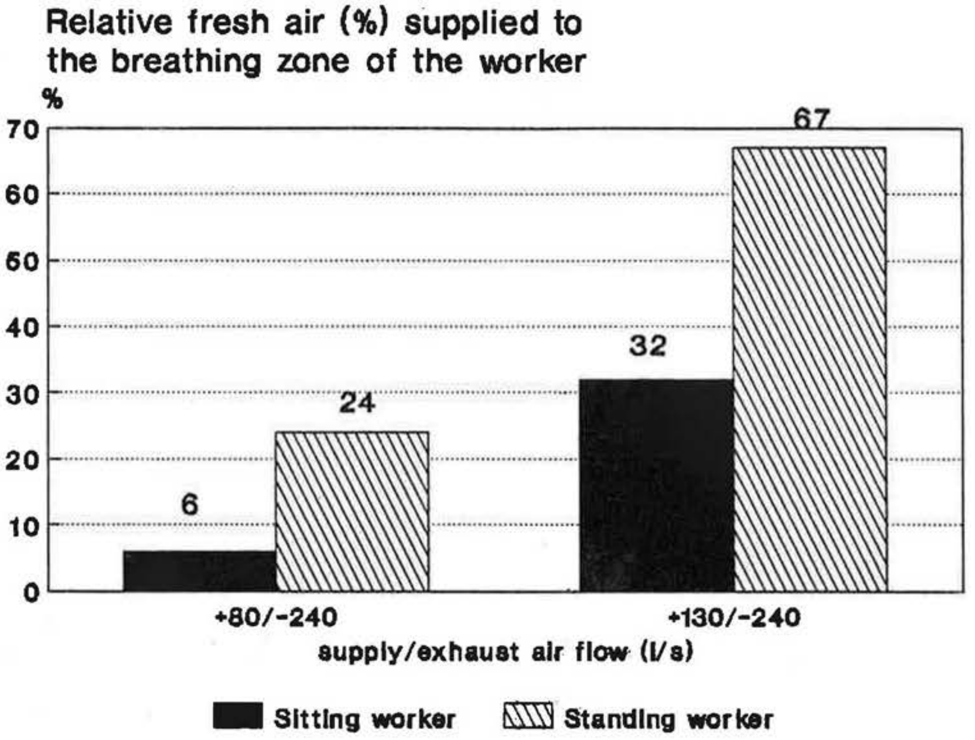


Fig. 4. Relative fresh air supplied to the breathing zone of the worker



DISCUSSION

Our results indicate that the capture ability is strongly dependent on the amount of the supply air in the breathing zone and the distance between the source and the breathing zone as well as the convection properties of the source. Reductions of 90 % in solvent exposures of the standing worker were achieved by using the local ventilation unit. The reduction was somewhat lower in the case of sitting worker and with a convection source.