Larhyss Journal, ISSN 1112-3680, n°13, Mars 2013, pp. 63-75

CHARACTERIZATION OF LIQUID WASTE UNIT PREPARATION AND PACKAGING OF SOFT DRINKS

FELLAH S.[1], ATTARASSI B.A.[1], CHAFI A.H.[2]

[1] Laboratory of Applied Microbiology, Faculty of Sciences, University Ibn Tofail, BP 133, 14000 Kenitra, Morocco
[2] Laboratory of Hydrobiology and General Ecology. Faculty of Science B 524, Oujda Morocco

sophiafellah@hotmail.fr , attarassi@hotmail.com, chafihafid@yahoo.fr

ABSTRACT

According to the latest census of the Ministry of Commerce and Industry, the Oriental Region of Morocco is home to more than 337 industrial establishments dominated by chemical and para-chemical (34.12% of the 337 schools in the region), followed very closely the food industry (33.8% of the 337 establishments in the Region) (Industrial Statistics, 2010). This sector is based on the exploitation of agricultural resources of the regions, and pours effluent directly into the municipal collectors and in the Oued of Moulouya.
The aim of this paper is to contribute to the characterization of a type of discharge agri-business widespread in Morocco, the soft drink industry and the water table. Thus, a study on the release of the industry shows that they are highly loaded biodegradable organic matter and suspended solids rate very high.

Keywords: Industry, food, effluent, industrial pollution.

INTRODUCTION

Morocco is facing a water shortage due to increased drought in two decades by population growth, industrial and domestic consumption and overexploitation of groundwater particularly in agricultural areas. If the rate of growth of Morocco holds, we must move from a consumption of 830 in 1990 to 411 m^3/ha/year m^3/ha/year in 2020, two times less, while more than 70% of potential mobilized (Beauchamp, 2003). In 2009, the cost of damage due to water degradation

accounted for more than 1.23% national GDP, more than 33.15% of the total estimated environmental damage in the country according to the National Council of the Environment (Conseil National de l'environnement, 2009).
The industrial basin of Moulouya is overall very dense and is characterized by about 200 industrial units, of which 80% are concentrated in the provinces of Nador and Oujda. Most representative sectors of industrial activity in the pelvis Moulouya match the food and metallurgy which represent 77% of industrial production.
The Oriental Region will experience significant growth with new projects that are related to: Industrial Park Selouane, Berkane AGROPOLE, The Science Park, adjacent to the site Oujda airportIndustrial pollution load discharged into the basin is currently estimated at about 2,500 tons of oxidizable materials, and increase to about 3,500 tons in 2020 if no remediation scenario is implemented by stakeholders. More than 85% of the pollution load current industry is rejected diffuse directly into the environment (river and soil) and only 15% of industrial pollution is collected by the sewerage cities of Oujda and Nador (Agence de Bassin Hydraulique de la Moulouya, 2012). The objective of this work is to study the characteristics of a unit of agri-food production unit and packaging of soft drinks to give an example of the type and degree of pollution generated by this sector.

MATERIALS AND METHODS

Liquid discharges studied come from a unit of production and packaging of soft drinks located in the industrial area of the city of Oujda. It employs approximately 300 people, including the number of seasonal staff of up to 100 people per season. Production period lasts 12 months a year with a significant increase during the summer season. This is justified not only by the high temperatures that cause consumers to consume more fluid and refreshing, but also because of the many festivals that continues to grow during this season. production is mainly for local consumption and accounts for about 22% of the national market. Its output is designed to feed the various outlets of the Eastern Region (Oujda, Nador, Berkane, Taza, Taourirt ...). In case of insufficient production of one of the sites of the company, the unit may provide the missing quantity.
The water used is the raw material of all the company's products and serves different purposes namely cleaning of facilities and workshops. The water is city water from the ONEP (Office National de l'Eau Potable) that, prior to use, undergoes a series of treatments before meeting the standards of physico-chemical and microbiological determined by the company. For all processes, drinking tap water is about 250 000 m^3 per year.
Analyzes of effluents studied were performed at the Laboratory of Physico-chemical and microbiological Basin Hydraulic Moulouya, except for the

analysis of heavy metals has been achieved by the Laboratory Unit Technical Support to Scientific Research. To avoid the problem of sampling due to the plurality of production facilities, raw materials, demand and cleanup activities, we conducted our sampling during a normal period of operation of all the workshops of the unit audited and covers in time and frequency of sampling all types of activities and processing of raw materials.
The samples were taken in accordance with the AFNOR NF EN 25667 (ISO 5667). Direct measurements (temperature, pH, electrical conductivity, dissolved oxygen) (Table 2) were performed every half-hour specimens of 25 June 2011 for a period of 10 hours, from 8.30 am to 18.30. The characteristics of the collection period are as follows (Table 1):

Table 1: Characteristics of effluent sampling times

Period	**Characteristics**
8.30h to 10h	Operating line of beverage packaging in PET bottles + Operation line preparation and packaging of water table in PET bottles + Operation syrup room.
10.05h to 13.30h	Operating line of beverage packaging in PET bottles + Operation line preparation and packaging of water table in PET bottles + Operation line of beverage packaging in glass bottles + emptying bottles outsized sewer in the line of beverage packaging in PET bottles + Operation line preparation and packaging of the water table in PET bottles + Operation syrup room
13.30h to 16.45h	Operating line of beverage packaging in PET bottles + Operation line preparation and packaging of water table in PET bottles of the syrup room + sanitation
16.45h	Stop sanitation
16.45h to 18.30h	Operation of the packaging line of bottled beverages PET + Operation line processing and packaging of the water table in PET bottles + Operation line beverage packaging in glass bottles.

Several physico-chemical parameters were measured on samples consisting of twelve hours means in proportion to flow measured every half hour (Table 1) SS (suspended solids), BOD5, COD, nitrogen compounds (ammonium, nitrite, nitrate, Kjeldahl nitrogen), phosphorus compounds (orthophosphate, total phosphorus), chloride, and heavy metals (Crome, copper, iron, lead, nickel, zinc). Several physico-chemical parameters were measured on samples consisting of twelve hours means the proportional speeds measured every half

hour (Table 1) MES (suspended solids), BOD_5, COD, nitrogen compounds (ammonium, nitrite, nitrate, Kjeldahl nitrogen), phosphorus compounds (orthophosphate, total phosphorus), chlorides and heavy metals (Crome, copper, iron, lead, nickel, zinc).

Table 2: Standards used for the analysis of the measured parameters

Settings	Reference Method	Method analytical procedure
output	-	-
Sampling	NF EN 25667 (ISO 5667)	-
pH	NF T 90-008	PRS/180/29
Temprature	NF EN 25667 (ISO 5667)	-
Conductivity at 25° C	NF EN 27888	PRS/180/32
chlorides	NF T 90-014	PRS/180/30
nitrates	NF EN 26777	PRS/180/10
nitrites	NF EN ISO 13395	PRS/180/51
ammonia	NF T 90-015	PRS/180/33
nitrogen kjeldhal	NF EN 25663	-
total phosphorus	NF EN 1189	PRS/180/42
Biochemical oxygen demand (BOD_5)	NF EN 1899	PRS/180/11
Chemical oxygen demand (COD)	NF T 90-101 (par respirométrie)	PRS/180/9
sodium	NF T 90-020	PRS/180/30

RESULTS

Origin of waste water

Industrial wastewaters are from seven main sources of liquid waste having been identified within the unit during operations:

Prewash Manual: This method employs a system of manual washing of glass bottles with water and detergent. This process generates large quantities of water daily for an average of 370 m^3.

Process of washing glass bottles: daily flow releases from this circuit varies between 5 m^3/h to 7.2 m^3/h, if the recycling station does not work. For washing baths, a periodic change is performed according to the results of analyzes performed to determine the QS efficiency soda cleanser and percent saturation level of the washing water and dissolved solids. Emptying washers generate large quantities of liquid effluents.

Washing the filters of the washer: at the end of each production and during the change of flavor or size, the filters are cleaned by water jet to remove any adhering particles on filters at the previous protection (limestone , MES).

Cleaning: This is water from the cleaning of premises and equipment during and after production and also loss of product depends on the setting of the filler and the importance of explosions bottles especially when production gaseous products.

Purges boilers: steam used in various purposes is obtained from the boiler. The latter generates effluents which load varies according to its maintenance, the contact of the steam with surfaces containing chemicals, anti-corrosion and anti-oxidant additives and added to the water of the boiler.
Cleaning the filters in the line of water treatment: depending on the filter clogged

Sanitation*:* This operation generates alkaline effluent at high temperature (85° C).

Elimination of non-standard products: this operation is to remove obsolete or non-standard drinks by pouring directly into the manifold industrial.

Parameter values of physical and chemical waste at the collector industrial

The results (Table 2) show that several physical parameters (TSS, TDS) as chemical (BOD_5, COD, Na +) are high and far exceed the values allowed by the standard Moroccan or Tunisian direct discharges.

Table 3: Physical Parameters (mg/l) at the collector of a unit of general production and packaging of soft drinks and water tables in the region of Oujda in 201 (Moroccan or Tunisian standards * authorized brackets).

T (°C)	**output (l/s)**	**pH**	**Conductivity (µs/cm)**	**turbidity (NTU)**	**MES**	**TDS (mg/l)**
26,38	21,54	8,7	64390	115,94	369,6	1766,81
(30)	-	(6,5-8,5)	-	-	(50)	-

Table 4a : Chemical parameters (mg/l) at the collector of a unit of general production and packaging of soft drinks and water tables in the region of Oujda in 2011 (Moroccan or Tunisian standards * authorized brackets).

O_2 dissolved	Al	Cl_2 free	Na^+	NTK	NO^{3-}	NO^{2-}	NH^{4+}
4,55	0,022	0	2511,32	0,77	18,6	0,2	0,44
-	(10)	(0,2)	(300)	(30)	-	-	-

Table 4b : Chemical parameters (mg/l) at the collector of a unit of general production and packaging of soft drinks and water tables in the region of Oujda in 2011 (Moroccan or Tunisian standards * authorized brackets).

PT	PO_4^{-3}	DCO	DBO_5
0,91	0,44	1141,5	373,27
(10)	-	(500)	(100)

Table 5 : Heavy metals (mg/l) at the collector of a unit of general production and packaging of soft drinks and water tables in the region of Oujda in 2011(Moroccan standards authorized in brackets).

Cr (mg/l)	Cu (mg/l)	Fe (mg/l)	Ni (mg/l)	Pb (mg/l)	Zn (mg/l)
0.0093	0.014636364	1.006090909	0.1017	0.02766667	9.129
(20.5)	(0.5)	(3)	(0.5)	(0.5)	(5)

The analysis of the daily evolution of the temperature is relatively stable; it varies between 23°C and 34°C. The pH values above 7 with an average of 8.7 and values up to 11, which allows us to characterize the effluent discharges studied alkaline. These two parameters are relatively high by the standards required by the standard Moroccan values that direct discharge limits set the temperature to 30° C and pH between 6.5 and 8.5.

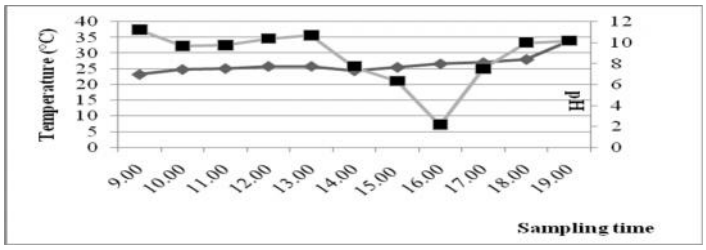

Figure 1: Evolution of daily temperature and pH of industrial wastewater collector.

At the collector industrial conductivity manifold industrial shows that overall mineralization is high enough. During normal production process, the values range between 2000 and 2500 µs/cm. However, higher values (6000 µs/cm) were recorded.

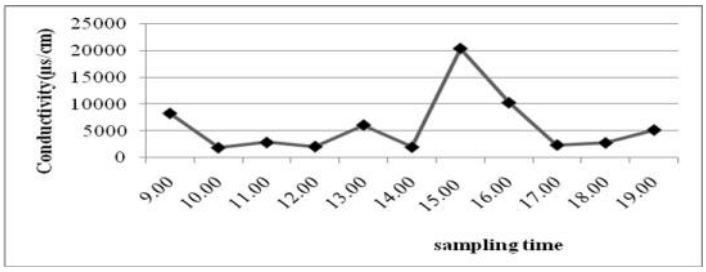

Figure 2 : Evolution of the daily electrical conductivity of industrial wastewater collector

Monitoring the value of suspended solids gives values between 120 mg/l and 900 mg/l, with an average of 370 mg/l.

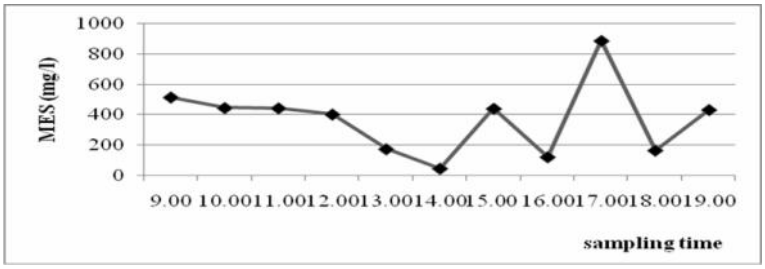

Figure 3: Evolution of daily suspended solids in industrial wastewater collector.

DISCUSSION

The daily evolution of BOD_5 and COD in industrial collector shows significant changes slightly during the day. COD average of about 1141.5 mgO_2/l, respectively, the minimum and maximum extreme values of 837.9 mg/l and 1501.5 mg O_2/l. On BOD_5, she recorded an average value of 373 mg/l, a minimum of 270 mg O_2/l and a maximum of 472 mgO_2/l but remains lower than the COD oil extraction industry which can reach 190 000 mg / l (Bensassi et *al*., 2004).

The average values of COD and BOD_5 data are very high compared with the values determined by the standard Moroccan limits on direct discharges, which are 500 mgO_2/l and 100 mgO_2/l respectively. DCO/DBO_5 reports vary between two extreme values 2.7 and 3.25, this ratio is not very high for industrial effluents whose ratio can reach 10. However, this ratio is greater than 0.3, implies biodegradability (Benyakhlef et *al*., 2007).

Based on these results, we can see that the study area shows a high load of organic matter, this is explained by the fact that the collector drains effluents containing residues multi-products used in various cleaning operations (for production rooms, the room for water treatment, the room syrup preparations) using detergents and various adjutants and disinfection by sodium hypochlorite, the multiple use of the soda (washing bottles, bins sanitations finished syrup, the production system, and filler), purification of the simple syrup by the use of charcoal and residues produced in recycled glass bottles and containers in the preparation of syrups finished soda.

The water temperature is an environmental factor that causes significant environmental repercussions. It acts on the density, viscosity, solubility of gas in water, as well as the chemical and biochemical reactions, dissolution of the salts dissolved, the development and growth of living organisms in the water and particularly the microorganisms (Who, 1987).

Temperature has an influence on the amount of oxygen dissolved in water, the decomposition of organic matter, respiration of plants and animals, the development of the parasites responsible for certain diseases and the proliferation of blue-green algae that release toxins. It is both the electrical conductivity on pH, which allows identification of the origin of these waters and any mixtures (AFNOR, 1985).

The pH influences the carbon balance and directly affects the degree of ionization of the species contained in salt water. The ionized forms are less dangerous than the dissociated forms (ammonia, sulfides, and cyanides). It also has an effect on the viability of some microorganisms to values lower than 5 or higher than 8.5 and it can affect their growth if its value differs from the optimum 6.5-7.5 (WHO, 1987, MARA, 1980).

The analysis of the daily evolution of the conductivity of industrial collector shows global mineralization is high enough. During normal production process, the values range between 2000 µs/cm and 2500 µs/cm. However, higher values

(6000 ms/cm) were recorded, this because of the contributions of releases baths washer with high conductivity is related to the nature of detergents (NaOH) are added in the bath and are also used in the sanitation of all production processes. High conductivity also originated the chlorides of sodium (NaCl) contained in the effluent during regeneration softeners and elimination of defective products by direct discharge into the collector studied. On the other hand, the high temperature at the time of sampling was involved in the formation of the peak result. The average value of conductivity is 5853 µs/cm or twice the limit set by the standard Moroccan releases direct.

Increased salinity has a direct effect on the flora and fauna that occurs by migration and sometimes mortality. Indeed, a very high osmotic pressure can cause, in the gills of fish and other external bodies phenomena of diffusion through the cell walls and sometimes death of the corresponding cells. Beyond 3000µs/cm, unfavorable conditions for a normal ecological balance (Bremon et *al*., 1977).

Monitoring the value of settleable suspended solids and non-settleable organic or mineral, gives values between 120 mg/l and 900 mg/l, with an average of 370 mg/l. high values are recorded at the time of regenerating a filter of the water treatment plant or on the production circuits sanitation, during which operations having all kinds of unwanted body are discharged which explains the high levels. However, even the lowest values recorded during follow-up are very high compared to the value set by the standard Moroccan limits on direct liquid discharges and is 50 mg/l. This is the effluent from the washer bottle.

Indeed, suspended solids can be considered a form of pollution at high levels (ONEP, 1994). They cause pollution accumulation of floating particles and turbidity due to small particles in suspension. The disturbing effect of the medium is due to low levels of radiation in water that directly affects aquatic life (Rodier, 1984). The suffocation of fish by clogging gills is often the result of high levels of suspended solids. (Matuhe, 2001)

Industrial areas and urban wastewater contribute to the elevation of suspended solids whose rates vary in quantity and quality according to the type of industry concerned. The abundance of suspended solids in the water reduces the brightness and thereby lowers the productivity of a stream, and causes a decrease in dissolved oxygen by slowing the photosynthetic processes that contribute to the ventilation water. Similarly, they are responsible for physical clogging of soil, which leads to a decrease in permeability and hence destruction of the quality of the soil during irrigation (Landreau, 1987).

The daily monitoring of the evolution of the ammonium in the industrial collector shows very low values not exceeding 1 mg/l, between 0 mg/l and 0.135 mg/l. Traces recorded from product residues in glass bottles and recycled effluent lubrication.

The biological oxidation of ammonium can develop anaerobic zones in parts of distribution networks and thus cause corrosion of pipes, including copper. Ammonia also has the disadvantage of requiring an increase in the consumption

of chlorine during the disinfection and produce undesirable organochlorine compounds (organic or inorganic chloramines). Virtually per milligram of nitrogen from ammonia, it takes about 10 mg of chlorine to form chloramines and decompose into gaseous nitrogen (Rodier, 2009).

As ammonium, changing daily to record low values of nitrite does not exceed 1 mg/l, and the maximum and minimum values respectively of 0.443 mg/l and 0.044 mg/l, with a mean of 0 and 2 mg/l which varies, depending on the daily flow. This varies according to the production rate; the increase in the peak season of production increases the flow of the discharge and the importance of load nitrites.

In the manifold industrial nitrate levels are a variation on the daily cycle. Nitrate nitrogen present in the form of the most dominant in this collection. Indeed, the mean values of 21.45 mg/l. These high levels are related to the values of the water table whose average value is 26.05 mg/l. most of this collector has a plurality of air vents which inhibits the denitrification of nitrate.

The total Kjeldahl nitrogen is an indicator of environmental pollution and allows monitoring contamination (Rodier, 1996). This element is present in industrial wastewater but at low concentrations ranging from 0.45 to 1.1 mg / l. These levels are due to residues and traces of products, waste lubricating and detergent used for prewash.

The daily evolution of orthophosphate and total phosphorus shows the dominance of the second compound. Orthophosphate contents are generally low; the extreme values are respectively about 0.943 in mg/l and 0.051 mg/l with an average of 0.446 mg/l, and show an increasing trend in the late afternoon around 19:00 h. This is the cleaning of the premises, facilities and production system using detergents and soaps.

Total phosphorus present day developments. The minimum and maximum concentrations of this compound are respectively of the order of 2.78 mg / l and 0.17 mg/l with an average of 1.7 mg/l. these values are low in comparison with the requirements of the Moroccan limit values for discharges of liquid is 10mg/ l. Excess phosphorus can cause disturbances in water (Ménard, 1992).

The analysis of the daily evolution of chlorides in the industrial receiver can detect significant fluctuations. Indeed, the extreme maximum and minimum levels are 2805mg/l and 292mg/l with an average value of 2511mg/l. the peak of the chlorides is recorded with the use of hydrochloric acid for the regeneration of a filter of the water treatment plant and the release of beverage out of date or standards in the manifold directly.

Chlorine with organic nitrogen form chloramines and chlorinated toxic in water (Bliefert et *al*., 2001). They have an influence on the aquatic flora and fauna as well as plant growth and they also promote the corrosion of metals in excessive concentrations (200 to 400mg/l) (Rodier, 1984), excluding these concentrations are much higher than what we allows to conclude that these effluents have the effect of degrading the factory pipes and that in a relatively time course.

Heavy metals studied showed low values and below the limits allowed by the standard limit values for discharges directly. Except zinc that stores extreme values of 27.178 mg/l and 0.47 mg/l, and an average value of 9.129 mg/l against a value of 5 mg/l according to said standard used. In metallurgy, this element enters the composition of numerous alloys, it is also widely used for metal galvanization (Rodier, 2009), something which is the case of unit facilities. Low pH values drinks and the use of acid in the regeneration of some filters cause precipitation of zinc which is entrained in the water sanitation, which explains the high values recorded during the operation of the two lines of packaging soft drinks and acid during regeneration of the filter sand.
Aquatic life, zinc has some toxicity, depending on the mineralization of the water and the species. Toxicity to fish is exercised from a few milligrams per liter (Rodier, 2009).

CONCLUSION

This type of industry is not considered the most polluting agro-food sector. Water consumption is well known in the studied company, which began saving actions such as recycling wash water from glass bottles. Other opportunities to improve the management of water resources exist and can be applied.
Currently different processing technologies have been implemented for water reuse in the industry. Floating media filtration and nano-filtration system to help achieve a reduction in consumption of tap water more than 60% (Hitoshi et al., 2004; Camperos Ramirez et al., 2004).
The qualitative and quantitative characterization leaves out three key areas were identified significant potential for optimization: water consumption through the use of pressure washers more efficient and economical for the cleaning of premises and equipment, and equipment of the factory valves that delivers when the operator holds. These measures not only reduce the consumption of drinking water, but also reduce the flow of pollutants (Benyakhlef, 2008).

REFERENCES

AFNOR (1985). Recueil des normes françaises des eaux, méthodes d'essais, AFNOR, 2ème édition, Paris, 566-622.

Agence du Bassin Hydraulique de la Moulouya (2012). Mécanisme volontaire de dépollution industrielle hydrique, p. 1, www.abhm.ma .

BENSASSI A., JAOUAD A., MANDI L., BOUSSAID A. (2004). Comparaison du traitement des margines par les levures, First Int. Symp. Management Liquid Solid Residues (MALISORE), Mohammedia, Morocco, April.

BENYAKHLEF M., NAJI S, BELGHYTI D. (2007). Caractérisation des rejets liquides d'une conserverie de poissons, Bull. Soc. Pharm. Bordeaux, 146, 225-234, p. 231.

BENYAKHLEF M. (2008). Etude et caractérisation des rejets des industries agroalimentaires en vue d'une économie et une optimisation des circuits des eaux (Région d'Agadir), thèse de doctorat en sciences, Faculté des sciences de Kenitra, p. 138.

BREMON R., PERRODON C. (1977). Paramètres de la qualité des eaux, Rapport du Ministère de l'Environnement et le Cadre de Vie, direction de la prévention de pollutions services des problèmes de l'eau, Paris France, p. 258.

BLIEFERT C., PERRAUD R. (2001). Chimie de l'environnement : air, eau, sols, déchets. Paris, Bruxelles : De Boeck Univ., XVIII, p. 477.

CONSEIL NATIONALE DE L'ENVIRONNEMENT (2009). Les instruments économiques au service de la protection de l'environnement au Maroc, p. 8.

HITOSHI M., SUSUMU A., KOJI, YASUNARI K. (2000). Water recycling by floating media filtration at a soft drink factory. Desalination 131, 47-53.

LANDREAU A. (1987). La réutilisation des eaux usées épurées par le sol et le sous sol : adéquation entre la qualité de l'eau, l'usage et la protection du milieu naturel, Séminaire sur les eaux usées et le milieu récepteur, Casablanca 9-11 avril, 1-13.

MARA D. (1980). Sewage treatment in hit climate, Ed. John Willey and sons, p. 56.

MATUHE, Ministère de l'Aménagement du Territoire, de l'Urbanisme, de l'Habitat et de l'Environnement, (2001). Milieu physique eau. In Royaume du Maroc, Ministère de l'Aménagement du Territoire, de l'Urbanisme, de l'Habitat et de l'Environnement, Rapport sur l'état de l'environnement du Maroc, p. 51.

ONEP (1994). Séminaire sur le maintien de la qualité de l'eau dans les réseaux de distribution, Rabat du 7-8 juin, p.12.

RAMIREZ CAMPEROS E., MIJAYLOVA NACHEVA P., DIAZ TAPIA E. (2004). Treatment techniques for recycling of bottle washing water in the soft drink industry, Wat. Sci. tech. Vol. 50, 2 (2004), 107-112.

RODIER J. (1984). Analyse de l'eau, eaux naturelles, eaux résiduaires, eau de mer, 7ème édition, Dunod, Paris, p.1365.

RODIER J. (1996). L'analyse de l'eau : eaux naturelles, eaux résiduaires, eau de mer : chimie, physico-chimie, microbiologie, biologie, interprétation des résultats. Dunod, Paris, 8ème éd., p. 1008 (XLVII, 1383 p.).

RODIER J., LEGUBE B., MERLET N., COLL (2009). L'analyse de l'eau, 9ème édition, DUNOD Paris, p. 1217, 1381.

WHO, World Health Organization (1987). Division of Environmental Health United Nations Environment Programm Global Environment Monitoring System, Global pollution and health results of related environmental monitoring, Global Environmental Monitoring system, UNEP, p. 12.

MENARD F. (1992). Quelle eau demain ?, Institut National de Recherches et d'Application Pédagogiques (INRAP), (102), p. 28.