Pergamon

J. Aerosol Sci. Vol. 30, Suppl. 1, pp. S893–S894, 1999

Printed in Great Britain
0021-8502/99/$ - see front matter

Good article on the new inhalable fraction
How CIP-10 samples this fraction

INHALABLE AEROSOL SELECTOR FOR THE CIP 10 PERSONAL AEROSOL SAMPLER

P. Görner, R. Wrobel, F. Roger, J.-F. Fabriès

INRS – Institut National de Recherche et de Sécurité,
Laboratoire de Métrologie de la Pollution par les Aérosols,
BP n° 27, 54501 Vandoeuvre les Nancy, France

KEYWORDS

Aerosol sampling, Inhalable fraction, Occupational hygiene.

INTRODUCTION

The CIP-10 personal aerosol sampler based on the rotating filter cup was designed by Courbon et al. (1988) and is widely used in coal mining and occupational hygiene for the assessment of the individual exposure of workers to respirable dust. A selector for the thoracic aerosol fraction was later designed to satisfy the need of thoracic dust sampling in cotton and textile industry (Görner et al. 1994). Its nominal flow rate is 7 $l.min^{-1}$. In the static version (Kauffer et al. 1996, Fabriès et al. 1998), the device is used for the measurement of the airborne concentration of asbestos and other fibres.

Recently, a selector of the inhalable aerosol fraction was designed and tested.

METHOD

The inhalable selector of the CIP-10 aerosol sampler was designed on the basis of the original respirable selector housing. The first prototype (Fig. 1a) was tested as a personal sampler (Kenny 1995) against the conventional particle-size selective sampling criteria (CEN 1993, ACGIH 1994-1995, ISO 1995). The experimental sampling efficiency was found to be lower than the conventional efficiency for the inhalable aerosol fraction. The solution to improve the global sampling efficiency was either to increase the aspiration efficiency of the annular inlet or to eliminate the particle inner losses in the selector. The experimental measurement of the sampling slot entry efficiency was carried out in a horizontal wind tunnel at the wind speed of 1 $m.s^{-1}$ using the method described by Witschger et al. (1997). The measurements showed a fair particle aspiration up to about 60 μm in particle aerodynamic diameter (Görner et al. 1996). A study of the inner wall losses led to discover an important inertial particle deposit under the selector protecting cap. The second prototype with a modified inner air circuit (Fig. 1b) still exhibited an unsatisfactory transmission efficiency. In this case the particle deposit was mainly observed in the conical tubing probably due to the turbulent flow. The third prototype uses a two horizontal plate annular aspiration slot with a vertical cylindrical tubing (Fig. 1c). This geometrical configuration was studied earlier by Witschger et al. (1997) and Roger et al. (1998) but not in connection with the CIP 10 sampler. The nominal flow rate of the inhalable selector is 10 $l.min^{-1}$ and is identical to that used for the respirable aerosol fraction.

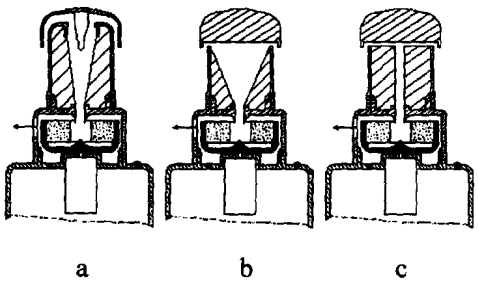

Fig. 1 Prototypes a, b, c of the inhalable aerosol selector for the CIP 10 personal aerosol sampler

RESULTS

Due to the radial acceleration of the flow rate in the annular slot and the cylindrical downwards oriented tubing (Fig. 1c), the inner particle deposit was minimised in the third prototype. The particle size-dependent transmission efficiency is close to 1 and clearly higher than that of two previous prototypes (Fig. 2). The overall sampling efficiency of the isolated sampler (without any manikin) was measured for the external wind speeds W = 1 and 3 $m.s^{-1}$ in the horizontal wind tunnel (Witschger et al. 1997), and in calm air conditions in a vertical tunnel (Roger et al. 1998). The results are reported in Fig. 3 along with the CEN-ACGIH-ISO inhalable convention. The vertical bars represent the 95 % confidence intervals of the experimental measurements.

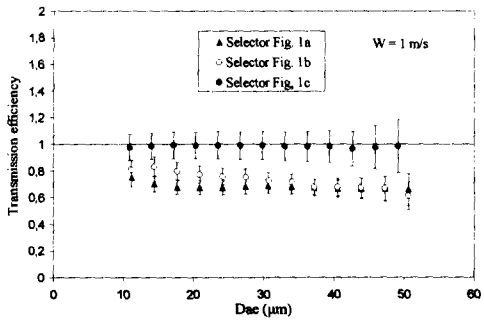

Fig. 2 Size dependent transmission efficiency of the inhalable selector prototypes (Fig. 1 a,b,c)

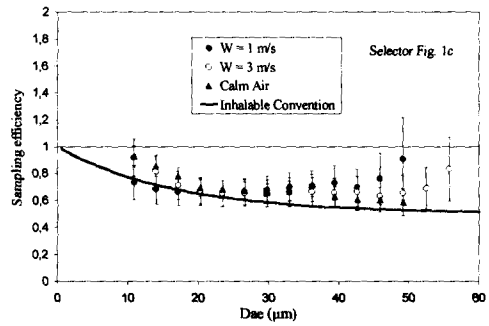

Fig. 3 Overall sampling efficiency of the CIP 10-I inhalable aerosol sampler

CONCLUSION

The CIP 10-I (Inhalable) aerosol sampler used as a static sampler exhibit a particle-size dependent sampling efficiency close to the conventional inhalable curve. The sampling efficiency does not seem to depend on the external wind speed from 0 to 3 $m.s^{-1}$. The behaviour of the CIP 10-I used as a personal sampler (attached to a manikin torso) is under study.

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