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IMPACT OF HOSPITAL DISCHARGES OF LEACHATE : STUDY AND ECOTOXICOLOGICAL PERSPECTIVE AND SOLUTION STRATEGY

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ABSTRACT: Materials such as leachate or leachate from hospital waste as a source of contamination and impact on nature and the environment. These juices are sources or vectors of pollution, justifying the purpose of our study. We had carried out three sampling campaigns in 2006, 2008 and 2010, the leachate four hospitals (CUK, HGRK, HGK and HGRN). Thus, we studied the physicochemical parameters in leachates and global settings to the toxicity tests. The results of our study are consistent with each other and show that ecotoxicity is constant for leachate that appear stable while their composition is variable. The toxicity test leachate sorting studied at each hospital establishment.

Splits leachate can find a lasting solution in the nano filtration technique membranes during preparation of a wastewater treatment plant in the hospitals studied. Leachate contaminating the surrounding environment if not treated are at their rejection. Thus, instead of using reverse osmosis is an expensive technology and is justified if the standards are drastic, nano filtration is an intermediate way to help avoid pollution of hospital discharges juice. This technique helped us in our study to remove the chemical oxygen demand in the case of CUK. Thus we evaluated the performance of organic and inorganic membranes during the lowering of the inorganic filler according to the speed and pressure that are hydrodynamic conditions. The membranes have a specific behavior with respect to the leachate at the absorption, polarization and clogging of the pores. Indeed, the N01A membrane, discharge of COD is of 70% for a 10 bar pressure. The MP20 has a low membrane adsorption with leachate.

The MP-31 provides a high retention rate of COD. There is then a strong membrane-fouling interaction improves the selectivity of the membrane. Leachate particles clog the membrane pores and obstruction and static adsorption increase membrane rejection rate. We studied the coagulation mechanism as a pretreatment to improve the membrane performance on the N01A.

On this membrane COD reduction from 70 to 77%, the flux increases to 105 l. $h^{-1}.m^{-2}$ at a pressure of 10 bar for a COD concentration of 300 $mg0_2l^{-1}$. The other two MP-31 membranes and MP20 provides for a flow limit of 11 l. $h^{-1}.m^{-2}$ COD respectively 1457 $mg0_2l^{-1}$on MP-31 MP20 and a concentration of COD 1417 $mg0_2l^{-1}$. For a max flow of 13 $l.h^{-1}.m^{-2}$ the retention percentage is 70% for COD 960 $mg0_2l^{-1}$
After coagulation, fouling index was 4.8 for the raw leachate and increases to 4.5 with the supernatant. Both indices are similar. Internal fouling content is 76%. This shows that clotting does not eliminate the molecules of molecular weight around 1000 Da. These particles continue to clog the pores of the membrane and the membrane performance is limited. With the membrane N01A we can treat 77% of COD which consists of chemical substances with a carboxylic function and the aromatic rings. We can in the leachate treatment and in order to install treatment plants in developing countries membranes kind N01A.

KEYWORDS: Impact, leachate, hospital discharges, zcotoxicological, solution.

1 INTRODUCTION

In all hospitals in our study, we observed several open landfills as shown in the pictures in this work. These discharges include both the waste similar to household waste and waste similar to waste infectious healthcare (syringes, soiled wadding, blood bags, the anatomical parts ...).

The open dump sites are a potential source of contamination of soil by leaching materials that have accumulated there. The juice is considered the major carrier of pollution. Therefore we assess the risk posed by landfills for water by studying the parameters related to the conductivity, pH, chemical oxygen demand (COD), metals, ions ecotoxicity using Microtox tests and Daphnia.

We thus conducted three sampling campaigns between 2006, 2008 and 2010 a study of four landfills sites leachate to find indicators that may be considered in the risk assessment.

We identified hospital waste storage sites CUK, HGRK, HGK and HGRN that impact on the water or on the ground using multistage sampling during the years of study.

Thus, we have established first a listing of data on the nature of discharges and type of material are deposited. Second, we have developed an inventory of materials and thirdly we have identified particular sites for water. The risk assessment shows that the discharge on the receiving environment is inherent in the nature of the medium that it releases.

Our comments focus on research qualifiers elements juices or liquids (leachate) out of landfills. The so called juice is the main vector of pollution that has an impact on the soil or groundwater by the discharges of the four hospitals.

2 EXPERIMENTAL METHODS

2.1 LEVIES

Our study focuses on three seasons starting from 2006, 2008 and 2010. The first campaign (I) was held on 10 September 2006, the second campaign (II) September 10, 2008 and the third campaign June 10, 2010. The selected dates and are not made at random but to allow us to work on undiluted leachate and during the period before the dry season (June) and the start of the rainy season (September). Leachate wear A1 references, A2, A3 and A4 for the campaign I, A12, A21, A31 and A41 to the countryside II and finally A121, A211, A311 and A411 for the campaign III and two places samples in each case.

2.2 TECHNIQUES

The oxidation reaction in the presence of potassium dichromate has enabled us to the DCO titrated in the presence of ferrous iron. The AFNOR dilution method for incubation at 20 °C allowed us to assay BOD_5.

Ammonium ions were determined by the colorimetric assay, nitrates and ortho phosphate by colorimetry. Ion chromatography enabled us to measure the chlorides, bromides and sulphates.

Technical known for the determination of metals in leachate, we opted for the atomic absorption spectrometry, which in principle for the determination several elements even in trace amounts (about a few mgl^{-1}). The technique is based on the absorption by the elements in the atomic state of radiation from a discharge cathode lamp. We then take the linear relationship between the light absorbed and the concentration of the analyte in the sample. The atomising process is performed by a flame in an electrothermal device is in a graphite furnace. The sensitivity threshold is 0.1 to 100 gl^{-1} and even at the level of 20 $nmoll^{-1}$ in the blood, metal, hence its interest when the amount of sample collected is limited. This technic is mono-elemental and widespread for its reasonable cost [1].

2.3 PHYSICOCHEMICAL PARAMETERS

The analysis focuses on determining the overall parameters such as chemical oxygen demand (COD) and biochemical oxygen demand in 5 days (BOD_5) and physico-chemical parameters such as conductivity, pH, nitrate (NO_3), ammonium (NH_4^+), ortho phosphate, chloride (Cl^-), sulfate (SO_4^{2-}), bromide (Br^-), analysis of metals and some organic compounds dissolved (DOC).

2.4 ECOTOXICITY TESTS COVER THE DAPHNIA TEST AND MICROTOX TEST

Daphnia are small crustaceans that measure 1 to 5mm transparent and easy to raise. Before leachate, this species modifies its heartbeat. During acute tests, they can immobilize and die. Similarly we can observe long-term effects in chronic tests. This test takes place during the long life of the organism and its effects can be seen on reproduction. We use Daphnia magna large. The substances act on the reproductive cycle [2] the test is done on the product to which the toxicity poses no problems in handling. We observe different concentration effects heartbeat, inability to swim for 15-20 seconds, decreased respiratory activity. We will measure the degree of stress caused by the leachate. Finally on a graph, we will determine EC_{50} for the substance. It is a concentration which causes 50% of the daphnia after 24 hours. This concentration allows us to rank them according to their level of toxicity products. The main parameter that bare had studied so this is the inhibition of mobility. Daphnia magna being a hard water species, it is found in the natural environment at higher hardness of 150 mgl^{-1} of calcium carbonate. [3] The terms of the toxicity test allow us to use Daphnia whose age is less than or equal to 24 (neonates) for 24 h test period. The volume of sample required is 500 ml and the intensity of light between 500 to 1000 lux and the number of daphnia per tube is 5.

The Microtox test is based on inhibition of the luciferase is an enzyme which catalyzes the oxidation of luciferin, which is accompanied by light emission. If the result is positive, there is the presence of substances which act on cell metabolism. The samples tested on bacterial bioluminescence measured after 30 minutes of exposure for a period of half a day. His interest was based on a good screening to evaluate the toxicity of samples of unknown composition and is used for the study of wastewater, sewage effluent, various leachates. [4] A single concentration of test (100%) can be made when the IC_{50} is greater than the highest concentration of the sample. Results are expressed as percentage of control. [5]

Also this test is used in the characterization of wastewater, sewage effluents, in the study of all kinds of leachate (STANDARD ISO 2007 WATER QUALITY). This test is reproductible, fast(5-15 min exposure) acceptable as an effective test of toxicity.

3 RESULTS

The Physico chemical parameters are shown in Tables 1 to 3 where we show that the measured values are variables that we do not know by comparing the values of literature nor the Congolese order in the matter as not existing.

TABLE 1. Country Analysis Leachate in 2006 with two locations of samples (1) and (2)

	A1(1,2)		A2(1,2)		A3(1,2)		A4(1,2)		Average
pH	8	8,2	8,2	6,0	7,8	8,0	7,1	7,5	7,6
CE(μScm^{-1})	2500	4600	13200	9500	11600	600	400	2800	5525
DCO(mgO_2/l)	300	400	271	1060	1920	1900	206	40	762,13
DBO_5(mgO_2/l)	60	50	150	160	180	170	15	20	81,88
DBO_5/DCO	0,20	0,13	0,55	0,15	0,09	0,09	0,07	0,5	0,11
PO_4^{3-}(mgP/l)	0,98	0,16	15,0	2,40	4,60	0,04	0,04	0,06	2,91
NH_4^+(mgN/l)	90	110	800	370	780	0	0	50	175
NO_3^-(mgN /l)	1,9	7,3	2,6	1,1	2,8	1,1	1,8	1,2	2,50
Cl^-(mg/l)	170	450	1060	300	1700	4,4	1,90	200	485,79
SO_4^{2-} (mg/l)	32	29	240	177	165	115	17	350	140,63
Br^-(mg/l)	0,6	4,3	1,1	14	8	0,2	0,2	2,7	3,91
COD (mgC/l)	99	184	702	288	547	2,7	2,1	72	237,1

Dissolved organic compound (DOC) were determined by gas chromatography coupled to a mass spectrometer, the liquid chromatography-detector stage diode array. The chromatography head space is labeled FID-ECD and the spectrometer is the type ION TRAP.

TABLE 2. Country II. Leachate analysis in 2008 with two locations of samples (1) and (2)

	A12(1,2)		A21(1,2)		A31(1,2)		A41(1,2)		Average
pH	7	9	7	7	7	9	11	8	8,12
CE(μScm^{-1})	3500	7840	1254	2330	1540	11760	12970	6020	5901,8
DCO(mgO_2/l)	3000	1103	200	220	75	2500	470	600	1021
DBO_5(mgO_2/l)	1170	210	65	47	23	560	10	110	274,4
DBO_5/DCO	0,39	0,19	0,33	0,21	0,31	0,22	0,02	0,18	0,23
PO_4^{3-}(mgP/l)	3,5	3,2	1,1	1,2	1,0	3,6	1,7	1,8	2,03
NH_4^+(mgN/l)	83	401	19	113	19,4	686	17,4	177	189,5
NO_3^-(mgN /l)	0,2	14,9	6,9	11,3	0,6	0,2	95,3	6,8	17,03
Cl^-(mg/l)	260	707	88,1	172	52,4	1472	102	956	474,94
SO_4^{2-} (mg/l)	785	126	135	68	257	74	1774	705	491
Br^-(mg/l)	0,2	4,6	0,2	0,2	0,2	0,2	0,2	6,1	1,49

COD unmeasured.

TABLE 3. Country III. Leachate analysis in 2010 with two locations of samples (1) and (2).

	A121(1,2)		A211(1,2)		A311(1,2)		A411(1,2)		Average
pH	6,8	7,9	7,3	8,3	7,9	8	9,2	8,1	7,04
DCO(mgO_2/l)	2280	2340	71	1530	1450	715	915	815	1264,5
DBO_5(mgO_2/l)	1070	280	7	180	140	74	125	410	285,75
DBO_5/DCO	0,47	0,12	0,098	0,12	0,097	0,10	0,14	0,50	0,19
PO_4^{3-}(mgP/l)	1,08	14,20	0,03	4,25	5,87	1,50	2,47	3,10	4,06
NH_4^+(mgN/l)	300	1200	17,2	800	701	250	400	300	469,02
NO_3^-(mgN /l)	0,08	0,22	1,00	1,07	0,59	0,70	1,65	2,14	0,81
Cl^-(mg/l)	1070	82,5	1110	1200	1300	1570	290	229	856,44
SO_4^{2-} (mg/l)	83,8	490	200	60	40	35	183	190	160,23

EC and Br^- unmeasured

3.1 COMMENT ON THE CHARACTERIZATION OF GLOBAL PARAMETERS

Chemical oxygen demand: in the tables below seals, the average value of IBD varies from 762.13 mg O_2l^{-1} to 1264,45 mg O_2l^{-1} with more than 50% of the leachate have a value close to 71 mg O_2l^{-1} which is the lowest value in Kinshasa reference General hospital during the campaign 2008 de leachate is diluted and probably belongs to the class 3 because there other lower values in the study. The three lowest values in class 3 are expressed in mg O_2l^{-1} respectively measured for leachate HGRN (40) HGRK (71) and HGK (75). The highest values of COD in Class 1 also expressed in a mg O_2l^{-1}re measured for leachate Kintambo General Hospital between 1900 and 1920 during the campaign I, a value of 2500 for the hospital General Kintambo 3000 and the university clinics of Kinshasa during the campaign II and finally in 1530 during the campaign in Kinshasa II reference General hospital and 1450 for Kintambo General hospital during the same campaign. The highest COD value indicates a high organic load associated with young leachate (acetogenic phase) or accidental pollution. As against the low COD values characterize stabilized leachate (methanogenic phase) for a lower redox potential [6].

The biochemical oxygen demand five days vary an average of the lowest of 81.08 mg O_2l^{-1} louse Campaign 1 and the average highest equivalent to 285.75 mg O_2l^{-1} for the campaign III. 50% of leachate have an average value of less than 81.88 mg O_2l^{-1} the lowest values in mg O_2l^{-1} (class 3) were observed at university clinics in Kinshasa (50) and 15 to 20 in the general hospital N'djili reference to the current campaign I. In the course of the campaign 2, the following values are observed BOD5 respectively at Kinshasa General reference hospital (47 and 65), the Kintambo General hospital (23) and at N'djili General hospital (10). Finally, other low values of leachate is obtained at the General Hospital of Kinshasa (7 mg O_2l^{-1}) and Kintambo General Hospital for 74 mg O_2l^{-1} during the campaign III. The highest values (class 1), mg BOD_5 belong to leachate university clinics in Kinshasa (560-1170) during the campaign II and 1070 mg O_2l^{-1} during the campaign III. At the General Hospital Kintambo recorded BOD5 in leachate is 180 mg O_2l^{-1}during the campaign I.

By observing the ratio of BOD_5 / COD, we find in our study values below 0.1. Indicating that campaign low biodegradability. What is not in agreement with a former landfills leachate then stabilized, what meets the assumption of a diluted leachate.

The values of COD/BOD_5 more than 0.3 shows a significant biodegradability and leachate does not exclude good biodegradability [7].

3.2 TREATMENT OF THE PHYSICO-CHEMICAL PARAMETERS

The conductivity measurement took place on two campaigns. Electrical conductivity values are not comparable from one country to another. Indeed the values we observed vary between 400 and 13200 μScm^{-1} for both campaigns. The minimum value corresponds to that obtained in the 2006 campaign to the general hospital Ndjili reference to a maximum value of 13200 μScm^{-1} corresponding to the EC leachate general referral hospital in Kinshasa. The average value of the leachate EC is 5902 μScm^{-1} which corresponds to that of 2008 campaign Thus, we observe that about 50% of leachate have a conductivity below that average value in this work. The lowest values for Class 3 are observed for samples taken at the General Hospital N'djili reference (= 400), the University Clinics of Kinshasa (2500 and 4600) in 2006 when first campaign tracking EC General hospital N'djili reference (1254 and 2330) and the EC leachate Kintambo General hospital (1540) and finally that of the University clinic of Kinshasa (3500).

Leachates which have higher conductivity are in Class 1 and are observed in reference Kinshasa General Hospital (= 13200) for a value corresponding to the leachate conductivity General Hospital N'djili reference (= 6020). Other leachate have a value between the two and are all Class 1.

The pH as the basic medium corresponding to 8.12 shows that we are in the presence of old landfills. 80% of leachate from our study have an average pH of between 7.04 and 8.16. The lower value of leachate pH (= 6.8) was observed during the 2010 campaign to CUK, followed respectively CUK (= 7), HGRK (= 7) and HGK (= 7) of the 2008 campaign. This low value is derived sample taken from the leachate is young. The highest value leachate pH is that of 11 of the 2008 campaign in the general hospital N'djili reference.

The concentration of nitrated in leachate has an average nitrate content which is less than the max value of 17.06 $mgNl^{-1}$. The levels measured are from 0.08 to 17.06 $mgNl^{-1}$ and the median value is 2.50 $mgNl^{-1}$. the lowest levels comprise the class 3 landfills with a low value corresponding to the leachate KGRK (=1.1), HGK (= 1.1) and HGRN (=1.2) during the 2016 campaign to campaign 2008, low values correspond to the leachate CUK 2010 (=0.22 $mgNl^{-1}$), from 1 to 1.07 $mgNl^{-1}$ for the general hospital in Kinshasa last respective values of 0.59 and 0.70 $mgNl^{-1}$ General hospital of Kintambo.

Ammonium also comprises nitrogen because it is expressed to which the ammonium content in $mgNl^{-1}$. And leachate are ammonium content between 17.4 and 1200 $mgNl^{-1}$. what is measured varies between 0 and 1200 $mgNl^{-1}$. Class 3 has the lowest levels are observed for leachate CUK (90 and 110 $mgNl^{-1}$), HGRK (50 and 370 $mgNl^{-1}$), HGK (0 $mgNl^{-1}$) and finally HKRN (0 and 50 $mgNl^{-1}$) for the campaign I. for the campaign II, the low levels range from 19 $mgNl^{-1}$ for HGRK, 83 $mgNl^{-1}$ for CUK, 19.4 $mgNl^{-1}$ for HGK and 17.4 $mgN.l^{-1}$ for HGRN. For the 2010 campaign, the low levels are recorded in CUK (= 17.2 $mgN.l^{-1}$) and 300 $mgN.l^{-1}$ for HGRN. The highest grade (class 1) correspond to reference Kinshasa General hospital (800 $mgN.l^{-1}$ for the 2006 campaign), 686 $mgN.l^{-1}$ for HGK and finally 1200 $mgN.l^{-1}$ for CUK.

Ortho phosphate: several leachates have a content below 0.9 mgP/l, the lowest levels (Class 3) are observed for the leachate University Clinics (0.6 to 0.98) and for hospital N'Djili general reference to (0.04 and 0.06) during the 2006 campaign during the 2008 campaign the low levels of leachate values are assigned to CUK (3.2) HGRL (1,1) HGK (1.0) and finally HGRN (1.7). For the campaign III in 2010, the low levels are assigned to the leachate CUK (1.08), the HGRK (0.03), and the content of the leachate of 1.50 for the HGK. Class 1 with high levels of leachate matches for the 2006 campaign HGRK (15.00 $mgP.l^{-1}$), HGK for 4.60 $mgP.l^{-1}$. For the 2008 campaign, CUK (14.20 $mgP.l^{-1}$) and HGK (5.87 $mgP.l^{-1}$). These leachates were collected at two-year intervals. In view of our results, the leachates are stable.

The anions that have served in our study concern the chloride, bromide and sulfate in three seasons (2006-2008-2010).

Indeed the chloride contents vary from 4.4 to 1700 $mg.l^{-1}$ the average is 485.78 $mg.l^{-1}$. For the campaign I, Class 1 includes Kintambo Hospital (1700)> HGRK (1060)> 450 HGRK. For the campaign II, General Hospital Kintambo (1472)> HGRN (956)> 707 for university clinics of Kinshasa. For the campaign III General Hospital Kintambo (1570)> HGRK (1200)> CUK (1070). Unquoted contents are in Class 3.

For bromide ions, the measured values range between 0.0 and 6.4 $mg.l^{-1}$. Class 1 includes the campaign I leachate levels HGRK bromide (14 $mg.l^{-1}$)> 8 $mg.l^{-1}$ General Hospital of Kintambo and 4.3 to CUK. For Class 3, 2.3 $mg.l^{-1}$ for HGRN> 1.1 $mg.l^{-1}$ HGRK for the 2006 campaign.

Finally for the 2008 campaign for all hospitals in the study the leachate content is 0.2 $mg.l^{-1}$. As regards the sulphate ions, the levels obtained vary between 7 and 1774 mg/l. Thus, Class 1 includes HGRK (1774 mg/l)> CUK (185 mg/l) in Class 1 and other levels correspond to class 3.

3.3 CHARACTERIZATION OF METALS

The four hospitals produce leachate in which we find heavy metals. To ensure this, we proceed to a plasma emission spectrometry study coupled with mass spectrometry as a way to detect. We think of aluminum, copper, zinc, cadmium and lead. Next the three years 2006, 2008 and 2010, we present the results in Tables 4, 5 and 6. Sampling points 1 and 2. A1 = CUK, A2 = HGRK, A3 and A4 = = HGK HGRN

TABLE 4. Determination of metals in the leachate of the campaign I (2006)

Metals	A1(1,2)		A2(1,2)		A3(1,2)		A4(1,2)	
Al(µg/l)	201	33	200	20	500	537	232	243
Cu(µg/l)	20	17	21,3	25,1	180,4	121,7	4,1	5,7
Zn(µg/l)	60	115	100	80	70,0	285,9	96,0	15,8
Cd(µg/l)	2,23	2,54	4,8	5,5	0,70	2,2	2,50	2,23
Pb(µg/l)	9,4	7,8	6,6	10	27,8	1,1	26,7	1,1

TABLE 5. Determination of metals in the leachate of the campaign II (2008).

Metals	A1(1,2)		A2(1,2)		A3(1,2)		A4(1,2)	
Al(µg/l)	400	289	320	287,9	19,7	46,5	320	445
Cu(µg/l)	2,7	4,5	14,1	9,8	n.m	n.m	140	100
Zn(µg/l)	384	150	33,2	31,7	18,4	71,7	56,3	103
Cd(µg/l)	3,19	1,5	n.m	n.m	0,83	3,10	2,25	2,54
Pb(µg/l)	14,7	13,8	3,1	4,2	14,8	21,4	18,5	25,7

TABLE 6. Determination of metals in the leachate of the campaign II (2010).

Metals	A1(1,2)		A2(1,2)		A3(1,2)		A4(1,2)	
Al(µg/l)	435	840	55	60	273	171	47	n.c
Cu(µg/l)	10	20	25	41	23	26	48	n.c
Zn(µg/l)	600	315	61,9	41,5	550	400	15,8	130,2
Cd(µg/l)	1,3	1,9	1,5	2,3	2,3	4,7	19	10
Pb(µg/l)	16	21	16	21	500	<0,1	5,8	2,1

n.c : uncalculated

All three of the above tables confirm our assumption that the leachates are heavy metals and have a considerable impact even trace on the environment. The study was carried out by ICP-MS in semi-quantitative mode. The interest of the determination of metals in leachate spectrometry inductively coupled mass (ICP-MS) return to find their toxicity even trace and can simultaneously measure a large number of items in a wide concentration range. The technique is to sample the digestion by making metals extractable analysis. The metals here are atomized and ionized at high temperature in the plasma. Collision/ reaction chamber removes the interference and are thus separated at the detector depending on mass / charge ratio [8]. The interest of the ICP-MS technique is the need to dose of minute concentrations until ngl^{-1}involving adequate environnemental protection [9].

3.4 VIEWPOINT ECOTOXICITY

We express ecotoxicity tests EC_{50}, a concentration able to immobilize 50% of Daphnia after a given time and that induces a 50% decrease in luminescence of a population of bacteria in the case of your Microtox. We also will express in u.t. (toxic unit to calculate by dividing 100 by the EC_{50} value. The Daphnia test gives a limit of values between 0 and 16 u.t. and leachates were grouped into classes determined by us into five classes. For the Microtox test, the answer varies 0 to 250° C in five class 1 quality group 5 more toxic and non toxic. About 30% of leachate had no toxic to the Microtox test. The results are in table 7.

TABLE 7. Analysis of ecotoxicity tests

	MX (u.t.) 30min	DI (u.t.) 24h	Class MX	Class DI	Class TXI
A1(1,2)	240	6	1	3	1
	180	15	1	1	1
A2(1,2)	110	7	1	3	1
	105	11	1	2	1
A3(1,2)	24	13	2	2	1
	10	16	3	1	1
A4(1,2)	200	0,1	1	5	2
	97	7,0	2	3	2

Mx : Microtox, DI : Daphnia, TXI : class Mx+DI

The first preliminary tests were conducted on mobile equipment within 12 hours of harvesting. Then the tests were continued about 7 days for the Microtox test on the "Inhibition of marine bacteria bioluminescence with the AFNOR T 90-320, VIII revised in 2005. For the test Daphnia, it was performed as test immobilization of Daphnia magna. Then we measure the concentration of leachate produced a capital of 50% of the daphnia after 24 hours of incubation on our portable device for incubation at 20°C. We determine an effective concentration and 24 designated CE_{50} 24h.

In view of the results in Table 7, the ecotoxicity test shows that the samples used are the classification perspective (the University Clinics of Kinshasa, Kinshasa General Hospital Reference and Kintambo General Hospital) 1. class toxicity may be zero or greater than or equal to 1. The leachate three hospitals are stable. Samples taken at N'djili Reference General Hospital are classes 2. It is here a contribution of toxic waste and leachate are unstable. Data analysis of the three campaigns (2006, 2008, 2010) differentiates stable leachates that the constant ecotoxicity, unstable leachate including ecotoxicity and composition variables.

In the context of sustainable development charter completed by the polluter pays principle; how to assist hospitals in waste management and especially avoid pollution of any kind?

The implementation strategy is oriented in creating instead of purifying water and other waste from the care environment (recycling ...)

Thus, our study is a treatment of leachate collected by nanofiltration membranes. To control the removal of chemical oxygen demand remaining in the juice or percolate within hospitals, we will proceed to the biological treatment. We use three membranes, organic and mineral for lowering the organic filler according to the pressure and speed conditions (hydrodynamic conditions). These membranes have specific behavior with respect to the adsorption, concentration polarization and clogging of pores. It's also a way to purify liquid waste to this hospital in the DRC, which is a durable solution and a way to control the environmental impact of hospital activities.

Indeed nanofiltration (NF) is a membrane technology, which aims to stop the selective molecules whose size varies between 100 and from 10 to 0.5 nm. It was then microfiltration which retains substances of different sizes of the past. [10] The principle shows that the transfer takes place under the effect of pressure which is from 3 to 20 bar [11]. For separation, the mechanism is made by

In view of the results in Table 7, the ecotoxicity test shows that the samples used are the classification perspective (the University Clinics of Kinshasa, Kinshasa General Hospital Reference and Kintambo General Hospital) 1. Class toxicity may be zero or greater than or equal to 1. The leachate three hospitals are stable. Samples taken at N'djili Reference General Hospital are classes 2. It is here a contribution of toxic waste and leachate are unstable. Data analysis of the three campaigns (2006, 2008, 2010) differentiates stable leachates that the constant ecotoxicity, unstable leachate including ecotoxicity and composition vary sieving in a porous membrane where the transfer happens, and there results in the difference of the size of components to that of pores (<2 nm).

This technique replaces the reverse osmosis membranes in that its less dense and excellent physical barrier for dissolved molecules and retention of monovalent salts is low and the by-products is less rich brines. [12]

We have the beginning of our study, carried out the first stage is the preliminary step of sizing an installation. It was then step to define the performance of three membranes on the abatement of organic load [13].

In following our study there that leachate that has a stable character and shows that we are in the old part of the landfills according to the classification adopted for all leachate because the ratio of BOD_5 / COD gives an average 0.176 [14].

We consider in the study the average value of three campaigns for COD in leachate stabilized. The value is between 762.13 and 1264.5 mg O_2 l with an average of 1015.88 mg O2 / l. We will then fouling index (ASTM) different samples of leachate for their clogging power nano filtration [15]. To assess this index, we use membrane filtration technique 0,45 microns.

3.5 PREPARATION OF THE MEMBRANE OF NANOFILTRATION

Consider three membranes to reduce the chemical oxygen demand:

MP-20, 450 Da cut-off, its nature is polyester carrier and plane geometry. The surface area is $70cm^2$, a pressure of 30 bar and a temperature of 50 ° C and pH between 2-10. The flow is 3,5 $l.h^{-1}m^{-2}.bar^{-1}$. Finally, the rejection rate of 5% for 5% NaCl, 40% for the 0.2% Na_2SO_4, 65% for the 5% glucose and sucrose 5% to 85%. Lowering the permeability is 4%

MP-31, 450 Da cut-off, its nature is polypropylene support and plane geometry. The surface area is $70cm^2$, to a pressure of 40 bar and a temperature of 70 °C and pH between 2-14. The flow is 4 $l.h^{-1}m^{-2}.bar^{-1}$. Finally, the rejection rate is 20% for the 5% NaCl, 60% for the 0.2% Na_2SO_4, 65% for the 5% glucose and 80% to 5% sucrose. 27% is the reduction of membrane permeability.

N01A. cut-off 1000 Da, its nature is alumina support and tubular geometry. Its surface is $1250cm^2$ to a pressure of 50 bar and a temperature of 25 ° C and a pH between 0-14. The flow is 30 $l.h^{-1}m^{-2}.bar^{-1}$. Finally, the rejection rate of 5% for 5% NaCl, 25% for Na_2SO_4 and 0.2% to 30% sucrose 5%. Lowering the permeability is 17%

The membrane mentioned above is capable of separating organic salts and organic molecules with low molecular weight. It comes from the reverse osmosis and intermediate position by the pressure range of 5 to 20 bar for 100 to 1000Da cutoff.

It is in the physico-chemical interactions between the solutes of the solution and the membrane material where there is the static adsorption membranes.

The nanofiltration pilot comprises a multi-stage centrifugal pump for recirculating the fluid, a positive displacement pump (which provides power to the recirculation loop) and a flow meter (the tip speed is between 1 and 5 ms^{-1}). Downstream pressure can reach 15 bar in the installation and upstream we measure the pressure membrane. To maintain the temperature at 20 °C a cold Mouvex group does when the module is Plan (MP-20 and MP-31) is tubular (N01A). The tests being carried out at a concentration observed, we can thus estimate the permeability, clogging, the rejection rate and finally regeneration of the membrane.

As we found the TSS in the leachate, colloids; high turbidity that we begin with the pre-filtration. A keg test, pre filtration is required on canvas before we pass on the membranes. After pre-filtration, the reduction of MES is around 40% or 80 $mgMES.l^{-1}$. In our study, the performance of the filter depends on the prior coagulation leachate, so we use ferric chloride [16].

Stirring conditions: $160trs.min^{-1}$, 5 min for coagulation. To promote flocculation must 40trs. min^{-1} for 20 min. Just 2 sludge stabilization hours to collect samples of supernatant. The ferric chloride dosage is determined by measuring turbidity.

3.5.1 INFLUENCE OF SPEED AND PRESSURE IN NANO FILTRATION: RESULTS

We illustrate our results on the evolution of the flow limit after two hours for the three membranes according to different traffic speeds in the following tables 8-18:

TABLE 8: filtration flow of the pressure on the MP-20 for water

Pressure (bar)	Flow ($lh^{-1}m^{-2}$)
0	0
1,4	10,01
4	34,20
10	15,01
15	107,02

TABLE 9 : filtration flow of the pressure on the MP-20, v=1ms^{-1}

Pressure (bar)	Flow ($lh^{-1}m^{-2}$)
0	0
1,4	0
5,2	20,01
10	55,20
14	60,10
15	69,2

TABLE 10 : filtration flow of the pressure on the MP-20, v= 3,4 ms^{-1}

Pressure (bar)	Flow($l.h^{-1}.m^{-2}$)
0	0
4	24,01
10	55,20
14	68,03
15	79,02

TABLE 11. flow of the pressure on the MP-20, v= 5 ms^{-1}

Pressure (bar)	Flow ($lh^{-1}m^{-2}$)
0	0
5,2	32,5
10	60,01
14	69,01
15	87,01

The following tables summarize the data obtained on MP-31 on different speeds.

TABLE 12. flow depending on the pressure on the MP-31, for water

Pressure (bar)	Flow ($lh^{-1}m^{-2}$)
09	9,0
10	91,1
15	120,9

TABLE 13. flow depending on the pressure on the MP-31, v= 1ms^{-1}

Pression (bar)	flow ($lh^{-1}m^{-2}$)
0	0
5	19,8
10	47,1
13,1	53,3
15	60

TABLE 14. flow depending on the pressure on the MP-31, for water v =3,4ms^{-1}

Pressure (bar)	Flow ($lh^{-1}m^{-2}$)
0	0
5	20
10	60,1
13,1	64,8
15	78,1

TABLE 15. flow depending on the pressure on the MP-31, for water v=5ms^{-1}

Pressure (bar)	flow ($lh^{-1}m^{-2}$)
0	0
5	20
10	52,8
13,1	65,2
15	77,9

The following tables relate to the study of membrane NO1A.

TABLE 16: flow depending on the pressure on NO1A for water

Pressure (bar)	flow ($lh^{-1}m^{-2}$)
0	0
1,2	13,1
5,0	58,9
10	104,7
15	105,1

TABLE 17. Flow depending on the pressure on NO1A, v=1ms^{-1}

Pressure (bar)	Flow (lh^{-1}m^{-2})
0	0
6	9,1
10	10,9
13	13,0
15	14,1

TABLE 18. Flow depending on the pressure on NO1A, v=3,4ms^{-1}

Pressure (bar)	Flow (lh^{-1}m^{-2})
0	0
4	8,9
6	13,1
10	27,02
15	28,01

TABLE 19. Flow depending on the pressure on NO1A , v=5ms^{-1}

Pressure (bar)	Flow (lh^{-1}m^{-2})
0	0
6	13,1
10	17,2
13	17,9
15	25,3

By observing the membrane throughput for the case of MP-20 and MP-31 membranes, they operate in a linear fashion for the studied speeds. On the two membranes, the permeation flux is important that the mineral membrane. If we draw the graph to the speeds 3.4 and 5 ms^{-1} the curves are almost confused while for NO1A membrane of Table 18, the pressure has less effect on the permeability of the flux. For a speed for example 10 bar, v = 3,4 ms^{-1}, the flows are 60 l.h^{-1}m^{-2} respectively while for the NO1A membrane, the recorded stream is 27 l.h^{-1}m^{-2}.

3.5.2 THE CHEMICAL OXYGEN DEMAND, EVOLUTION AND THE REJECTION RATE IN THE CUK

Consider the studied velocity of 1 to 5 ms^{-1} to MP-20 membrane and NO1A for a 10bar pressure. The results are shown in Table 20. The average COD in the CUK is 762.13 mgO$_2$.l^{-1}., Any time during the 2006 campaign, for example, we have achieved a range of COD of between 40 and 1920 mgO$_2$.l^{-1}. This will be the basis of our study as shown in Table 21 on the first N01A membranes and MP20 and Table 20 summarizes the results of the effect of pressure on the rejection rate on membranes MP20, MP-31 N01A for a speed of 3,4ms^{-1}.

TABLE 20. The COD depending on the speed at 10 bar

Membranes	Speed (ms^{-1})	COD (mg0$_2$/l)
NO1A	0,55	960,00
MP20	0,55	1457,14
NO1A	3,00	937,14
MP20	3,00	1440,00
NO1A	3,14	960,00
MP20	3,14	1417,15
NO1A	4,80	960
MP20	4,80	1417,15

For 10bar pressure and a temperature of 25°C, the evolution of COD knew the two membranes do not significantly change with increasing speed. The results are similar on the two membranes. Performance of abatement of COD, the speed does not bring any influence. The permeate stream can vary in either direction (increasing or decreasing) without depending on the COD and then we can choose an appropriate speed. The favorable observation shows that under the same hydrodynamic conditions the better NO1A membrane eliminates COD that MP20 membrane and then the rejection rate of the inorganic membrane is greater than that of the organic membrane.

TABLE 21. Effect of pressure on the rejection rate for v = 3,4ms^{-1}

Pressure (bar)	Membranes	(%)
4	MP20	60,0
	MP-31	76,1
	NO1A	65,5
6	MP20	70,0
	MP-31	76,2
	NO1A	70,0
10	MP20	76,0
	MP-31	76,0
	NO1A	77,1
13	MP20	76,0
	MP-31	84,5
	NO1A	76,2
15	MP20	76,0
	MP-31	84,5
	NO1A	77,1

We set the flow rate to 3.4 ms^{-1}, our finding that there is a slight increase in rejection rates with pressure. From 10bar, there is a stabilization of retention around 76-77%. The acceptable value of the chemical oxygen demand of 1417.15 mg0_2l^{-1} as shown in Table 22 for a stabilized flow to three hours.

TABLE 22. Performance membrane at 10 bar

Membranes	Flow (lh^{-1}m^{-2})	COD permeat (mg0_2l^{-1})
N01A	97,01	960,00
MP-31	60,1	-
MP20	55,2	1417,15

The behavior of each membranes is described in Table 23 to a pressure ranging from 6 to 10 bar, speed of 3.4 ms^{-1} for a temperature of 25 ° C.

TABLE 23: Behavior of each membrane as a function of determined operating conditions

	NO1A	MP-31	MP20
Gross flow(l.h^{-1}.m^{-2})	8,9	20	24
flow limit (l.h^{-1}.m^{-2})	13	11	55,2
Clogging (%)	28	34	5
Lowering of permeability (%)	18	29	8
Nanofiltrat COD (mg0_2/l)	960	1457	1417
Percentage retention (%)	70	76	70

N01A the membrane adsorbs the components of the leachate as MP-31 membrane and adsorption is only part of clogging for a retention rate of 70%.

MP-31 membrane has a retention rate of 76% longer than the two other membranes for low pressures. The irreversible blockage is 34% larger than the other two cases. The other two show values related to the static adsorption showing a strong interaction between solute-membrane [17]. For a flow of permeate acceptable, retention of COD is improved due to this adsorption.

In MP20, there is a concentration polarization at the membrane surface and the flux decreases with respect to the flux limit. The leachate has less connection with the membrane that absorption is static. This explains an irreversible clogging of 34% with a retention rate of 70%. So there is not an electrostatic effect.

It should be noted in this study that clogging arises from clogging of pores by molecules contained in the leachate. The molecular weight of leachate molecules is between 500 Da and 1000Da according to [18]. Following this high molecular weight, there is internal clogging and penetration of these molecules in the membrane. Indeed, all that is clogging internal and surface absorption alter the membrane rejection and for the three membranes increases with pressure. According to Fick's law [19] such developments rejection rate highlights the importance of solubilization-diffusion process in the transfer mechanism in relation to the law of Hagen-Poiseuille (which describes the laminar flow of a viscous liquid in a cylindrical pipe for the capillary process. This process translates the irreversible transmission which is in the migration of chemical species in the environment and under the effect of thermal agitation there is movement of the components areas high concentration to those of concentration reliable. The law of Poiseuille gives theoretically the relationship between the rate of flow and viscosity of the fluid. [20]

3.5.3 THE PERFORMANCE OF THE MEMBRANE N01A: COAGULATION INFLUENCES

The flux decreases this is an observation and it is caused by fine organic molecules. We have developed a pre-treatment of coagulation-floculation to eliminate it. As there hydroxides in the leachate, there is also a sudden change of the solution has changed supernatant of color and increases the concentration of COD. We observe a reduction of COD of around 70% N01A membrane. We observed the presence of colloid in the leachates from which the acidic pH which was observed during treatment of data [21]. Colloids flocculate around pH 7-8 where in the presence of organic compound (carboxylic functions). Characterization data of the leachate and the supernatant concentrated in Table 24 and Table 25 that concentrates the performance of the membrane after coagulation N01A.

TABLE 24. Parameters of the leachate and the supernatant

Parameters	leachate of CUK	Supernatant
COD($mg0_2$/l)	762,13	410,15
pH	7,6	6,1
Turbidity (N.T.U)	536	4
MES(mg/l)	280	80
Fouling Index (1/min)	4,8	4,5

TABLE 25. N01A performance of the membrane after coagulation in 2006.

COD leachate	P (v=3,4 ms^{-1})	Flow($l.h^{-1}m^{-2}$)	Tr	COD Lt	Rt
762,13 $mg0_2$/l	5bar	58,9	70%	400$mg0_2$/l	70%
762,13 $mg0_2$/l	10 bar	105,1	77%	300$mg0_2$/l	76%

P= pressure, F= flow, Tr : percentage of rétention, Lt = treated leachate, Rt= total reduction.

Coagulation-flocculation is insufficient for the simple reason that it is difficult that the small molecules of acids coagulate. It is for this reason also that the clogging index is similar before and after treatment as shown in Table 25. However, after coagulation, the membrane performance is improved so that the reduction of chemical oxygen demand ranges from 70% to 77% so teaches that a pressure of 10 bar, the final permeation flux was 105 $l.h^{-1}.m^{-2}$ instead of 58.9 $l.h^{-1}.m^{-2}$. Thus the coagulation-flocculation has a goal of making the chemical oxygen demand of leachate stabilized.

Since fouling index is 4.5 the supernatant a character crushing because the molecules which it is composed have molecular weights close to 500Da and 1000Da, and are not completely removed during coagulation. These compound then clog the pores of the membrane causing the limitation of the performance and thus cause clogging. This requires the use of more dense membrane then the N01A will have a lower flow than organic membranes.

Seeing the relationship that may exist between the flow and pressure for a speed of 3.4 ms^{-1} N01a the membrane before and without coagulation, we see the clogging value remains high. Tables 26, 27 and 28 show the results to confirm our hypothesis.

TABLE 26. Flow function of pressure, pure water, v=3,4 ms^{-1}

Pressure (bar)	Flow (l.h-1.m^{-2})
0	0
1,1	7,5
10	100

TABLE 27. Flow depending on the pressure, with coagulation, v=3,4 ms^{-1}

Pressure (bar)	Flow (l.h-1.m^{-2})
0	0
5,12	25,5
10	40
15	54

TABLE 28. Flux en fonction de la pression, no coagulation, v=3,4 ms^{-1}

Pressure (bar)	Flow (l.h-1.m^{-2})
0	0
4	8,0
6	19
10	21
13	25,5
15,5	25,6

At a temperature of 25 ° C, an increase in the flow in function of the pressure is observed at the same time if coagulation or not. Clogging remains so high and irreversible hence increased flow.

4 CONCLUSIONS

Our study's primary motive ecotoxicity leachate few hospitals in Kinshasa and especially we focus on CUK. The ecotoxicity was assessed using Daphnia and Microtox tests. The main approach for the evaluation of physicochemical parameters. It appears that the tested leachate are stable for ecotoxicity notes for leachates whose composition is variable. This toxicity test is the first integration tool to study complex mixtures that can replace a physical and chemical analysis. The analytical resources that we used are important and help find the leachate which have a high potential ecotoxicity. Both tests did not identify the nature of the contamination but show the synergy of the components of a complex mixture. At high pH, toxicity is unambiguous. It is also louse us a physical and chemical indicator to control or monitor. The use of quality classes allows us to see the eco-toxic leachate behavior. We have developed our analysis that stable leachate are when ecotoxicity is constant for those who are unstable ecotoxicity which is variable. The tests are then sorting tool different landfill leachate studied. The second aspect of our study concerns the response to treatment with membrane nano filtration of the resulting leachate. This study allowed us to develop the technique for removing COD obtained after biological treatment. Instead of using the reverse osmosis technology which is expensive, we evaluated the performance of organic and inorganic membranes for assaying the lowering of the organic load. The performance of the three membranes were evaluated advantage of leachate CUK. The membranes also have a stabilized leachate behavior such as adsorption, polarization, pore clogging. Whatever the membrane, the abatement rate was around 70% in all cases. We at the hydrodynamic parameters used high traffic speeds for limiting the polarization and a decrease in permeation flux. With chromatographic methods, NMR spectrometry on ^{13}C, pyrolysis and mass spectrometry we have obtained in leachate stabilized naphtoic acid whose molecular formula is $C_{11}H_8O_2$ [22] (naphthalen-1 carboxylic acid) and other compounds the carboxylic group as fulvic acid and humic similar. The chemical formula of these acids present aromatic nuclei linked by the aliphatic chain and functional groups [23] acidic. The fulvic acids have similar molecular formula $C_{12}H_{12}O_5$ to which the O/C ratio is 0.7 with a -COOH function to a great abundance of carbohydrate [24]. The polymerization reduces the aliphatic chain and its importance. It is therefore a yellowish liquid such as tea or gold whose molecular weight varies from 900 to 2000 $g.ml^{-1}$ different from the mass of the humic acid (between 1,000 to 100,000 $g.ml^{-1}$) of a light brown [25] which is not observed without our experimental study. That's the difference between naphtoic acid and its counterparts cited in this study. With the nano filtration we have to determine the transfer mechanism.

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