Atmospheric Environment, Vol. 14, pp. 1449–1450.

0004-6981/80/1201-1449 $02.00/0

SHORT COMMUNICATION

A STUDY OF THE SUSPENDED PARTICULATES IN THE ATMOSPHERE, IN THE UNIVERSITY CAMPUS IN MADRID, DURING THE PERIOD 1977–1978

(*First received* 31 *May* 1979 *and in final form* 6 *March* 1980)

Abstract – The evolution and the distribution of the concentrations of the total suspended particulate matter in the University Campus, Madrid, has been followed during the years 1977–1978. The results were compared with others realized by different methods, giving similar results in this area of low pollution.

This paper reports on a study of the concentrations of the total suspended particulate matter in the air at the University Campus in Madrid.

Taking account of the results of the monitoring determinations of "soot concentration" carried out for several years at this point by the Laboratory of Environmental Health (School of Public Health), W.H.O. (1976, 1978), this sampling point can be labelled as an area of low pollution.

Considering that using smoke shade method for these determinations it was not possible to determine the total mass of suspended matter in the atmosphere, but only the carbonaceous content, determinations were carried out in the same place by a high volume sampler, the location considered to be a "residential area". Situated on the outskirts of Madrid, in the northern part of the town, where the buildings of the University are surrounded by lawn, trees and gardens. There, the air pollution sources of the city are distant. Local sources comprise exhaust fumes of cars, and heaters in a limited number of buildings.

In the study, samples were collected on the roof of the building of the School of Public Health, 18 m above ground level, avoiding the dust loading of the surface by air turbulences, and the relatively large particles collected at low levels.

The technical conditions of the apparatus were previously described (de la Serna and Blond (1975)). The average flow rate of the sampler was $40\,m^3\,h^{-1}$, measured by a gas-counter. Particles are collected on a glass-fiber filter of about 15 cm diameter. Results are reported gravimetrically. Previously, the filters were kept in a chamber, at room temperature and at less than 50% humidity.

The period of study lasted two years (1977–1978), giving a total of 206 samples, 110 in 1977 and 96 in 1978.

The standardization test and the statistical study of the measure of the mass concentration realized by the sampler, has also been published (de la Serna and Perez Carles (1977)). Among the conditions of measurement, the minimum concentration appreciated by the method is $1\,\mu g\,m^{-3}$ of air, for a 22 h sampling period, similar to the standards required for other high volume samplers (McKee *et al.*, 1971).

The concentrations of particulate matter, expressed in $\mu g\,m^{-3}$ were distributed into units representing intervals of $10\,\mu g\,m^{-3}$, as they are shown in Fig. 1, in histograms of frequencies.

The low concentrations obtained are illustrated in Fig. 1, the shape of the distribution appears to be log-normal. To verify this supposition, theoretical points were plotted on the histograms (Fig. 1).

At the same time, percentages of cumulative frequencies (y) and concentration intervals (x) were plotted on a log-Gaussian paper, giving a straight line, in agreement with this distribution Calot (1974) (see Fig. 2).

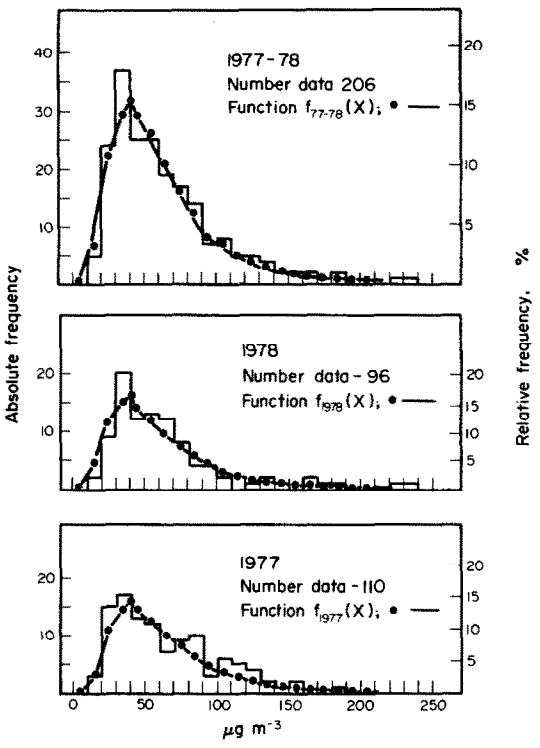

Fig. 1. Distribution of concentrations of particulate matter.

A statistical study was carried out, assuming the distribution was log-normal, to obtain the functions "distribution" and "density", which best fitted the experimental data [Calot, (1974)]. The experimental results give as characteristic parameters of the distribution:

for the two-year period	$m = 4.001$ and $\sigma = 0.56$,
for 1977	$m = 4.008$ and $\sigma = 0.58$,
for 1978	$m = 3.980$ and $\sigma = 0.60$,

where "m" is the average value of the logarithm (ln) of the concentrations, and "σ" its standard deviation.

These functions (density functions) are plotted on typical histograms in Fig. 1, and show good agreement with the experimental values.

The "distribution function" gives the probability of finding a concentration smaller than any given value (Fig. 2).

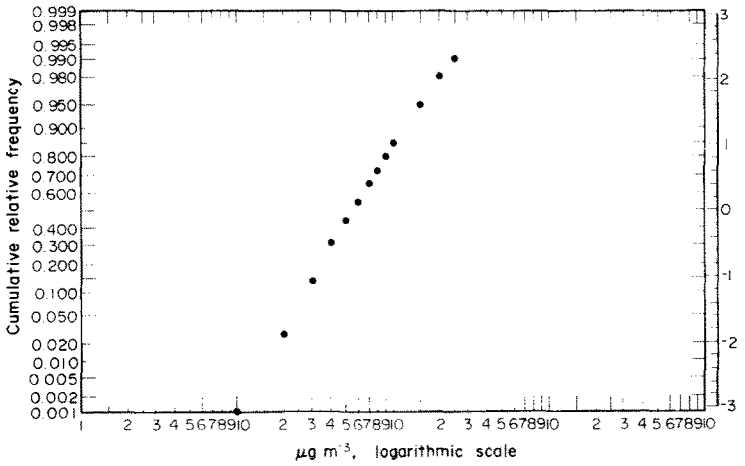

Fig. 2. Distribution of cumulative frequencies of SPM.

DISCUSSION

This study shows that the distribution of the concentrations of particulate matter in the atmosphere, taken, is log-normal.

The maximum point for the "density" function is nearly 40 $\mu g\,m^{-3}$. This point agrees with the results of four-year determinations of "soot concentration" at the same sampling point, published in the W.H.O. papers previously mentioned (W.H.O., 1976, 1978), whose geometric means are: 34.4 (for 1973); 37.5 (for 1974); 42.4 (for 1975); 40.8 (for 1976), also, it agrees with the most recent results published by the W.H.O. (1980) for 1975–1977. Both sets of data show that, during the years 1973–1977, mean values of "soot concentration" determined by the smoke shade method are very similar to the total suspended particulate matter values of this study, determined by the gravimetric method, using the Hi-Vol sampler. For this reason, at this location with low pollution, both methods, although theoretically different, show agreement of experimental results.

It is worth mentioning that the agreement found in this study is very similar to the one found in other work carried out on 1976–1977 in this laboratory to correlate both methods Carlex *et al.* (1978). In this study, the calculated regression coefficient to transform "soot concentration" into gravimetric values was 1.28 for the whole period of study, confirming that the methods give similar results.

The distribution functions show that during the two-year period studied no changes occurred in the levels of concentrations, or in the parameters "m" and "σ" that define this function. Also, it can be deduced that there are 90% probabilities to find smaller values than 115 $\mu g\,m^{-3}$; 95% less than 135 $\mu g\,m^{-3}$; and 99% under 205 $\mu g\,m^{-3}$.

No experimental values less than 10 $\mu g\,m^{-3}$ were found.

Within the data for 1978, some values higher than expected (220–240 $\mu g\,m^{-3}$) were found, but this does not affect the distribution significantly.

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