

# PRESENT ASPECTS ON ENVIRONMENT PROTECTION AND SUSTAINABLE DEVELOPMENT ON DOBRUDJA LITTORAL ZONE

Adrian Bavaru\*, Rodica Bercu, Elena Bavaru, Lucica Barbeș  
Faculty of Natural and Agricultural Sciences, "Ovidius" University, Constanța

## ABSTRACT

The paper attempts to present some aspects concerning the natural frame of the mentioned littoral zone and some recommendations for a durable and quality development especially for pleasure and balneary tourism field. After a short description of the natural frame of the mentioned littoral zone are presented the known pollution factors especially in the north part of the investigated zone and the negative anthropic actions which affected for a long time the terrestrial and waters environment, next to the coast. The numerous constructions transformed Mamaia in a small town with negative impact on the green spaces, considerably reduced in the last years. Important is another negative impact factor, the land clearing of the *Eleagnus angustifolia* L. skirt from the sand beaches upper-water mark. At last are presented some concrete measures which may be taken to extend the green spaces to limit the pollutants emission in the north part of the investigated zone.

Key words: pollution factors, durable development, civil and industrial buildings, *Eleagnus angustifolia*

## INTRODUCTION

The climatic conditions in the researched area: Mamaia North – the town of Navodari. From the thermal point of view, the annual average temperatures in the Romanian coastal area oscillate between 11.2°C (in northern Dobrogea) and 11.5°C towards the south, according to the data in the meteorological Registry of the stations Sulina and Mangalia. Because of the marine influences, there is a tardiness of the warming and cooling of the air in the annual evolution of air temperature in the coastal area. In autumn it is warmer, while in spring it is colder than in central Dobrogea, the average temperature being 3 - 4.5°C higher in October compared to April. The summers are very hot, while the winters are moderate (Iancu, 1966). In the coastal area, the values of the global solar radiation are the highest in the country, of over 125 kcal/cm<sup>2</sup>/year.

The annual rain average in the coastal area varies between 350-400 mm/year, but there are also years when these values rise considerably, without exceeding 700 mm, not even in the most rainy years. In the dry years, the rain values can drop under 250 mm/year. The heaviest quantities of rain fall in April and May, September and November. A low level of rain occurs in July and August. In winter, the layer of snow lasts for very little time, registering thus the smallest number of days with snow layer (24). The annual average of snowy days does not exceed 13.

On the littoral, the N, NE and NW winds dominate, as they are under the influence of the pressure centers in northern Europe. If we take into account the monthly values, there is an increase of the wind frequency in autumn and winter and a decrease for the rest of the year. The average wind speed is 3.8 m/s in Mamaia-Constanta. In winter (December-February), the highest value of wind speed is recorded on the littoral (8-15 m/s in Constanta). In what regards the daily variations, wind

intensifies at noon and reduces its intensity during the first hours of the morning.

## MATERIAL AND METHODS

The measurements made over the past three years followed the concentration of various air pollutants which have still not been done inside to the Company, but in the Navodari city, specifically at the entrance to it from Mamaia, including camp Navodari for children and students.

Were analyzed, mainly immission concentrations of pollutants in areas related to the two chemicals objectives from Navodari zone (Fertilizer Company and Petrochemicals Unit Complex), with repeated measurements. Assessment of air quality in areas close to the two industries followed by daily measurements of gaseous compounds: NO<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, CO and fine particulate solids existing with a mobile laboratory equipped with a modern analysis. This equipment monitoring air immission concentrations is composed of four performance analyzers and a weather station connected to a PC, with the possibility of on-line tracking of various concentrations of pollutants (Holloway, 2005, Pereira, 2007, Pires et al., 2008a, b).

## DISCUSSION

The studied area, between the North of Mamaia resort and the town of Navodari, has known lately a strong economical and social development through the numerous touristic facilities (hotels, villa complexes, restaurants and entertainment locations) that will make this littoral portion a second resort, practically linked to Mamaia, a continuation of it all the way to the town of Navodari (Figs. 1, 2).

It is known that Navodari has had a strong economical development beginning with the 1960s, as two important industrial objectives were established

here: the first was “The Chemical Fertilizers Complex” such as Superphosphate and its annexes, the factories that produced sulphuric acid and phosphoric acid and the second was “The Petrochemical Complex: at Cape Midia Navodari.

Both offered jobs for numerous local people, for many technicians and specialists from other places, the town becoming known all over the country and not only. But these industrial units, apart from their positive side, have also represented major sources of water, air and soil pollution. And all these negative anthropic impacts

took place in the neighborhood of the most representative Romanian resort at the Black Sea – Mamaia – including the Navodari children camp in the north of the resort. Due to the fact that “The Chemical Fertilizers Complex” has been the main polluter of the area we are interested in and it is still a point of interest for environmentalists, we will insist on this element, leaving the “The Petrochemical Complex” only for the air pollutants that reach the town of Navodari and northern Mamaia.



Fig. The map of the studied area



Fig. 2. The North-Mamaia beach area

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In order to understand better and facilitate a comparison with our data, we will try to remember briefly, by means of figures and tables, the situation caused by “The Chemical Fertilizers Complex” before 1999 (Environmental Balance - level 1 and 2, 2006).

Thus, the flow of waste water discharged into the sea by this combination was about 3000 m<sup>3</sup>/h. Daily and annual value of the monitoring data has been the following: phosphates - 6300 kg/day (2000 tons/year); fluorides - 6300 kg/day (2000 tons/year); sulphates - 58,000 kg/day (19,000 tons/year); calcium - 41,000 kg/day (13,000 tons/year) and 3200 kg/day (1000 tons/year) for different suspended particles (Table 1).

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The phosphoric acid plant had been generate the greatest flow of waste water, approximately 2200 m<sup>3</sup>/h, which must be neutralized and discharged to a large dam on the southern Port of Midia at 2 km from shore.

Operation of all manufacturing plants from Fertilizer Company, but particularly that of sulphuric acid plant, has been generate a significant pollution of the atmosphere gas rich in oxides of sulfur (SO<sub>2</sub>, SO<sub>3</sub>) and fine particulate matter from the pyrite cinders.

Annually, on the air it was removed 6000 t SO<sub>2</sub> and 300 t SO<sub>3</sub> at the stops and restarts of chemical fertilizers plants, the quantities of such gases and ash of pyrite increased more often they reach, with the wind, in the Navodari City to the camp of children and students on the bank of the Black Sea.

**Table** The average values representative flow of phosphates, fluorides, sulphates, calcium and various suspended particles of sewage discharged into the sea from Chemical Fertilizers Company, until 1999 year.

No.	Chemical species	Average value (kg/day)	Average value (tones/year)
	Phosphates	6300	2000
	Fluorides	6300	2000
3.	Sulphates	58000	19000
4.	Calcium	41000	13000
5.	Suspended particles	3200	1000

Children were presented in several such situations, negative symptoms and breathing more difficult. In this area, soil and groundwater were heavily affected to the phosphogypsum and the pyrite cinders deposits, which are all stored in the settling tanks, respectively depositions close Fertilizers Company. Similarly, manufactured acids deposits (storage tanks of different acids produced in Company) and infiltrate into the soil leading to a major pollution of groundwater.

Groundwater water analysis conducted by drilling inside the Company during 1997-2000, showed a situation of contamination very high (Table 2):

- sulphates - from 3500 mg/L to 1850 mg/L - vs. the maximum admissible concentration (M.A.C.): 400 mg/L
- phosphates - from 122 mg/L to 6.4 mg/L - vs. M.A.C.: 0.5 mg/L
- fluorine - from 86 mg/L to 8 mg/L - vs. M.A.C.: 1.2 mg/L

**Table** Values of obtained concentrations from the analysis of groundwater from the Company of Chemical Fertilizers Navodari (1997-2000).

No.	Chemical Compunds	Concentration [mg/L]		Maximum admissible concentration (M.A.C.) [mg/L]
		Min.	Max.	
1.	Sulphates	3500	1850	400
2.	Phosphates	122	6,4	0,5
3.	Fluorine	86	8	1,2

Latest environmental balances achieved in 2000 year to the Fertilizer Company apprise the following issues:

- significant pollution of the soil with sulphates, over the alert threshold from activities conducted in the past
- significant pollution of soil and micro-nutrients present in pyrite and them ashes, including some health hazardous heavy metals (lead, arsenic, copper, zinc, selenium)
- hazardous air pollution made especially technologically outdated facilities that were up in early 1997
- Company area significant pollution of the subsoil and groundwater aquifers

All these issues point out to present the area of chemical fertilizers a “serious risk” and the area around the impact of its, like as “moderate risk”. As a result of this critical situation, the new owner of the Company in 2004 (SC. Marway Festilchim Navodari) a taken that first step off the manufacture sulphuric and phosphoric acid, old outdated facilities were dismantled entirely, reducing the massive pollution. Currently, the Chemical Fertilizers Company Navodari operates to a manufacturing superphosphates plant and a line of granular triple superphosphate.

Measurements made over the past three years, in collaboration with local Environmental Agencies, of the main pollutants emitted by the Company activities present a real improvement of the situation. Thus, NO<sub>2</sub>, SO<sub>2</sub>, CO and particulate matter in the atmosphere, the

concentration values determined at the children camp and Navodari entry into the city Navodari very small differences between samples taken during the day, at least twice each month on during 2006, 2007 and 2008 years. The fact is that the obtained values are below the European and national as indicated in the Table 3. It can be seen that for NO<sub>2</sub> minimum values vary between 0.0015 mg/m<sup>3</sup> in July 2006 and up to 0.0948 mg/m<sup>3</sup> in March 2007, well below the limit required by EU: 0.14 mg/m<sup>3</sup>

At minimum SO<sub>2</sub> values are often 0 and maximum not exceed 0.0801 mg/m<sup>3</sup>, a value recorded in May 2007, located at the limit imposed by the EU (0.075 mg/m<sup>3</sup>).

The values recorded for CO varies between 0 (rare) and reached a maximum of 4.142 mg/m<sup>3</sup> as the EU limit has the maximum 7 mg/m<sup>3</sup>. Regarding H<sub>2</sub>S concentration, were measured minimum values of 0 and a maximum of 0.0074 mg/m<sup>3</sup>, a value much lower than the EU limit (0.075 mg/m<sup>3</sup>) (Directive, 2002, Directive, 2008).

The solid particles in suspension, with 10 µm in diameter (PM<sub>10</sub>), were recorded minimum value of 0.007 mg/m<sup>3</sup> (October 2006) and maximum 0.189 mg/m<sup>3</sup> which exceed EU limits of 0.05 mg/m<sup>3</sup>. Most measurements are below 0.05 mg/m<sup>3</sup> mainly after 1 January 2007, when it has exceeded the value 0.05 mg/m<sup>3</sup> (Table 3).

Other tests performed inside Chemical Fertilizers Company by Agency Environmental Protection Constanta in the same period show different concentrations of pollutants in emissions compared to those recorded for immission concentrations analysis reported in urban areas.

**Table** Concentrations of inorganic pollutants in the registered immissions of Navodari camp of children and students and the entry into Navodari City (2006-2008) compared with the permissible limits of European environmental legislation.

No.	Chemical species	Concentration		Limit values for human health * (European limits) ** [mg/m <sup>3</sup> ]
		Min. [mg/m <sup>3</sup> ]	Max. [mg/m <sup>3</sup> ]	
	NO <sub>2</sub>	0,0015	0,0948	0,14
	SO <sub>2</sub>	0	0,0801	0,075
	H <sub>2</sub> S	0	0,0074	0,075
	CO	0	4,1412	7
	PM <sub>10</sub>	0,011	0,1891	0,05

Thus, for the hot gases generator from Fertilizer Company, the values reported in 2008 showed minimum values for NO<sub>2</sub> of 35.56 mg/m<sup>3</sup> and 89.78 mg/m<sup>3</sup> maximum, all under the limits set by Directive 462/1993 of 450 mg/m<sup>3</sup>. For SO<sub>2</sub> values range from a minimum 24.89 mg/m<sup>3</sup> to 82.75 mg/m<sup>3</sup> maximum limits under the same Directive 462/1993, 1700 mg/m<sup>3</sup>. Values determined for CO varies between 0.053 mg/m<sup>3</sup> and 0.128 mg/m<sup>3</sup> - well below the imposed limits of 170 mg/m<sup>3</sup>.

Regarding last analysis on total suspended particulates during 2008 were determined concentrations ranging from 0.148 mg/m<sup>3</sup> to 1.52 mg/m<sup>3</sup> when the maximum admissible concentration according to STAS

12574/87 is 0, 5 mg/m<sup>3</sup> in 24 hours as an average but below 0.5 mg/m<sup>3</sup>.

In parallel, the Environmental Protection Agency Constanta verified by drilling more in the perimeter Company concentrations especially phosphates and sulphates in water groundwater. They have shown that there is an increased pollution of groundwater, sulphates having values 6 times higher than permissible limit and phosphates by approximately 4 times higher than the values allowed by environmental legislation.

**2.2.** A second aspect we wish to approach in this paper is the necessity for sustainable development in the area between the north of Mamaia resort and the town of

Navodari, with a particular reference to the littoral zone (of balneal interest). Already this area has known a well-deserved touristic development by the construction of numerous hotels, restaurants, villa complexes and other facilities for a modern and diversified tourism in terms of recreation and entertainment possibilities.

The wish of many investors to build fast, forcing sometimes the hand of the Constanta City Hall (Mamaia belongs to the city of Constanta), as well as Navodari City Hall, has led many times to the breaking of the law or to the evasion of a large part of our legislation that

deals with these aspects. It is known that in October 2000, our country signed the “European Landscape Convention,” whose purpose is to ensure sustainable development based on the balance between the socio-economical needs and the environment, considering the landscape an important component of the general interest at ecological and environmental level. In the Convention, chapter 6 details the issues of landscape organization and maintenance: of the natural, rural, urban and peri-urban spaces.

**Table 4.** Comparative data concerning the green space surface and the institutions and logistics afferent areas from Mamaia resort between 1999 and 2007.

Year	Category	Area (ha)	Percentage (%)
1999	Total area	284.71	100
	Green space	116.328	40,86
	Afferent zone aferent of institutions and logistics	108.582	38,14
2007	Total area	282.19	100
	Green space	28.21	10
	Afferent zone aferent of institutions and logistics	172.14	61

Thus, Mamaia and the new resort that is born between Navodari and Mamaia needs well organized green spaces, sufficient for the numerous tourists that arrive in summer (Mamaia alone has a capacity of over 10 000 tourists). The Government Decree 114/2007 stipulates about 26 m<sup>2</sup> of green space per capita. Is this provision respected in the area? We believe it is not (Iliescu, 2003). For example, for Mamaia resort, a comparative situation between 1999-2007, offered to us by Urban Comfort Constanta, comes to support our opinion (Table 4).

Thus, in 1999, the green space was approximately 116.328 ha, which is about 40.86% of the entire surface of the resort. In 2007, only 28.21 ha were left, which represent 10%. No comment... and if we were to measure again now, in 2009, there is no doubt that the green space represents under 10% of the resort surface. It is important to mention that before 1989 the green surface in Mamaia exceeded 60%.



A



B



C

**Fig. 3.** Blocks of flats in North-Mamaia resort (A-C)

Without a doubt, it is good that new hotels and restaurants were built, as well as new villa complexes. However, why were blocks of flats built in the northern part of Mamaia since they have nothing to do with tourism and they transform this area in a kind of district of Constanta, instead of remaining a touristic resort? (Fig. 3, A, B).

Moreover, here and there in Mamaia and in the north of Mamaia, buildings were built on the beach, right on the shore near the water edge (restaurants and hotels) (see Figure 4, A-C).

A similar situation cannot be found anywhere else in the world. Only here it is possible, in spite of interdictions in this regard according to the following norms:

- the law of authorizations for buildings on the littoral beaches 50/29.07.1991;
- the law for the protection and authorization of buildings on the Black Sea coast (including Mamaia), no. 597/31.10.2001, with the modification of art. 4 of this law by the Government Decree no. 32/2006.



A



B



C

Fig. 4. Constructions on the beach near the sea water (A-C)

Why is the law not respected, why is this permitted to individuals whose only law is money? After 1900, when Mamaia resort was projected, specialists in landscape architecture also designed two special parks: in front of the Casino in Mamaia, whose initial destination is almost completely changed and a second one in front of Hotel Rex, which maintains its original purpose. No one knows till when...

Specialists at that time also planted along the street limit of the beach, a skirt of *Eleagnus angustifolia* (Russian olive), a tree species that develops very well on sandy soil and fixes the sand, not allowing it in winter or when there are strong winds, to be blown on asphalted streets, on green spaces or in the hotels and restaurants nearby. They were a kind of natural protection against sand. These trees have been cut since before 1989 because it was believed that some indecent activities took place in these bushes. Thus, the sand began to invade the

resort in the areas where deforestation had taken place. In the spring, the citizens of Constanta were taken out to perform patriotic duties, to use shovels and wheelbarrows to bring the sand back to the beaches.

Mindless work! At some point, realizing their mistake, the party members asked specialists who informed them of the role of the tree skirt and thus the deforestation was stopped. Unfortunately, this deforestation continues today because of some “enterprisers” who, without any authorizations (from the City Hall or any environmental agency), cut the tree skirt mercilessly in order to set up some restaurants, pizza places or other booths (Figs. 5, A-C).

The question is who must stop and penalize these “enterprisers”? However, over the past few years, Constanta City Hall has begun to replant *Eleagnus angustifolia* and this action must intensify in the future in order to cover the barren portions.



A



B



C

Fig. 5. The *Eleagnus angustifolia* L. skirt deforestation (A-C)

## CONCLUSIONS

1. Based on the information provided, the following conclusions were made:

- by comparative analysis of the data presented on the existing chemical pollution in the area Mamaia North and the town of Navodari activity that have the principal source the two Chemical Company: the chemical fertilizer production and the processing of crude oil, does not affect the quality of environmental factors in general and in especially air.
- data presented as compared with those of the Agency of Environmental Protection are near Constanta, which certifies keeping control of air pollution. For fluorine, the amounts emitted into the air are below the maximum allowed, according to tests made in the final chimneys of gas installations from Chemical Fertilizers Company.
- regarding technological sewages of Chemical Fertilizers Navodari are neutralized and reused in the technological process, so it is worthy to note that they have not been discharged into coastal marine waters, there were recycled in plants like as water cooling process.
- the measurements of groundwater for drinking made have shown that water pollution of groundwater canvas decreased obviously compared to the past years but still exceeded the content of sulphates, phosphates, and even fluorine, which confirm the existence of a strong pollution - pre (historical) specific

activities conducted previously in Fertilizer Company

- analysis conducted for the quality of soil and subsoil Company both inside and outside his still exceeded the normal values of Pb, Zn and Cu, and obviously there is a remaining legacy - historical pollution - which still makes its effect. They were common at that time large quantities of raw materials: phosphates, pyrite cinders, sulphates, etc.

2. The urgent elaboration of an urban plan for the sustainable development of this area. It should stipulate to:

- stop the construction of blocks of flats which would lead to the transformation of the littoral zone from a touristic resort into a residential district of the city of Constanta.
- stop the building of permanent constructions of any kind on the beach near the water edge. Exceptions are the beach-bars and the temporary buildings for the summer.
- continue the building of modern hotels, villas, and places for entertainment, bathing, sports, beaches, etc, such as the AquaLand built in the south of Mamaia.
- to design and arrange green spaces with ornamental trees and shrubs acclimatized to the littoral (plane trees, maple species, *Catalpa bignonioides* Walt.) linden trees, Russian olives – which fix the sand, other willow species, boxthorn, *Hibiscus syriacus* L. etc), lawns, with colorful flower beds.



- to continue to plant protection tree skirts at the edge of the beach in order to fix the sand and prevent it from being blown by strong winds over the green spaces or in hotels.
- to gradually replace the poplars from the old part of Mamaia because their considerable bloom in May and June is dangerous for allergic people and plant instead rapid-growing trees with pleasant aspect.

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\*Directive 1993/462/RO - Technical conditions concerning the atmosphere protection and the Methodological standards concerning the analysis of the atmospheric pollutants produced by stationary sources.

\*\*Directive 2002/592/RO - the Normative for determination of the limit values, threshold values and criteria and methods for assessment of sulphur dioxide, nitrogen dioxide and nitrogen oxides, particulate matter (PM<sub>10</sub> and

PM<sub>2,5</sub>), lead, benzene, carbon monoxide and ozone in ambient air.

\*\*\* Directive 2008/50/EC on ambient air quality and cleaner air for Europe.

\*\*\*\* Environmental Balance - level 1 and 2, Chemical Fertilizer Company- Navodari. 2006.