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# APPROPRIATE SEWAGE TREATMENT SYSTEM WITH VALUE ADDITION FOR SCHOOLS

## JUSTIFICATION

### 1. Threat to public health

The fact that about 2.6 billion humans around the world, especially in Africa and Asia, suffer from lack of access to proper basic sanitation reveals the necessity of acting innovatively.

Without sufficient sanitation people have to face not only an unworthy and polluted environment, but also a high risk of infection as well as a deficiency of privacy and safety.

- In considering the state of public health, it becomes clear that in particular children are afflicted with life threatening sanitation conditions –

Most notably at school.

> Over 980 million children under the age of 18 do not have access to adequate sanitation (UNICEF).

>Due to unhygienic toilets, hundreds of millions of school children are infected with parasites and worms (UNICEF).

> 5000 children a day die from diarrhea which is caused by poor sanitation (UN-Water).

### 2. Environmental pollution

Most wastewater and droppings from schools is discharged untreated into the surrounding environment.

This additionally threatens the health of residents who live near schools.

### 3. Environmental degradation

Global warming and environment degradation has become great threat to mankind.

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Too much release of carbon dioxide in the air due to human activities is the major cause

Amongst these activities is sourcing of fuel for cooking meals which is must for people to live.

In the African context wood is the major source of fuel for millions of people in the rural areas, in schools and prisons.

Trees are known to be the best means of mitigating carbon and enhancing of reliable rainfalls.

Felling down of trees to source for **WOOD-FUEL** is therefore a grave practice that must be curbed urgently through developing alternative and sustainable energy solutions.

## KENYA STATISTICS

Facts sheet

- Kenya loses 5.6 million trees daily, despite campaigns on environmental conservation. (Green Africa Foundation)-GAF
- 64.6 percent of Kenya's households depend entirely on firewood as their cooking fuel, where each harvests between 10kgs and 20kgs of firewood daily.(GAF)
- Deforestation in Kenya translates to 2.04 billion trees every year, exclude more than 1.5million households in urban centers (or 16.9 per cent of population) who use charcoal.(GAF)
- 24,000 primary schools, 9500 secondary schools, Prisons, Medical Colleges and factories also rely on firewood, thus further depleting trees.
- Schools are by far the most significant consumers of fuel. About 90 percent of public schools use firewood for cooking and some pay up to USD 20,000 (Ksh.2M) per year for the wood. This makes cooking fuel one of the biggest expenses in schools' meal budgets. (Kenya Climate Ventures)
- The government pumps over 10Billion in schools. (National Treasury)
- Mau tree planting initiative to rehabilitate the forest – Kenya's "water tower" cannot improve the situation any much if high rate of felling trees for fuel in other parts of the country is a daily routine affair.
- Boarding schools, colleges and prisons in Kenya are the main consumers of huge volumes of firewood.

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**SPECIFIC OBJECTIVES OF THE PROJECT**

- To provide a long term solution to tackle the problem of poor sanitation and the associated human health risks.
- To create an alternative source of "green" energy for institutions
- Create awareness on the importance of biogas technology in the mitigation of climate change
- To optimize benefits that are currently underdeveloped in the Kenya biogas sector, specifically related to:

♣ Gender aspects, women economic and children's educational status
♣ Improved health from nutrition and reduced indoor air pollution
♣ Environmental protection through reduced deforestation and environmental degradation
♣ Employment creation, especially in the rural areas
♣ Improved food security due to agricultural application of bio-slurry
♣ Tapping of carbon finance

Kenyans are replanting only 12 percent of the trees cut and unless concrete measures are taken to arrest the current depletion rate, the country afforestation efforts will amount to nothing.

The government pumps over 10Billion in schools. How can this project ultimately reduce this spending, deforestation/desertification and increase forest cover?

## SCHOOLS CASE STUDY

1. Most schools consume 0.5 to 1 tonne of firewood per day to prepare meals for students. This is equivalent to 0.87-1.7 tonnes of carbon per day (1kg of wood = 1.7kgs of carbon)(K.U Research library paper)
2. In monetary form, most schools spend Kshs 150,000 to 600,000 per every 3 months of one term in buying wood fuel.
3. Most schools spend Kshs 50,000-100,000 per term to exhaust their pit latrines or dig new ones.
4. In a day, most schools produce 500-1500Kgs of human waste and organic food waste.

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# Appropriate technological interventions

Through promotion and adapting appropriate technologies, we can be able to solve the above highlighted problems simultaneously.

Human waste which is considered as unwanted waste by the society can be used to produce clean fuel source and also recover finite resources like water that is used to transport this waste through recycling.

This fuel (biogas) can replace woodfuel in schools

Our systems have practically proved to be capable of both tapping the gas and treating of the sewage to high efficiencies hence solving sanitation problem in schools as well.

# Benefits of our systems

- ✓ Conserves our resources
- ✓ Biogas for cooking and power source
- ✓ Recycled clean water for gardening
- ✓ Protection of our environment
- ✓ Promotes safe recovery and use of nutrients, organics, trace elements, water and energy.
- ✓ Nutrients (agriculture, forestry, aquaculture)
- ✓ Methane = greenhouse gas
- ✓ Treated sludge as organic fertilizer preserves soil fertility and improved agricultural productivity
- ✓ Promotion of health standards
  Improves health by minimizing the introduction pathogens from human excrements into the water cycle.
- ✓ Monetary savings
  Good for decentralized systems and more appropriate, cost-efficient solutions.
- ✓ Promotion of a holistic, interdisciplinary approach. >Material flow cycle instead of disposal.
- ✓ Fuel substituted by biogas enables savings

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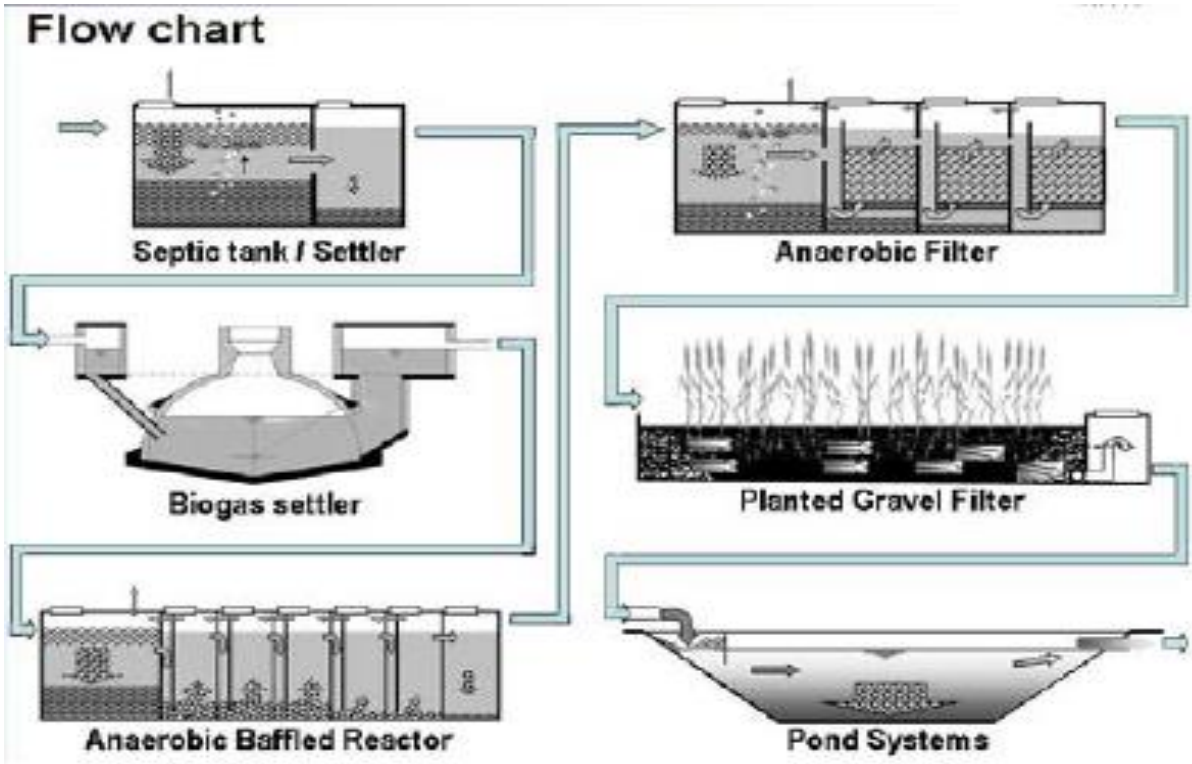
# THE PROCESS FLOW



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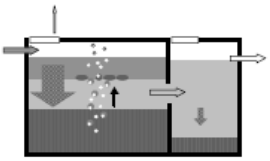
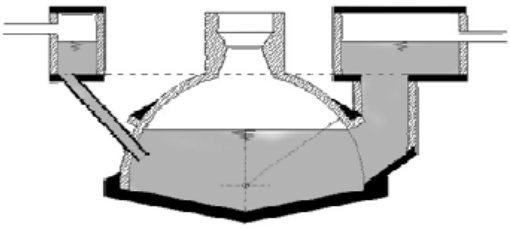
# THE FIRST TWO STAGES

- **Treatment principles**
- **Septic tank / Settler**
- Consists of minimum 2 to 3 compartments
- Settling / Sedimentation tanks for retaining particle
- Outlet is free from settleable solids
- Dissolved and suspended matter passes untreated to next stage of treatment
- Efficiency 25% - 40%
- Desludging period 1 to 3 years depends on sludge storage

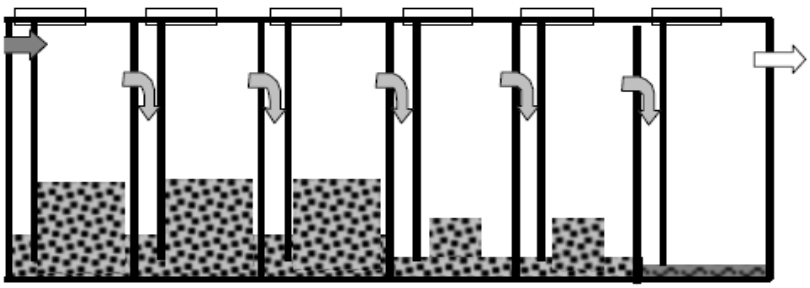


- **Biogas Settler**
- Sedimentation tanks for retaining particles
- Biogas is formed due to the digestion of settled organic matter in anaerobic condition
- Outlet is free from settleable solids
- Dissolved and suspended matter passes untreated to next stage of treatment
- Efficiency 25% - 40%
- Desludging period 1 to 3 years depends on sludge storage
- Biogas production - Gas storage is needed (gas tight)



# ANAEROBIC BAFFLE REACTORS

- **Anaerobic Baffled Reactor**
- Treatment occurs in the absence of Oxygen (anaerobic)
- Wastewater passes in a series of chambers in Up-flow form
- Sludge (activated) at the bottom of each chamber
- Further treatment (degradation) of suspended and dissolved solids by available Bacteria
- Efficiency 75% - 85%
- Desludging is needed only if excess sludge (activated) is generated



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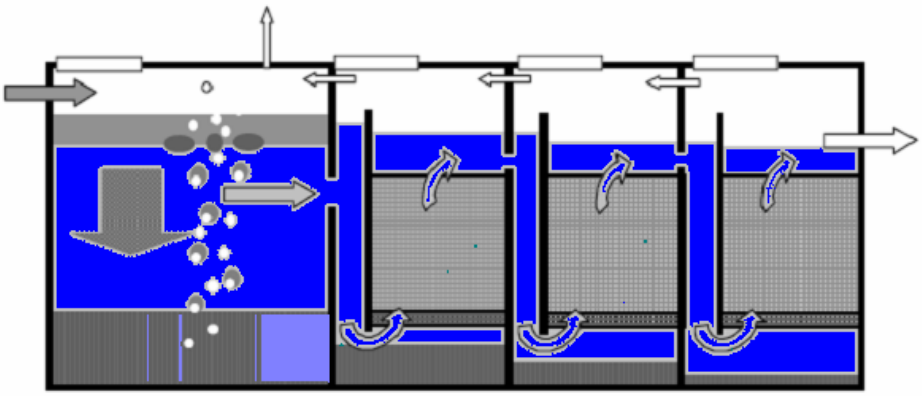
# ANAEROBIC BAFFLE FILTERS

- **Anaerobic Fixed bed Filter**
  - Treatment occurs in the absence of Oxygen (anaerobic)
  - Wastewater passes in a series of chambers through the filter material in Up-flow form
  - The filter is made out of gravel, slag or plastic elements.
  - To avoid plugging pre-treatment (sedimentation) is necessary.
  - Efficiency 75% - 90%
  - Desludging is needed only if excess sludge (activated) is generated



# PLANTED GRAVEL FILTER

- **Planted Gravel Filter**
- Treatment occurs in the presence of Oxygen (aerobic)
- Treatment concentrates more on removal of smell & colour
- Planted Gravel Filter (PGF) consist of plants (reeds) & filter materials (graded gravels, river pebbles)
- The filter is permanently soaked (up to 50 cm from bottom) in water
- The flow direction is mainly horizontal

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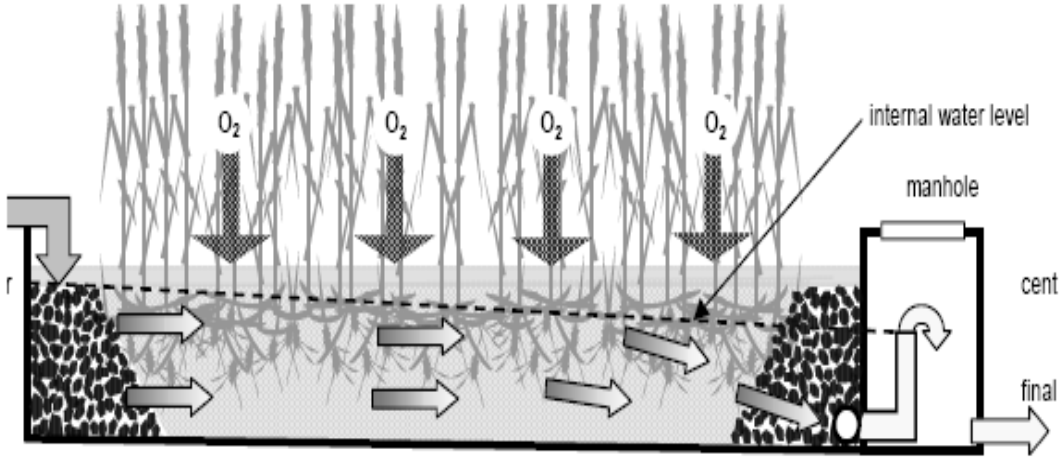
- Suitable for pre-treated wastewater




# GENERAL PARAMETERS

- General Statutory requirements for wastewater disposal

| Sl. No. | Parameter | Inland surface water | Public sewers | Land for irrigation |
|---|---|---|---|---|
| 1 | Suspended solids mg/l, max. | 100 | 600 | 200 |
| 2 | Particle size of suspended solids | shall pass 850 micron IS Sieve | - | - |
| 3 | pH value | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 |
| 4 | Oil and grease, mg/l max, | 10 | 20 | 10 |
| 5 | Biochemical oxygen demand (3 days at 27oC), mg/l, max. | 30 | 350 | 100 |
| 6 | Chemical oxygen demand, mg/l, max. | 250 | - | - |
| 7 | Bio-assay test | 90% survival of fish after 96 hours in 100% effluent | 90% survival of fish after 96 hours in 100% effluent | 90% survival of fish after 96 hours in 100% effluent |

* These standards shall be applicable for industries, operations or processes other than those Industries, operations or process for which standards have been specified in Schedule of the Environment Protection Rules. 1989.

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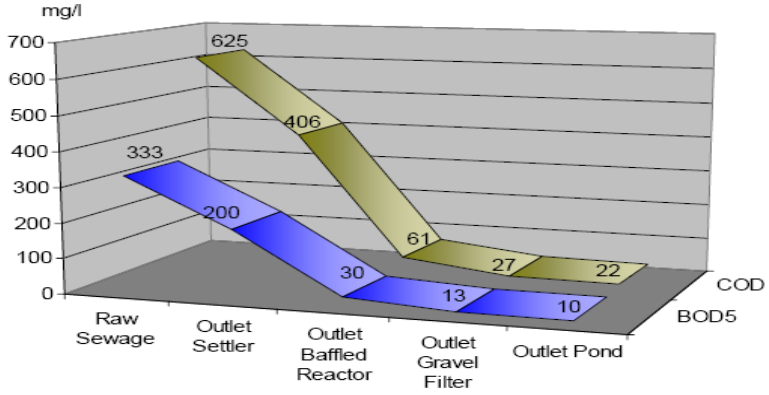
# ACHIEVABLE TREATMENT LEVELS


# EFFICIENCY OF OUR SYSTEM

- Treatment efficiency

BOD and COD reduction in different modules




Let's Go Green on Mother Earth!