

# **Statistical approach on the impact of the activity of the industrial zone of Skikda on the quality of the waters of Saf-saf wadi (Algerian East coasts).**

**Tahar Ali**

*Laboratory of Biology and environment,  
Badji Mokhtar University, Po Box 12, 23000 Annaba. Algeria.  
E-mail : Pr\_Tahar\_Ali@hotmail.com*

**Mezedjri Lyamine**

*Department of Biology, Faculty of sciences,  
University of 20 august 1955, Po Box 26 rooad El Hadeik, 21000 Skikda. Algeria.  
E-mail : Mezedjri.lyamine@gmail.com  
Tel : +213 661 767 872*

## **Abstract:**

During the period that spreads between August 2005 and October 2006, has been done a follow-up of the variations of eight physicochemical parameters, in the residuary waters of the Saf-Saf wadi upstream and downstream the passage of this wadi by the petrochemical zone of Skikda " ZIK1 ". This sampling is completed by another sample done at sea, which is in continuity with the diffusion of the water flux of the Saf-saf wadi in the bay of Skikda.

The chosen parameters are represented by the temperature, the pH, the dissolved oxygen and the conductivity, by two elements considered like undesirable Iron and the Copper and by two toxic elements mercury and lead. The choice of these parameters is justified by the nature of the industrial activities in the petrochemical zone of Skikda and their impact on the aquatic life of the gulf of Skikda.

**Key words:** residuary waters, industrial zone of Skikda, Statistical treatment, chemical pollution, impact on the environment.

## **Introduction:**

The pollution by the residuary waters to the level of the Saf-saf wadi is linked to the industrial dismissals (petrochemical, agro-alimentary industry etc.), to waters from urban origins and to the results of the use of the pesticides and fertilization in agriculture.

Our preoccupations move toward the quality of water that decreases with time in this important river in this region, from where the necessity to conduct frequent and extended controls.

The present work is interested in the identification of the chemical pollution in the Saf-saf wadi during the period spreading between August 2005 and October 2006 either a period of 15 months.

Our objective is to achieve a comparison between the qualities of the water of this river, before and after its passage by the petrochemical pole of Skikda, on the basis of the regulation texts adopted in Algeria (J.O.R.A, 2006) as well as to note the impact of these changes on the receiving environment.

## **Material and Methods:**

### ***Presentation of the survey zone:***

The industrial activity is especially intense in the department of Skikda. The industrial zone of Skikda (ZIK) is located at the East of the city of Skikda with a surface of 1200 ha

(Fig1). It regroups several specialized units in transportation, refinement and transformation of the hydrocarbons.

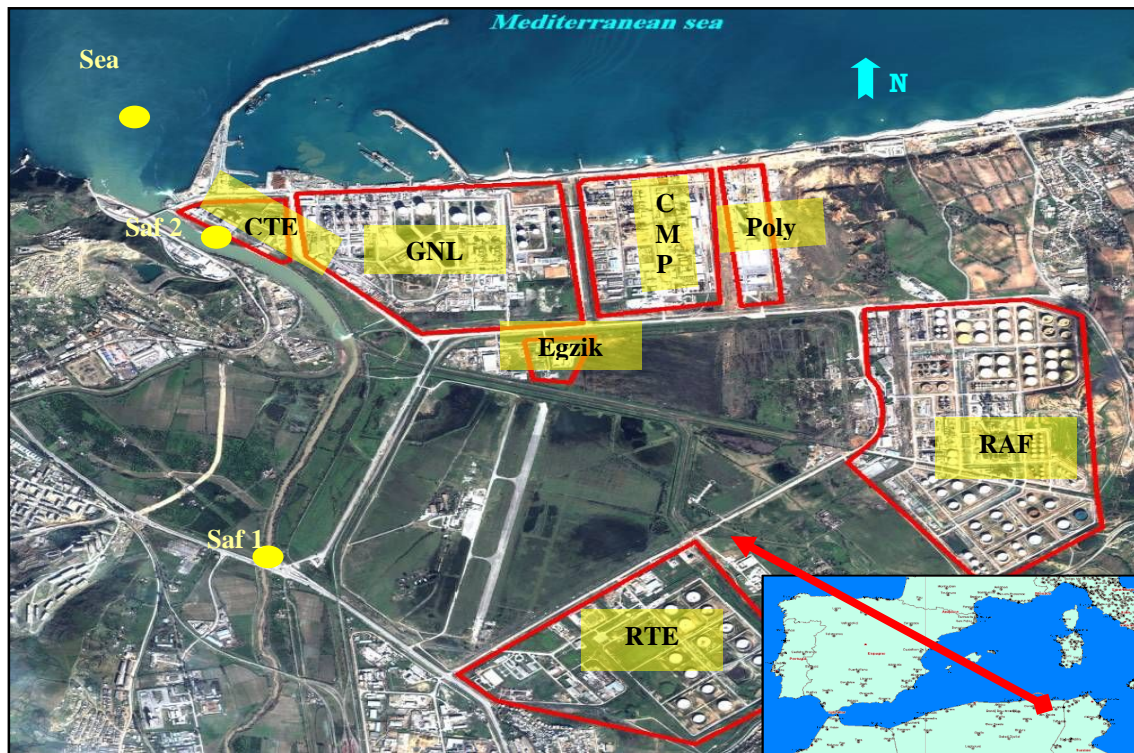
All this concentration of activities generates liquid dismissals. These dismissals are either, rejected directly in the sea or by the slant of Saf-saf wadi that it also succeeded thereafter in the sea. Saf-saf is a river that borders the (ZIK) by the West on a length of 6 km, its middle width is of about twenty meters with a debit of  $569 \text{ m}^3/\text{s}$  (SCI, 1989) (fig. 1).

To better surround the problems and the nuisances generated by the industrial zone of Skikda (ZIK), we conducted survey on the water quality of the Saf-saf wadi upstream before its passage by (ZIK) (Saf 1) and a station downstream in the mouth of the Saf-saf wadi with the sea (Saf 2) and the third witness point in the Sea (figure 1).

***Collect and chemical analysis of the data:***

Because of the difficulty to define a satisfactory and representative sampling technique, the withdrawals are done manually and instantaneously. This type of sampling is of a big interest when it is about studying some parameters in the state of traces or susceptible of very big variations (Prichards, 1995 and Rodier, 2003).

Three points are chosen, two to the level of the riverbed of the Saf-saf (upstream and downstream) to the coordinates (Saf 1:  $6^{\circ}56'17'' \text{ E}$  &  $36^{\circ}51'23'' \text{ N}$ ) and (Saf 2:  $6^{\circ}55'54'' \text{ E}$  &  $36^{\circ}55'54'' \text{ N}$ ). The third point is located at level of sea, to the coordinates (sea:  $6^{\circ}56'5'' \text{ E}$  &  $36^{\circ}52'56'' \text{ N}$ ) (figure 1).



**Figure 1:** Sampling stations for the study

The physicochemical characteristics measured in the sampled residuary waters are: the temperature ( $T^{\circ}$ ), the (pH), the conductivity (condi) and the dissolved oxygen ( $\text{O}_2$ ). All these parameters are measured by means of land probes WTW type 197-S. The inorganic parameters are represented by four metals iron (Fe), the copper (Cu) and lead (Pb), they are measured out by means of a spectrophotometer to flame references D2576 (ASTM, 1974).

The mercury (Hg) is measured by means of a mercury-meter references D3223 (ASTM, 1974).

### Statistical analysis of data:

After data's collection, a statistical treatment of these last is imposed. The data collected by stations constitute a matrix (8X15 = 120). At first, we calculate the statistical parameters of basis for every characteristic, and then we compare the 3 stations between them for each of the 8 variables with the help of the test of analysis of variance to criteria of classification (ANOVA) (Dagnélie, 1975 and 2006).

An observation in group or hierarchical classification has been achieved according to the method of Bouroche and Saporata (1980), which permits to estimate the level of likeness or divergence between the sites, object of our survey, and to get a distribution of these stations in groups or homogeneous classes. The survey of the structuring and the classification of the 3 stations in groups are achieved with the help of the method of the simple linkage and the Pearson distance (Dagnélie, 1975 and 2006; Palm, 2000 and X, 2000).

All calculations have been executed with the software MINITAB of analysis and statistical treatment of the data, version 14.1 for Windows (X, 2000).

### Results and discussions:

The description of data in each site, for all physicochemical parameters, is presented in the table 1.

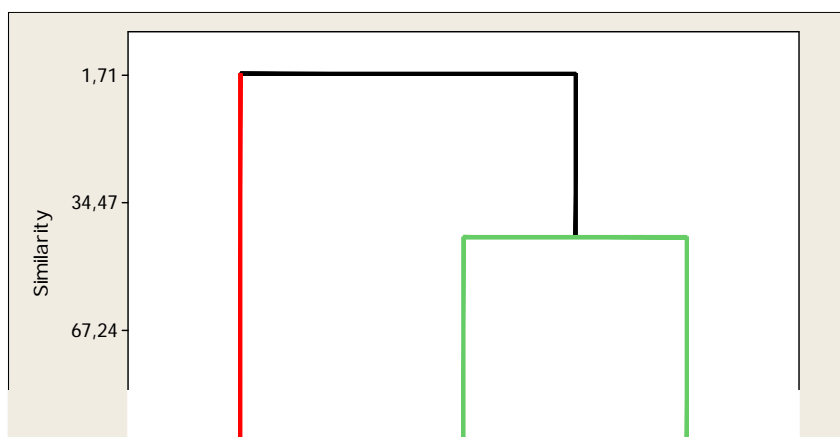
**Table 1:** Description data results.

Variable	Saf-saf 1			Saf-saf 2			Sea		
	M	SE	SD	M	SE	SD	M	SE	SD
T (°C)	18,93	1,26	4,89	24,82	1,17	4,53	20,67	1,16	4,48
PH	7,4833	0,0949	0,3674	7,565	0,112	0,435	7,768	0,122	0,473
Condi (mS/cm)	1,498	0,100	0,388	49,40	1,96	7,58	55,497	0,761	2,948
O <sub>2</sub> (p.p.m)	4,925	0,485	1,879	5,777	0,217	0,841	6,326	0,268	1,037
Hg (p.p.m)	0,0928	0,0795	0,3081	0,00449	0,00267	0,01034	0,00165	0,00105	0,00406
Fe (p.p.m)	3,10	1,48	5,73	0,526	0,149	0,578	0,519	0,114	0,440
Cu (p.p.m)	0,00667	0,00256	0,00993	0,00887	0,00378	0,01464	0,01513	0,00854	0,03307
Pb (p.p.m)	0,0251	0,0152	0,0588	0,0378	0,0183	0,0708	0,0561	0,0232	0,0898

The results of the test of analysis of variance to a criteria of classification (ANOVA) presented in the table 2, show the existence of significant differences between the three stations for [T (°C), O<sub>2</sub> (mg/l), Condi (mS/cm)]. These differences are linked to the nature of waters rejected in the river, by the industrial pole of Skikda, which changes its main physicochemical features completely. For the pH the differences are non significant. With regard to the variations of the heavy metals (Fe, Cu, Hg, Pb) significant differences don't exist between the 3 stations, it is linked to the diffusion of these metals in the import quantity of rejected waters and also to the different variations of these inorganic variables in the natural habitat (absorption by the living organisms, combination with other elements more complex to detected, evaporation or precipitation) (Rodier, 1982,; Bliefert and Perraud, 2001 and Quevauvillers, 2001).

**Table 2:** the ANOVA results

Variable	F	p
T (°C)	6,39	0,004 **



<b>PH</b>	1,77	0,183	ns
<b>Condi (mS/cm)</b>	593,35	0,000	***
<b>O<sub>2</sub> (p.p.m)</b>	4,22	0,021	*
<b>Hg (p.p.m)</b>	1,27	0,291	ns
<b>Fe (p.p.m)</b>	2,99	0,061	ns
<b>Cu (p.p.m)</b>	0,62	0,544	ns
<b>Pb (p.p.m)</b>	0,66	0,522	ns

$p > \alpha = 0,05$  : (ns) not significant

$p \leq \alpha = 0,05$  : (\*) significant

$p \leq \alpha = 0,01$  : (\*\*) highly significant

$p \leq \alpha = 0,001$  : (\*\*\*) very highly significant

The regrouping of the 3 stations according to the physicochemical quality of analyzed waters, by means of a dendrogram with simple linkage and Pearson distance, with a level of similarity of 43,40% (Figure2), permits to distinguish two distinct groups. This classification gives a first group composed by the point (Saf 1), characterized by river waters with normal temperature following the seasons, low conductivity, a neutral pH and a rate of dissolved oxygen relatively middle. The second group shows the closeness between the point (Saf 2) and the point (Sea). This two stations in spite of their different natural features, the first point is situated to the level of the mouth of Saf-saf wadi and the second point is located at sea level are very close. This likeness is bound to the liquid dismissals rejected by the industrial zone of Skikda which have a direct influence, not only on the quality of the waters of Saf-saf wadi, but also on the quality of the waters of the bay (more elevated temperature, very elevated conductivity, relatively neutral pH etc.).

### Conclusion:

The present work is about the variability of the industrial chemical pollution in the residuary waters of Saf-Saf wadi (Skikda).

The gotten results are exploratory, and show the influence of the industrial activities on the quality of the waters of the waters courses in the region of Skikda. The present work must be done on several years in order to better surround the accumulation of these parameters, especially the heavy metals, in the sediments and in the marine fauna and flora, and therefore to follow their cycles in the food chain.

In the future this type of survey must be driven not only in an aim to satisfy the texts and guides, but also to succeed to a better respect of the middle while assuring a reasonable effort to decrease these nuisances in their whole.

### References:

- [1] A.S.T.M., 2004. Anal Book of American society for testing and material Standards. Water. Part 31.
- [2] Bliefert, C. and Perraud, R. 2001. Chimie de l'environnement. Air, Eau, Sol, Déchets. De Boeck. Bruxelles. 477 p.
- [3] Bouroche J.M, & Saporata G., 1980. L'analyse des données. 1èr édition. Presses Académique de France. Paris, 127 p.
- [4] Dagnélie P., 1975. Théorie et méthodes Statistiques. Volume 2 : applications agronomiques. Les presses agronomiques de Gembloux, 451p.
- [5] Dagnélie P., 2006. Statistique théorique et appliquée. Tomme 2 : Inférences à une et à deux dimensions. Bruxelles-université DE BOECK et LARCIER : 659 p.
- [6] JORA, 2006. Journal Officiel de la République Algérienne. Décret ministériel n°06-141., portant organisation et réglementation des déchets liquides industriels.

- [7] Palm, R. 2000. L'analyse de la variance multivariée et l'analyse canonique discriminante : principes et applications. Notes stat. Inform. (Gembloux) 2000/1, 40 p.
- [8] Prichard, E. 1995. Quality in the analytical laboratory, John Wiley & Sons Ltd., Chichester: 307 p.
- [9] Rodier J., 2003. L'analyse de l'eau, 8e édition, Dunod, Paris.
- [10] Scandia consults international AB (SCI). 1989. Protection contre les inondations de l'Oued Saf-saf. Etude de remodelage de l'embouchure de l'oued Saf-saf. RADP Wilaya de Skikda : 120 p.
- [11] Quevauviller, Ph. 2001. Métrologie en chimie de l'environnement. TEC & DOC. Paris : 257 p.
- [12] X., 2003. MINITAB version 14.1 for windows.