ATMOSPHERIC PARTICULATES IN THE CASTELLÓN LA PLANA AREA. NATURAL AND ANTHROPOGENIC CONTRIBUTION PROCESSES

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INTRODUCTION

The Mediterranean coastal area, with a semi-arid climate, presents serious pollution problems by the total suspended particulates coming from natural and anthropogenic contribution processes. For this reason control of atmospheric pollution in the area is important. The key parameters for discerning between the different types of contribution processes are the size and composition of the atmospheric particulates. These two characteristics, which are the object of the present study, were evaluated jointly by a cascade sampling impactor.

METHODOLOGY

Samples of suspended particulates were collected with a Retsch cascade impactor. This apparatus, made up of eight impacting rings and programmed at a flow rate of 2.4 m^3/h, allows obtaining samples fractionated in seven particle-size ranges from 0.5 μm to 32 μm.

Samples were collected from July 1999 to November 2001 at five fixed sampling points. Three of these sampling stations (A: Alcora, B: Onda and C: Vila-real) were located in towns close to the industrial ceramic area, one station (D: Grao de Castellón) was located on the coast and other (E: Ludiente) in a mountain area approximately 35 km from the industrial ceramic nucleus, 500 meters above sea level.

The characterisation of the concentration levels according to the different particle-size ranges was done by gravimetry at controlled temperature and humidity of each of the impacting rings.

Based on the mineralogical characterisation, the composition of the suspended particulate was established. The mineralogical analyses were performed by X-ray diffraction (XRD) of crystalline powder.

RESULTS

The concentration values found at the stations located in the ceramic areas were always higher in all the particle-size ranges. Analysis of the data shows similar behaviour for stations, A, B and C. The highest concentration levels at these sampling stations were found during the winter. A drop was observed in the spring months, followed again by a rise in concentration toward the summer time. This same behaviour was already detected by Gómez[1] in studies carried out at the town of Onda.

Station	Sampling period	Number of samples	PST		PM_{10}		$PM_{2.5}$		PM_1	
			x	Range	x	Range	x	Range	x	Range
A	Sep 99									
Alcora	Nov 01	23	63.9	10.6-123.8	55.6	9.0-108.5	27.2	2.9-50.9	13.5	1.2-25.4
B	Jul 99									
Onda	Jul 00	9	86.0	60.1-139.2	68.5	45.1-109.5	31.2	20.2-41.3	17.7	12.1-23.8
C	Sep 00									
Vila-real	Oct 01	14	59.8	22.3-116.0	52.9	21.5-97.8	25.8	14.6-35.6	13.3	8.7-18.5
D	Jul 99									
Grao	May 01	9	46.3	27.8-64.1	38.9	21.2-56.2	18.7	7.8-28.4	11.1	5.2-17.4
E	Aug 99									
Ludiente	Apr 01	7	26.8	13.3-43.0	21.7	10.9-35.0	11.9	4.6-17.0	6.3	2.0-10.0

x: mean value; PST: total suspended particulate; PM_{10}: particulate to 10μm; $PM_{2.5}$: particulate to 2.5μm; PM particulate to 1μm.

Table 1: Concentration levels in $\mu g/m^3$ at the different sampling stations. Source: Own data.

At station D, located on the coast, the values found were lower than at the stations in ceramic areas, but higher than those of interior station E. There is no general tendency in the behaviour of the concentrations at sampling station D, unlike what occurred at the stations close to the industrial ceramic area.

The lowest concentration values were found at interior station E, with a difference of 50-70% in all the particle-size ranges compared to stations A, B and C in winter, while these differences decreased toward summer in the finest particles (<2.5 μm). During April, a month of greater atmospheric instability, the particle levels increased at interior station D in all the particle sizes, while the values found were 30-40% lower than those of the stations located in the industrial ceramic areas.

The data in relative percentages of each particle-size fraction of the suspended particulates indicate the ranges exhibiting the greatest enrichment at each station, independently of their concentration.

	Particle-size fraction in %													
Sampling	**<0.5 μm**		**0.5-1.0 μm**		**1.0-2.0 μm**		**2.0-4.0 μm**		**4.0-8.0 μm**		**8.0-15.0 μm**		**15.0-32.0 μm**	
station	**x**	**Range**	**x**	**Range**	**x**	**Range**	**x**	**Range**	**x**	**Range**	**x**	**Range**	**x**	**Range**
A														
Alcora	10	4-20	9	5-13	14	8-27	19	11-31	19	2-34	14	0-22	16	8-26
B														
Onda	13	9-18	8	6-11	11	7-18	17	15-19	22	9-35	15	9-22	18	13-27
C														
Vila-real	12	6-20	9	5-24	14	7-20	17	8-23	20	8-33	12	5-18	16	6-24
D														
Grao	12	8-20	9	6-12	10	6-16	15	11-19	21	7-33	21	9-30	13	7-18
E														
Ludiente	13	4-22	8	4-10	14	10-22	13	7-20	17	7-24	20	11-42	16	11-23

x: mean value

Table 2: Values in % corresponding to each particle-size fraction. Source: Own data.

The mineralogical analysis of the different particle-size fractions of the particulates showed that the degree of homogeneity in the mineralogical composition of the samples is the key characteristic defining the three studied environments. The identification of the maximum concentration level values and percentage of mineral phases as a function of particle size allow distinguishing between the different natural and anthropogenic contribution processes. The episodes of long distance particulate transport have also been evaluated according to the SKIRON atmospheric model and the measurements carried out of suspended aerosols by the NASA TOMS satellite, as recommended by ECWGPM[2].

CONCLUSIONS

The study of the size distribution and composition of the atmospheric particulates indicate enrichment of some particle-size fractions as a function of sampling point location.

The similarity of the concentration level values and behaviour found at the stations located in towns near the ceramic industrial areas indicate that these are controlled by

processes present in this industrial sector. On the other hand, external factors such as natural contribution processes aggravate the situation relative to the base level studied at the interior station.

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REFERENCES

[1]. E.T. GÓMEZ, T. SANFELIU, J. RIUS, D. HERNÁNDEZ "Caracterización granulométrica y mineralógica de la materia particulada en el área cerámica de Castellón", pp. 179-188 in Boletín de la Sociedad Española de Cerámica y Vidrio, 40(3) 1-10 .2001.

[2]. ECWGPM "Naturals Events", pp. 21-26 in Draft final Report On Guidance to Member States on PM10 Monitoring and Intercomparison with Reference Method. Ed. Martin Willians, Peter Bruckman. January 2001.