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Integrated Management of Environmental Risks Related to The operation of a Domestic Sewage Treatment Plant in Cameroon

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Abstract—**The rehabilitation of semi-collective wastewater treatment plants and the construction of new ones in the city of Yaoundé are timely, in a context of general insalubrity. However, the technologies of Yaoundé's stations are still unknown and difficult to master, causing often, damage to the environment like pollution. The studies carried out, demonstrate risks of chronic toxicities, because the excess of individual risk (EIR) are all superior to 1.10^{-6} per person per year for the employees who mainly deal with the tasks of managing the sludge and the screening in the enclosure. This demonstrates a probabilistic appearance of cancers in these employees. In order to put in place an integrated risk management plan for all future stations, the concerns of local residents and wastewater treatment plant(WWTP) staff have been taken into considerations. Through the surveys carried out, it has been observed that more than 70% of the people interviewed do not know the role of the wastewater treatmentplan (WWTP) and more than 48% of the same population make poor waste management in toilets. In addition, the method of analysis of system malfunctions (MASM) and a method of scientific analysis, risk assessment, highlight sludge as the main source of danger and people as the main target source. Moreover, the physic-chemical analyzes made at the entrance and at the exit of the purification stations confirms the high risk that the surrounding population run. The process of collection of wastewater up to the purification plants presents several dysfunctions. So the results of the water samples analyzed at the exit of the treatment plants after treatment could be better. As well as before and after the outlet, we confirm the pollution of the watercourse connecting to the water leaving the stations; It should also be noted that this pollution also attacks underground flows, the surrounding wells, because people complain of diseases caused by the water they use. These results enable the implementation of an Environmental and Social Management Plan (ESMP) that does not exist in the various treatment plants studied.**

Index Terms— **Wastewater treatment plant, MASM; Risk; management; EIR**

I. INTRODUCTION

Preserving the environment is a global challenge to ensure the safety of future generations. The treatment of wastewater prior to release to the wild represents a major challenge for many countries around the world. The latter is increasingly accentuated in developing countries, which not only suffers from a lack of capital, but is confronted with urbanization and anarchic industrialization. In Cameroon, most of the wastewater from agglomerations and industrial structures is now rejected in the natural environment without prior treatment. In the city of Yaoundé, all the sewage treatment plants that have existed since the 1960, there are few that are still functional today, which favors urban pollution and poses enormous environmental and health risks for the population. . The observation of the operation of a hybrid treatment plant, filter and plant as well as the maintenance of it reveals some shortcomings, making the ecosystem of the receiving environment, the health of the staff and the population bordering the city vulnerable. Yaounde capital of Cameroon. We are particularly interested in the operation of the Messa sewage treatment plant that purifies the wastewater of social housing built by the Cameroonian government. The general objective of this study is to identify and implement an integrated management system, social and environmental risks related to the operation of the treatment plant. And more specifically it will be for us: to make an inventory of the treatment plant and carry out physicochemical and bacteriological analyzes of effluents from the treatment plant; to make a risk assessment by the method of analysis of system dysfunction and by the scientific approach; to characterize the risk and put in place an environmental and social management plan.

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II. LITERATURE REVIEW

A. *Impact of wastewater on the environment*

Environmental impacts are changes in the natural or built environment, resulting directly from an activity, that can have adverse effects on the air, land, water, fish, and wildlife or the inhabitants of the ecosystem (Abdallah, 2017).Y. LIBES in his article "Urban sewage and treatment" raises the problem of the contamination of waterways by the discharge of wastewater that has not been completely treated. According to him, rivers have a natural capacity for purification. He supports the fact that areas deprived of oxygen by pollution cause the death of fauna and flora or create impassable barriers that prevent migration in particular. Pollution caused by sewage causes several impacts on the ecosystems that receive them, the most important of which is eutrophication, or premature and accelerated aging of a body of water. Organic matter contains phosphorus and nitrogen, which are two important elements for the survival and growth of all living things. A surplus of these two nutrients causes the proliferation of algae and aquatic plants. These can quickly invade a body of water or interfere with the flow of a stream. The proliferation of algae and bacteria in the water causes a drop in oxygen in the water, which literally chokes fish and the insects that live there.

B. *Impact of wastewater on human health*

Globally, the utilization of wastewater for irrigation is widespread (Molden, 2007; Drechsel & Evans, 2010). While the planned reuse of wastewater, as promoted by urban agriculture, can induce significant environmental and economic advantages (Bellows et al., 2003; Holt-Giménez & Patel, 2009; Drechsel et al., 2010), the unstructured and often unaware utilization of wastewater for irrigation bears health risks to the farmers and their families, the consumer as well as the wider community (Lee-Smith & Prain, 2006; Hamilton et al., 2007). Water-borne infections remain a key public health challenge on the global level(Falkenberg et al, 2018). Diarrheal disease threatens thehealth and adequate development of young children, with 800,000 premature deaths still attributed to the disease annually (UNICEF, 2012). In recent years, various global and national efforts to reduce the burden of diarrhea have been initiated, aiming at creating safe and improved drinking water sources through the adequate provision and treatment of drinking water, as well as providing access to improved sanitation (Wolf et al., 2018). For Andreanne Demers, non-disinfected wastewater is a source of bacteriological contamination. In Quebec, 60% of wastewater is not disinfected, i.e. not all microbes are destroyed by treatment. Fecal coliforms, a kind of bacteria that survive wastewater treatment, pose a threat to human health by causing gastro-enteric diseases. This contamination prevents many riverside communities from having access to water. Ingestion of water contaminated with blue-green algae toxins may cause stomach upset, vomiting, headache, fever or diarrhea, sore throat and irritation of the skin of the eyes.

C. *Definition and classification of risks*

Risk is a concept that is variously understood, represented, identified, estimated, interpreted, perceived, evaluated, mastered and managed (Mohamed, 2009). R. Flanagan and G.Norman (Flanagan et al, 1993) report in their book "Risk Management and construction" that the word "risk" is relatively modern. It comes from the French word "risqué" (Mohamed, 2009). It’s only in the middle of the 17th century the Anglo-Saxons adopted the term "Risk", before it was very present in the insurance vocabulary. Risk is a poorlydefined concept and has different meanings depending on the epidemiologist, the environmental specialist, the insurer, the safety engineer, the caregiver or the executive. The risk manager associates it with the term vulnerability (Semirath, 2009).

Generally, the gravity and probability of occurrence levels are crossed in a criticality matrix in order to position the risk zones. We can therefore define the different risks as:

- Negligible risk (manageable)

It refers to a level of risk whose occurrence is 1 per million and per year below and whose probability of realization does not affect everyday life.

NB: Negligible risk is not taken into account in the overall risk assessment of a system

- Acceptable risk (manageable)

It reflects the concept of integrated risk as in the context of everyday life. A risk perceived as insignificant can easily be accepted.

- The undesirable risk (controllable)

This is a risk that can be tolerated through appropriate control and monitoring measures.

- Residual risk (non-controllable)

It is a risk remaining after the various possible measures have been taken.

- Unacceptable risk (not manageable)

This is a residual risk that is not tolerable.

Table1.Gravity scale according to ISO 14971 (ISO 14971, 2000).

Gravitates	Signification
Negligible	Incident requiring no medical procedure
Minimal	Minor first aid injuries (not requiring medical treatment)
Minor	Minor injuries or illnesses requiring medical treatment
Major	Injury or serious illness, permanent disability
Catastrophic	Death of one or more persons
Negligible	

Frequency is the incessant repetition of an action. The product of its two variables, its criticality, must measure each risk that has the potential to be realized.

$$C = FxG \begin{cases} F: frequency \\ G: gravity \end{cases} \quad (1)$$

D. *Normative framework of wastewater discharge*

Table 2: Standard for domestic sewage discharge in Cameroon

Settings	maximum acceptable value at the entrance to the WWTP	Max value
Température (°C)	30	
BOD_5(mg/l)	800	30
COD(mg/l)	2000	100
SM (mg/l)	60	50
pH	6 - 9	6.5 – 8.5
TKNNitrogen(mg/l)	150	20
Total phosphorus	50	10
Coliform UFC/100ml		2 000
Streptococcus fecal UFC/100ml		1000

(Source: MINEPDED Cameroon, 2005)

However, the absence of an independent body should be noted in order to ensure the validation of the performance of the wastewater treatment technologies in place and, on the other hand, to encourage municipalities to go further than simply respecting standards in order to protect the environment.

(1) European environmental standards for the discharge of wastewater

In the absence of a decree implementing the laws governing pollution in Cameroon, we will work with European standards, which will give us an indication of the possible fate of our effluent after purification.

These standards only concern the discharge of domestic wastewater. It is said that waste water or urban effluent discharge is domestically dominated if the COD /BOD_5

(Chemical Oxygen Demand/Biochemical Oxygen Demand)ratio does not exceed 2.5, and its COD (Chemical Oxygen Demand) is less than 750 mg / l and its nitrogen less than 100 mg / l. The performances of the main treatment process currently in use worldwide.

Table3:Wastewater discharge standards

Wastewater discharge standards
pH : 5.5 < pH < 8.5 ; 9.5 if there is alkaline neutralization
Temperature: below 30 ° C
COD(Chemical Oxygen Demand): 150 mg / l For non-decanted effluent: 300 mg / l if the maximum permissible daily flow does not exceed 100kg / d. Receiving waters: 50 kg / d; 125 mg / l above.
BOD_5(Biochemical Oxygen Demand)(mg / l)for non-settled effluent: 100 mg / l if the maximum daily permissible flow does not exceed 30 kg / d. Receiving waters: 15 kg / d; 30 mg / l above.
SM (Suspended Matter): 100 mg / l if the maximum daily rate authorized by the order does not exceed 15 kg / day; 35 mg / l above. 150 mg / l for a lagoon treatment plant
Global nitrogen, including organic nitrogen, ammonia nitrogen and oxidized nitrogen: 15 mg / l in monthly average concentration when the maximum daily permissible flow is equal to or greater than 150 kg / d.
Total phosphorus: 2 mg / l in monthly average concentration when the maximum allowed daily flow is equal to or greater than 40 kg / d.

Source: Arrete 2 February 1998 J.O European Community

E. *The classification of water*

The multipurpose grid of the water agency artois - picardie (WAAP) (1971) was used to assess the quality of water discharged into the receiving environment. This grid classifies the waters into four main classes:

Class 1A: it characterizes the waters considered as examples of pollutions, able to satisfy the uses of the most demanding in quality.

Class 1B: of a slightly lower quality, these waters can nevertheless satisfy all uses.

Class 2: passable quality, sufficient for irrigation, industrial uses, production of drinking water after extensive treatment. Watering animals is generally tolerated. the fish lives there normally but its reproduction can be random. Water-related hobbies are possible when they only require exceptional contact with it.

Class 3: "poor" quality: just fit for irrigation on cooling and navigation. Fish life can subsist in these waters, but this is uncertain at times of low flow or high temperatures, for example.

Out - Class: waters exceeding the maximum permissible value in class 3 for one or more parameters. They are considered unsuitable for most uses and may pose a threat to public health and the environment.

The most unfavorable parameter is used to assess the general quality of the water. The table opposite shows the values of the parameters used

Table4: The values of the parameters used

Quality				
Parameters	Class 1A	Class 1B	Class 2	Class 3
BOD_5 (mg/l)	≤ 5	≤ 10	≤ 25	>25
COD(mg/l)	≤ 25	≤ 40	≤ 80	>80
SM total (mg/l)	≤ 70	-	> 70	-
Conductivity (µS/cm)	≤ 2000	-	> 2000	-
pH	$6.5 \leq PH \leq 8.5$	-	6.5<pH<8.5	-

III. Methodology of Study and State of Place

A. *Material resources used*

To carry out this study well, the following technical material resources were necessary:

- Liquid effluents entering the treatment plant for treatment;
- Personal protective equipment such as gowns, gloves, nose covers, laboratory glasses for handling effluents;
- Remediation reports;
- Laptop for data entry and storage;
- Excel and SAS (statistical analytic system);
- Data collection elements (pen, notebook, pencil);
- Camera for different views.

B. *Presentation of the grand Messa wastewater treatment plant*

The site is located in the surroundings of Yaounde 2, in the Mingoa basin, a tributary of the Mfoundi River.The supply basin is the housing of Camp SIC Grand Messa which is a housing complex comprising 480 housing including commercial premises. It is spread over 9 hectares and is home to nearly 3200 inhabitants. The station was commissioned for the first time in 1967 (activated sludge treatment at low load), then rehabilitated respectively in 1985 and in 2010. The last rehabilitation was at the demand of the Urban Council of Yaoundé financed with the funds transferred by the MHUD(Ministry of Housing and Urban Development) within the framework “transfer of skills and resources to local councils”. The current treatment process is the so-called "underground spreading on a reconstituted and non-drained soil" (Source: UCY 2010). It counts nearly 2000 people and covers a ground surface of9 hectares (Emile TANAWA, et al, 2003).

Initially it was sized by 4500 EH(Equivalent Habitant) And treated a volume of 450 m^3 of wastewater per day containing a quantity of 243 kg of BOD_5/ d (Biochemical Oxygen Demand /day). This subterranean filtering system has a capacity of nearly 1000 m^3 / d approximately 3500 EH (Equivalent Habitant).

C. *Inventory of equipment upstream of the MESSA wastewater treatment plant*

The domestic wastewater collection network upstream from the Messa station consists of (source: UCY (Urban Community of Yaoundé) 2013):
3,450.7 m sewage pipe, of which 80% is defective;

02 outlets, one of which leads to the rehabilitated treatment plant and the other to the Ekozoa - Abiergue watershed at the site of the lifting station;

202 manholes counted and defective in almost all;

A lifting station totally deteriorated and out of use;
In fact, the wastewater is collected from their point of production from the manholes connected to the public sewer using a PVC pipe 125 mm in diameter. The public sewer is made of fiber cement and has a diameter of 160 mm and is buried between 100 and 200 cm deep.The reinforced concrete manholes are of square section with dimensions varying between 60 and 150 cm, closed by a reinforced concrete cover.

From these observations, two orders of dysfunction were observed:

- Structural dysfunction
- Functional dysfunction

D. *Structural dysfunction*

We could observe some dysfunctions such as: the cracking of manholes, the exposure of the slab reinforcement due to the recess of the concrete,the deterioration of structures, fractures on pipes, the broken or missing slabs, and crusts of scum (Figure1-6).

Figure 1: Rusty and open lid

Figure 2: Waste water flowing on the pavement

Figure3: Rainwater and sewage mix

Figure 4: Open and obstructed concrete manholes

Figure5: Waste water flowing on the pavement

Figure 6: Bad treatment of waste

E. *Functional dysfunction*

It has been noted considerable deposits of solid (condom, plastic bags, bottles, linens ...), stagnant liquids, traces of loading , obstructions of pipes , manholes partially or completely filled with mud, overflow of water from manholes which streams on the road and in the gutters, constituting a permanent danger to the health of the neighboring populations .These manholes give off foul odors and is a vector for the proliferation of insects, especially mosquitoes, flies and cockroaches.
This last order of dysfunction is accentuated by the incivility of the populations due to which the vandalism on the covers of manholes leads to rainwater being found in the separate-type network, household waste such as apparatus from diverse origin are poured into the open manholes.

IV. Analysis of Results and Discussions

A. *Quality of water discharged into the receiving environment*

Thevaluation of the performance of a wastewater treatment plant requires the control of the values of physico-chemical parameters through the following activities principles:

The verification of SS capture rates, as well as the recycled head loads of BOD_5(Biochemical Oxygen Demand), COD(Chemical Oxygen Demand), conductivity, total nitrogen and total phosphorus:

Verification of the good distribution of sludge on the surface of the bed used

Verification of the quality of the seeding in rainwater: The point here is to look for empty zones, desiccations and / or existence of parasitic plants.

The experience on the filters planted with reeds in France and elsewhere has made it possible to note that the use of the vertical filter makes it possible to ensure almost complete nitrification if it is well dimensioned . However, de-nitrification is negligible. On the other hand, the use of the horizontal filter guarantees a low nitrification but a good de-nitrification provided that the waters are still sufficiently rich in organic matter (source: OIE 2004)

B. *Performance of the messa purification station*

Table 5:Test results of the water

Settings	Acceptable release standard	Location	August 6, 2011	January 17, 2014	09/15/2018
pH	7.5 – 8.5	Entrance	6	6.9	7
		Exit	9	7.9	6.99
SM (mg/l)	50	Entrance	258.4	326	1148
		Exit	3.04	<1	120
DBO_5(mg/l)	30	Entrance	298	496	245
		Exit	27	0.5	16
COD (mg/l)	100	Entrance	444	2015	1447
		Exit	47	12.3	38
TKN (Nitrogen)	20	Entrance	64.54	9.7	-
		Exit	18.44	<1	-
$NO_3^-(Nitrate \frac{mg}{l})$	50	Entrance	8.4	<5	44.4
		Exit	2.3	<5	0.2
Conductivity 25°C µS/cm	400	Entrance	596	466	477
		Exit	335	161.1	179.2
Phosphore total	10	Entrance	13.15	-	10.5
		Exit	0.98	-	1.7

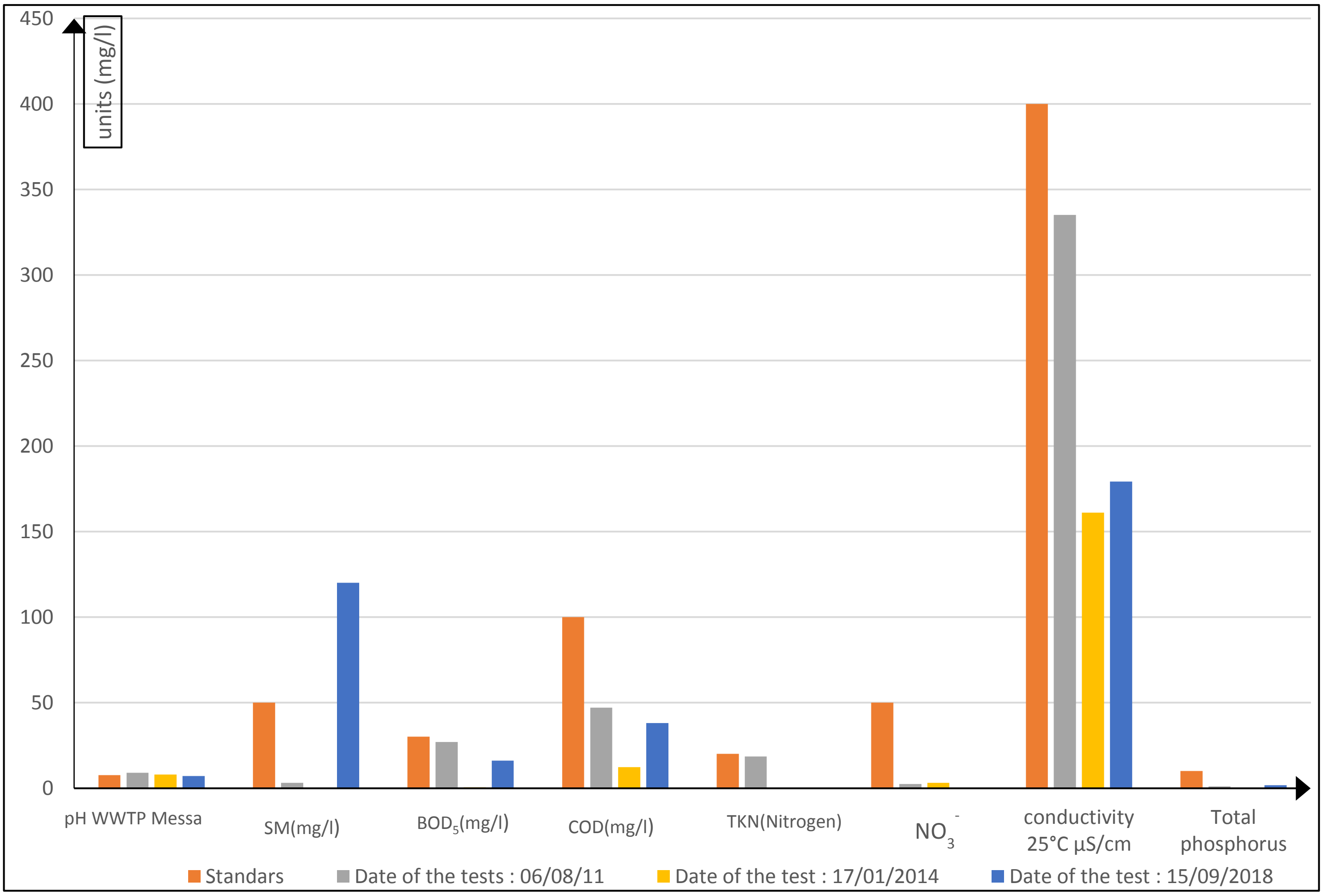

Figure 7: Reject values

These results show that some parameters are above the standard, for example suspended matter (SM). hence a risk of environmental contamination.

C. *Water purified by the Messa wastewater treatment plant*

The average values of BOD_5, COD, SM, conductivity and pH are respectively 10 mg / l, 21.37 mg / l, 1.68 mg / l, 221.87 µs / cm and 7.96. This makes it possible to classify the water purified by this station to a water of class 1B, that is to say a water of slightly lesser quality, these waters can nevertheless satisfy all the uses

D. *Qualitative analysis: risks present in the WWTP*

The Pareto diagram is a simple way to rank the phenomena in order of importance. This diagram and its use aim to:

- To reveal the essential causes of a phenomenon;
- Prioritize the causes of a problem;
- Evaluate the effects of a solution;
- Better target actions to implement;

Table 6:Table of causes major and frequent

Major causes	Justification	Frequency observed (3 months)
Flood of the station	The rains of the short rainy season flooded the resorts	3
Staff contact with sludge and domestic sewage	At each maintenance service the staff is always in contact with the sludge and domestic sewage	38
Air pollution	The presence of personnel at the station exposes them to pollution at CH_4 and also during maintenance activities	96
Enrichment of the surrounding streams	During rains, runoff from sludge deposited on the ground reaches watercourses	10
Slipping and falling in the structure	The presence of granular gravel implanted in the concrete causes falls The old covers also cause falls. It should be noted that I myself have been a victim of a fall from the dilapidated steel lid basin	3
Digestive disorders	The person is especially at the beginning of activities of gastro-enteric disorders	10

It shows

Table 7: Cumulative Percentage

Major causes	Frequency (3 months)	%	% cumulated
Air pollution	96	60	60
Staff contact with sludge and domestic sewage	38	23.75	83.75
Enrichment of the watercourse	10	6.25	90
Digestive disorders	10	6.25	96.25
Slipping and falling in the structure	3	1.875	98.125
Flood of the station	3	1.875	100
totals	160	100	60

With a total frequency of 160, the Pareto graph can be plotted knowing that the first 2 causes more than 80% of all the registered causes

The Pareto diagram (Figure 7) shows that the observed risk classes (microbiological risk, risk of incident and pollution) originate at the level of the major subclasses, We want to at least reduce the risk of 83.75% we must be able to put protective barriers for air pollution and the cause of personnel with the products of the treatment plant

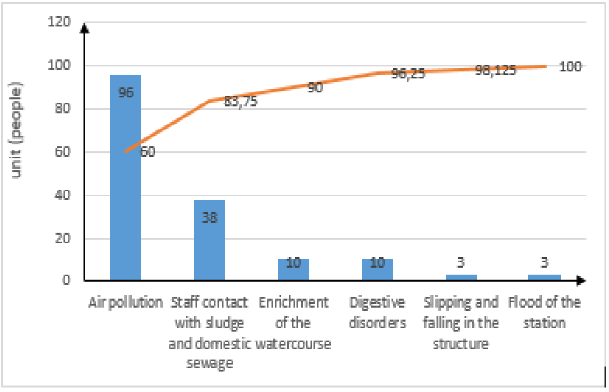

Figure 8: Pareto diagram of the treatment plant

E. *Quantitative analysis: risks present in WWTP*

Table8: Calculation of HQ with threshold effect

	Mixed concentration (mg/m^3)	Sources / years	exposure(L/D)	HQ
Cd	$2.0e^{-05}$	OEHHA/2004	$1.0e^{-07}$	$5.0e^{-03}$
Cr	$6.0e^{-02}$	RIVM/2001 and US EPA	$1.0e^{-07}$	$1.7e^{-06}$
Cu	$1.0e^{-3}$	RIVM/2002	$1.0e^{-07}$	$1.0e^{-04}$
Hg inorganic	$3.0e^{-04}$	US EPA/1996	$1.0e^{-07}$	$3.3e^{-04}$
Ni	$5.0e^{-05}$	RIVM/2001	$1.0e^{-07}$	$2.0e^{-03}$
Pb	$5.0e^{-04}$	WHO/2000	$1.0e^{-07}$	$2.0e^{-03}$
Zn	/	/	/	/
PCB(detergents)	$5.0e^{-04}$	RIVM/2001	$1.0e^{-07}$	$2.0e^{-04}$

We have a summation of HQ= $-7.84e^{-03}$

Table9:Calculation of HQ without threshold effect

$TRV(\frac{mg}{m^3})^{-1}$ without threshold effect (EUR)	Sources / year	Dose (L / d)	IR or HQ with threshold effect
Cd	1.8	USEPA/1992	$1.00e^{-06}$
Ni	$3.80e^{-01}$	WHO/2000	$1.00e^{-06}$
PCB(detergents)	$1.10e^{+00}$	Derivation	$1.00e^{-06}$

We have a summation of HQ = $4.10e^{-06}$

HQ or threshold index and no threshold (summation): HQ<1 this means that the exposed population is theoretically outof danger and the occurrence of a toxic effect is considered excluded, even for sensitive populations. But, the final decision on the acceptability of the risk lies with the risk manager

Table10: EIR (Excess of Individual Risk) determination

	Cd	Ni	PCB (detergents)
$TRV(\frac{mg}{m^3})^{-1}$ without threshold effect (EUR)	1.8	$3.80e^{-01}$	$1.10e^{+00}$
Sources / year	USEPA/1992	OMS/2000	Derivation
Dose	$1.00e^{-06}$	$1.00e^{-06}$	$1.00e^{-06}$
HQ(Hazard Quotient)	$5.56e^{-04}$	$2.63e^{-06}$	$9.09e^{-07}$
Fe (d/yr)	144	144	144
T(yr)	20	20	20
Average weight (kg)	56.33	56.33	56.33
Tv (time of life) (d)	20440	20440	20440
DOD (mg/kg/d)	$1.88e^{+00}$	$3.97e^{-01}$	$1.15e^{+00}$
EIR	$3.31e^{-03}$	$1.48e^{-04}$	$1.24e^{-03}$

Per person, EIR (Excess of Individual Risk) equals $3.31e^{-03}$ for the Cd; $1.48e^{-04}$ for the Ni; and $1.24.e^{-03}$ for detergents, all greater than $10e^{-06,}$ hence the risk is unacceptable because the sum of the EIR $4.7e^{-03}$. Contrarily to the HQ which showed that there was no risk

For the metals present in the sludge, they are removed essentially at the level of the first settling tank and mainly on the decantation on the particular form of the metal as shown by Fars, on its study on the elimination of heavy metals (Cu, Zn, Pb and Cd) contained in wastewater. The residual content of these metals remains in accordance with the rejection standards.

The quantitative risk analysis was very difficult indeed, the documentation is very rare, and the concept of apprehension of the excess risk on the size of the population remains. The risks calculated for a human health risk assessment are not based on population size (Dor et al., 2007), but an observation based on the size of the potentially exposed population and individual risk is strongly desired (Zmirou et al.2006)

V. Risk Classification

Table 11:Severity, frequency determination

	Types of risk	severity				Frequency			
		1	2	3	4	1	2	3	4
Microbiological risk	Respiratory morbidity								
	Digestive morbidity								
	Cutaneous morbidity								
Pollution risk	Degradation of air quality								
	Soil contamination by sludge								
	Enrichment of watercourses								
Risk of incident	Fall or slip in the resort								
	Snake bite or other								
	Stopping the second filter basin and plant								
Chroniccarcinogenic risks	Inhalation of Cd,Ni,PCB								

The classification is made by determining the criticality (frequency x gravity). The majority risk observed is that of the undesirable risk that must be mastered, by a ESMP (c)

Gravity: (4) = very serious; (3) =serious; (2) =serious; (1) =benign Frequency: (4) = very serious; (3) =frequent; (2) =rare; (1) = very rare

Table 12 Criticality

		Severity			
		1	2	3	4
Frequency	1	Acceptable risk	Acceptable risk	Acceptable risk	Unwanted risk
	2	Acceptable risk	Unwanted risk	Unwanted risk	Unwanted risk
	3	Acceptable risk	Unwanted risk	Unwanted risk	Unacceptable risk
	4	Unwanted risk	Unwanted risk	Unacceptable risk	Unacceptable risk

The risk present at the station is that of the undesirable risk

VI. Conclusion

From this study, it is clear that the operation of the Messa, wastewater treatment plants creates health and environmental risks. The health risk is highlighted during maintenance activities by the staff, which is exposed to 83% of the recorded damages that may occur at the station. People working in the compound may be exposed to chronic toxicity effects that may lead to respiratory, skin and even skin cancersIn addition, physicochemical analysis, made at the Messa treatment plant whose treatment process is underground spreading seems to be the more efficient, however, these waters are classified in class 1B.

Nevertheless, there are environmental risks on residents, which can cause epidemics such as cholera, typhoid ... on one hand, and on the other hand the eutrophication phenomenon \ can be observed if this continues. These risks come from the mismanagement of the sludge from the station after screening.

However, the dangers and risks can be reduced by the integration of the ESMP(Environmental and Social Management Plan)in the daily activities particularly: by the wearing of PPE model sewer, by a regular sensitization of the personnel and the residents through the flyers and panels.We recommend:

Put the ESMP (Environmental and Social Management Plan) as soon as possible into the document;

Regular training of personnel in HSE (Health Safety Environment) and sludge management (eco-composting, agricultural spreading, incineration ...) by environmental engineers;

To the UCY (Urban Community of Yaounde) to consider additional investments for the installation of drying beds that will be sized and maintained by the environmental engineer and also to make unexpected controls to the structure in order to make the station and managers on standby;

Recruit a medical consultant to regularly take light and advanced exams for staff to prevent already known infections;

To the population, to take part in the sanitation of their environment by building the appropriate waterproof latrines, to avoid throwing garbage in the nature and more specifically in watercourses.

For our future work, we propose to extend the analysis of the risks on the chemical pollutants of medicinal origin very complex to detect and neglected but responsible according to the literature review of the destruction of the aquatic and even terrestrial micro-fauna.

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