THE IMPACT OF THE INDUSTRIAL PROCESSING ACTIVITY OF THE OIL AT S.C. ARPECHIM ON THE AIR QUALITY

Emilia POPESCU[1*], Marian POPESCU [2†], Mihai Lucian MĂNOIU[3‡]

[1]Faculty of Economic Sciences, University of Piteşti, Romania
emilia.popescu@yahoo.com

[2]Faculty of Economic Sciences, University of Piteşti, Romania
marian.popescu@yahoo.com

[2]Faculty of Economic Sciences, University of Piteşti, Romania

***Abstract**: The atmospheric air is the main component of the surrounding environment directly involved in the pollution phenomenon. Together with the other sequences of the biosphere it represents a prior element for maintaining life, for keeping its natural quality, representing a major objective for human communities. As Barde I. Ph., Economie et Politique de l'environment, P.V.F. Paris 1992 showed, we can talk about air pollution when the presence of a foreign substance from its normal composition, or the variation of its natural components, in important proportions, are susceptible to determine a harmful effect or to create a prejudice or discomfort. The European Council environmental protection Committee stated even since 1967 that a normal constituent of the air must be considered pollutant when its concentration exceeds the normal background with 0, 03%.*
The purpose of the present work is to analyze the pollution degree of the environment (air) generated by S.C. ARPECHIM in the areas of Pitesti – Environment protection agency, Pitesti – Stadium, Pitesti – Prundu neighborhood, Bradu, Oarja, Topoloveni, Stefanesti – Valea Mare.

***Keywords**: pollutants, chemical compounds, industrial processing, monitoring, quality indicators, emission concentration, monitoring*

JEL Classification codes: **Q530, L500**

1. INTRODUCTION

The main sources of the atmospheric air pollution are:

- industrial pollution;
- pollution generated by transports;
- agricultural pollution;
- anthropogenic pollution due mainly to combustion.

The pollutants generated in the atmosphere from these four categories of pollution sources, can be classified from a chemical point of view as follows, as Vivien F.D., Economie et ecology, Editions La Deconverte, Paris, 2002, mentioned:

- gases or inorganic substances comprising:
  - ➢ sulfur oxygenated derivates: sulfur dioxide and trioxide, sulfuric acid, sulfates;

[*] PhD Professor
[†] PhD Professor
[‡] Master student

- oxygenated derivatives of nitrogen: nitrogen oxides, nitrous and nitric acid;
- other inorganic pollutants: lead derivatives, ammonia, hydrogen sulfide, chlorine, etc.

- gases or organic substances comprising:
  - saturated and unsaturated aliphatic hydrocarbons, cyclic, aromatic, polycyclic condensed;
  - aldehydes and ketones: formaldehyde, acrolein, acetone
  - other organic pollutants: alcohols, mercaptans, chlorinated derivatives, various compounds with complex and undefined structure.
- aerosols comprising:
  - solid particles as smoke, dust;
  - liquid particles as oil fog, tars, entrained droplets etc.

This particularization of the emissions illustrates the special complexity of the atmospheric pollution, where the great number of pollutant substances is in close connection with the simultaneous presence of several chemical compounds, with different generation sources, the interconnection between chemical compounds having a prior place (Bran P., 2004).

Worldwide, the data regarding the quality of the air is studied by WMO (the World Meteorological Organization) within the program „Background Air Pollution Monitoring Network" and on national plan, by INMH in collaboration with the county environmental protection agencies.

It is known that any constituent of the surrounding environment has influence on human and animal health due to a close relation, as showed by NEGULESCU M. and collaborators, in "The surrounding environment protection", Technical Publishing House, Bucharest 1995.

In this context, the impact of the irritating, suffocating or allergy pollutants, as well as the toxic ones from the atmosphere, affects mainly the respiratory and cardiovascular system provoking most of the times chronic intoxications leading in the end to a morbidity and mortality increasing.

The effect of the pollutants on the living world cannot exclude the plants which are directly influenced by the presence of emissions in the atmosphere. It must be underlined the fact that generally, the inorganic substances have a more accentuated harmful effect than the organic compounds. (Popescu E., 2005).

2. THE METHODOLOGY OF THE RESERCH.

To reach the purpose of the research an analysis has been done of the specialty literature to identify the main indicators used in measuring the pollution degree.

Thus the following quality indicators were identified:

- sulfur dioxide, STAS limit 0,25, variation domain: 0,0045-0,0972, no exceeding were recorded;
- chloride acid, STAS limit 0,1, variation domain: 0,0040-0,0220 no exceeding were recorded;
- ammoniac, STAS limit 0,1, variation domain: 0,0120-0,0481, no exceeding were recorded;
- azoth oxides, STAS limit 0,1, variation domain: 0,0040-0,0468, no exceeding were recorded;
- aldehyde, STAS limit 0,012, variation domain: 0,0005-0,0056 no exceeding were recorded.

3. THE MAIN ATMOSPHERIC POLLUTANTS AND THEIR ACTION ON PLANTS

The different emissions present in the atmosphere, directly influence the development of the plants as shown by HILL A. Agricultural Ecosystem Effect son Trace Gases and Global Climate Change – Ed. Mc. Graw – Hill New York 1998, who made a classification of the chemical compounds based on their effect on plants:

$$SO_2 > HCI > NO_2 > CO_2 > NO_X > CO$$

Hereunder there are briefly presented the main atmosphere pollutants and their action, as follows:

- **sulfur dioxide**

This occupies a prior place in the atmosphere pollutants class, being released in all the combustions, its generation sources being very different, from the petrochemical industry to the household heating, to waste incineration and nevertheless the increasing contribution of transports etc.

The SO_2 concentrations are constantly fluctuating not only because of the intake variation but also of the air masses movement. The intensity of the sulfur dioxide effect on the surrounding environment is very different depending not only on the concentration, area ecological characteristics, but also on the climate conditions.

Along with humans and animals, the plants are very sensitive to SO_2, with different foliar symptoms, accompanied by damages and drying although the concentration registered in the atmosphere is reduced.

Sulfur dioxide is not a systemic poison, the intensity of the damages that its presence determines depending on environmental conditions.

Recent studies have highlighted how easy the enzymatic systems get out of order, as well as the essential physiological processes, these negative effects being accompanied by a chlorophyll loss up to 40%.

The harmful effects of this emission are fragmented after the level of concentrations as follows:

- in high doses of over 50 ppm towards 0.25 ppm as CMA represents through STAS 12574/87, this chemical compound generates serious, irreversible damages, at the level of the entire plant.

The external symptoms caused by this pollutant is a characteristic one, especially in acute cases where large amounts of SO_2 present in the atmosphere give drops of sulfuric acid on all the organs of the plant, causing burns and white, dried stains, by removing the magnesium in chlorophyll.

In case the sulfuric acid is formed in the atmosphere, the different native resistance of the plants loses its meaning, the phytotoxic effect exceeding the possible resistance limits.

- Small, intermittent doses of SO_2 with chronic character destroy the chlorophyll, the leafs having a mosaic aspect. At monocotyledonous it appears white stripes parallel with the main rib.

The sensitiveness of the plants is different at this chronic pollution, depending on their genetic nature and their physiological state.

Recent physiological studies have demonstrated that there is a difference in sensitiveness between leafs of different ages, variation that is due to height and number of stomata. (Cămăşoiu C.,1994).

It is possible that an atmosphere with SO_2 in reduced concentration, to favorably influence the nutrition of the plant.

For the growing of the plants, the phytotoxic effects prevail on these advantages, which induce the precipitations of the tannins in the leafs, the plasmoliza of the cell content, auxins blocking, magnesium and fitolului hydrolysis of the chlorophyll molecule, the phytohormones impaired balance, etc.

The researches of .C.D.A. – Albota in controlled spaces regarding the effect of certain doses of SO_2 from the atmosphere on white clover, considered as an indicating plant for the pollution level with sulfur dioxide emphasize the following:

- in the option with 0,15 mg SO_2/m^3 in the air, 5% of the plants have their first top leafs damaged, the rest of the plants not being damaged. The burning of the leafs appears like a loss of color arriving at a pale yellow, without necrosis or malformations.
- in the option with 0,25 mg SO_2/m^3 in the air, 20% of the plants had their first top leafs damaged, the first leaf level in proportion of 20%, and the second, in proportion of 15%. The rest of the plants hidden under the leafs of the surface vegetal carpet were not damaged.
- in the option with 0,50 mg SO_2/m^3 in the air, 85% of the plants had the top leafs damaged, the first level being damaged in proportion of 90% and the second level in proportion of 65%.
- in the option with0,75 mg SO_2/m^3 in the air, 90% of the plants were damaged, the first leafs level being damaged 100% and the second level in proportion of 75%. Small plants delayed as growing rhythm and hidden under the surface leafs of the vegetal carpet are damaged only a little, under 10%.
- the option with 1,00 mg SO_2/m^3 in the air, 95% of the plants were damaged. There were not damaged the leaf levels and young sprouts from the base, protected by the vegetal carpet.
- The option with 1,50 mg SO_2/m^3 in the air, all leafs levels are 100% damaged except for the young sprouts at the base.

After 48 hours from the treatment the aspect of the options has not changed and, after seven days from the treatment the young and not damaged plants from each option have redone the clover culture.

The presence of increased amounts of SO_2 in the air, has besides the losing of color phenomenon effect, that is visually noticed, also the effect of reducing dry substance production.

- **ethylene and other organic compounds specific to the plant.**

At the industrial processing of the oil it results a wide range of organic compounds, with very different chemical structures and which, in high concentrations can negatively influence the development of the plants.

So, the ethylene in high concentrations, can cause damages to the leafs or even to the entire plant.

The other chemical compounds that can exist in the atmosphere except for the aldehydes do not show aggression towards the plant because they are found in small quantities.

- **hydrochloric acid**

Another chemical compound, possibly pollutant for the agricultural cultures is the hydrochloric acid, which arises both from incinerations and from industrial activity in the presence of moisture in the air.

The hydrochloric acid present in the atmosphere in concentrations below the phytotoxic limit with a CMA of 0,1 ppm, it has a benefic effect upon plants growing. In high concentration this compound induces the color of the leafs and in very high quantities the plants are affected by necrotic points.

- **ammonia**

The ammonia has on plants a toxicity similar to the one produced by the hydrochloric acid. The limit of the concentration bore by sensitive species, during a long period of time, is of approximately 3 ppm.

- **nitrogen oxides**

The nitrogen oxides present in the air, over the maximum admission concentration limit, can cause to plats chronic intoxications and leafs burns, and at concentrations over 10 ppm, generalized burns appear.

FS – very sensitive SR – reduced sensitiveness S – sensitive R – resistant

- **aldehydes**

One does not have to omit from the study of the atmospheric pollutants the photochemical oxidant pollutants, which generate chemicals compounds that emphasize the toxic character of certain emissions.

Catalytic transformation of gasoline in internal combustion engines is a source of aldehydes, but if they are within the limits quantitatively standardized, do not have a harmful effect on plants.

On the other hand, in the incomplete burnt organic combinations, resulting in exhausting gas, there are also the aldehydes, which in the presence of solar radiations initialize reactions, leading to more toxic and irritating compounds than the initial aldehydes.

If in the air there are also lower valence nitrogen oxides, which happens frequently, when the pollutant gases come from internal burning engines, the aldehydes can react with these, leading to chemical compounds of type PAN, very toxics and carcinogenetic. (Nicolae A., 2004). These aspects regarding pollutants and their effects on plants have been synthesized in Table 1.

Table 1. Pollutants and their effects

Nr. crt.	Plant	Pollutant		
		SO_2	HCI	NO_X
A	**CEREAL**			
1	wheat	SR	SR	S
2	barley	FS	S	S
3	oat	S	S	S
B	**FODDER PLANTS**			
1	clover	FS	FS	S
2	alfalfa	SR	SR	S
C	**VEGETABLES**			
1	cabbage	R	R	-
2	beans	SR	SR	S
3	pepper	R	SR	-
4	Cucumbers, zucchini	SR	-	-
5	tomatoes	R	R	-
6	onion	R	R	-
D	**DECORATION PLANTS**			
1	lilac	R	S	-
2	rose	SR	SR	SR
3	carnations	SR	SR	-
E	**FRUIT TREES**			
1	fleshy fruits	S	S	S
2	dried fruit	SR	S	SR
3	nuts	S	S	S
4	grape vine	FS	S	S

4. DETAILING ON STATION POINTS OF THE PARTICULAR ASPECTS REGARDING AIR QUALITY

The chemical- analytical data obtained underlines the following aspects.

- the modifications of the concentrations are presented under the form of variation fields for: hydrochloric acid, ammonia, nitrogen oxides, sulfur dioxide, aldehydes, phenols, carbon monoxide;

- the dispersion in the air of the analyzed emissions follows at different levels the one of the wind vector
- the emission concentrations monitored were much below the admission limit by STAS 12574/87.
- approximately equal phenol contents on the entire monitor space which indicated the fact that they do not come from the industrial processing activity of the oil;
- sulfur dioxide is closely following the wind vector. The highest concentration of these emission was registered in May 2010 at Oarja, but below the maximum standardized limit, and the lowest one at the Stadium in September 2011;
- the variation fields of the ammonia and the hydrochloric acid indicate also the existence of other generators than the industrial processing activity of the oil, the highest concentration not being correlated with the direction of the wind.
- the increased contribution of the internal combustion cars traffic to the atmosphere pollution
- the air quality indicators situated at maximum level were register at Pitesti - Environmental Protection Agency which indicates an increased contribution of the cars to pollution
- towards 2010, when it had been performed an air quality monitoring, in 2011, this has improved significantly following SO^2 content reduction.

The quality of the air in each station - point has a certain particularity, well defined, through which it is performed a classification of the effect of the industrial processing activity of the oil on the surrounding environment.

In this context, hereunder there are detailed on station - points certain particular aspects regarding the quality of the air, namely:

- **Piteşti – The Environmental Protection Agency**

In this station - point the monitoring of the air quality during the warm period of the year indicates:

- the standardized concentrations were not exceeding, except for the carbon dioxide content in May 2010;
- the SO2 content has registered a decreasing tendency from spring towards autumn, from July being almost constant;
- very reduced content of phenols and aldehydes, at traces levels most of the time;

- **Piteşti – Stadium**

The monitoring data of the air quality in this station - point reveals the following aspects:

- the amount of the chemical compounds tested are much below the maximum admissive limit, the highest emissions coefficients being registered at NO_2 and NH_3;
- the emissions coefficients had a decreasing tendency from spring towards autumn, thing also confirmed by the very reduced modifications of the general pollution coefficient.
- phenols were present in the atmosphere in very reduced amounts, their presence in the air being a consequence of increasing vehicles traffic.

- **Piteşti – Prundu**

In this station - point the monitoring of the air quality during the warm period of the year indicates:

- during the entire investigated period there were not registered exceeding of the chemical compounds concentrations taken into consideration in the study, the emissions coefficients being situated in a subunit field.

- the highest emissions concentrations registered in the warm period of the year, but which were below the standardized admissible maximum limit, were for ammonia.
- it is interesting to be noticed the fact that in June, considered a very polluted month, the evolution of the main monitoring emissions indicates a tendency to diminish
- the phenols were dosed in small amount, way below the standardized limit, which indicated the fact that by the oil industrial processing the atmosphere is not polluted with this emission.

- **Bradu**

Sampled in an amount of 15 samples per day, the quality of the air at Bradu presents the following aspects:

- the air was quite with impurities during the warm period of the year, the highest emission coefficients being registered at aldehydes and sulfur dioxide in July, then the concentration of these compounds decreased in September, but not up to spectacular levels;
- all the possible pollutant tested were below the standardized maximum admissible limit;
- certain chemical compounds as ammonia and aldehydes have diminished quite a lot, twice in September towards July;
- the variation fields are quite high for all the chemical compounds tested;

- **Oarja**

The chemical - analytical data obtained after testing the quality of the air in this station-point, indicates the following aspects:

- the atmosphere was not polluted, the concentrations of chemical compounds considered emissions, being much below the maximum admissible limit, except for May 2010 when the sum of the concentrations of the system ($NH_3 + NO_2 + SO_2$) was over the standardized value;
- the concentrations of the main possible pollutants, specific to the activity of the plant, have registered uneven variations;
- the highest concentrations were registered at SO_2, the emission coefficients being at very reduced levels in 2011;
- the emission coefficients had quite reduced values towards the others plant points;
- the emission coefficients of phenols and aldehydes were situated at quite high levels towards the other plants point;
- the quality of the air from this station point registered improvement at the end of the monitoring period;

- **Topoloveni**

The air samples taken in this station point underlines the following:

- whether it's about chemical compounds specific to the plant or to the human community activity, the emissions have registered quite reduced coefficients, way below the maximum admissible limit, only the sulfur dioxide having a higher value, but below CMA.
- in the case of phenols, these have registered quite low values, even the maximum values were far away from the maximum admissible limit;
- the emission coefficients registered indicate a cleaner atmosphere.

- **Ştefăneşti – Valea Mare**

In this station point upon analyzing the quality of the air the followings are to be noted:

- low emission contents, way below CMA and more reduced than in other station points from the area;

- the highest emission coefficient and concentration were registered at sulfur dioxide.
- the phenols and the aldehydes registered emission coefficients below the standardized value;
- the emission coefficients for the compounds tested have a quite constant value, situated at reduced levels during the monitoring period. On the one hand, this proves that the atmospheric air was not polluted, and on the other hand it illustrates the fact that the existent emissions are not due to the activity of the plant but have another generator.

With the help of the emission coefficients established based on the concentrations it was calculated a pollution coefficient for the system (NH_3 + NO_2 + SO_2), the substances having a synergic effect on the surrounding environment. (Ionescu C., Manoloiu M., 2000).

By putting on a diagram the modification of the pollution environmental coefficient, on months and station points, in Figure 1, the following aspects are noticed:

- the representation on the diagram, under the form of a "radar" of the synergic indicator for pollution for the system (NH_3 + NO_2 + SO_2) is more adequate for the illustration of the general tendencies of evolution of the quality of the air and of dispersion of the pollutants in a larger space, as the one monitored in this study;
- nitrogen oxides and ammonia are not emissions specific to the industrial processing activity of the oil but to transports, agriculture and animals breeding;
- the existence of a direct connection between the quality of the air, represented by the monthly average indicator for pollution for the substances that action synergic (NH3 + NO2 + SO2), the direction of the wind and the amount of rainfall;
- the average monthly indicator of the air pollution for the system (NH3 + NO2 + SO2), is generally situated in a variation field below the standardized limit of STAS 12574/87. During the month of May 2010 at Oarja and August 2010 at APM there were registered exceeding in a field of over 10%.
- monthly variation fields almost equal of this indicator, regardless the station point monitored;
- the increasing area tendency of this indicator towards the South – West of the areal at the beginning of the monitoring period, so that in 2011 the accumulation of the emissions to take place especially in the city;
- the poorest quality of the air from the monitoring area was registered generally in June;
- in the area Prundu – Ştefăneşti – Călineşti, the general pollution indicator for the system taken into consideration has registered the lowest values, the quality of the air being superior towards the area Bradu- Oarja.

Comparing this data with the values obtained in 2010 and presented in Table 2, it results the complex effort and especially the financial effort made by S.C. Arpechim to improve the quality of the air at the above mentioned levels.

Table 2. Quality indicators in 2010

City	SO_2		HCL		Atrazine
	Medium Conc.	Emissions coef.	Medium Conc.	Emissions coef.	
Piteşti – Prundu	0,057	0,228	0,2130	2,13	0,0116
Albota	0,074	0,296	0,1793	1,793	0,0022
Bradu	0,041	0,164	0,2117	2,117	0,015
Oarja	0,096	0,384	0,2113	2,113	0,008
Ştefăneşti	0,051	0,204	0,1265	1,265	0,0111

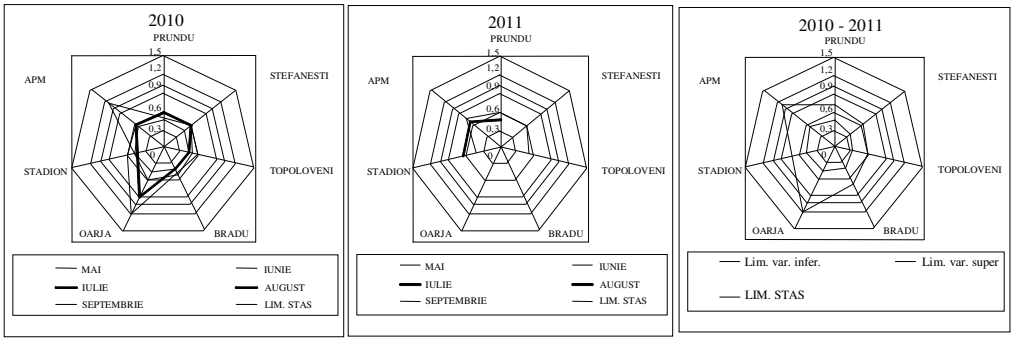

Figure 1. Monthly variation of the SYNERGIC ACTION INDICATOR for the air of the influence area of S.C. Arpechim, between May – September 2010- 2011

5. CONCLUSIONS

Conclusions regarding the scientific research performed at S.C. Arpechim

This study of the environment from the influence area of S.C. Arpechim is extremely complex due to the multiple aspects monitored starting from air, rainfall, plants, soil and water wells.

It was tried the quantification of the modifications of SO_2 and HCI content from the system air – rainfall – soil.

The atmospheric air represents the main component of the surrounding environment directly involved in the pollution phenomenon, constituting together with the other sequences of the biosphere a prior element for maintain life.

The quality of the air tested according to STAS 12574/87, through the determinations of hydrochloric acid, aldehydes, ammonia, nitrogen oxides and sulfur, phenols and sediment particles, was monitored between May- September 2010-2011 in the following station points Piteşti – The Environmental Protection Agency, Piteşti Stadion, Piteşti Prundu, Bradu, Oarja, Topoloveni and Ştefăneşti Valea Mare.

- **The sources of the emissions present**, which can pollute the air are various:
  - anthropogenic activity.
  - industrial activity.
  - transport.
  - climatic conditions.

- **The emission concentrations** and the quality of the air depend directly of the rainfall and in the wind direction;

- The accentuated and uneven variations of the emissions and of the emission coefficients;

- **The emission concentrations monitored,** were way below the CMA limits according to STAS 12574/87, during the entire researched period and in all the station points.

- The highest emission content present in the air was registered at Pitesti the Environmental Protection Agency in June and September and the most clean air was at Pitesti Stadium and Bradu in September and at Oarja in June when the general pollutions coefficients registered an almost identical value, slightly over 0,4.

- **The dynamic evolution of the average monthly coefficient** of air pollution for the synergy system $NH_3 + NO_2 + SO_2$, in the influence area of the industrial processing activity of the oil by S.N.P. PETROM Bucureşti - Sucursala Arpechim – Piteşti clearly demonstrates that the AIR IS CLEAN, the emissions specific to the plant being way below the CMA limits accepted by STAS 12574/87.

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