SETTLEABLE PARTICULATE MATER IN THE CASTELLÓN CERAMIC CLUSTER

A.B. Vicente, S. Pallarés, E.T. Gómez, A. Soriano, T. Sanfeliu

Unit for Applied and Environmental Mineralogy.
Dept. of Experimental Sciences. Universitat Jaume I - avicente@sg.uji.es

1. INTRODUCTION

A study has been conducted of the concentration levels of air-borne settleable particulate matter, at four towns located in the ceramic cluster of Castellón, three of them (Alcora, Almazora and Vila-real) located near the industrial estates, and one (Castellón) in an urban enclave, during the years 2004 and 2005. These towns display high levels of particle concentrations in the air, partly due to the continuous emission of pollutants produced by the important industrial activity in the area (table 1). The settleable material consists of solid particles in sizes between 10 and 100 μm, with a rapid sedimentation speed and a relatively short dwell time in the atmosphere.

Manufacture of ceramic tiles	Pollutant particle emissions
Preparation of raw materials	Coarse fractions >100 µm, deposited near the emission points, chemical and mineralogical composition similar to that of the material used as raw material.
Drying of suspensions by spray drying	Aggregates of fine fractions <10 µm, forming mechanical suspensions that can be borne long distances by the wind.
Pressing	Aggregates of fine fractions, proceeding from the transfer of the raw material from the silos to the presses, and by the pressing and brushing of the formed piece.
Drying	Aggregate of fine fractions, accumulation of broken tiles in the interior of the dryer and inadequate brushing of the material at the dryer exit.
Firing	Aggregates of fine fractions, particles swept along by the flue gas stream.
Manufacture of frits	
Fusion kilns	Aggregates of fine fractions that do not display a chemical composition similar to that of the material used as raw material owing to the characteristics of the chemical changes that take place in raw materials fusion.
Ceramic mining operations	
Open-air mining	Coarse fractions >100 µm, excavation, handling and treatment of the material, vehicle traffic, clearing of tracks, etc.

Table 1. Emission of atmospheric pollutants from the different production cycles in the studied area.

2. METHODOLOGY

In order to conduct the present study a sampling network has been set up with four stations, in the municipalities of Alcora, Vila-real, Castellón and Almazora. These sampling points have been located in representative locations in accordance with European Directive 1999/30/CE. Sampling has been simultaneously performed in the four towns for two years. MCV, model PS, settleable particulate samplers have been used. The exposure time of each sampler has been thirty days (Royal Decree 833/75 of 6 February 1975 and Order of 10 August 1976, legislation on the protection of the environment and technical standards for the analysis and evaluation of atmospheric pollutants present in the atmosphere).

The samples collected were then analysed by X-ray diffraction to identify the crystalline phases present in the settleable particulate matter; a Siemens D500D TWIN instrument was used with Bragg-Brentano θ:2 geometry.

Figure 1. Settleable particulate sampler.

3. RESULTS AND CONCLUSIONS

The levels of settleable particulate concentrations detected in each municipality are shown in table 2. In general the values detected in the localities of Alcora and Vila-real are higher than those obtained in Castellón and Almazora. This fact indicates there is a greater anthropogenic contribution in these towns, which comes from the industrial activity that takes place there. No seasonal variation in the levels of settleable particulate concentrations has been observed in the course of the two years of study.

Month	Alcora		Castellón		Vila-real		Almazora	
	2004	2005	2004	2005	2004	2005	2004	2005
January	45	76	75	74	156	254	-	76
February	201	52	120	125	379	94	-	160
March	228	108	240	97	572	202	265	181
April	293	98	147	114	211	197	109	124
May	103	147	183	-	162	110	149	71
June	187	195	130	-	243	333	163	176
July	136	187	115	-	301	224	145	81
August	-	137	150	-	-	210	105	130
September	85	-	482	-	118	-	536	-
October	103	-	143	-	158	-	181	-
November	190	-	116	-	224	-	119	-
December	46	-	105	-	51	-	141	-

Table 2. Mean monthly values of settleable particulate matter at the different sampling points in mg/(m²day).

The mineralogical analysis of the dustfall shows a degree of homogeneity of the mineralogical composition of the samples at the three sampling points. The abundance of mineral phases such as illite or kaolinite detected in the collected samples is associated with an anthropogenic origin, evidenced by the presence in the study area of an important number of companies dedicated to the milling and spray drying of clays, mainly of an illitic–kaolinitic character. The calcite and dolomite originate in the geological substrate of calcareous-dolomitic mountains of the Castellón region. In this area there are large-scale mining operations of these phases, which explain their abundance in the settleable particulate matter. The origin of the potassium feldspar and sodium-calcium plagioclase stems from the natural environment itself and/or the industrial activities in the area, described previously. The abundance of quartz mineral in the earth's crust poses the question of its possible natural or anthropogenic origin.

The long-distance transport episodes, involving African intrusions, have been evaluated according to the SKIRON atmospheric model and the measurements made of suspended aerosols by the NASA TOMS satellite, as recommended by the ECWGPM. These intrusions of material increase the concentration levels of the atmospheric pollutants in the study area. During these episodes an increase in particulate concentration has been detected at all the sampling stations.

4. ACKNOWLEDGEMENTS

The authors thank the Generalitat Valenciana for financing the project GV04-B57, and the City Councils of Castellón, Alcora, Almazora and Vila-real for financing the atmospheric pollution monitoring projects in their municipalities.

REFERENCES

[1] E.T. Gómez, T. Sanfeliu, J. Rius, D. Hernández. (2001) "Caracterización granulométrica y mineralógica en el área cerámica de Castellón", pp. 179-188. In: Boletín de la Sociedad Española de Cerámica y Vidrio, 40(3)1-10.

[2] T. Sanfeliu, C. Álvarez, E.T. Gómez, D. Henández, M. M. Jordan, A. Boix (2002) "Contaminación atmosférica: Particulado sedimentable". Editor: Fundación Dávalos Flecher.

[3] ECWGPM (2001) "Natural Events", Final report on guidance to European states on PM10 monitoring and intercomparison with reference. Ed. Willians, P. Bruckman.