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Development of a Domestic Fiber for the Fight against Insalubrite in the Community of Kikula Case of the City of Likasi

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Abstract: ***This study gives the solution to the problem of insalubrities in the municipality of Kikula. Despite the efforts made for the competent services of the State, the collective solution is far from realistic and the insalubrity is only increasing from day to day. The present work proposes a solution valid for each household avoiding displacement of the waste in the respective speech. This will avoid dumping waste and protect the water drainage works. The solution consists of a heated incinerator A chimney equipped with an expanded heating system allows the evacuation heat A hand-operated ventilator provided for the necessary air for combustion, recover ash can be used as a disinfectant: a) The load consists of all types of domestic waste. b) The exhaust gas is used for drying wet waste.***

Keywords: waste, garbage and incineration.

1. Introduction

The present work presents a model of a household waste incineration bin to clean up the environment and protect the health of the inhabitants of Kikula commune.

Despite the efforts made by the competent services of the city, the collective solution is too far from being better and insalubrities is growing.

The problem of domestic waste management and its destruction remains a concern for every household; we quote: I. ATLAN and P.BOURRELIER preliminary examination of the profitability of the incineration with energy recovery of garbage from Fort-de-France. The results obtained are as follows:

Recovery of energy in the form of non-competitive steam with other projects, Recovery in electrical form: the internal rate of return of the project is 5.7% and. The internal rate of return of the additional investment to move from an incinerator to an energy recovery incinerator is 18%

The inhabitants helplessly attend to this plague of which they are victim and sometimes they resort to practices which amplify the risks on the ecology.The decomposition of accumulated waste in plots and elsewhere are a real source of threat of waterborne diseases. Our concern is to eradicate this source.

The movement of waste in plots to other places aggravates the insalubrities in the commune of Kikula.

Indeed, Colette and the transfer of this waste to another place are not an ideal solution in the current context. We must avoid this movement until the mayor is well equipped and the producing population is sufficiently sensitized.Incineration should be done locally avoiding that smoke is not another source of pollution and does not concern scrap metal, porcelain, and glass.

2. Definition of Concepts

a) Waste

The word "waste" always refers to the mind, something that has no value, destined for abandonment but which can harm health and the environment. Waste is all that is not useful to man. Like the protection of the environment, security is not achieved by laws, but by the awareness of the population. As a result, unsanitary conditions in Kikula commune must be of concern to all inhabitants of Kikula. The insalubrities is observed in this commune by the presence of sachets, kitchen waste, tin cans scattered along the avenues, man's excrement, domestic animals and others on which the flies, mosquito, etc.

b) Incineration

The word incineration comes from the word "incinerate", which means to return waste and garbage to ashes, so we must produce the heat necessary for the destruction of waste. The problem of incineration of waste is the production of usable heat in each parcel to avoid the movement of waste to transit dumps that may be the corners of avenues, drainage collectors etc. Like the protection of the environment, security is not achieved by laws, but by the awareness of the population. As a result, unsanitary conditions in Kikula commune must be of concern to all inhabitants of Kikula.

The insalubrities is observed in this commune by the presence of sachets, kitchen waste, tin cans scattered along the avenues, man's excrement, domestic animals and others on which the flies, mosquito, etc. Talking about the domestic incinerator makes us think of a homemade oven. The source of thermal energy must be within the reach of all inhabitants regardless of their social rank. Among the existing sources, we opted for the use of charcoal. The use of this type of fuel will make the craft machine simple and compact. The air needed to activate the combustion is produced by an artisanal fan. Except glass and metal materials, all other waste will be incinerated.

c) Garbage

Garbage is rubbish garbage produced in households.

3. Nature and Waste Management in Kikula Commune

1) Brief overview of the Kikula commune

The commune Kikula is located to the south-east of the city with an area of ... it abounds ten quarters

2) Nature of waste

a) Domestic activities

Household waste is a rubbish of everyday life that has become cumbersome and unwanted. This waste comes mainly from cooking food and any other corner of the house. In this waste we find: organic waste, oily liquids, cooking and decomposition

b) Commercial activities

It is all the waste that results from commercial activities. In fact, they are the remains of the defective goods, the goods having reached its expiration date. We find organic waste composable, peremplary, oily liquids and marchanises defective.

c) Industrial activities

It is all the waste generated by companies, companies that can be:

Toxic, organic, radioactive, inorganic and inert waste.

3) Waste collection in Kikula commune

a) Definition

Waste collection is an operation that consists of collecting the waste by depositing it at a well-marked transit or final dumpsite awaiting destruction.

b) Collection by voluntary contribution of producers

The population carries its own waste by using garbage cans, baskets, bags or any other capacity to a container or gathering space located near homes. The voluntary contribution contributes to the reduction of the cost of the collection and is well adapted to the district whose access is difficult to the pickup gears.

c) The deposit on the same soil

This is a poorly recommended method of dumping solid waste on the ground, in specific places without any precaution. These deposits are observed in neighborhoods with spontaneous habitat and peri-urban areas.

d) Collecting organized by third parties

The analysis done on the organization initiated by the town hall in previous years shows that the methods of depositing on the same soil and by voluntary contribution did not hold because the number of collection trucks was insufficient for the whole city. For successful collection by these two methods, the government must increase the number of collection gear for each municipality.

e) Final dump

It is a space that is reserved on the place of incineration is located in Katuzembe more or less 8 km from the municipality of Kikula

4) Consequence of poor waste management in the Kikula community

Household waste depots not only represent an aesthetic pollution of the living environment, but they are above all a very diverse source of diseases and others; malaria, food poisoning, typhoid fever, cholera ...

This waste clogged the drainage networks of the water causing several cases of disasters during the rainy season.

On the other hand, putrefaction produces unpleasant garbage and irritating vapors, which can cause phenomena. Indeed, during putrefaction, household waste releases toxic gases such as sulfurous hydrogen, methane, carbide dioxide.

5) Factors contributing to insalubrities in Kikula commune

This is the increase of commercial and industrial activities; rampant demography Low average standard of living; Absence of a sanitation service, bad management of waste by the inhabitants and the city of Kikula mary Ignorance of the risks related to insalubrities; and the lack of supervision

4. Description of the Incineration Bin

1) Descriptive schemes

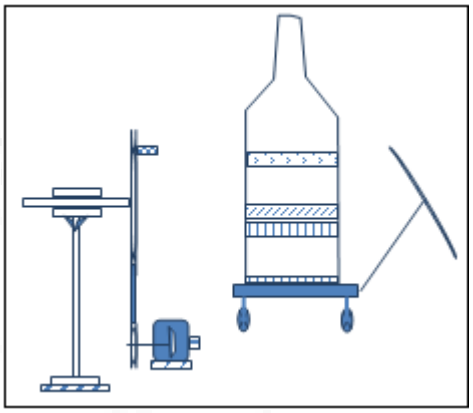

Figure 3.1: Configuration of the incineration bin

1 ferrule (bowl) made of stainless steel sheet 3081
2: brick refractory lining
3: grid tray for the charge to incinerate
4: grid tray to hold charcoal
5: air hose
6: fireplace
7: slide
8.9: loss of grid access
10: volute of the blower
11: blower wheel
12: bearing
13: pulley
14: transmission belt
15: rim wheel
16: control arm
17: wheel axle
18: cannon
19: support
20: chassis
21: metal wheels
22 control arms

5. Statistical Estimation of Number of Households and Waste Mass Produced by Plot and Day

We conducted our survey in the ten neighborhoods of Kikula commune, taking 20 plot samples per neighborhood.

5.1 Number of households and waste mass by plot

Quartiers																			
Kisuka		Kanona		Kyubo		Okito		Musumba		Kampemba		Kibadi		Kalipopo		Nkolomoni		Kaponona	
NF	NM	NF	NM	NF	NM	NF	NM	NF	NM	NF	NM	NF	NM	NF	NM	NF	NM	NF	NM
2	0,9	1	0,5	2	0,8	3	1,2	3	1,2	2	0,7	4	2,2	3	0,7	1	0,4	2	0,6
2	0,8	2	1,2	2	0,9	3	1,4	2	1	2	0,9	3	1,8	2	0,6	3	1	2	0,6
1	0,4	1	0,8	3	1,3	2	1	4	1,7	1	0,4	2	1	1	0,4	2	0,7	2	0,5
3	1,1	3	1,3	3	1,5	1	0,4	1	0,6	3	0,9	3	1,3	4	1,2	1	0,4	1	0,4
1	0,4	1	0,6	2	1,6	2	0,9	2	0,9	1	0,4	2	0,9	3	1	2	0,7	1	0,4
1	0,4	2	0,8	4	2,1	4	1,8	3	1,2	1	0,4	2	0,8	2	0,8	2	0,7	3	0,4
2	0,7	2	0,9	3	1,9	4	2	2	1	1	0,4	2	1	3	1	3	1	2	0,7
2	0,9	2	1	4	2,3	3	1,5	1	0,7	2	1	5	2,6	4	1,2	2	0,9	2	0,7
2	1	3	1,2	2	1,1	2	1,2	4	2	3	1,2	5	2,8	1	0,4	2	0,8	3	1,2
1	0,4	1	0,4	4	2,4	3	1,3	3	1,4	1	0,5	4	2,2	2	0,4	1	0,4	4	1,5
3	1	1	0,6	4	1,8	3	1,7	2	0,9	1	0,4	3	1,7	2	0,5	2	0,8	3	1,1
2	1	2	0,8	1	0,5	4	1,8	4	1,6	2	0,9	2	0,9	3	0,8	2	0,8	3	1,1
1	0,5	1	0,6	2	0,7	4	2	3	1,4	3	1,6	2	0,9	2	0,6	3	1,2	2	0,8
1	0,4	3	0,9	4	1,9	5	2,5	2	1	3	1,4	2	0,8	2	0,5	3	1,1	1	0,4
3	1,2	2	1,3	1	0,5	3	1,3	2	0,9	2	1	3	1	3	0,7	3	1,3	1	0,4
3	1,2	3	1,2	1	0,4	2	1	2	0,7	3	0,9	3	1	3	0,9	1	0,7	1	0,5
2	0,8	2	1	3	1,3	4	1,9	1	0,4	1	0,4	3	1,1	3	0,7	1	0,4	2	1
2	0,9	1	0,6	2	0,8	1	0,4	3	1,2	3	1,2	2	0,9	1	0,4	2	0,8	3	1,3
3	1	1	0,5	2	0,9	3	0,9	2	0,8	3	0,8	1	0,6	4	1,5	2	0,7	2	1
3	1,1	1	0,4	3	1	3	1,3	1	0,5	2	0,5	1	0,5	3	1,2	2	0,6	2	0,9

Table No.: Number of households and mass of waste by house (in kg)
With: NF: number of households per house
NM: quantity of waste per house in kg

5.2 Estimation of average household numbers by house

Are:
Xi: the number of households per house
Fi: the frequency
Fi%: frequency in%
N: number of samples = 20
X = the weighted average = $\sum XiFi\%$

Xi	Fi	Fi %	$\bar{X} = \sum XiFi\%$
1	45	22,5	0,225
2	75	37,5	0,75
3	58	29	0,87
4	19	9,5	0,38
5	3	1,5	0,075
	200	100	2,295

From which we took the average of 3 households

5.3 Estimated average mass per day in a plot

Xi	Fi	Fi %	$\bar{X} = \sum XiFi\%$
0,4	30	15	0,06
0,5	11	5,5	0,0275
0,6	12	6	0,036
0,7	16	8	0,056
0,8	18	9	0,072
0,9	23	11,5	0,1035
1	24	12	0,12
1,1	7	3,5	0,385
1,2	17	8,5	0,102
1,3	12	6	0,078
1,4	5	2,5	0,035
1,5	4	2	0,03
1,6	2	1	0,016
1,7	3	1,5	0,017
1,8	4	2	0,036
1,9	2	1	0,019
2	3	1,5	0,03
2,1	3	1,5	0,0315
2,3	1	0,5	0,0115
2,4	1	0,5	0,012
2,5	2	1	0,025
2,7	1	0,5	0,0135
	200	100	$\bar{X}$ = 1,33

The weighted average mass: mp = 1.33 kg / day
In the calculation, we considered the mass of 5 kg / day. This in anticipation of population growth.

6. Thermal Review of the Incinerator

1) Calculation of the amount of useful heat

This is the amount of heat needed to incinerate the expected load for a definite time.
It is given by the formula:
Qu = md.Cp (Tfd - To)
With:

- Md = mass of waste equal to 5kg
- Cp = average mass heat capacity of the considered waste, content of the incineration temperature, we considered that of glass: $750^{J}/_{Kg\,°K}$is 2,0832 10^{-4} $^{Kwh}/_{Kg\,°K}$

- T_O initial temperature which is 293 ° K
- T_{fd}final temperature which is 2123 ° K

From the above we had replaced each term by its value, we will have:
Q_u =22079,20 10^{-4}kWh
Let Q_U = 7948.44 or 1907.6256 kCal

2) Dimensioning of refractory walls

a) Actual temperature inside the device

The device is dimensioned for a temperature of 2123 ° K. This temperature will be regulated by a portable infra-red thermometer.

b) Material of refractory layers.

The quality of the refractory layers is determined as a function of the temperature level in the furnace and the chemical interactions at the surface, the choice and the dimensioning of the refractory and insulating back layers are chosen according to thermal losses and the temperature of the maximum outer walls assuming thermal equilibrium achieved with the objective of:

- Find an optimum between thicknesses and losses of energy
- Obtain on the outside walls a temperature compatible with the circulation of people in its direct environment (the people of the parcel or the neighbors must not be embarrassed)

$$\Delta T = \frac{R_{th}}{R_{thtotale}}(Tfe - To)$$

With: Tfe = temperature at the entrance of the considered layer.

$$\Delta T_1 = \frac{15{,}015}{27{,}3}.(2123 - 293) = 1006{,}5°K$$

3) Calculation of the outside temperature of the walls

a) Calculation of thermal resistance

It is given by the formula:

$$R_{th} = \frac{e}{\lambda}$$

With: - Rth. = thermal resistances in $\frac{m^{2}°K}{N}$

– E = thickness of the layer considered in m

– λ= thermal conductivity in W/°K m^2

- **Fireclay**

$$R_{thm} = \frac{0{,}055}{3.663.10^{-3}} = 15{,}015\frac{m^{2}°K}{N}$$

- **Corundum**

$$R_{thc} = \frac{0{,}045}{3.663.10^{-3}} = 12{,}285\frac{m^{2}°K}{N}$$

Steel = $\frac{0{,}002}{50}10^{-5}\frac{m^{2}°K}{N}$

Total Rth = 15,015 + 12,285 + 0, 00001 = $27{,}3\frac{m^{2}°K}{N}$

b) Calculation of the intermediate temperature

The intermediate temperature is the temperature between layers of materials.

It is given by the formula:

$$\Delta T_{1-2} = T_{fe} - \Delta T_1 = 2123 - 1006{,}6 = 1116{,}5\ °K$$

- $\Delta T_2 = \frac{R_{th}}{R_{th}}(T_{fd} - T_o)$

$$\Delta T_2 = \frac{12{,}285}{27{,}3}.(2123 - 293) = 823{,}5°K$$

$$\Delta T_{2-3} = T_{1-2} - \Delta T_2 = 1116{,}5 - 823{,}5 = 293\ °K$$

- $\Delta T_3 = \frac{10^{-5}}{27{,}3}.(2123 - 293) = 176.10^{-4} = 67{,}03°K$

$$\Delta T_{3-4} = T_{2-3} - \Delta T_3 = 293 - 67{,}03\ 10^{-5} = 293°K$$

773
491
293
292,9824
19,9648 = 20 °C

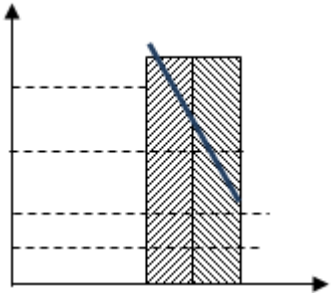

Figure No..: Evolution of the temperature in the layers

4) Calculation of the energy accumulated by the walls

The heat stored in the walls plays the role of a thermal flywheel favoring the uniformity of the reckless in all the volume of the enclosure and makes it possible to avoid the sudden variations of temperatures. In continuous operation furnaces with infrequent shutdowns the impact of this energy on the heat balance and furnace efficiency can be neglected. These are the first furnace thermics that play a major role in thermal efficiency

Calculation of the flux crossing the walls, it is given by the formula:

$$Q_m = \frac{T_f - T_o}{R_{tht}}$$

With: Tf: final temperature = 733 ° K

To = initial temperature = 293 ° K

Rtht = total heat resistance = $27{,}3\frac{m^{2}°K}{N}$

$$Q_m = \frac{2123 - 293}{27{,}3} = 67{,}03\ w/m^2$$

Calculation of the energy passing through the walls

The vessel has the shape of a rectangular parallelepiped of length L = 1300 mm, width l = 800 mm and height h = 900 mm

The energy passing through the walls is given by the formula:

$$Q_{tr} = Q_m.s.t$$

S = 2(h.L + h.l + L.l)

By replacing each term by its value, we will have: Qh = 81.60 kCal

5) Calculation of the total energy to be expected

Qpv = Qu + QR

This leads to finding the total energy to be expected Qpv equal to 2300.4114 kCal.

6) Performance calculation

We calculated it by the formula:

$\eta = \frac{Q_{pv} - Q_h}{Q_{pv}}.100$ This gives 82.9%

7) Estimation of the mass of charcoal to use

Atequilibrium, we have:

Qpv = Qu + Qh = mch.Pc With:

mch: mass of charcoal in kg

Pc: calorific value of charcoal equal to 4320

The minimum mass is given by the formula:

$$m_{ch} = \frac{Q_{pv}}{p_c} = \frac{2300{,}4114}{4320} = 0.53$$

T°

To take into account the unforeseen, the actual quantity is greater than
By adopting a 20% security
The expected mass is: $m_{Chp} = 1{,}20.m_{Chp}$

7. Conclusion

This study was conducted in order to reduce the insalubrities and the presence of household waste everywhere avenues, playground, enclosure schools, plots, streams etc.)

Indeed, the presence of waste renders the commune unsuitable and exposes the inhabitants to diseases and other disaster of all kinds (flooding, demolition of houses and other works, clogging of drainage collectors of rainwater ...)

Our investigation focused in Kikula commune. It consisted of:

a) The identification of household waste and other types most widespread in the plots of said commune;
b) Determination by a static approach of the average mass (in kg) of waste produced in households per day as well as the average of households per plot
c) This data allowed us to size the oven.
d) The incineration bin designed is a charcoal-fired appliance operating at a temperature limit of 2300,4411 ° K.

It consists essentially of:

e) A ferrule made of 308L stainless steel sheet lined inside a fireclay and corundum refractory brick lining.
f) An artisanal fan controlled by a transmission by pulleys and belts operating in gear multiplier;
g) agas extraction chimney;
h) Two removable grids in stainless steel sheet 308L, one for the charge to be incinerated and the other for containing the charcoal.

The ash produced will help some poor families to disinfect toilets, wash their hands and enrich the garden soil.

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