

SUSTAINABLE DEVELOPMENT AND AIR QUALITY IN THE CATANIA CITY WITHIN.

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ABSTRACT.

The concept of sustainability, known like the set of relations between the human activities, their dynamics and the biosphere, with its dynamics, generally slower, previews that the variations brought to the nature from the human activities are within sure limits therefore not to destroy the total biophysical context.

In this optical the norm that regulated several environmental compartments is developed passing from who pollutes pay, in years 60/70, to the emanation of limits, in years 70/80 (still not able to safeguard environment), to the maintenance of the quality, in years 80/90, that it has carried to the programming through environment, VIA, until to the actual concept of sustainable development. The National normative guidelines, therefore, pursuing the concept of sustainable development, have been those to place attention on important problems which the pollution measure and to data evaluating. This for the eventual reorganization of the city centres characterized from the presence of polluting in concentrations often incompatible with law limits. PM10, Benzene and IPA, giving serious damages to the population health, were particularly placed in attention. For such polluting the air quality of the city of Catania has had a progressive improvement, also still remaining in an attention situation that needs of measures and interventions to determining an ulterior emissions reduction, to assure attainment and respect in the time of the fixed law limits of security. All to also maintain a high state of air quality continuing to carry out the fundamental city activities.

INTRODUCTION.

Air quality is included among the objectives of the EC in the plan of prevention and reduction of pollution in order to achieve a high level of environmental protection. To maintain this, it is necessary to establish an integrated and a long term strategy to fight against atmospheric pollution and at the same time to protect man and environment health from pollution.

Since the sixties in European countries there has been a commitment in defining various types of pollution; in our Country concerning atmosphere the first step was the law number 615/66 (1) and already DPR 203/88 (2) gives a complete atmospheric pollution definition that is: "Each modification of composition or physical status of atmospheric air due to the presence of one or more substances in such amount and with such characteristics to:

alter the normal environmental conditions and the healthy air,
constitute danger or direct or indirect prejudgment for man's health,
compromise the recreational activities and the other legitimate uses of environment,
alter the biological resources, the material ecosystems and both private and public assets."

From then on, International and National legislation has been very width. In all fields of pollution there has been an evolution from the concept of "the one who pollutes should pay" (1) to the concepts of "air quality" and of "planning through environment" (2), up to the

concept of “sustainable development”, which still today is not completely regulated by legislation.

In 1987, the World Commission for Atmosphere and Development, known also as “the Brundtland Commission” from the name of its president, has elaborated a definition of the concept of sustainable development, which, by now, is generally accepted. It asserts that: "Sustainable development is any development which meets the needs of the present without compromising the ability of future generations to meet their needs" (3). Sustainable development concerns therefore in equal measure three fields: economy, environment and society. Despite of that, the principle “the one who pollutes should pay” is still on, and it is worldwide applied (4).

Though its concept is correct, it is not accepted as a juridical instrument for equity, but as a principle of economic effectiveness. Environment has been looked at from the financial view point; that has involved accepting its degradation as an inevitable fatality, and legitimating the one who pollutes saying: “I pay, therefore I can pollute”. Another consequence of this approach has been to privilege the curative perspective giving up all together preventive measures (5).

Because of all this, though atmospheric pollution has been one of the main political concerns of Europe, there have not been any of the expected results.

From the seventies European politics on air quality has aimed at developing and putting into action right instruments to improve air quality. Some of those instruments are the following: control of emissions from mobile sources, improvement of fuel quality, promotion and integration of requirements for protection of the atmosphere in the transport sector, and in the field of energy. The 1992 the United Nations Conference on Environment and Development (UNCED), identified city environment degradation as one of the areas which demands immediate attention(6,7). The “Agenda 21” (Alborg 1994), the action plan of sustainable development for the 21st century, underlines in several chapters the importance of urban atmospheric pollution and it invites territorial and national public agencies and the International Community to increase their efforts in order to obtain data and true information on concentrations of polluting substances, their sources and their effects (6,7). Therefore our attention will particularly be on urban atmospheric pollution.

THEORY.

In big cities, where atmosphere polluting substances have been for long time studied and monitored, lot of attention is now drawn towards Benzene, PM10, IPA; all these get remarkable interest because of their effects on health and because of the short period of having been monitored.

Since IPA still wait for appropriate legislation, we will pay special attention to what concerns Benzene and PM10.

Benzene (C₆H₆) is an aromatic volatile hydrocarbon, having a characteristic smell. It comes mainly into air from vehicles emissions, and from refuelling losses; smoke from tobacco contains benzene and, in closed spaces, it constitutes the greater source of such polluter.

Medium benzene concentrations oscillate between 5 and 573 micrograms/m³ (WHO 1999) even if near petrol stations one can get up to 10,000 micrograms/m³ (WHO 1987).

Short term effects on man act on the nervous system while long term ones produce progressive reduction of blood platelets and effects on leucocytes. Due to its toxicity,

benzene has been inserted from IARC (International Agency for Research on Cancer) in group I, together with other cancerous substances.(8, 9, 10)

The DM n. 60/2002(11) establishes the following benzene values limit in micrograms/m³ (table 1).

(DM 2/4/2002 n. 60)							
		<i>Start value aumented by tolerance value</i>					<i>Limit Value</i>
		Entrance in vigor (13/12/2000)	1/1/2006	1/1/2007	1/1/2008	1/1/2009	1/1/2010
Limit value for protection of human health	Civil year	10	9	8	7	6	5

Table 1: benzene values limit in micrograms/m³.

PM10 are defined as powder particles with an aerodynamic diameter inferior to 10 micrometers. The powder is a complex physico-chemical mixture composed by primary components, emitted directly from the source, and by secondary components formed subsequently, all of natural or anthropic origin (e.g. soot, geologic material, particles deriving from the abrasion processes, biological material).

Its composition, therefore, turns out to be various (heavy metals, sulphates, nitrates, ammonium, organic carbon, aromatic polycyclic hydrocarbons, dioxins/furans).

PM10 formation happens during industrial and handcraft production, during combustion processes, as a result of mechanical processes (abrasion, lifting up of powders previously deposited on the ground) and by means of secondary processes (from SO₂, NO_x, NH₃, VOC). Main sources are traffic, factories, handcraft, agriculture and forestry. Therefore, we may have solid and liquid particles of variable dimensions and composition. Repercussions of fine inhaled powders and soot are generally: respiratory tract and cardio-circulatory pathology, increase of mortality and cancer risk. Deposited powders, instead, provoke contamination of ground, of plants and, through alimentary chain, also contamination of man because of the content in heavy metals, dioxins and furans.(8, 10, 12)

The DM n.60/2002 (11) establishes the following PM10 values limit in micrograms/m³(table 2).

Measuring benzene concentrations and PM10 in city centres is a quite recent practice. The DM 15 April 1994 has for the first time made compulsory for cities with more than 150.000 inhabitants to have measured, among the others, also these unconventional pollutants. From this, one can understand why there are not historical series of data like for the conventional pollutants, which, instead, have been checked for much more time. The DM 25 November 1994 fixed quality objectives for these pollutants which have been put in place as from the 1st January 1999.

The D M 2 April 2002 n. 60 took up both European directives and repealed the DM 15/4/94 and the DM 25/11/94 relatively to the mentioned pollutants; by doing so: it repealed the quality

objectives for PM10 and for benzene, it fixed annual limits for them, it introduced the daily limits for PM10; moreover, by aiming at halving within the year 2010 concentrations of both pollutants, it has fixed the measuring methods for PM10 (see Annexure XI), while for benzene, waiting for a standardized method based on norms CEN, it continues to be in place the method described in DM 25/11/94. As far as the PM10 is concerned, the new decree fixes the operating procedure for the certification of equivalence of the methods of sampling by the primary laboratories of reference and the principles for equivalence between the with drawal head of a certain system and that one of the reference system.

(DM 2/4/2002 n. 60)							
		<i>Start value aumented by tolerance value</i>					<i>Limit Value</i>
		<i>Entrance in vigor (19/7/1999)</i>	<i>01/01/01</i>	<i>01/01/02</i>	<i>01/01/03</i>	<i>01/01/04</i>	<i>01/01/05</i>
Fase 2							
24h Limit value for protection of human health	24 ore	75 (Not to exceed more than 35 times in the year)	70	65	60	55	50
Year Limit value for protection of human health	Civil year	48	46,4	44,8	43,2	41,6	40
Fase 2			<i>01/01/06</i>	<i>01/01/07</i>	<i>01/01/08</i>	<i>01/01/09</i>	<i>01/01/10</i>
24h Limit value for protection of human health	24 ore	To establish based on phase 1					50 ug/m3 not to exceed more than 7 times in the year (tolerance to establish)
Year Limit value for protection of human health	Civil Year	30					20

Table 2: PM10 values limit in micrograms/m³.

In this phase of rapid legislative changes we have the problem of measures quality, which, definitely, must be standardised in the European Community territory in general, and in Italian territory in particular.

That places problems which, though already wide expressed in the abovementioned Decrees, have not been always attended to by those who had responsibility of net management and of monitoring systems.

In fact, although the Decree 25 Nov.1994 imposed adoptions of systems equal to the reference ones (whereby “equal” meant having a certificate of equivalence issued by an Italian laboratory or by a foreign one with adequate experience), actually systems have been used which did not have such quality guarantee; as a result, many measures have been made by using methods not complying with the reference ones, and therefore not coherent with them. To prove all this it is enough to have a look at the average and at the annual concentrations of those pollutants measured in several parts of the world (13, 14). The average annual values are not, however, much different than those found in our national territory and in our cities (15, 16).

In our Country benzene has been usually measured through an automatic analyser able to give a specific concentration at a specific time, being based on enrichment on active coal and analysis in gas-chromatography or through periodic surveys using passive samplers. Data obtained through monitoring campaigns allow benzene concentration analysis in a much wider space, not only limited to the area of interest of the fixed instrument.

PM10 has been measured either by means of gravimetric method, or by means of automatic methods based on the attenuation of beta radiations, and on oscillating scale.

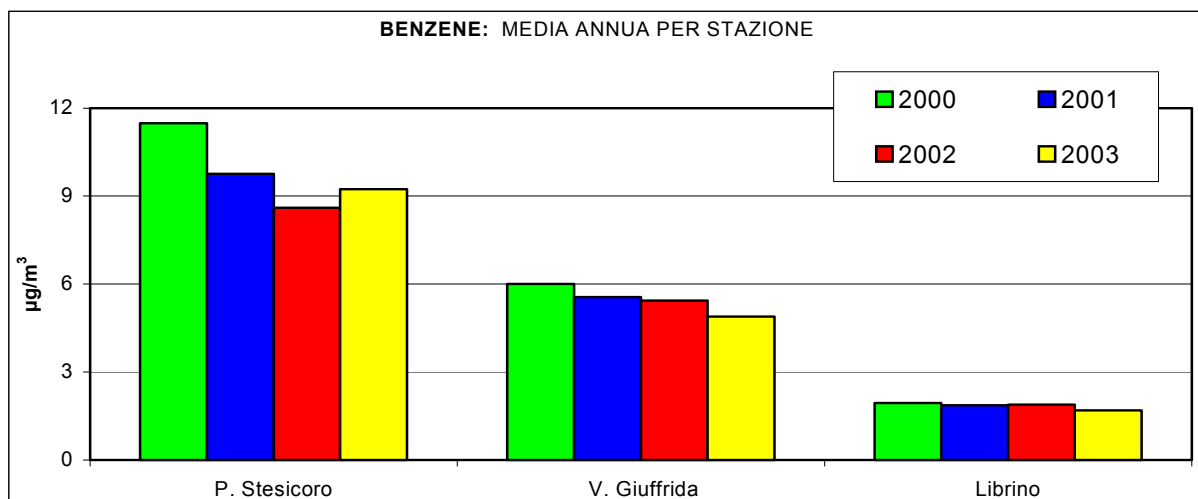
On all National territory, like anywhere else in the world, methods for measuring the PM10 have been however extremely variable; as a consequence, adjustments of measurements had to be made in order to correct them, when they were not made through gravimetric method; this has often resulted in increasing twice or even three times their original values.

As far as the city of Catania is concerned, the benzene concentration has been maintained under the objective value of $10 \mu\text{g}/\text{m}^3$. The overall trend of the average annual values goes towards lessening for the same reasons why the Carbon monoxide concentration diminishes (circulating car, increase of the Diesel vehicles). The average concentration found in the Stesicoro square ($9,23 \mu\text{g}/\text{m}^3$), remains however next to the reference limit; when meteorological circumstances favour pollutants accumulation or during peak traffic hours (evening time) concentrations go up to $20\text{-}30 \mu\text{g}/\text{m}^3$. Increase recorded in 2003 is partially due to temporary traffic modifications caused by street works carried out throughout the year. For some months, in fact, the square was crossed by vehicles from both sides of the road where the survey station was placed (table 3).

Benzene	<i>Concentration (year average in $\mu\text{g}/\text{m}^3$)</i>			
	2000	2001	2002	2003
Librino	1,94	1,86	1,89	1,68
P.zza Stesicoro	11,48	9,76	8,61	9,23
Via V. Giuffrida	6,0	5,55	5,42	4,88

Table 3: Benzene concentration in micrograms/ m^3 of the last four years in Catania.

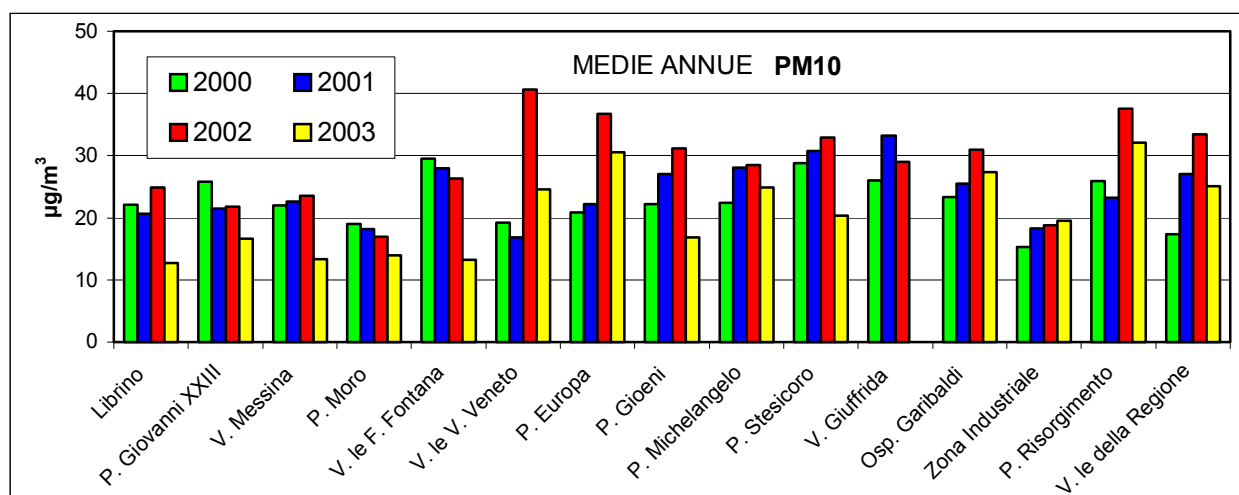
We can understand better the trend given by data from the past years by looking at the following graph 1.



Graph 1: year average of benzene for every Station.

The remarkable evening pollution at the “Stesicoro square” persists because of the traffic generated by all people attending the huge number of gathering places located in the immediate neighbourhood. Provisions were made to stop traffic in via Etnea also after 22 hours, and on “Ecological Sundays”, aimed at reducing respectively the evening peak and the average annual values; however, they haven’t been applied with due severity.

The PM10 concentration in Catania is maintained at levels below the limits foreseen by the DM 60 which for 2003 were of 43,2 $\mu\text{g}/\text{m}^3$ as annual average, and of 60 $\mu\text{g}/\text{m}^3$ as daily average which should not be exceeded for more than 35 days in a year. The 2002 values, and part of the 2001, are influenced by the consequences of falling back of volcanic ashes; though these are mainly composed by big particles (from 100 μm on), they comprise also one fraction of few micron dimension (Graph 2).



Graph 2: PM10 year average for every station.

As already discussed in the previous annual reports, on the base of the document written up by the specific task-force instituted by the E.C., the values read by the beta beam attenuation analysers are underestimated; as a consequence one should use the corrective factor 1,3 as advised by the mentioned document. Nevertheless, even by doing so, we obtain values within the aforesaid limit, even if often they are still above the 2010 limit.

The following table 4 shows the values above the daily average during the 2003.

PM10	Number of overcomings during 2003 of value di 60 mg/m³ of the daily average (allowed max 35 overcomings)
<i>Europa</i>	15
<i>Fontana</i>	0
<i>Garibaldi</i>	4
<i>Giovanni XXIII</i>	0
<i>Librino</i>	0
<i>Messina</i>	0
<i>Michelangelo</i>	6
<i>Moro</i>	0
<i>Regione</i>	2
<i>Risorgimento</i>	20
<i>Stesicoro</i>	0
<i>Veneto</i>	28
<i>Zona Industriale</i>	0

Table 4: values above the daily average during the 2003

One should also consider that during the year some analysers have been removed, being out of order (stations of: Librino, Giovanni XXIII, Giuffrida, Gioeni, Fontana); for those stations data have been recorded only when instruments were working long enough to provide meaningful values.

DISCUSSION AND CONCLUSIONS.

So far, we have seen that atmospheric pollution problems are essentially linked to:

- quality of measurements, whose precision and accuracy are not just optimal. All that is reflected negatively on the ability to interpret data and, consequently, on the ability to predispose improvement plans, which are able to upgrade air quality with minimum financial, social and political cost;
- lack of definition of the fundamental structure of the quality programs on the instrumentations and on the measure laboratories.
- the fact that in the cities interventions and limitations for emission control has not yet been put seriously in action.

Administrators and Mayors must engage themselves in decisive way so that the pollution harm should no more be the main one of our cities. Improving mobility, making bus routes faster protecting their preferential lane, supporting the use of alternative transport: from car-sharing to experimental vehicles with more modern and ecological technologies, are all possible interventions in order to contain atmospheric pollution, obtaining important consequences in terms of health and indirect social costs.

Based on Directive 2001/81/CE it has been issued the national Program for the progressive reduction of the annual national emissions of sulphur dioxide, nitrogen oxides, organic volatile compounds, and ammonia.

The CE Directive 81, of the European Parliament and of Council, of 23rd October 2001 (17), has been emanated in order to assure in the European Community a greater protection of atmosphere and human health from the injurious effects provoked by:

- acidification phenomena (acid pollutants deposition on vegetation, on superficial waters, on lands, on buildings and monuments);
- eutrophication (alteration of land and water ecosystems as a consequence of nitrous compounds deposition from atmosphere);
- ozone formation at ground level.

For such a task, the directive establishes emissions limitation of polluting substances having acidifying and eutrophicant effects, and ozone precursor ones, through the predisposition of a system of national limits (ceiling's values) for sulphur dioxide emissions (SO₂), nitrous oxides (NO_x), volatile organic compounds (VOC) and ammonia (NH₃). Each State Member must reduce, within 2010, the aforesaid pollutants' annual national emissions within the maximum limits established by the directive.

In order to achieve such task, each State Member can independently decide modalities of adaptation to emission limits, by establishing necessary measures and interventions to be adopted in order to stay below them. In such context the directive foresees the predisposition

of a National Program for progressive reduction of polluting emissions of substances considered by the same directive. Such program must eventually be communicated to the European Commission and updated and modified according to necessity.

The National Program sent by Italy to the European Commission has been organized in four main sections:

- the first section (chapters 1 and 2) explains the context in which the directive is born and it illustrates its content;
- the second one (chapter 3) describes the last 20 year Italian emissions situation, relatively to the polluting substances considered;
- the third one (chapter 4) reports on emission scenes for the 2010 for every polluter considered by the directive;
- the last section describes one list of measures and interventions able to reduce further the emissions, and aiming at assuring achievement and continuous attainment of national limits fixed by the directive.

Of course, still many aspects of pollution must be taken into consideration by National and International programs and many are interventions to be carried out in order to have a total recovery of air quality in our cities.

Our wish is to succeed in organizing ourselves Nationally and Internationally in order to develop and put into effect development strategy for compatible development, and to continue therefore the journey towards a more sustainable future.

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