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## Assessment of the Liquid Waste Management Practice of Condominium Houses in Addis Ababa, Ethiopia

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### Abstract:

*Background; Human beings pollute the environment with their anthropogenic activities. The liquid effluent generated from condominium residents of Addis Ababa city is not appropriately managed.*

*Objective; To determine the Effluent Management system and Practice of selected Condominium Houses in Addis Ababa*

*Methodology; the data were collected from 8 condominium site. Group discussion with each condominiums site sanitation committee was held. Primary and secondary data were collected from sanitation committee and Addis Ababa water and sewerage Authority. Various aspect of liquid waste management was inspected on site and observed by researchers and Assessed by developed check list. The Sample size of the selected condominium was determined using stratified random sampling technique based on sated criteria's. The study was conducted 2014 G C.*

*Result; during study period, peoples who live in A.A condominium houses are 18.7%. The liquid waste generated by direct link to sewer line of the city, collecting by vehicle and onsite management. The condominium houses generate 50,715,335 liter liquid waste per day (93.5 l/d/p) is liquid waste discharged. 24.8 % of the total condominium houses connected their waste to sewer lines and 24,400 m<sup>3</sup> amount of effluent waste of the city inters to kality treatment.*

*Conclusion and recommendation; liquid waste management practice in the condominiums site, sewer line and vehicle was unsatisfactory because of the lack of waste management supervision of concerned bodies, weak policies and institutional frame works, slope of the constructed treatment plant, sewer line damaging due to road construction in the city, an adequate number of vehicle and carelessness of resident, therefore, the Addis Ababa City water and sewerage Authority and Addis Ababa Housing and construction Agency should develop the waste management supervision and strictly follow the National effluent Waste Management guideline.*

## 1. Introduction

### 1.1. Back Ground Justification

All living species generate by-products through their activities (1). Moreover, the complexities of waste which modern civilization produce is directly related to the living standards, socio-economic and cultural attributes of that particular environment(2,3). Addis Ababa, particularly Capital city of the country, Ethiopia, which is the centers of industrial expansion and both governmental and non-governmental organization's experiencing socio-economic and environmental problems due to population density(4,5).

The word condominium is recorded in English since C.1714, from modern Latin. Apparently coined in Germany C.1700 from Latin, 'con' means together and 'dominium' means right of ownership(6).

Water Treatment required to render water suitable for human consumption varies depending on the water source, but may include removal of suspended solids, removal of dissolved materials, and disinfection. Primary disinfection achieves the desired level of microorganism kill or inactivation, while secondary disinfection maintains a disinfectant residual in the finished water that prevents the regrowth of microorganisms(7).

Tertiary treatment is any practice beyond secondary treatment and is designed to remove non-biodegradable organic pollutants and mineral nutrients such as nitrogen and phosphorus salts. Tertiary treatment can remove more than 99 % of impurities from the wastewater, and is capable of producing effluent of nearly drinking water quality (8). Typically, sewage treatment involves up to three stages, called primary, secondary and tertiary (or advanced) treatment.

In Ethiopia the effluent waste management was started in 1934 G.C. The residents of Addis Ababa were used river side's and forests as a toilet. Then after, modern houses began to construct with septic tanks. But the effluent waste was discharged around 'rapi' and riversides before Kality Catchment (waste water treatment plant) which has constructed in 19842 G.C. After this the effluent waste starts to connect by sewer lines, which are closed conduits, usually circular in cross section, which carry wastewater.

Improper management of effluent harms and affects both environment and human health. In order to safely manage and dispose of the effluent waste, we must know their hazardous nature through laboratory result. Therefore these studies measure the effluents parameters being generated by the condominium dwellers.

### *1.2. Problem Statements*

The residents of condominium houses have been still suffering from lack of toilets as well as other infrastructures. There are frequent complains in almost all condominium sites related to the sanitation problems. The collection, Treatment and disposal of wastes provide a benefit to communities by removing waste. Otherwise decompose and became sources of disease, Pests and nuisance (9). More than 92.5% of the total effluent waste of Addis Ababa is not properly collected(5). A country wide study on environmental sanitation by the ministry of human health, department of environmental health revealed that the national coverage is only 26% (7% for rural and 71% for urban areas)(8). This indicate that, the majority of the Ethiopian population is defecting in areas other than a proper excreta disposal face.

The management of condominium effluents waste poses a major problem in developing countries. The improper disposal of this waste cause serious environmental problem in term of air, water and land pollution. The general public health can also be adversely affected by improper management of effluents waste.

Presently in Ethiopia, there is an increase in the number of condominium constriction to address the basic need of the society.

The main reason to conduct this proposed study in Addis Ababa city (AAC) condominium among other in AAC facilities are; Number of people is increasing, hence wastes composition and volume increases, Effluent being generated in the condominium house are not quantified and characterized to assess present potential of hazardous, and to assess the future potential

They have not improper effluent management system & Addis Ababa city Administration (AAC) is highly populated city, people may be at risk of exposures.

### *1.3. Significant of the Study*

Data and result of this study will serve as baseline information for future studies

To design police, rule and regulation

Outcome of proposed study will help AACA authorities to take better and appropriate measure to mitigate and control both public and environment effects.

## **2. Objective**

### *2.1. General Objective*

To determine the Effluent Management system Practice of selected Condominium Houses in Addis Ababa

### *2.2. Specific Objectives*

- To identify the type of effluent management practice of condominium houses in Addis Ababa
- To determine the current management status of effluents
- To determine the effluent management system of condominium houses
- To predict the environmental impact of the effluent.
- To propose sound effluent management system in condominium houses of Addis Ababa

## **3. Material and Methods**

### *3.1. Study Area and Period*

Addis Ababa city was established in 1894 G.C, is the capital city of the country, located in the central highlands of Ethiopia, between 8°55' and 9°05' northern latitude and 38°05' east longitude. The lowest elevation of 2326 m.a.s.l at Bole International Airport, in the southern periphery and the highest elevation is over 3000 m.a.s.l at Entoto Mountains. The total area of the city is 54,000 ha (540 km<sup>2</sup>) out of which 22,000 hectares of land is allocated for green use. Its population has been increasing at an alarming rate reaching around 2.9 million (recent population census). The city is home to African Union and the seat of many International organizations. The city was not founded based on a master plan. The study was conduct in 2014.

### *3.2. Data Collection Method*

Primary and secondary data were collected. Varies aspect of liquid waste management was on site inspected and observed by researchers and Assessed by developed check list; the stakeholders who live in selected condominium were interviewed in group to assess their level of awareness about the risk exposure to waste by focus group decision. The secondary data was collected from AAWSA.

### 3.3. Sampling Method and Size

A survey was conducted on 8 condominium sites out of 131 sites along the city based on different criteria; location of the condominium whether it is peripheral or center and year of it constructed and based on their treatment system. The Sample size was determined using stratified random sampling technique to select the representative condominium site. For the purpose of data collection 10 enumerators and 2 supervisors were take one day training by the principal investigator.

Location	Age & Population size			
	A 1&LPS	A 1&HPS	A 2&LPS	A 2&HPS
Peripheral	Kotebe m/hail	Mikland	Yeka Ayat 1	Jemo 2
Central	Libe fana	Gerji 3	Bole ayat 3	Lideta-1

Table 1: Sample method & size

KEY: A1= constructed between 2005/6-2008/9 A2= constructed between 2009/10-2012/13  
LPS= low population size below 861 HPS= high population size above 861

### 3.4. Data Analyzing

The data were analyzed and interpreted using the conceptual model and also we used administrative reports.

### 3.5. Data Quality Control

In order to make the study qualified

The data was collected by researchers only

The collected was cross-checked on daily basis

Each and every question of the developed checklist and inspection result was discussed by members of Addis Ababa Environmental authority, environmental pollution research office team.

## 4. Result and Discussion

### 4.1. Condominium House

Ethiopian government has constructed more than 175,246 condominium houses at the study period time. From those houses 108,482 houses transferred to beneficiaries within 131 sites in 9 rounds from 2006-2013 G.C. According to central statics Agency (CSA) report, 5 persons live in each house. During study period 542,410 peoples live in A.A condominium houses that are 18.7% out of the total population. The inadequate and insanitary disposal of any waste leads to the contamination of the soil and sources of water supplies.

No	Name of Sites	Sub-city	No blocks	No of houses	Estimated population live
1	Kotebe m/hayle	Yeka	8	266	1,330
2	Bole ayat 2	Bole	39	123	2345
3	Yeka Ayat 1	Yeka	19	508	2,540
4	Gerji 3	Bole	30	1,252	6,260
5	Libe fana	Kirkos	4	119	595
6	Lideta 1	Lideta	51	1,979	9,895
7	Mikland	K/keranyo	123	4,634	23,170
8	Jemo 2	N/S /lafto	163	3,830	19,150
Total	8 sites	<b>6 Sub-cities</b>	<b>403</b>	12,690	62,940

Table 2: Sub-cities, number of blocks, number of houses and number of population, 2014 GC

Out of the 131 condominium sites have transferred to public in Addis Ababa, 48 sites had built in peripheral areas & 83 sites had built in inner cities. The study has done on 8 condominium sites. The condominium houses generate 50,715,335 liter liquid waste per day (93.5 l/d/p) is liquid waste discharged. Environmental sanitation is very crucial in highly populated areas, such as condominium sites because communicable diseases can spread out easily.



Figure 1: condominium site 2014 G C

Sewers line carries waste water from residential, commercial, and industrial users, to storage, discharge. The waste water treatment 10,000 m<sup>3</sup> effluent wastes by sewer line & 14,000 m<sup>3</sup> by vehicles. Totally 24,400 m<sup>3</sup> amount of effluent waste of the city enters to Kality treatment plant daily. The sanitary development in the city has not gone fast which is similar within study done previously in Addis Ababa 2009 (). So the overall condition of poor sanitation and its environmental burden unfortunately still remains valid today. Indeed the total coverage of sewer line of the city is only 6.5 % which is similar study done in Addis Ababa by Addis Ababa water and sewerage Agency(AAWSA)(10).The other study done in Ethiopia in 2009 reported that the accessibility of the sewer line of the city is less 10% which is the same with the result of the study even after 10 years(10).This is due to concerned bodies weakness since they gave attention for solid waste management and drinking water rather than liquid waste and also due to absence of environmental friendly technology and easily accessible. The coverage of the vehicles is 7 %. The total coverage of effluent waste collection is < 14 % it is too small.

Totally 350 km sewer line is available in Addis Ababa. It allows passing 540 liters per second or 46,650 m<sup>3</sup>/day to Kality. Inadequate handling of waste water has serious consequences for human health, the environment and economic development(10). It contaminates the water supply, increasing the risk of infectious and deteriorating ground water and other local ecosystems, for instance after flooding(10).

#### 4.2. Generated Liquid Waste Management System

In the study areas responsible Agency uses typically three mechanisms to solve the problem of effluent waste in condominium houses of Addis Ababa. In the former ones, Addis Ababa water supply agency had built septic tanks & collects mechanically by vehicles. The second option is by connecting effluent waste of condominium houses to Sewer lines. More than 26,917 condominium houses have connected their effluent waste to sewer lines and treated at Kality treatment plant. That is 24.8 % of the total condominium houses have connected their waste to sewer lines of Kality treatment. But the treatment plant is not enough to treat the effluent waste come by sewer line and vehicles from the whole corner of the city because the plant was built to serve 50,000 people. But now it serves above 70,000 people (AAWSA road map). The third option is treatment system around the condominium houses. Condominiums having their own treatment system in Addis Ababa are Mikliland & Gerji condominium sites. They have their own treatment system and daily treated 3000 m<sup>3</sup> amount of effluent waste by oxidation pond & anaerobic reaction respectively.

## 5. Treatment

### 5.1. Mikliland Condominium Treatment Plant

The treatment plant is found near to the condominium site around 50 m. It serves for more than 23,000 people. It has 6 ponds which can treat the waste step by step. In the first two ponds the effluent waste treated for 15 days, then after it continues to the second 2 ponds due to gravity and treated for other 15 days. Finally the effluent goes to the last two ponds similarly by gravity & treated for additional 15 days. After it has completed its treatment (45 days) it discharged to the nearby river & the urban agriculture enterprises reuse the treated waste water for their home garden. The sludge comes out from the first two ponds is burned by fire. This may cause air pollution dioxin and furans because of the different organic and inorganic materials are available. But now they try to use as natural fertilizer. There is bad odor come from the first two treatment plants to the residents and there is complain from the nearby residents. Since it is an open treatment system insects and scavengers exist in the ponds. These insects may cause spread of communicable disease easily and other emergency problem.

### 5.2. Gerji Condominium Treatment Plant

The treatment plant is found far from the condominium house and near to the river. It serves for about 5 condominium sites; namely (Gerji 1, 2, 3, 4 & 5). The population who live here is more than 30,000 people; produce more than 2,640,000 m<sup>3</sup> effluent wastes daily that is beyond the treatment plant capacity. The anaerobic treatment plant is too small in size. As a result the effluent is simply discharged to the river without proper treatment. It has serious environmental problem. As a result there is high complain from the dwellers around the treatment plant. Due to the mismanagement of solid & liquid wastes the outlets of the sewage leaked & flow out



inside the condominium site before it enters to the treatment plant. During rainy the season sewages over flow to nearby open areas. In many cases, direct or indirect human contact with treated wastewater is likely.

### 5.3. Sludge of Treatment of Milkiland and Gerji Condominium Site

The some effluent sludge produced after treatment was collected and transported to treatment facility by 48 vehicles but which need additional truck mounted vacuum tanks and small. But in this case it is difficult. Because this needs several trips to collect the effluent sludge by vehicles but the vehicles engaged in such activity in Addis Ababa city are approximately 63, out of these only 48 are functional. They also burn it and use as fertile. On-site sanitation systems of septic systems require periodic removal of solids for proper functioning. Collection is accomplished by manual means with mechanical equipment.



Figure 2: waste water treatment plant 2014 G C

### 5.4. Libe Fana Condominium Site

This site use septic tank system. They have also tried to build treatment system. But it is not functional. As I have observed the septic tank is not fully functional. It connects illegally to the nearby river and the waste discharged to the nearby river directly. Due to this the nearby river was contaminated.

### 5.5. Kotebe Mebraht Hail Condominium Site

It has two septic tankers constructed to accumulate the grey water & toilet wastewater together. But the waste over flow inside the condominium compound due to the insufficient size of the septic tank to hold the waste, chock-full of the tanker and out let by solid waste & the slop problem during constructing of the sewerage pipes. Even if the septic tank is too large it is difficult to collect the grey water & the toilet wastewater together in one two tankers. During my study the waste over flow inside the condominium and make a little pond. This was a series health problem of the residential by that time. To solve this problem they connect tanker to the nearby river. As a result the effluent waste is directly discharged by pipe to the river illegally. Still there is bad smell around the condominium houses; which may leads to different breathing problems and communicable disease.

### 5.6. Lideta One Condominium Site

This condominium is constructed before 8 years, around 2007G.C. it has septic tank, but the effluent waste has never discharge from the septic tank up to this study was done reported by sanitation committees of the site. This shows us there is leakage or illegal connection to the runoff ditch or river as the above mentioned sites. The sanitation committees of the site said that they are suffer of over flowing of the effluent during the rainy season due to the entrance of solid waste to the lateral pit and improper slop of the sewer line. They also reported that they have series problem to discharge the grey water due to slope of the site.

### 5.7. Septic Tank Sewerage of Libe, Kotebe And Lideta Condominium

Sewage is typically conveyed by a system of pipes, pumps, and other associated infrastructure (sewerage) to a centralized storage and/or treatment system. Solids and liquids may be transported to a centralized location, or sewage solids may be collected in and periodically removed from on-site interceptor tanks while the liquids are transported to a centralized location for storage, treatment, or disposal.

In study area Grey water (water from laundry, kitchen, bath, and other domestic activities that normally does not contain excreta) is not collected and managed separately from sewage. Though grey water is generally less polluted than domestic or industrial wastewater, it may still contain high levels of pathogenic microorganisms, suspended solids and substances such as oil, fat, soaps, detergents, and other household chemicals and can have negative impacts on human health as well as soil and groundwater quality ((11)). In the case of Addis Ababa condominium houses the effluent waste over flow at before from man hole before interring to the treatment plant or septic tanker because of the sewerage line is easily broken out by vehicles and blocked by solid waste.

The management part of the condominium effluent waste is the duty of the committees. This is one cause of weak effluent waste management.

#### 5.8. *Jemo Two and Three Condominium Site*

In fact the effluent waste of this site is already connected to sewerage line, it has several problems regarding to effluent waste management due to numerous broken of the sewerage line. As the researchers that observed during my study time, many waste ponds were existed due to such problem. These waste ponds were created a bad smell and insects that causes different health problems. The both site has also similar problems.

#### 5.9. *Bole Ayat Two Condominium Site*

Even if the waste of this site is connected to sewer line, but I has very series problem of effluent waste management due to break down of the sewer line in different areas of the site; large over flow of effluent waste was existed in different areas of the site here and there. The dweller of the condominium complained, they has lost their daughter because of the effluent waste over flow, and they are highly suffered by the miss handling of the effluent waste in the respected condominium site.

#### 5.10. *Yeka Ayat One Condominium Site*

The waste of this site is connected to sewer line. Comparatively this site is better than the others. But still this site has also effluent waste management problem due to the miss management of solid waste. In addition to this the waste flow back to the houses (floor rooms) because of improper sewer line slop. The committee of the site reported that, such problems may emerge ones or twice a year and same time it stay beyond five months.

### 6. Conclusion

During study period, peoples who live in A.A condominium houses are 18.7%. The liquid waste generated is direct link to sewer line of the city from bole lemi, yeka and jemo condominium site, collecting by vehicle from libe, kotobe and lideta one condominium site and onsite liquid waste management by mikliland and Gerji condominium site.

The all condominium houses generate 50,715,335 liter liquid waste per day (93.5 l/d/p) is liquid waste discharged. 24.8 % of the total condominium houses connected their waste to sewer lines and 24,400 m<sup>3</sup> amount of effluent waste of the city inters to kalitiy treatment.

But the treatment plant is not enough to treat the effluent waste come by sewer line and vehicles from the whole corner of the city because the plant was built to serve 50,000 people. But now it serves above 70,000 people (AAWSA road map).

The awareness of the condominium dwellers towards liquid management is very poor. They discharge solid waste together with the liquid part. Regarding the solid & liquid waste management and other administrations of the condominium houses of Addis Ababa has no legally nominated body except the voluntary committees.

Same times the condominium houses of Addis Ababa transfer to beneficiary before they have finished the sanitary system. Due to this the waste water over flow simply to open ground.

In generally almost all condominium sites of Addis Ababa has yet series problem of effluent waste management.

### 7. Recommendations

Off-site options should be considered when on-site treatment could entail direction risks to public health or groundwater, or when the risk exists of fecal contamination or eutrophication of river waters, as in more density populated areas.

Centralized treatment systems require wastewater collection and transportation through a sewer system.

Treated wastewater effluents are typically discharged to surface water or re-used for irrigation or other purposes. Therefore, adequate wastewater treatment to remove contaminants and, especially, microorganisms and pathogens, is important not only to prevent adverse environmental impacts, but to protect public health as well.

It also built far away from the residential to protect the bad smell generated from treatment plant& to reduce disease come by insects and pests.

#### 7.1. *Addis Ababa Housing Construction Agency*

- The Agency should be design, construct, operate, and maintain wastewater treatment facilities and achieve effluent water quality consistent with applicable national requirements or drainage and sewer collection systems (including seepage systems), screening solids, and sludge from various unit operations used for wastewater treatment.
- Should involve public officials to select appropriate treatment technologies, considering factors such as the quality and quantity of raw wastewater and its variability; available land area for the treatment facility; and resources for capital expenditures, operation, maintenance, and repair.
- Should be consider installation of separate sewer systems for domestic wastewater and storm water runoff in the overall planning and design of new sewerage systems of condominium houses;
- Limit the sewer depth where possible (e.g., by avoiding routes under streets with heavy traffic). For shallower sewers, small inspection chambers can be used in lieu of manholes;
- Use appropriate locally available materials for sewer construction.

- Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation;
- Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize entry of garbage and silt into the system;
- During construction of treatment plants the load of effluent waste enters to it should be considered.

#### 7.2. Addis Ababa Housing Development & Management Agency

- Should have environmentalists in their structure( sanitary experts )
- Should not transfer condominium house before they have finished (sanitary work)
- They should have monitor including the environmental issues.

#### 7.3. Addis Ababa Water and Sewerage Authority

AAWSA should establish routine maintenance program, including:

- Development of an inventory of system components, with information including age, construction materials, drainage areas served, elevations, etc.
- Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups.
- Cleaning should be conducted more frequently for problem areas.
- Cleaning activities may require removal of tree roots and other identified obstructions
- Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance.
- Monitoring of sewer flow to identify potential inflows and outflows
- Conduct repairs prioritized based on the nature and severity of the problem.
- Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow
- Review previous sewer maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed.

#### 7.4. Addis Ababa Environmental Protection & Ministry of Environment Forest and Climate Change.

Make mechanisms to follow such projects to pass through Environmental and social Impact Assessment (ESIA)

Environmental monitoring activities should be based on direct or indirect recommended measures to prevent minimize, and control liquid effluents impact on the environment.

#### 7.5. Limitation of the Study

No similar research conduct in Ethiopia

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