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MOTORWAY POLLUTION: EVALUATION OF PM10 TRANSPORT PHENOMENA IN THE URBAN AREA OF PERUGIA - ITALY

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ABSTRACT

The pollution from total suspended particulate (TSP) and above all from PM10, i.e. the inhaling fraction of particulate matter with diameter less than 10 µm, constitutes a health hazard for the population. Specific weather conditions, for example thermal reversed gradient or absence of rain, contribute to worsen the pollution problem, since this hinders the dispersion of pollutants.

In the present paper the TSP (total suspended particulate) and the PM10 (fraction of TSP with diameter less than 10 µm) concentration and the weather climate parameters were recorded, near polluting sources and a sensitive receiver.

The measurements were used to assess a thermofluidodynamic model for evaluating the dispersion of the pollution in a commercial finite volumes calculation code called Fluent.

In particular, the temperature, the relative humidity, the rain, the solar radiation, the direction and the speed of the wind were monitored in real time with a GSM telephone. The PM10 and the total suspended particulate concentration were obtained with the gravimetric method, employing a portable equipment.

The main polluting sources in the area of study are a linear source coming highway and a point source, constituted of the end part of a 950 m long tunnel. The horizontal domain of study of the thermofluidodynamic model is an area of 85x85 m, in which the sources and the receiver are comprised. A numerical analysis with a model of dispersion of the pollution in a reference Lagrangian system was carried out. The results show that the model supplies mean values of TSP and PM10 in agreement with the values measured near the receiver.

INTRODUCTION

The impact of the emissions from different sources in the atmosphere is becoming more and more important, so it is necessary to predict the dispersion of pollutants [1].

There are different dispersion models and flow fields which could be applied. The hierarchy begins with the analytic Gaussian Plume Model and ends with sophisticated hydrodynamic models which use different kinds of turbulence models and solve all the governing equations [1].

In order to evaluate the dispersion of the pollutants, considering thermal stratification and topographic effects, without compiling a sophisticated hydrodynamic model, it is possible to use and to adapt a commercial CFD Software such as Fluent.

In the present paper the motorway pollution in a urban area of Perugia (Italy) was investigated.

In particular, the pollution due to the total suspended particulate TSP and to the PM10 (i.e. the inhaling fraction of the particulate matter, with diameter less than 10 µm) were considered.

The research was carried out in two phases: in the first, weather and air pollution measurements were carried out, in order to implement the data for a simulation with a finite volumes calculation model; in the second, the commercial finite volume calculation model called Fluent was applied to a domain of study of the urban area including the two sources considered (the linear, constituted by the highway, and the point, i. e. the end part of the 950 m long tunnel).

A comparison between the measurements and the simulation data was finally carried out.

NOMENCLATURE

C_C=Cunningham correction to the Stokes' drag low (-);
$C_{1\varepsilon}$ = model k-ε costant (-);
$C_{2\varepsilon}$ = model k-ε costant (-);
$C_{3\varepsilon}$ = model k-ε costant (-);
C_D = drag coefficient (-);
$\overline{D}$ = mean diameter (m);
D = diameter (m);
D_P = particle diameter (m);
F_D = drag force parameter (s^{-1})
F_X = additional forces per unit of mass (m/s^2)
g_x = gravity acceleration in x direction (m/s^2);
G_k = generation of turbulent kinetic energy due to the mean velocity gradients ($kg\ s^{-1}m^{-3}$);
G_b is the generation of turbulent kinetic energy due to buoyancy ($kg\ s^{-1}m^{-3}$);
k = turbolent kinetic energy ($m^2\ s^{-2}$);
M_D = mass fraction of particles with diameter greater than D (-);
n = spread parameter (-);
PM10 = fraction of suspended particulate matter with diameter less than 10μm (μg/m^3);
Re = relative Reynolds number (-);
σ_k = model k-ε costant (-);
σ_ε = model k-ε costant (-);
T = temperature (°C, K);
TSP = total suspended particulate (μg/m^3);
u = fluid phase velocity (m/s);
u = component of the flow velocity perpendicular to the gravitational vector ($m\ s^{-1}$);
u_P = particle phase velocity (m/s);
v = component of the low velocity parallel to the gravitational vector ($m\ s^{-1}$);
W = solar radiation (W/m^2).
M_D = mass fraction of particles with diameter greater than D (-);

GREEK LETTERS

ε = turbolent kinetic energy dissipation rate ($m^2\ s^{-3}$)
λ = molecular mean free path (m)
μ = fluid molecular viscosity (kg/m s);
μ_t = turbulent viscosity (kg/m s);
ρ = fluid density (Kg/m^3);
ρ_P = particle density (kg/m^3);
Φ = relative humidity (%);

1. DESCRIPTION OF THE SITE

The examined area is located in the town of Perugia; it involves a stretch of viaduct highway that continues into the tunnel and includes a hill with a residential zone.

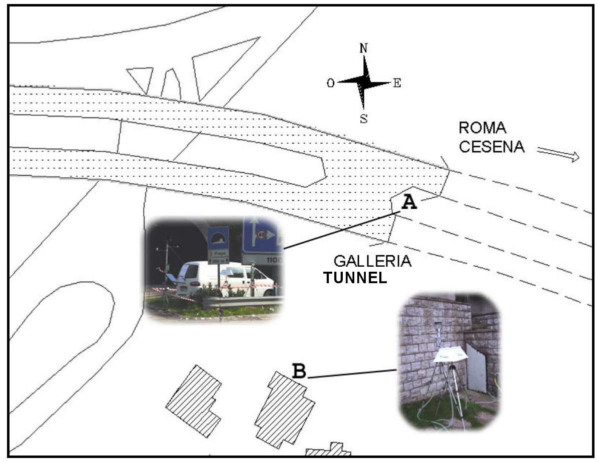

Figure 1. Examined area plant in the town of Perugia.

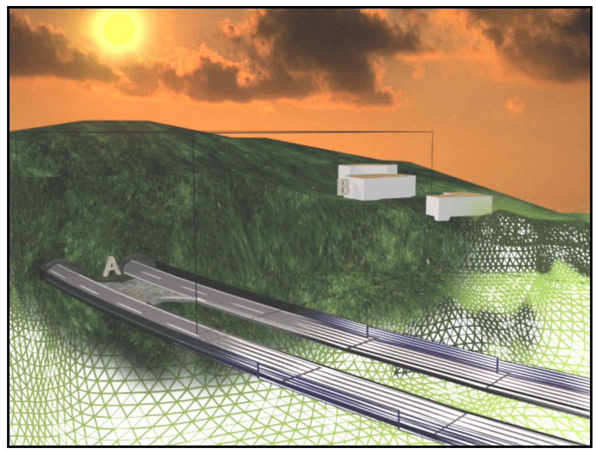

Figure 2. 3D reproduction of the examined area.

There are two main polluting sources in the area of study: a linear source due to the traffic along the highway and a point source, constituted of the end part of a 950 m long tunnel.

The sensitive receiver is located in the residential zone. The distance between the sources and receiver is about 65 m; the difference of altitude is about 15m.

Measurements were carried out in two different points, one close to the sources (A), the other one close to the sensitive receiver (B) (see fig.1). A 3D reproduction of the examined area is shown in fig. 2.

2. MEASURE MENTS

The experimental measurements were carried out from July 2001 to February 2002.

The microclimatic data, such as temperature, relative humidity, solar radiation, atmospheric pressure, rain, wind direction and speed were measured in real time, for all the above mentioned period, by a GSM telephone data exchange.

The concentration of the total suspended particulate and of the PM10 fraction were measured with the gravimetric method employing a portable equipment; each sampling lasted 7 days: the concentration of the total suspended particulate for six days and the PM10 for one day.

Five samplings 7 days long were carried out during the measurement period, the first in July 2001 (point A), the second in October 2001 (point A), the third and the fourth in November 2001 (point B), and the fifth in February 2002 (point B).

3. INSTRUMENTS

All the measurements were carried out at the Environmental Control Laboratory of the University of Perugia, Department of Industrial Engineering. The instruments employed are:

- Weather Station for environmental monitoring;
- Sequential Sampling system for the TSP and the PM10 fraction;
- Climatic Chamber for filters treatment;
- Precision Balance for filters weighing.

3.1.WEATHER STATION

The weather station Skye Minimet is a modular multi-channel system for environmental monitoring; it allows to measure weather data by means of sensors linked to a central unit.

The Skye Minimet weather station complies with the requirements of the EMC Directive 89/336/EEC and it is manufactured using the harmonised European standards EN50081 part 1 and EN50082 part 1 for emission and immunity respectively. It has a solar panel for power supply in absence of electrical power. A scheme of the weather station is sketched in fig. 3.

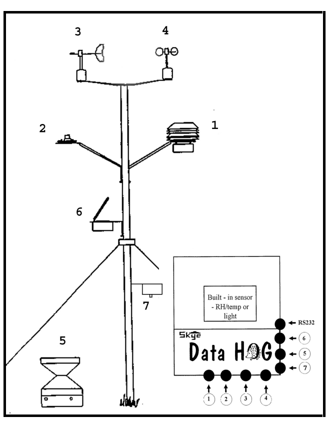

Figure 3. Weather station scheme: 1 Relative humidity and Air Temperature probes; 2 Solar Radiation probe (pyranometer); 3 Wind direction probe; 4 Anemometer probe; 5 Rainguage probe; 6 Solar panel for power supply; 7 Pressure probe.

The Relative humidity and Air Temperature probes are shown in fig. 4. The probes are located within the protecting screen, in order to avoid the influence of the solar radiation. The sensitivity of the probes is ±0,1°C for air temperature and ±.1,5% for relative humidity.

Figure 4. Air Temperature and Relative Humidity probes.

The solar radiation probe is a pyranometer (see fig. 5), constituted by silicon cells; its sensitivity is about 3%.

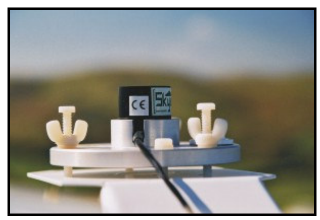

Figure 5. Solar radiation probe.

The wind direction and speed probes are shown in fig. 6. They measure the horizontal wind speed in the range 0÷50 m/s and its direction in the range 0÷360 degrees; the sensitivity is about ± 0,1 m/s for the wind speed and ± 5 degrees for its direction.

Figure 6. Wind direction and speed probes.

The Rainguage probe is shown in fig.7. The rainfall is measured by the well-proven tipping bucket method. Precipitation is collected with a funnel and is passed to one of the two buckets situated at either end of a short balance arm. The balance arm tips when the first bucket is full, emptying this bucket and positioning the second bucket under the funnel. The sensitivity of the probe is about ±0,2 mm.

Figure 7. Rainguage probe.

The Barometer probe is shown in fig. 8; it measures the pressure in a range of 800÷1100 mBar, with a step of 0,05 mBar; its sensitivity is about ± 1 mBar.

Figure 8. Pressure probe.

3.2 SEQUENTIAL SAMPLING SYSTEM FOR TOTAL PARTICULATE AND PM10 FRACTION

The system consists of a pump and of a volume meter to suck the polluted air; it is connected to 8 electric valve units for the sequential sampling of the total particulate and of PM10. The filter holders and the sampling probe for the PM10 fraction are sketched in figure 9 and 10; they are connected to the electric valves. Two kinds of filter could be employed: membrane or glass filters (fig. 11).

The PM10 sampler is a cyclone separator; air enters the cyclone through a tangential inlet and forms a vortex flow pattern (USEPA standard). Particles move towards the cyclone wall with a velocity determined by the geometry, the size and the flow rate in the cyclone. In the outer spiral of the gas the particles are driven to the wall by centrifugal force.

The Climate Chamber is employed for the filter treatment before and after the measurements; it is a Mazzali chamber mod. C330G45, with a temperature control in the range 40÷150 °C and a relative humidity control in the range 15÷99%. The temperature measurement error is ± 0,1 °C, the relative humidity one is ± 1 %.

The analytic balance employed for the filters weighing before and after the measurements has a weighing range 0 ÷ 210 g, with a precision of 0,001µg.

4 MEASUREMENT METODOLOGY OF TOTAL PARTICULATE AND PM10 FRACTION

The pump is programmed to suck a constant air flow of 20 l/m for the TSP and of 16,67 l/m for the PM10.

The duration of the sampling is 24 hours for each filter. The filters, before and after each exposure, are treated in a climatic chamber. The treatment consists of a maintenance in climatic chamber for 48 hours at T=20±1 °C and Φ=50± 5%.

Figure 9. Filter holders.

Figure 10. Sampling head for PM10 fraction.

Figure 11. Filters.

Another filter, which does not suck air, is used to evaluate the natural deposit of the particulate throughout the period (7 days).

Employing the difference in weight between the filters before and after exposure, and the normalized volume of the sucked air, the concentration of the total particulate and of the PM10 fraction are obtained.

5. WEATHER STATION RESULTS

The weather parameters for environmental monitoring were measured near the pollution sources. Data were analyzed and elaborated; results are shown in fig. 12, 13, 14, 15, 16 and 17.

The temperature, the pressure, the relative humidity and the solar radiation were elaborated considering a day-type for each month; every hour of the day is characterized by the mean value off all the data measured, at the same hour, during the entire month. The rain was represented by a cumulate curve for each month. The direction and speed were elaborated in wind rose: the angle represents the direction where the wind was coming from and the distance from the starting point represents the wind speed or the frequency of its direction.

The air temperature (fig.12) of each day-type has a sinusoidal trend; the minimum values, related to January 2002, vary in the range 2÷8 °C, the maximum values, related to August 2001, vary in the range 20÷ 33 °C.

The exposure of the solar radiation probe is South, so the maximum value is at 13.00 – 14.00 hour of each day-type (fig. 13); the maximum value related to July 2001 is about 950 W/m^2; the minimum value, related to December 2001, is about 190 W/m^2.

The Relative Humidity (fig. 14) has higher values in the winter months (maximum value ≅ 90% in February 2002); the minimum values, related to July and August 2001, varies between 30% and 60% in the day-type.

The rainfall is significant in September 2001, with 8 rain days, and in December 2001, with the maximum value of 50 mm (see fig.15)

The maximum wind direction frequencies are from NE ≅ 40% and from E ≅ 35% for all the months (fig.16); the wind speeds are respectively 1,8 and 1,1 m/s (November 2001) (fig.17); in N direction, where the frequency is about 20%, the wind speed is significant and about 1,4 m/s in September 2001.

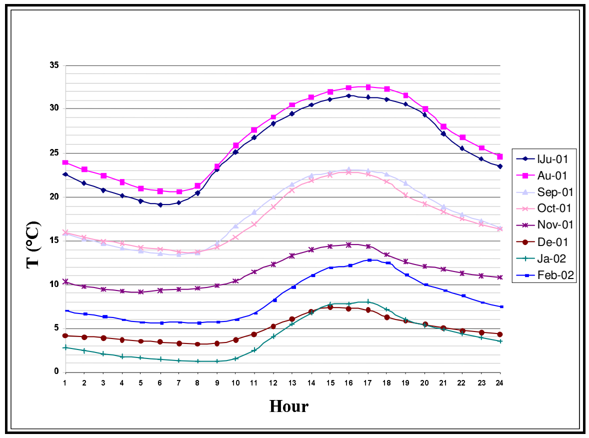

Figure 12. Temperature in day-type for each month

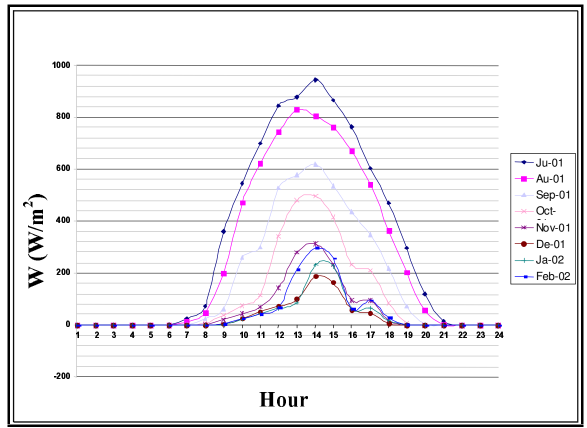

Figure 13. Solar radiation in day-type for each month.

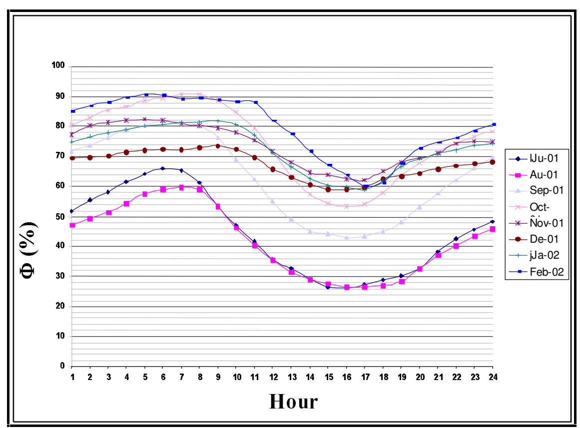

Figure 14. Relative Humidity in day-type for each month.

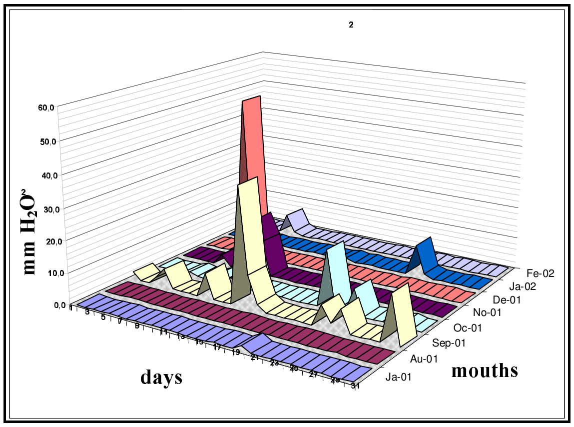

Figure 15. Cumulate rain.

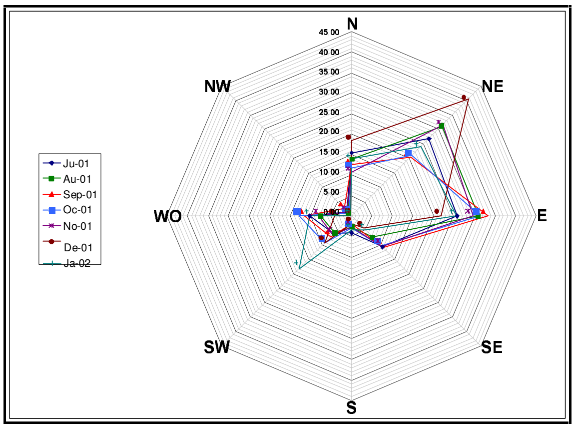

Figure 16. Wind direction frequency.

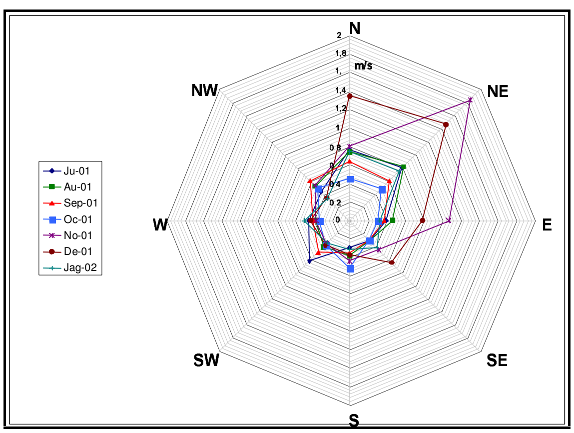

Figure 17. Speed wind rose.

6 TSP AND PM10 MEASUREMENT RESULTS

The concentrations of the TSP and PM10 were evaluated both near the source and the receiver.

The total particulate results are reported in fig.18, differentiated for each day of the week; the concentration near the source (point A) varies in the range 70 ÷ 150 μg/m^3, while near the receiver it varies in the range 20÷140 μg/m^3. The limit prescribed by the European law is 150 μg/m^3 [2].

The results of PM10 are reported in table 1. The concentration is about 50μg/m^3 near the sources, while it varies in the range 27 ÷ 43 μg/m^3 near the receiver (point B). The European Normative prescribes for PM10 concentration a limit value equal to 50 μg/m^3, with a measurement tolerance of 37,5% (18,75 μg/m^3) in 2001; the tolerance decreases from 37,5% to 25% (12,5 μg/m^3) in 2002 and to 0% after 1.1.2005 [3].

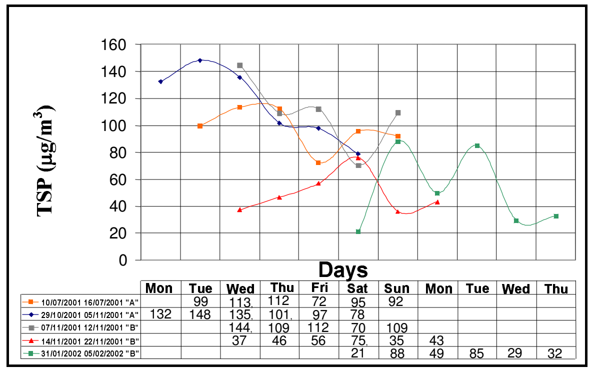

Figure 18. Total suspended particulate concentration.

Tab. 1. PM10 Concentration.

DATA	SORCE POINT A μg/m^3	RECEVEIR POINT B μg/m^3	LIMIT VALUE [3] μg/m^3
05/11/2001	54,63		50
22/11/2001		38,37	
30/01/2002		43,24	
07/02/2002		27,93	

7. THE THERMOFLUIDODYNAMIC ANALYSIS

The study of the pollutants dispersion was conducted by means of numerical analysis. The commercial Fluent software uses the numerical technique of finite volumes; it discretizes the domain of interest into elementary volumes and substitutes the initial differential equations with algebric equations of balance, one for each elementary volume [4], [6].

In the paper the segregated solver was used, where each discrete governing equation is linearized implicitly. Using this approach, the governing equation are solved sequentially (i.e., segregated from one to another). The governing equations are non-linear (and coupled), so several iterations of the solutions loop must be performed before obtaining a converged solution that satisfies the boundary conditions; the iterative process uses a scheme called Simple Method [6].

For the numerical solution of the problem, the equation of continuity, the Navier-Stokes equations "time filtered", two more equations to characterize the turbulence by means of a k-ε model, in a stationary regime, were used.

In order to simulate the PTS and PM10 dispersion in the flowfield, the model proposed from the software Fluent was used: Discrete Phase Modeling, a Lagrangian Dispersion Model.

The domain of study in 3D was divided into unstructured tetrahedral meshes.

8. THE MAIN EQUATIONS

The most appropriate model was chosen among the turbulence models available in Fluent, the k-ε model, used very much in Literature for homologous cases and characterized by a relatively short computational time [5] [6]. Such a model belongs to the class of models of turbulence based on the Navier-Stokes equation "time filtered ".

The standard k-ε model is a semi-empirical model based on model transport equation for the turbulent kinetic energy (k) and its dissipation rate (ε).

The turbulent kinetic energy, k, and its rate of dissipation ε are obtained from the following transport equations:

$$\rho\frac{Dk}{Dt}=\frac{\partial}{\partial x_i}\left[\left(\mu+\frac{\mu_t}{\sigma_K}\right)\frac{\partial k}{\partial x_i}\right]+G_k+G_b-\rho\varepsilon \quad (1)$$

$$\rho\frac{D\varepsilon}{Dt}=\frac{\partial}{\partial x_i}\left[\left(\mu+\frac{\mu_t}{\sigma_\varepsilon}\right)\frac{\partial \varepsilon}{\partial x_i}\right]+C_{1\varepsilon}\frac{\varepsilon}{k}G_k+C_{3\varepsilon}G_b-C_{2\varepsilon}\rho\frac{\varepsilon^2}{k} \quad (2)$$

The turbulent viscosity, μ_t, is computed by combining k and ε:

$$\mu_t=\rho C\mu\frac{k^2}{\varepsilon} \quad (3)$$

$C_{1\varepsilon}$, $C_{2\varepsilon}$, $C_{3\varepsilon}$ are constants, σ_k and σ_ε are the turbulent Prandtl numbers for k and ε, respectively.

G_k represents the generation of turbulent kinetic energy due to the mean velocity gradients. G_b is the generation of turbulent kinetic energy due to buoyancy [6].

$C_{3\varepsilon}$ is equal to tanh |v/u|, where v is the component of the low velocity parallel to the gravitational vector and u is the component of the flow velocity perpendicular to the gravitational vector.

The model constants $C_{1\varepsilon}$, $C_{2\varepsilon}$, C_μ , σ_k and σ_ε, have the following default values in Fluent:

$C_{1\varepsilon}$=1.44, $C_{2\varepsilon}$=1.92, C_μ =0.09, σ_k =1, σ_ε=1.3 (4)

These default values were determined in experiments with air and water for fundamental turbulent shear flows including homogeneous shear flows and decaying isotropic grid turbulence. They were found to work fairly well for a wide range of wall-bounded and free shear flows [6]. The constants could be changed, if needed; e.g. in the study of Regional Dispersion Modelling, to adapt the k-ε turbulence model constants for an atmospheric boundary layer, they were used C_μ = 0.0256 and σ_k=2.19 [1].

In the paper, considering the domain of study, the default values of constants were used.

As regards the Lagrangian Dispersion Model, the phase in a Lagrangian frame of reference consists of spherical particles dispersed in the continuous phase. Fluent computes the trajectories of these discrete phase entities, as well as heat and mass transfer to and from them [6].

Figure 19 shows the forces acting on a spherical particle settling through a fluid under the influence of gravity.

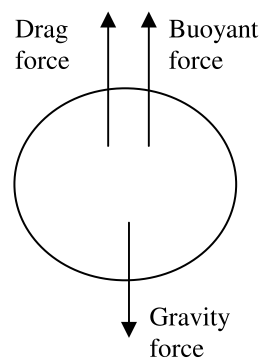

Figure 19. Forces acting on a particle of fluid (Lagrangian Dispersion Model).

The calculation of the discrete phase trajectory is predicted by integrating the force balance on the particle. This force balance equates the particle inertia, the hydrodynamic drag and the force of gravity and they can be written (for x direction in Cartesian coordinates) as [6]:

$$\frac{du_p}{dt}=F_D(u-u_p)+g_x(\rho_P-\rho)/\rho_P+F_X \quad (5)$$

where F_D (u-up) is the drag force per unit particle mass and:

$$F_D = \frac{18\mu}{\rho_P D_P^2}\frac{C_D \mathrm{Re}}{24} \qquad (6)$$

with:

$$\mathrm{Re} = \frac{\rho D_p \left| u_p - u \right|}{\mu} \qquad (7)$$

C_D is the drag coefficient and it can be yielded by Morsi Alexander's expression [7], or by Haider and Levenspiel's expression [8].

For sub-micron particles, a form of Stokes drag law is available [9]; in this case, F_D is defined as:

$$F_D = \frac{18\mu}{D_p^2 \rho_p C_c} \qquad (8)$$

The factor C_C is Cunningham's correction of Stokes' drag low [6], Cc is defined as:

$$C_C = 1 + \frac{2\lambda}{D_p}\left[1.257 + 0.4\exp\left(-1.1\left(D_p / 2\lambda\right)\right)\right] \qquad (9)$$

The calculation of the particle dispersions was carried out through two steps:

1. calculation of the flowfield;
2. calculation of the dispersion by immission of an appropriate number of random particles.

When the discrete phase model was included, the initial position, velocity, size and temperature of individual particles must be defined. These initial conditions, defining the physical properties of the discrete phase, are used to initiate trajectory and heat and mass transfer calculations.

The program Fluent provides five types of injections of particles: single, group, cone, surface and read from a file; in the paper was chosen the surface, to create an injections from a rectangular grid of particles.

The particle size distribution may be defined by fitting the size distribution data to the Rosin-Rammler equation. In this approach, the complete range of particle sizes is divided into a set of discrete size ranges, each to be defined by a single stream that is part of the group.

The Rosin-Rammler distribution function is based on the assumption that an exponential relationship exists between the particle diameter, D, and the mass fraction of particles with diameter greater than D, M_D :

$$M_D = \exp\left[-\left(\mathrm{D}/\overline{\mathrm{D}}\right)^n\right] \qquad (10)$$

where

$$n = \frac{\ln\left(-\ln M_D\right)}{\ln\left(D / \overline{D}\right)} \qquad (11)$$

The parameters $\overline{D}$, Mean Diameter and *n*, Spread Parameter, are input (calculated from the experimental data) to define the Rosin-Rammler size distribution [6] [10].

9. DOMAIN DIMENSIONS AND GRID GENERATION

In the first phase of the thermofluidodynamic analysis, the physical features schematization of the domain of study was chosen. The domain should be sufficiently extensive, so that the boundary conditions do not affect the results; but if it is too extensive, the computational calculation could be onerous. A horizontal domain of 85x85 m was chosen, considering the topography of the site in which the sources and the receiver are placed. The height was fixed to about 30 m over the highway quote.

The tetrahedral mesh was chosen and the grid size with 1x1x1m was kept; about 350.000 cells were obtained.

10. BOUNDARY CONDITIONS

Many boundary conditions are available in the Fluent software; the most appropriate for the present study was chosen. Figure 21 and Table 2 show the domain of study, with the relative boundary conditions.

Physical feautures, such as pollution emissions, either from the tunnel or the stretch of highway , and inlet velocity conditions were assigned; such condition is used to define the velocity and scalar properties of the flow.

Then, the land, the road, the noise barriers and the residential building conditions of "wall" were assigned; such a condition is used to bound fluid and solid regions.

In the domain sides exposed to the predominant winds, the conditions of "velocity inlets" were assigned. In the remaining sides "pressure outlet" in order to define the static pressure at flow outlet were assigned.

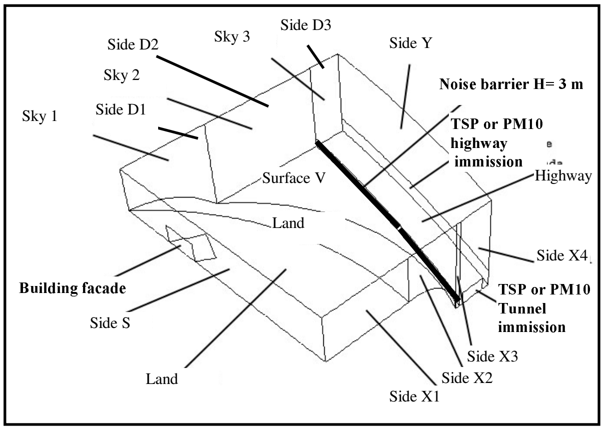

Figure 20. Study domain and the boundary conditions.

Tab. 2. Boundary conditions

Physical conditions	Boundary conditions
TSP or PM10 tunnel immission	Velocity Inlet
TSP or PM10 highway immission	Velocity Inlet
Side Y	Velocity inlet
Side X1, X2, X3, X4	Velocity inlet
Land	Wall
Highway	Wall
Noise barrier	Wall
Building facade	Wall
Surf. V	Pressure outlet
Side S	Pressure outlet
Side D1, D2, D3	Pressure outlet
Sky 1,2,3	Pressure outlet

11. INPUT DATA

The measurements were used as input data for the thermofluiddynamic model. As shown in fig. 16, it was estimated that the predominant wind direction is comprised between NE and E while the wind speed varies in the range 0,4÷1,8 m/s.

Two different simulations were carried out: one for the TSP evaluation, the other for the PM10; the wind speed was variable, the other parameters were constant.

The concentrations of TSP and PM10 were attributed to the following immission surfaces:

A. Linear source, equal to 54$\mu g/m^3$ for PM10 and 120 $\mu g/m^3$ for TSP (mean measured values);
B. Point source, equal to 120 $\mu g/m^3$ for PM10 and 270 $\mu g/m^3$ for TSP (estimated value by the number and emission factors of the vehicles transiting through the tunnel)

The aerosol size distribution is quite variable in an urban area. Extremely high concentrations of fine particles (less than 0,1 µm diameter) are found close to sources (e.g., highways) [11]. The particulate size of the diesel engines emissions are included between 0,01 and 0,1 µm diameter [12]. The data found in Literature [11], [12] regarding the size distribution of particulate of emissions near highways and from diesel engines were employed as input data for the immission of pollution.

12. SIMULATION RESULTS

The PM10 concentration on the ground and on two significant sections is shown in fig. 21 and 22; results relate to wind speed at 0,7 m/s and wind direction at 70° from N.

The wind speed and direction and the orography influence the concentration of PM10; it has a mean value of 32 $\mu g/m^3$ in the receiver (height 2 m over the ground , distance from the road of 65 m, distance from the East side of the domain about 54 m).

The acoustic barrier affects the motion field; reducing the PM10 concentration over the barrier, at height of 2 m.

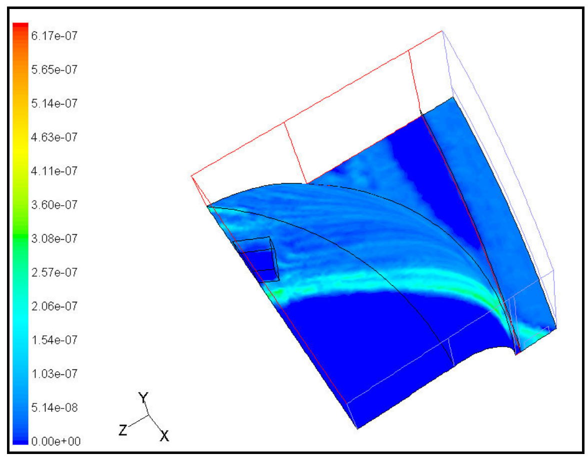

Figure 21. PM10 concentration in the study domain

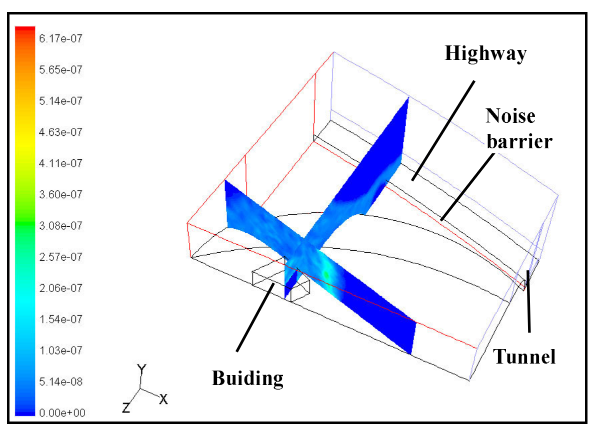

Figure 22. PM10 concentration in two significant sections of the domain.

The concentrations measured of TSP and PM10 are related to daily average, which the speed wind rose and the wind direction frequency in the 24 hours are note. The measurements of TSP in the days with predominant wind direction at 70° from N and wind speed variable in the range 0.3÷1.4 are considered. The relative simulation with the wind direction and speed equal to measurements are carried out. The TSP calculated and measured concentrations are shown in fig.23. The mean relative error between the calculated and the measured data is about 10%.

The PM10 measured and calculated values are less than the limit value of 50 μg/m^3, with tolerance of 25% (12,5 μg/m^3) in 2002 [3]. The mean relative error between the measured and calculated values is less than the tolerance, according to the law [3].

After 1.1.2005, the limit value will be 50 μg/m^3 with tolerance 0%.

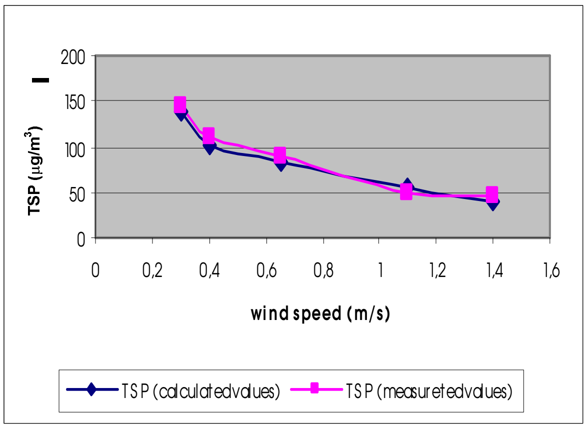

Figure 24. TSP concentration: comparison between measured and calculated data.

13. CONCLUSIONS

PM10 and TSP constitute a health hazard for the population; so the evaluation of their concentration by means of reliable diffusion models is becoming more and more important.

In the present paper a pollutants diffusion model was validated; it is a finite volumes model, in a Lagrangian reference system. The validation was carried out employing the data of weather parameters and TSP and PM10 concentrations measured in an urban area of Perugia town, in Italy. Such data were employed as input data for the model; the weather data were recorded from July 2001 to February 2002.

The TSP and PM10 concentrations measured close to the sources were used as input data, the ones measured close to the receiver were compared with the simulation results.

The results show that the model supplies mean values of PM10 e TSP, in agreement with the values measured near the receiver. The mean relative error between the calculated and the measured values is about 10%.

The error is less than the measurements tolerance now prescribed by the European Normative, equal to 25%.

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