

QUANTIFYING AIR POLLUTION COST

PR. Hassine DIMASSI

Faculté de droit et des sciences économiques et politiques de Sousse

M.A. EL Weriemmi Malek (to contact)

Malek.Elweriemmi@isaeg.rnu.tn

Directeur de l'Institut Supérieur d'Administration des Entreprises de Gafsa

Assistant Amara Tijani (to contact)

Institut Supérieur d'Administration des Entreprises de Gafsa

[Tijani amara@yahoo.fr](mailto:Tijani_amara@yahoo.fr)

SUMMARY

This article provides an estimation of the health damage cost of air pollution in a chemicals industrial factory. For morbidity cost, our estimates are a lower limit because they take into account only those impacts (hospitalization, doctor's visit and sick leave) and costs (treatment costs and loss of productivity) for which we found data.

In its first part, this paper makes a fast presentation of the theoretical concepts of pollution. It presents then in the second part, the ground of research, the method used for the evaluation of the medical damage and the results obtained while stressing the importance of the principal objective represented by the measurement of the real cost of the harmful negotiable instruments of the pollutants on human health.

Key Words Air Pollution cost, chemical, costs external, the evaluation of the damage, mortality, impact on health, uncertainty, industry.

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INTRODUCTION

The responsibility for the industrial firms in the degradation of the ecosystem is not any more to show and all the concerned ones today largely relay on it. The problems involved in the air pollutions are not recent. For a few years, the quality of the air has become the purpose of an increasing number of researches, as well as a subject of debate aiming at highlighting the harmful negotiable instruments of pollution on health and the ecosystems.

To maintain and improve the standards of quality of the air automatically implies the participation of several agents. Thus, the best alternative of industrial technologies forces to take into account their environmental impact, in particular on the public health.

Since the Men gathered in cities, they were confronted with the diseases and harmful effects related to the issued pollutants. However, since the XX 2nd century beginning the disturbance of the natural cycles became new extensive because of exploitation, by the firms, of the fossil resources. Thus, the degradation of the ecosystems passed from a local scale to a total scale, concerning the whole Earth and of its atmosphere.

It is increasingly complex. Because of this complexity, it is difficult to know and estimate perfectly the consequences of the pollutants and the evolution of the ecosystems. The impacts of the current issuing of certain pollutants known and will be felt only by the generations which will follow us what forces the actors concerned to take measures in order to avoid these harmful negotiable instruments.

The three generally identified sectors, as principal sources of pollution are agriculture, industry and transport. Percentage of participation in the pollution of each sector varies according to the environmental problem. We will devote ourselves in this paper to the industrial sector.

More and more, the environmental problems are related to the economic and social components in order to direct the company towards a «durable development ». Thus, the various actors of the company will be gradually positioned on the shares allowing preserving the natural resources. Our study falls under this prospect. However, we will restrict our research with the identification of the impacts of the pollutants also known in the form of externalities on the performance of the polluting firm.

The question which installation is to know how to identify the environmental impacts? The monetary evaluation of these impacts and their incidence on the social performance of the polluting firm? Therefore, the research task, carried out within chemical Group Tunisian-factory of M'dhilla, relates thus to " the occupational diseases due to the atmospheric pollutants: impact study on the performance of the firm ".

In this context, this paper provides an estimation of the damage and the medical costs of pollution (internal and external costs) due to the chemical and the industrial activities. The results are used to answer several significant questions of the environmental policy.

Adopted methodology rests on the costing of the damage. This methodology consists of a step of analysis of the real data received from the various services of the factory and hospitals, the employees and the townsmen through the questionnaire. In this direction we present the various costs related to the damage medical intern and external medical damage generated by the issued pollutants.

With this intention, our study is made up of two parts. The first seeks to show through a thoroughly analysis of the theoretical concepts used and the nature of the ground of research. The second part illustrates, through an empirical study, the estimate of the medical costs intern and external pollutants issued and their impacts on the performance of the firm represented by the loss of earnings to evaluate in physical and monetary unit super phosphate triple.

I. Theoretical concepts used and the nature of the ground of research

1. Air pollution: concepts and negotiable instruments on the performance of the Firm

The air pollution is, in the literal sense of the term, a stain, which affects the air. According to the Kapp economist, pollution is the residue of the manufacturing processes. It represents the negative secondary product. (Kapp.k, 1963, p50) the air pollution is an extremely vast problem. It has consequences often underestimated on pubic health. The air pollution has multiple consequences. It can be harmful on the health of the human beings, the animals, on the development of the vegetation and the state of the materials (UNESCO, 1989, P26)

In the field of the public health, the negotiable instruments of the air pollution concern mainly, but not exclusively, the respiratory system. They are marked on the sensitive populations (children, insufficiencies respiratory, asthmatic, prone allergic, old people). Various symptoms can appear such as respiratory gene, nasal irritation and of the throat, cough, irritation of the eye, etc. The precise knowledge of the negotiable instruments of the air pollution on health proves to be complex for several reasons:

- Diversity of the pollutants;
- Exhibitions multiple and varied individuals;
- Difference in sensitivity between exposed people.

The consequences of pollution are as numerous as the pollutants. They affect the human being itself by the fall of motivation, regard in oneself and its environment. This consequence appears mainly by occupational diseases affecting the profitability of the employees and consequently, the performance of the firm. They can generate negative consequences on the firm represented by the delay or the stop of the production. The occupational diseases, much less spectacular than the industrial accidents, were largely ignored, but represent from now on a strong share of the hoop nets associated with work.

Thus, the occupational diseases present costs for the individuals, the firms and the community. These costs are of two types:

- The direct costs represented primarily by the costs of regulation such as the expenditure of the medical departments and the costs of disturbance such as loss of earnings;
- The indirect costs expressed in term of contributions poured for the gone away patients.

This last type of costs presents much ambiguity either at the level of calculation and estimate, or on the level of lack of real and objective data. Therefore this study is interested only in the direct costs.

2. Description of the ground of research

The commune of M dhilla is located at approximately 18 km of the town of Gafsa in the Western south of Tunisia. With the exception of a bar of horizontal hills in the south of the commune, the vast communal territory is flat. The area is subjected to local dominant winds favourable to a good dilution of the pollutants. The Southern east winds blow approximately

40 % of time over the year. The area of M dhillia consists of four cities: Ennacim, El Amel, El kaous and Essaria. Currently, the factory source of the pollutants is placed at 1 km of the first city and 1.5 km of the second. With the winds often in charge of sands and natural changes of temperature going of 0° with 50°, the quantities of pollutants issued in the air affect the cities mentioned directly below. According to the census of the inhabitants and habitat of 2004, the number of townsmen of the area of M dhillia rose with 16285 inhabitants resident in 2714 habitats and this, with an average of 6 people by household.

3. Sources of pollutants

The factory is located at 4 km of the area of M dhillia. It started since 1981 and the start-up was in March 1985. The principal activity of this factory is the transformation of rough Phosphate into Super Triple Phosphates intended mainly for export. This transformation follows a reactional sequence, which is carried out in three stages, the production of the sulphuric acid starting from the combustion of suffers, the production of the phosphoric acid and finally the production of the TSP witch is made starting from phosphate and of the phosphoric acid

4. Pollutants issued by the factory and their impacts on human health

The risks related to the air pollution are very numerous, at least with regard to the short-term negotiable instruments. The various pollutants of the factory are:

4.1. Suffers and the toxicological characteristics

L' absorption by digestive tract of the dust of suffers in sufficient quantity would have certainly serious consequences on the organisation. Absorption by respiratory tract causes a light irritation of the mucous membranes. The eyes are particularly sensitive to suffer finely divided which starts the whimpering and the irritation of the conjunctive one.

4.2. Phosphate

Fluorinated derivatives are released in a gas state or vesicular under the action of the sulphuric acid on phosphate. The hydrofluoric acid HF is very irritating for the respiratory tracts, its unbearable, prohibited smell any stay in polluted atmosphere and so its consequences go beyond the factory.

4.3. Sulphuric acid and toxicological characteristics

The sulphuric acid presents the dangerous characteristics of the strong acids. In contact with the skin, the sulphuric acid causes burns which gravity is a function of the concentration, the temperature, the time of contact and the importance of surfaces reached. A cold acid causes a light burn and the projection of concentrated acid causes serious burns and sometimes mortals. The sulphuric absorption of acid results in major lesions of the digestive tract followed by an acute peritonitis and death.

4.4. Sulphurous anhydrite and specific risks

It acts mainly on the respiratory tracts and the bronchi causing the pulmonary oedema and the paralysis of the respiratory system. It is also dangerous for the eyes. It causes an irritation and an ignition of the conjunctive one.

4.5. Phosphoric acid and toxicological characteristics

It can cause burns when it is in contact with the skin but the feeling of burns is not immediate. These burns can be serious. It can also cause internal lesions in the event of ingestion. Under the action of heat, it releases from the anhydrite fume, which exerts an irritating share on the respiratory tracts.

5. Monitoring of the quality of the air

In practice, it is useful to define, for the atmospheric concentrations, of the levels to be respected. These professional levels or exposure limit values (VLEP) are allowed limiting securities (VL) in indicative matter in the general case and which represents the concentration in the air of a chemical compound that a person can breathe during a time determined without risk of deterioration of her health, even if reversible physiological modifications are sometimes tolerable. No organic or functional attack is irreversible or prolonged matter is reasonably foreseeable with this level of exhibition. The value is generally expressed in volume (ppm or left per million) or in weight

(mg/m^3) For the lawful limiting securities (VR), they provide quantified reference marks of appreciation of the quality of the air of the places of work but suppose the preliminary development of sampling procedures and of analysis as well as the definition of criteria for the evaluation of the health risks.

Measurements of concentrations of the pollutants in the air taken by the Tunisian agency of the environmental protection into 2007 with the factory are presented as follows:

Dust in suspension
limiting Value: - Percentile 50 of the daily average securities during the year: $80 \mu\text{g}/\text{m}^3$ - Percentile 98 of the daily average securities during the year: $250 \mu\text{g}/\text{m}^3$ Real measurement: $83 \mu\text{g}/\text{m}^3$
Carbon monoxide (CO)
Qualitative aims: Average on 8h: $10 \text{mg}/\text{m}^3$. Real measurement: $12 \text{mg}/\text{m}^3$.
Dioxide of sulphur (SO₂)
Qualitative aim: - $0,5 \mu\text{g}/\text{m}^3$ on average annual Limiting value: - $2 \mu\text{g}/\text{m}^3$ on average annual. Real measurement: $2.4 \mu\text{g}/\text{m}^3$ on average annual.
Plumb (Pb)
Qualitative aim: - $0,5 \mu\text{g}/\text{m}^3$ on average annual Limiting value: - $2 \mu\text{g}/\text{m}^3$ on average annual. Real measurement: $2.1 \mu\text{g}/\text{m}^3$ en moyenne annuelle.

**Table (1) values of reference national into force of the pollutants
Source: Tunisian agency of the environmental protection in 2007**

The results mentioned in the table (1) show that the actual values of the pollutants issued by the factory exceeded entirely the limiting securities fixed by the Tunisian agency of the environmental protection. Thus, the report/ratio of the person in charge for the regional service of the protection of health and the environment dated on December 04 2007 indicate failures to the level of the safety of the employees and townsmen of the area because of the issued pollutants. According to this report we note that dust in suspension is very remarkable on the area of M Dhillia, the absence of the plants within the factory, the

absence of a continuous assessment of the polluting matters within the factory and the absence of the treatment units of dust in suspension within the factory.

Moreover, of the studies were carried out by the persons in charge for the service of health safety within the factory. The objective was to modify the manufacturing processes current with the possibility of increasing the height of the chimneys. These studies showed that the realization is possible but has very high costs. For that, these studies were abandoned. The search for other alternatives according to the persons in charge is in hand. Finally, any visitor with the area of MDhilla can easily identify the existence of the issued pollutants. The latter are visible.

II-Presentation of the method used and the results

1. Method used

Several methods can be used to conclude the medical costing related to the air pollution. However, we limit ourselves in this study to the use of the method of the costs of the damage. This method traces the passage of the pollutants from the place where they are issued until the final impact while following a logical series of stages:

- Identification of the dangers related to the issued pollutants;
- Establishment of the bonds between the dangers and the issued pollutants;
- The quantitative estimate of the medical impacts;
- The monetary estimate of the medical costs related to the issued pollutants.

In order to establish the dangers related on the industrial accidents and the pollutants issued by the factory, this study retains some causes of industrial accidents and their consequences on the workers as well as the indicators of pollution aimed by the Tunisian agency of the environmental protection clean to the monitoring of the quality of the air and of its environmental impacts and health in particular.

For the characterization of the bonds between the two environmental physical factors and the expected medical negotiable instruments, we supposed that all the employees are regarded as talks. Thus, the relative risk is obvious and certain. In practice, the number of victims of the industrial accidents and the pollutants, medical event ascribable, is calculated for each generated disease.

The identification of the dangers and the characterization of the bonds between the two environmental physical factors and the expected medical negotiable instruments, make it possible to quantify and of monitories these impacts on the performance of the factory

2. Results

2.1. Identification of the diseases due to the pollutants issued within the factory

The data received from the employees via the questionnaire prepared for this reason and the monitoring sheets of the patients near the service of safety hygiene made it possible to draw up a list of the dominant diseases within the factory. This list is presented as follows:

N°	Nature of the diseases	Negotiable instruments on health
1	Dermatological diseases	Skin dries. Widening of the blood veins. Phenomena of allergies
2	Respiratory diseases	Of the respiratory disorders (coughs, embarrassments respiratory, lower of respiratory capacity, bronchi tides, attack of asthma)
3	Cardiovascular diseases	Giddiness, asthenia or vomiting. Suffering of chronic cardio respiratory pathologies. Psychological disorders
4	Orthopaedic diseases	Spinal Column.
5	O.R.L Diseases	The irritation of the mucous membranes and the eyes Infection in the ears.
6	Digestive diseases	Dental Diseases. Ulcerate.

Table (2) Diseases within the factory

Source: Service of safety hygiene and the infirmary of the factory

By carrying out a thorough analysis of the data provided by the internal infirmary of the factory, the approximate number of patients victims of pollutants lasting year 2007, rose with 607 victims classified according to the nature of the disease.

Nature of the diseases	2007	Rate%
Dermatological diseases	105	19.62
Respiratory diseases	157	23.28
Cardiovascular diseases	3	0.47
Orthopaedic diseases	112	18.55
Diseases O.R.L	108	20.05
digestive diseases	122	18.03
Total	607	100%

Table (3) Classification according to the nature of the diseases in 2007

Source: Analyze statistical data of the service of safety hygiene

We notice that the respiratory diseases come to the first rank and this with a rate of 23.8%. That is due primarily to the suspension of pollutant gases in the atmosphere. Diseases O.R.L recorded a rate of 20.05%, occupying the second rank. The operation of the machines and especially boiler making can easily cause buzzes of ears. The dermatological diseases come in third rank with a rate from 19.62%. The fine particles attack the skin of the employees especially those working in the phosphoric service.

The data received from the infirmary of the factory are perfectly coherent with the complaints of the questioned employees who affirm the existence of several pollutants affecting their health. They are 86.8% to answer that the environment of work is completely polluted. In this direction, 89.21% of them see that the pollutant gases and the chemicals are indeed; the principal causes their sufferings. According to them the relation between the degradation of their health and the pollutants is significant and very strong. The statistics confirm it: the coefficient of correlation amounted to 0.8753 with R^2 adjusted equal to 0.8242 and a degree of confidence of 95%.

For the majority of the participants, the pollutants do not affect only their health and their productivity but also disturbs their rate/rhythm of ordinary life. They are 87.81% to answer that the diseases cause family sufferings.

2.2. Measuring units of the centers of care

In the medical centers, the measuring unit reflecting the real activity for the not hospitalized cases is represented by the number of visits. However, the measuring unit is that of hospital of day for the patients resident less than 24 hours and a number of admissions for those which reside more than 24 hours. These measuring units express in monetary unit, which the patient benefits from the services provided by the medical center.

For the factory, we noticed that the majority of the affected patients undergo medical treatments the internal infirmary. This treatment generally does not require the hospitalization. Thus, the number of visits represents the measuring unit during the period of research. For the cases transferred to the hospitals from the area, we will apply the three measuring units to knowing the number of visits, hospital of day and a number of admissions for those, which require the hospitalization.

Environ 58 % of the patients undergo medical treatments within the infirmary. The external hospitals deal only with 42 % whose 22.40 % of the treated cases require the hospitalisation.

Nature of the diseases	Number	Infirmary	Hospital of the area		
			Number of ordinary visit	Number of hospital of day	Number of days of hospitalisation
Dermatological diseases	105	61	44	0	0
Respiratory diseases	157	91	24	30	12
Cardiovascular diseases	03	0	01	2	0
Orthopaedic diseases	112	65	17	25	5
Diseases O.R.L	108	62	17	23	6
Digestive diseases	122	71	18	19	14
Total	607	350	121	99	37
Rate	100 %	57.66%	19.94 %	16.31%	6.09%

Table (4) Distribution according to places' of treatment
Source: Analyze statistical data of the infirmary of the factory

2.3. Estimation of the average cost of the medical treatment within the factory

The determination of the average cost of the medical treatment requires as a preliminary, a classification of the costs in direct and indirect costs. The latter must be assigned to the various activities of the units of care in order to be able to determine the costs of medical treatment. With this intention, a system of cost accounting specific in the units of care is considered to be necessary.

This system makes it possible to provide the precise data on the costs of medical care of each patient with the help of a monitoring sheet. It records the nature of the disease, the duration of treatment and the costs of care. Actually, there is not currently such a system within the factory of M dhilla. That constrained the study with the application of an indirect methodology of calculation of the costs of care of the existing diseases. Indeed, determination of the average cost of treatment medical is obtained by splitting the whole of the real charges of the medical center on the real activity. The latter is expressed in a number of patients profiting from the services provided by the medical center.

In cost accounting, the whole of the costs is expressed in unit of work or measurement. The latter must reflect the real activity of the center. However, the measuring unit reflecting the real activity of the medical center for the not hospitalized cases is represented by the number of visits

The identification of the cost of the unit of work requires as a preliminary the determination of the total cost of the medical center. During the period of research, the whole of the expenditure of the medical center within the factory is presented in Tunisian dinars at the table (5)

Elements of the cost	Years 2007
Dépréciation	4800
Operational Budget	53400
Budget of drugs	6800
Total of the charges	65000
Number of total visits all confused events (victims of the pollutants, accidents of travails and others)	1034
Average Cost of a visit	62.75

Table (5) Capital costs of the center of care
Source: statistical data of the financial management of the factory

The totality of the expenditure invested during the period of research amounted to 65000 D. This amount represents indeed, the whole of the capital costs (goods and means of transport), remunerations of the medical personnel and the operational budgets of the center.

To evaluate the physical damage thus quantified within the hospitals of the area, we retained the economic securities recommended by the ministry for the public health. The table (6) presents the selected economic securities for each disease. These securities present the tariff of an ordinary visit per patient and the tariff of day in hospital and the tariff of a hospitalization. For reasons, which escape our capacity, the study was limited to the data provided by the hospitals of the area. The two private cabinets of existing medical treatment in the area refuse to provide us with the necessary data for our research.

List of impact on health and their economic value in Tunisian dinars			
Impacts on the public health	Tariffs Of a visit ¹	Tariffs of day in hospital ²	Tariff of one Admission ³
Dermatological	20	150	800
Respiratory	25	240	800
Cardiovascular	25	350	800
Orthopaedic	20	160	750
O.R.L	20	200	750
Digestive	25	200	780

Table (6) economic value of treatment of the diseases
Source: statistical data of the Ministry for the public health

Indeed, these economic values are specified on the basis of convention between the ministry for the Public health and that of the Social Affairs and Solidarity. The patient must according to this convention pay 20% of the invoice at the hospital. This last will receive moreover, the complete invoice near one of the two cases concerned. (National Case of the social security and the national case of the retirement and social welfare). Thus, the hospital receives 120% of the tariff of invoicing for all the cases treated medically.

2.4. Identification of the victims of pollutants in the hospitals

The analysis of the statistical data inspired from the registers of the hospitals and the direct meetings with the doctors made it possible to draw up the same list of the diseases recorded within the factory. The number of victims of pollutants was very high. The townsmen count approximately 16285 inhabitants. The identification of the victims of pollutants is carried out on the whole of the population all confused ages.

The analysis of the questionnaire showed that 94.52 % of the questioned individuals find that the area is really polluted by the activity of the factory. Concentration of the pollutants in the air is remarkable. Only 13.84 % of the participants see that the concentration is weak. Moreover, this population resides from the factory a little further.

We then asked to the participants to identify if the pollutants have an impact on their health. They were 87.55 % to answer that there is a remarkable impact.

Moreover, 75 % of questioned see that the pollutants affect not only their health but also their properties. Thus according to them, the relation between the pollutants and their family sufferings is completely

¹ Article 13 of convention enters the ministry for the public health and the ministry for the social affairs and solidarity of 2007

² Article 7 of convention enters the ministry for the public health and the ministry for the social affairs and solidarity of 2007

³ According to article 7 this tariffs correspond to the patients having resided in the hospitals for one period which does not exceed the 24 hours

³ Patients hospitalized for one period higher than 24 hours (some is the period necessary for the medical treatment)

strong. The statistics confirm it: the coefficient of correlation amounted to 0.8537 with R^2 adjusted equal to 0.8462 and a degree of confidence of 95%. Moreover, in spite of the advantages of this project, 93.42% of the population prefers that the factory is moved further.

The majority expresses their dissatisfaction especially when it is dealing with the health of the children and the old people. According to the census of the inhabitants in 2004, 52% of the populations are young. The old children aged from 6 to 18 years count approximately 31%.

While asking the doctors to specify the approximate number of the victims of pollutants compared to the other patients affected for other causes which the pollutants, they were 94.37% to answer that 2 among 10 patients visitors suffers from the diseases caused by the issued pollutants of the factory. Thus, the pollutants affect approximately 10% of the patients.

The analysis of the registers of follow-up of the patients within the hospitals of the area made it possible to identify the victims of pollutants classified according to the nature of treatment and this, after having taken account of the contractual percentage specified by the doctors. The results are presented at the table (7)

The respiratory diseases rose with 1475 cases. Indeed, the people most touched by the pollutants are mainly the old children and people. The number of cardiovascular diseases is irrelevant compared to the other diseases. The doctors affirm that this kind of disease appears generally long-term. Moreover, the patients of this kind prefer being treated in private specialised clinics. For the lack of information we neglected these cases.

According to the statistical data provided by the hospitals of the area and those received from the doctors, there is not any case of premature death. Some doctors (42% of the questioned population) think that it is probable to have premature deaths and more particularly for the cases transferred to other hospitals concerning the old people. Moreover, they affirm that they are unable to treat these cases, either because of the lack of the material necessary, or because the cases of diseases are very advanced.

Diseases	Number of visit	Number of hospital of day	Number of days of hospitalisation
Respiratory	1192	213	70
O.R.L	1039	115	13
Dermatological	622	105	3
Digestive	312	6	40
Orthopaedic	189	25	17
Cardiovascular	18	8	20
Total	3372	635	163

Table (7) Classification according to the nature of treatment
Source: Statistical data of the hospitals of the area

2.5 Estimate of a number of admissions

In order to determine the total number of admissions for all the recorded diseases, we questioned 48 doctors to specify roughly the number of days of hospitalisation necessary for an admission.

Indeed, the invoicing for the hospitalizations, which exceed the 24 hours of residence, is fixed contractually.

The answers were varied from 2 days to 15 days and this, according to the treated disease and of the medical situation of the patient.

For that we focused on the average number of days balanced to determine the number of admissions. The results are presented at the following table:

Diseases	The average number of days by admission	The number of days of hospitalisation	The number of admission
Respiratory	5.46	70	13
O.R.L	5.76	13	2.25
Dermatological	4.20	3	1
Digestive	6.23	40	6.40
Orthopaedic	6.7	17	2.5
Cardiovascular	8.5	20	2.35

Table (8) victims classified according to the nature of treatment
Source: Statistical data of the hospitals of the area

3. Estimation of the medical costs of the issued pollutants

The total impacts of the air pollution estimated by indicator of pollution are additive which measurement or population is exposed to a whole of pollutants. Moreover, the pollutants can interact and the negotiable instrument of a pollutant can vary according to the level of other pollutants.

In the field of the public health, the relations «amount-negotiable instrument » established on the basis of epidemiological studies also often lead to the medical costing of morbidity. The damage related to pollution is measured then in «end of line», starting from the total cost of the care.

3.1 Medical costs of the employees within the factory

The table (9) presents the approximate medical costs relating to the air pollution within the factory. These calculations are made after having taken account of the average cost of medical treatment within the factory and of the number of hospital of day and admissions for the victims treated with the hospitals of the area. The medical costs of the pollutants rose with **21962.5** Tunisian dinars. The results are presented at the following table:

Unit: Tunisien dinars

Diseases	Infirmary of the factory		
	N ^{Br} of visits	Unit cost.	Total
Respiratory	91	62.75	5710.25
O.R.L	62	62.75	3890.5
Dermatological	61	62.75	3827.75
Digestive	71	62.75	4455.25
Orthopaedic	65	62.75	4078.75
Cardiovascular	0	62.75	000
Total	350	62.75	21962.5

Table (9) medical costs with the infirmary

However, the medical costs of the victims of the pollutants having to be treated with the hospitals of the area rose with **27942** dinars. This amount includes the costs of the ordinary visits, of hospital of day and admissions for the employees who were hospitalized more than 24 hours. The results are presented at the following table:

Unit: Tunisian dinars

Diseases	Hospital of the area								
	N ^{Br} of visits	Unit cost.	Total	Hospital of day	Unit cost.	Total	Admissions	Unit cost.	Total
Respiratory	24	25	600	30	240	7200	2.19	800	1752
O.R.L	17	20	340	23	200	4600	1	750	750
Dermatological	44	20	880	0	150	000	0	800	000
Digestive	18	25	450	19	200	3800	2.25	780	1755
Orthopaedic	17	20	340	25	160	4000	1	750	750

Cardiovascular	1	25	25	2	350	700	0	800	000
Total	121	21.77	2635	99	205.05	20300	6.44	777.48	5007

Table (10) medical costs at the hospitals
Source: Statistical data of the hospitals of the area

For the factory, the working payroll represents one of the significant factors of the production. The issued pollutants and consequently, the capacity to produce of the factory drops proportionally with the absences of the employees affect this payroll.

The occupational diseases generated by the issued pollutants seem very numerous. Moreover, the duration of the absences is prolonged more and more. The absences do not amount any more in a number of days but rather in a number of weeks and months. The explanatory factors of such a situation would be the additional time, which is not any more one exception but a weekly reality.

3.2. External medical costs of the issued pollutants

For the medical costing of the air pollution of the area of M dhilla, we carried out a thorough analysis of the data received from the hospitals. The table (11) presents the approximate medical costs relating to the air pollution at the hospitals. These calculations are made after having taken account of a unit tariff of medical treatment of each disease and number of hospital of days and admissions for the hospitalized victims. In this direction, the medical costs of the pollutants rose **195354,5 Tunisian dinars**. The results are presented at the following table:

Diseases	Hospital of the area (Unit: Tunisian Dinars)								
	N ^{Br} of visits	Unit cost.	Total	Hospital of day	Unit cost.	Total	Admission	Unit cost.	Total
Respiratory	1192	25	29800	213	240	51120	13	800	10400
O.R.L	1039	20	20780	115	200	23000	2.25	750	1687.5
Dermatological	622	20	12440	105	150	15750	1	800	800
Digestive	312	25	7800	6	200	1200	6.40	780	4992
Orthopaedic	189	20	3780	25	160	4000	2.5	750	1875
Cardiovascular	18	25	450	8	350	2800	2.35	800	1880
Total	3372	22.5	75850	635	216.67	97870	4.583	777.48	21634.5

Table (11) external medical costs
Source: Statistical data of the hospitals of the area

3.3 Total medical costs of the issued pollutants

The whole of the total medical costs during the period of research rose with **245259 dinars** Tunisian. This amount includes the costs of the ordinary visits, the costs of hospital of days and the costs of admissions. The results are presented at the following table:

Elements	Infirmery of the factory	Hospitals of the area	Total (TD)
Costs of the ordinary visits	21962.5	78485	100447,5
Costs of hospital of days	-	118170	118170
Costs of admissions	-	26641.5	26641.5
Total	21962.5	223296,5	245259

Table (12) total medical costs

Although the securities of the damage are at least approximate, they give a general idea on the influence of pollution. They can be useful like indicators to react and solve this problem of its origin.

Indeed, the evaluation of the economic losses due to the air pollution has many sources of uncertainty, on the one hand of a scientific nature and on the other hand specific to the choices of money values. That indeed, should not delay progress in the evaluation allow from now on a more effective fight in the reduction harmful negotiable instruments of the pollutants, by providing economic tools more effective than the lawful or normative tools. The effective reduction of all the negative impacts of the pollutants must be well with the heart of the public policies.

CONCLUSION

We started from an enquiry on the environmental stakes of the chemical industry to present the method of the cost of the damage in order to monitor the medical costs intern and external ascribable to the pollutants issued by the factory. The presentation of the results confirms these remarkable costs. Moreover, on the place of the research, which counts approximately 16000 inhabitants, the air pollution causes each medical year of the damage of approximately **245259** dinars Tunisian? These figures even if they constitute only one order of magnitude and who account for approximately 11.32% of the profits of the factory, proves that the issued pollutants have a significant impact on the factory and the area at the same time. Thus, the air pollution must be regarded as factor of human health risk.

It's legitimate to ask how the data on the medical damage can be used and interpreted within the framework of the collective responsibility for the political office, which is reinforced. By definition, the market cannot deal with problems of harmful effects and external costs; it is with the policy to decide other tools of regulation.

Moreover, taking into account the operating model of our industrial companies this role of supervision requires the implementation of quantified and monitor elements. So that the securities finally selected are not simply the expression of a purely technocratic decision, it is still with the policy to begin the debate and to support the dialogue between the whole actors concerned with the harmful effects.

Within this framework, we see that the intervention to avoid the damage will be effective only with one legitimate capacity supported by the State.

Finally, we hope that this study will be supplemented by other research based on the impact of the pollutants on the properties and materials.

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