A Study of the Impact of Scrap on Ground Water: The Case of Scrap Essaada in Meknes–Morocco

Baili Rachida, Mili Mustafa, Gourja Bouchra, Tridane Malika

Abstract: ***The purpose of this research is to investigate a subject that is little approached in environmental circles in Morocco. It concerns the domain of scrap considered as an informal sector of important economic and industrial activities. Scrap yards which are generally poorly fitted out and populated spaces are scenes for activities that may cause risks, often ignored, to the natural environment as well as the human health. Indeed, waste stemming from activities of the scrap may present harmful effects on grounds, on groundwater, and on flora and fauna. This study is concerned with the impact of the activities of the Essaâda scrap of Meknes on the groundwater. This site constitutes a representative sample of scrap yards in Morocco for they all have (more or less) the same characteristics. To conduct this research, we collected water samples of subterranean waters of wells situated inside and outside of the scrap yard in December, March and May. The collected samples are studied by determining the existence of the compounds of hydrocarbons. Hence the need of the implementation of a device of environmental management. The products used in these environments are hydrocarbons: this includes detergents, antifreeze, liquids for clutches and brakes, (lubricants) engine oils, greases, polyester putties, diluents cellulosic. The majority of these junkyards are poorly designed and are part of the informal sector. However, work there remains generally precarious in very bad sanitary and safety conditions beyond any control of the public authorities: inhuman work and hygiene conditions along with negative externalities are observed in this sense. These externalities, particularly, those related to the landscape, public health and the air should be a concern of policy makers to outsource them or limit them (DJEMACI, 2013). And yet this scrap is neglected: no study, no monitoring and no reaction from the Government departments concerned. This research aims at studying the impact of the activities of scrap on the environment and on human health. . (This is how the questions call out to us.)***

Keywords: Scrap – Hydrogeology- Hydrocarbons- Water

I. INTRODUCTION

Rapid urbanization of the last 50 years has led to a gr adual artificialization of urban areas. This has some impacts on urban hydrogeology by potential pollution of receiving environments (groundwater and oueds).

Manuscript published on 30 December 2018.
***** Correspondence Author (s)
Baili Rachida, Ph.D Student in Environment Management-Faculty of Sciences, Moulay Ismail University, Meknes, Morocco.
Mili Mustafa, Professor Ability at the Faculty of Sciences, Moulay Ismail University, Meknes, Morocco.
Gourja Bouchra, Professor Ability at Regional Center of Training and Education of Casablanca Anfa CRMEF, Bd Bir Anzarane Casablanca, Morocco.
Tridane Malika, Laboratory of chemistry, physics and material sciences, Faculty of Sciences Ben M'sik, Université Hassan II of Casablanca, Casablanca, Morocco.

Human activity is the cause, especially that related to traffic (hydrocarbons, heavy metals...) (MUSY, 2014). In Morocco, the scrap is considered to be one of the most polluted areas. Indeed, most of the products used in these environments are hydrocarbons[1]: this includes detergents, antifreeze, liquids for clutches and brakes, (lubricants) engine oils, greases, polyester putties, diluents cellulosic. The majority of these junkyards are poorly designed and are part of the informal sector. However, work there remains generally precarious in very bad sanitary and safety conditions beyond any control of the public authorities: inhuman work and hygiene conditions along with negative externalities are observed in this sense. These externalities, particularly, those related to the landscape, public health and the air should be a concern of policy makers to outsource them or limit them (DJEMACI, 2013). And yet this scrap is neglected : no study, no monitoring and no reaction from the Government departments concerned.This research aims at studying the impact of the activities of scrap on the environment and on human health. We have chosen Essaada scrap in Meknès as it has almost the same infrastructure features as most scrap in Morocco. This is how the questions call out to us.

• Does groundwater of Essaada scrap in Meknès contain hydrocarbons infiltrated by the ground?

• Do the periods of the year have an influence on groundwater located within scrap?

• Does the direction of groundwater flow have an influence on transport (migration) of the components of the groundwater downstream scrap?

According to the study (NOWAK & VAN DER HAM, 2010), hydrocarbons seep into the groundwater through the ground. They possess a pollutant character at the body of surface water level. So, through this research, we will try to show if Essaada of Meknes scrap area groundwater contain hydrocarbons coming from the rainwater infiltration, that is, they penetrate the ground and pollute groundwaters. This dangerously impacts the environment and human health. Hence, the need for the implementation of an environmental management system adapted to the activities of scrap.

II. RESEARCH METHODOLOGY

A. General presentation of the study area

Scrap Essaada, located in Meknes (city in Morocco), is

The site of our study. It has the same infrastructure characteristics as other scrap in Morocco. Essaada scrap is a

[1] Hydrocarbons are part of organic pollutants persistent (POP) which are molecules with the properties to be toxic, persistent in the environment, bioaccumulable and that can be transported over long distances.

place of sale of spare parts for old or damaged vehicles. It is located in the South of Meknes, at 860m to the West of the Valley of the Boufekrane Oued. Its surface area is 13 hectares 66 are 83 centiares. The land was purchased from the urban district by the wrecker, title to the land : 31427/59, this scrap contains about 600 garages. It includes neither drinking water nor sewerage network.

Fig 1. Map of the location of scrap Essaâda (source: google earth)

It is through analyses, we have carried out, for the determination of the index of hydrocarbons in groundwater collected in different periods and locations of 5 wells located inside and around Essaada scrap in Meknes (Morocco) that we will show the presence of eleven compounds with their retention time.

B. Sampling and Experimental Method

In order to detect the presence of chemicals in the groundwater of the scrap under study, we proceededaccordi ng to the following steps: The first step is to collect water from wells in the above-mentioned places and on different dates as shown in the table below:

Table 1: Location of the Sampling Points

Location	Wording	Coordinated (m)	The sampling period		
			Dec, 2014	May, 2015	Dec, 2015
Inside of the scrap	Well: 2	X= 486823,77 Y =362307,79	x	X	x
	Well: 3	X=486974,75 Y =362403,9	x	X	x
	Well: 4	X=487152,7 Y =362245,6	x	X	x
Outside of the scrap	Well: 1	X=487959,32 Y =362014,88		X	x
	Source: 5	X=486879,31 Y =364957,36		X	x

Before taking a sample, we rinsed the bottles by hexane to avoid the contamination of our sample.

The choice of the wells is intended to study the components of the groundwater located within the scrap, those located upstream and downstream of the site following the direction of groundwater flow.

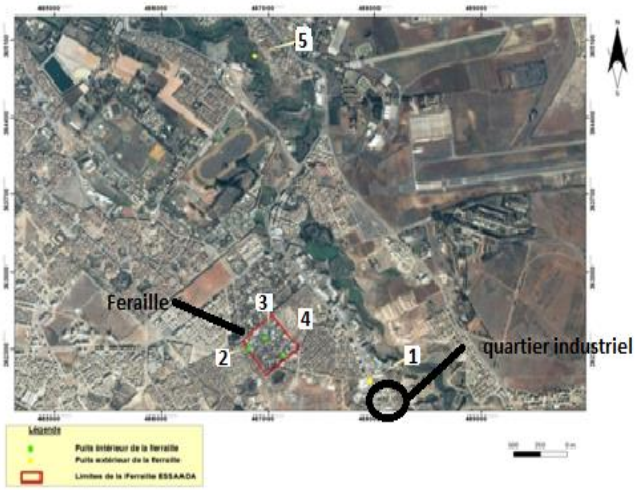

Fig 2. Map of The Location of the Sampling Points

The choice of periods, too, is meant to extend the study during the year characterized by an important rainfall in December and low in may phase II is to perform analyses to determine the hydrocarbons index in the sampled waters. To show whether groundwater contain hydrocarbons infiltrated by ground, we resorted to the analysis by gas chromatography gas (CPG) to highlight chemicals that can exist in the collected water samples. The interpretation of the spectra of chromatography has carried out by using the database of NIST (National Institute Standard and Technology).

C. The Organic Phase Extraction Procedure

We have conducted this study referring to the method of determining the index of hydrocarbons C_{10} to C_{40} by gas chromatography[2] in a gaseous phase under the standard NF EN ISO 9377-2 (12/2000) (ISO, 2016). The extraction procedure is done according to the following steps:

- The extraction of hydrocarbons in our sample using hexane.
- Purification on Florisil column.
- The analysis by GC–FID enabled us to measure the total area of peaks between the n-decane (C10) and n-tetracontane (C40).

III. ANALYSIS AND INTERPRETATION OF RESULTS

The results obtained by the gas chromatography based on the periods of the year are summarized in the following table:

[2]*Chromatography is a method of separation of the constituents of a mixture of gaseous, liquid or solid. It is a method of separation, so analytical, based on differences in affinities that can present two or more compounds for two phases, one fixed or stationary and the other mobile. The spectrum of the unknown components has been compared with the spectrum of the well-known components stored in the NIST library.*

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

Stations		Nomenclature										
AMONT : Puits : 1		Alpha – phenyl – alpha – tropolacetal dehydetoxyl hydrazone										
	TR*	24.15										
ferraille	Puits : 2	Alpha – phenyl – alpha – tropolacetal dehydetoxyl hydrazone	2,5 Heptadi en -4- one, 2,6 dimethyl	1- Monolinole oylglycerol trimethyl ether	1,4 – Diphe nyl- 1,3 – butadi ene	12 – Benzenedi carboxylic acid, bytyloctyl ester					Dodec ane	Cycloocta siloxane , hexadeca methyl
	TR*	24.15	9.01	11.45	15.39	17.14					6.02	13.48
	Puits : 3	Alpha – phenyl – alpha – tropolacetal dehydetoxyl hydrazone			1,4 – Diphe nyl- 1,3 – butadi ene	12 – Benzenedi carboxylic acid, bytyloctyl ester	Octane 2,3 dimethyl	2- trimethylsilo xy-6- hexadecenoi c acid,methyl ester	Benze ne, 1,1 –[1,3 – propa nediyl] bis-	1,2- Benzenedi carboxylic acid , bis [2- methylpro pyl] ester		
	TR*	24.14			15.41	17.15	6.7	9.16	13.5	15.94		
	Puits : 4	Alpha – phenyl – alpha – tropolacetal dehydetoxyl hydrazone	2,5 Heptadi en -4- one, 2,6 dimethyl	1- Monolinole oylglycerol trimethyl ether	1,4 – Diphe nyl- 1,3 – butadi ene	12 – Benzenedi carboxylic acid, bytyloctyl ester	Octane 2,3 dimethyl		Benze ne, 1,1 –[1,3 – propa nediyl] bis-	1,2- Benzenedi carboxylic acid , bis [2- methylpro pyl] ester		
	TR*	24.14	9.01	11.45	15.39	17.14	6.12		13.49	15.93		
AVAL : Source5		Alpha – phenyl – alpha – tropolacetal dehydetoxyl hydrazone		1- Monolinole oylglycerol trimethyl ether					Benze ne, 1,1 –[1,3 – propa nediyl] bis-	1,2- Benzenedi carboxylic acid , bis [2- methylpro pyl] ester	Dodec ane	
	TR*	24.13		11.44					13.49	15.93	5.9	
Formule Moléculaire		$C_{17}H_{17}NO_3S$	$C_9H_{14}O$	$C_{27}H_{54}O_4Si_2$	$C_{15}H_{16}$	$C_{32}H_{50}O_4$	$C_{11}H_{24}$	$C_{25}H_{50}O_3Si$	$C_{17}H_{17}$	$C_{32}H_{50}O_4$	$C_{12}H_{26}$	$C_{28}H_{56}O_4Si_4$

TR *: retention time

These results face the chromatograms obtained in standard oil standards. This is to ensure that hydrocarbons detected present the same profile. This allows us to locate the type of hydrocarbon in the analyzed stations.

A. Interpretation of Results:

The analyses of December 2014 and 2015 and May 2015 at the level of the existing wells both inside and outside the scrap yard show the existence of hydrocarbons peak, while they are scarce at the level of station N°1 located South-east of scrap and abundant at the level of the station No. 5 located in the North-east of the scrap.

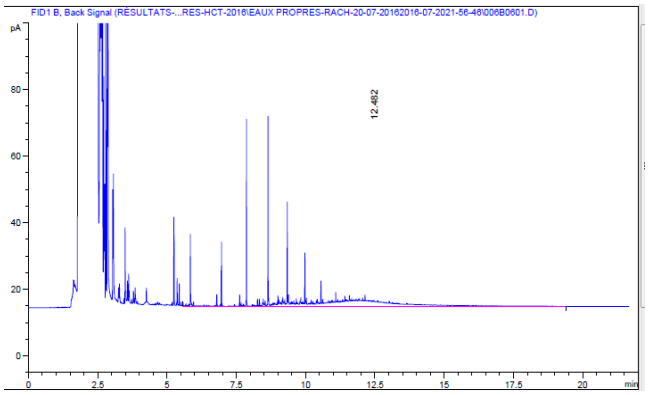

Fig3. Chromatogram of the Sample of the well 3 Located Inside the Scrap

We note that compounds detected at the level of station No. 5 located downstream of scrap are identified also at the level of the stations located within the scrap. Referring to the direction of the flow of the groundwater, it can be concluded that the composes issue of the different stations of scrap have migrated to the station number 5. These compounds are: $C_{27}H_{54}O_4Si_2$, $C_{15}H_{16}$, $C_{16}H_{22}O_4$ and $C_{12}H_{26}$. However, for other compounds have not migrated such as: $C_9H_{14}O$, $C_{16}H_{48}O_8Si_8$, $C_{16}H_{14}$, $C_{20}H_{30}O_4$, $C_{10}H_{22}$ and $C_{20}H_{40}O_3Si$. Referring to a course of (BEAUCHAMP, 2002) which itself refers to the work of BALLERINI and his colleagues (1998), these products can represent potentials of the compounds that will be adsorbed on the ground. Results are water/rock physicochemical actions.

The adsorption goes hand in hand with the specific surface of grain or cracks. It will be translated into a reduction in mobility and accessibility of the pollutants.

The adsorption depends on the electrical charge of pollutants. Electrically charged pollutants tend to be linked to particles of clay and other minerals, while those not charged will be preferably associated with the organic matter. The Pollutants can be adsorbed by ionic, polar, hydrophobic or hydrophilic interactions. Station N° 1 located upstream of the scrap contains a single compound hydrocarbon ($C_{22}H_{22}N_2O_2S$) detected at the level of all stations. This explains its migration from station N° 1 until N° station 5. However, this compound entitled $C_{22}H_{22}N_2O_2S$, is not part of the scrap hydrocarbon. It may be Be from an outside origin, especially that the scrap is located next to an industrial area that contains pharmaceutical companies upstream station N° 1. Station N° 1 water quality must be contaminated either by infiltrated hydrocarbons, or by hydrocarbons that are drained by the groundwater. Because of this, the source of pollution should be located upstream of station No. 1 which would require more sampling research and analysis to detect the source of pollution and mitigation measures. This study allowed us to show the existence of 11 organic compounds with different retention times. These hydrocarbons have a character that is polluting the surface water of on the one hand and on the other hand they have a toxic effect on human health.

IV. CONCLUSION

Recall that this study has aimed to study the impact of the activities of thescrap on the environment and on human health. We have chosen scrap Essaada in Meknès having almost the same infrastructure features as most scrap yards in Morocco. Thus, we have first conducted sampling of water in the wells located in several places and on different dates in the scrap yard, then we analyzed this water by referring to the method of determining the index of hydrocarbons C_{10} to C_{40} by gas chromatography under the standard NF EN ISO 9377-2 (12/2000). The results are confronted by the chromatograms obtained in standard oil standards. Indeed, water analyzed by the CPG shows the existence of hydrocarbons whose concentrations vary according to the time and the location from the scrap. The types of hydrocarbons that come from scrap and pollute groundwater contain a number of carbon between C9 and C40, they can be either of the kerosene, oil, light or heavy diesel fuel or tar. Station N° 1 located upstream of the scrap contains a single compound hydrocarbon ($C_{22}H_{22}N_2O_2S$) that we found at the level of all the stations, the latter is does not come from the scrap but from a drug. However, station 1 is located downstream an industrial area which includes drugs companies. As a result, infiltrated the groundwater present a significant pollution and require a pretreatment.

REFERENCES

1. L.C Briand, J. Daly, and J, Wüst., A unified framework for coupling measurement in object oriented systems, IEEE Transactions on Software Engineering, 25, 1, January 1999, pp. 91-121.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

2. J. I .Maletic, M.L, Collard, and A, Marcus, Source Code Files as Structured Documents, in Proceedings 10th IEEE International Workshop on Program Comprehension (IWPC'02), Paris, France, June 27-29 2002, pp. 289-292.
3. A, Dupot, A, Hydrocarbure urbaine (Paris : EYROLLES, 1986).
4. S. Bouchonnet, La spectrométrie de masse en couplage avec la chromatographie en phase gazeuse, (Paris : TEC& DOC, 2009).
5. C.Bocard, marées noires et sols pollués par des hydrocarbures enjeux environnementaux et traitement des pollutions, (Paris, France: technip, 2006).
6. J.A, Hertig, J.-A, Etudes d'impact sur l'environnement (éd. 2ème, Vol. 23), (Lausane: Presse polytechnique universitaire romandes, 2006).
7. B. Lemiere, J.Seguin, C.Le Guern, D. Guyonnet, D.Barnger, C. Le Guern, D. Guyonnet, P. Baranger, & A, Saada, Guide sur le comportement des polluants dans les sols et les nappes, (BRGM, Éd, Orleans Cedex, 2001), in (http://infoterre.brgm.fr/rapports/RP-50662-FR.pdf), Consulté le 03/02/2015.
8. M.Musy, Une ville verte : Les rôles du végétal en ville, (Amazon France: Quae, 2014).
9. C.NOWAK, & S.Van Der Ham, Rapport d'expertise: Contamination des eaux souterraines par des hydrocarbures à proximité du site SMCA de PARAY VIEILLE POSTE, (Paray Vieille Poste Essone: Brgm, 2010).
10. WIKI.AUREA, Les hydrocarbures, (in wiki.aurea: https://wiki.aurea.eu/index.php/Les_hydrocarbures, 2006). Consulté le 20 Octobre 2016,