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DECENTRALIZED WASTE WASTER TREATMENT (DEWATS); SOLUTIONS FOR LOW-INCOME URBAN COMMUNITIES (THE INDONESIAN EXPERIENCE)

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ABSTRACT

*Wastes are the effluents of human activity and use. The management of wastes is a problem. Increasing cost of raw materials, energy, transportation and land will make it much more feasible in the future to reduce the amount of generated wastes. The under-pinning principle of the Integrated Waste Management concept (IWM) is the three R's of Reduce, Re-use and Recycle. Wastes are of 2 broad categories; solid and liquid. Liquid wastes are either liquid in form or require water for their disposal. Health and safety standards governing the release of wastewater, stipulate that before wastewater is released into the environment it has to attain some purification standards. This is usually achieved through the use of central sewage treatment plants which have been found to be both in-adequate and expensive. The **DEWATS,** introduced in Indonesia is a system of decentralized wastewater treatment that is simple and in-expensive. The system utilizes a combined 4 treatment systems namely:- Primary treatment and sedimentation, Secondary anaerobic treatment in fixed-bed reactors or baffled upstream reactors, tertiary aerobic/anaerobic treatment in subsurface flow filters, tertiary aerobic/anaerobic treatment in ponds. Adaptations of this system in Africa will reduce to a large extent, its wastewater management problems.*

INTRODUCTION

Wastes are the effluents of human activity and use, they can be said to be the unwanted remains of any type of activity. The management of wastes is a problem evident in the world today, for both the developed and developing countries. This is visible in most urban centres with their large areas of un-collected wastes, improperly disposed wastes, and the attendant odours that pervade some of these areas. The chief reason for this poor situation could be ascribed to improper planning and implementation by the authorities responsible for the planning of urban areas; the plans are not adhered to, the factor of rural-urban migration is also almost always under estimated, and the poor areas are also not properly addressed in these planning schemes. The relationship between development and environment in most urban areas is a lop-sided one, chiefly as a result of the production system in practice in these areas which leads to a large quantity of wastes generated in both human and material terms. These wastes are inevitably dumped on the environment with little or no attention paid to them. Their polluting effect has a negative impact on the health and safety of the population as well as on the environment: damaging scenic resources, pollution of soil and water resources, and is a potential health hazard to plants, animals and people.

WASTE MANAGEMENT TRENDS

As a result of the identified flaws of past approaches of waste management, such as the concepts of dilute and disperse, which have proved in-adequate, new concepts are now being adopted to tackle the mounting problem of wastes. It is posited that the perfect system for waste disposal would be a technology that is capable of accepting an un-limited amount of wastes and safely containing it forever, outside the sphere of human life. However such notions are utopian and not environmentally sound. The environmentally acceptable option, would be a system that sees waste as a resource out of place, and though it may be considered impossible to recycle or re-use all wastes today, it seems apparent that the increasing cost of raw materials, energy, transportation and land will make it much more feasible in the future to reduce the amount of generated wastes, re-use and recycle all waste produced. Thus the under-pinning principle of the Integrated Waste Management concept (IWM) are the three R's of Reduce, Re-use and Recycle.

WASTE WATER MANAGEMENT

Generated wastes are of 2 broad categories; solid and liquid. Liquid wastes are those that are either liquid in form or that require water for their disposal, they are found in both industrial and domestic situations. Water being a natural resource is finite in its availability. It is a fundamental principle that the quality of water determines its potential, either for domestic or industrial use. Water used for domestic purposes is divided basically into 2 broad categories: for consumptions e.g., cooking and drinking, and sanitation e.g., washing

and flushing of toilets. Both uses derive water from the same sources and ultimately, the waste water has to be collected and treated before it is finally released into the environment. Health and safety standards governing the release of waste water both for domestic and industrial use areas, stipulate that before waste water is released back into the environment it has to attain some purification standards. This is usually achieved in urban areas through the use of central sewage treatment plants. These are long intricate system of channels connected underground from all domestic and industrial premises which carry waste water away from their points of origin to the treatment plants for treatment and release. These systems have been found to be difficult and expensive to operate and maintain, and can only be successfully implemented where an area is well planned, in addition the un-controlled rural-urban migration has over stretched the capacity of existing central sewage treatment plants while new ones are not constructed soon enough.

BACKGROUND TO INDONESIA

The nation of Indonesia is a collection of some 2000 Islands, scattered over the equator. It is the largest archipelago in the world. The terrain ranges from lush tropical rain forests to snow covered mountains. It has an estimated population of some 220 million people, most of them living in rural areas. The majority of the population lives below the poverty line, and lack basic facilities and infrastructure. About 15 million m^3 of waste water is produced daily and released into the environment without any treatment (The traditional Indonesian utilizes rivers, streams etc. for all activities such as, cooking, washing, faeces, and it is believed that the water cleans away the waste). As a result of this, the number of water related diseases amount to about 90,000 cases per annum, out of which about 20,000 result in fatalities. (WHO, 1998). The economic losses through inadequate sanitation and sewage treatment infrastructure is estimated to be about 47 million US $ per annum (ADB 1999). Existing systems of centralized waste treatment cater to only about 1% of the population, and is considered an economically non-viable option. Centralized sewage treatment options cater to only between 60-70% of the urban population, and usually not the urban poor due to such factors as socio-economic, legal, technical etc. The Decentralized Wastewater Treatment System (**DEWATS**)- developed by the Bremen Overseas Research & Development Association (**BORDA**) has been found to fill a significant "gap" between inappropriate on-site sanitation (e.g. absorption pits) and the short comings of conventional centralized sewage collection and treatment systems. **BORDA**, a non-for-profit organization founded 19977 in Germany has supported project activities in Indonesia since 1988.

DECENTRALIZED WASTEWATER TREATMENT (DEWATS)

The DEWATS technology is one that promotes that the principle of conversation of natural resources. The system utilizes the natural physical principles combined with the biological activities of micro organisms which occur naturally in wastewater. By reproducing and fine tuning the treatment processes occurring in nature, engineers have created systems which optimize the natural treatment cycle that is most efficient in a cost effective manner. A system of decentralized waste water treatment that treats discharged wastewater from areas in a simple in-expensive way, as opposed to the system of central wastewater treatment. The system can treat flow volumes of communities with a design capacity of between 1 and 1,000m^3 daily. This system can cater to both domestic and industrial wastes of such places as, communities, hospitals, hotels, dairy industries, slaughter houses, housing estates, etc. The DEWATS System is based on a modular, partly standardized technical design that can be tailor made to fit a particular requirement.

The system utilizes a combined four (4) treatment systems which are:-

- Primary treatment and sedimentation
- Secondary anaerobic treatment in fixed-bed reactors or baffled upstream reactors.
- Tertiary aerobic/anaerobic treatment in subsurface flow filters.
- Tertiary aerobic/anaerobic treatment in ponds.

These components of design are planned and laid out on sites depending on the technical requirements of an area. Some of the modules can be either placed underground or on ground. Laboratory analysis of wastewater treated using this system has shown that the discharged water conforms to discharge standards and environmental laws. (see table 1 below).

Table 1:- Efficiency of Wastewater Treatment Component

Wastewater Laboratory Analysis									
Location	Month	Parameter							
		PH	BOD5				COD		TSS
			Influent Mg/l	effluent Mg/l	% Reduction	Influent Mg/l	effluent Mg/l	% Reduction	Mg/l
Manis Jaya Rt.01 Rw.01	24-06-2004	7.67	2,132.00	66.00	96.90%	3,037.00	119.10	96.08%	18
Jatiuwung Rt.01 Rw.05	24-06-2004	7.90	2,133.00	67.70	96.83%	3,008.00	49.00	98.37%	6
Sukadamai Rt.01 Rw.02	24-06-2004	7.90	2,286.00	49.00	97.85%	3,127.00	67.70	97.83%	36
Keroncong Rt.03 Rw.05	24-06-2004	6.87	2,570.00	68.00	97.35%	3,529.00	74.50	97.89%	30
Average		7.60	2,280.00	62.68	97.24%	3,175.00	77.575	97.54%	30
MENLH No. 112,2003 Standards (mg/l)									
Domestic waste water		6-9	100						100

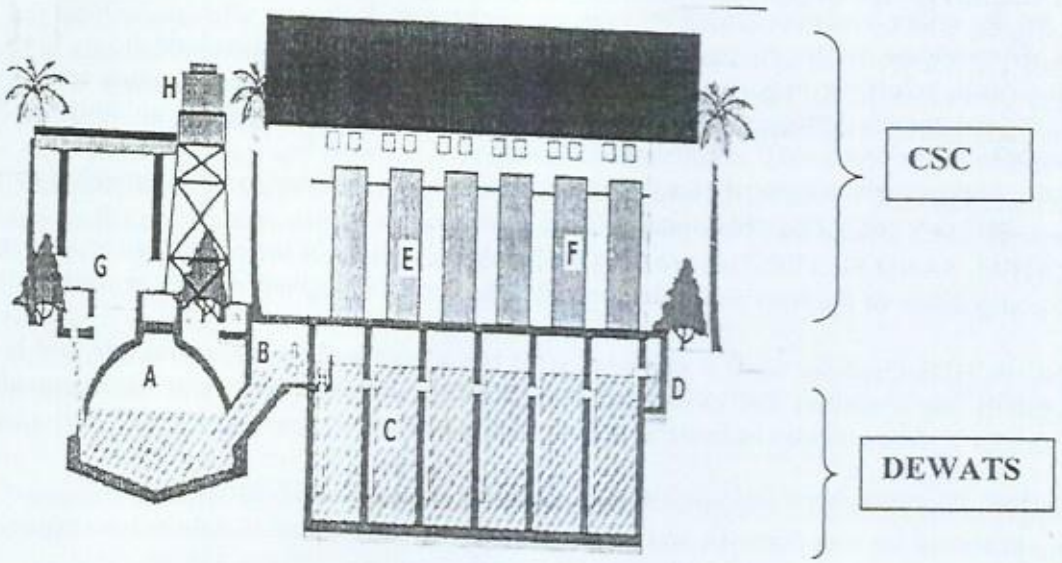
Note:
BOD = Biological Oxygen Demand (5 day)
TSS = Total Suspended Solids
COD = Chemical Oxygen Demand
pH and turbidity were also determined.
pH for both influent and effluent was consistently in the range of 6-7

The DEWATS system is the wastewater treatment component of a sanitation system. There are several methods by which this system can be complemented such as the:-
CBS-Community Based Sanitation:- a system where a community shares sanitation facilities with each other due to reasons of inadequate space or funds for individual sanitary provision. These could be

- Simplified Community Sewerage-where communities share the sewerage treatment plants that are connected to low-maintenance wastewater treatment plants.
- Shared Septic Tank.
- Community Sanitation Centre-where communities share communal services like toilets and bathrooms.

SME-Small and Medium Enterprises:- a system designed for small and medium enterprises to discharge and treat their wastewater in a simple, controlled and in-expensive manner (see diagram 1 & 2 below).

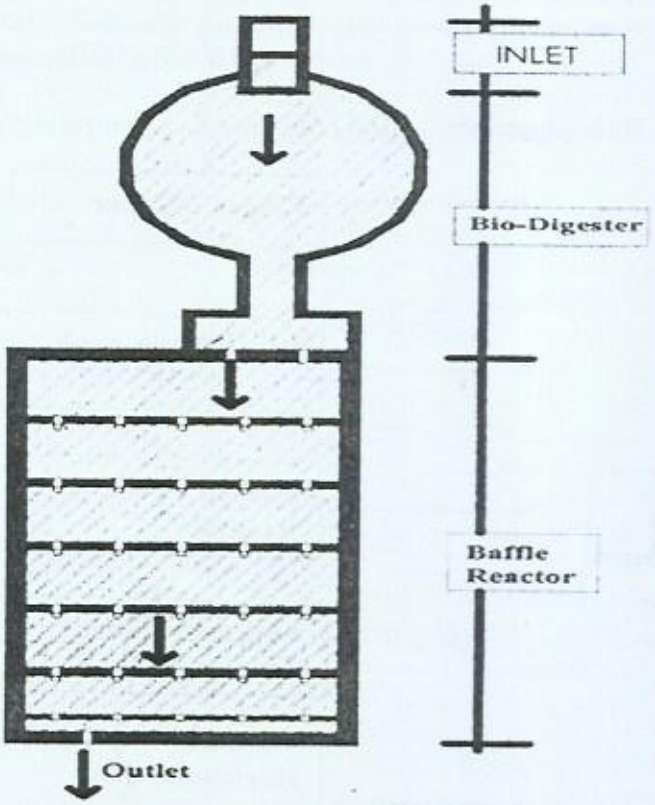
Diagram 1:- Combined DEWATS/CSC System



Legend:-

A-Biogas Digester
B-Sedimentation Chamber
C-Baffle Reactor
D-Outlet
E-Toilets
F-Bathrooms
G-Inlet
H-Water Tank

Diagram 2:- Flow pattern of DEWATS System



A DEWATS-plant consists of several interconnected modules that are adapted to the technical requirements of the construction site. DEWATS-plants are designed to operate continuously without the use of sophisticated machinery and technical energy. Many DEWATS-plants incorporate a biogas module. Biogas technology produces energy from organic waste and wastewater that can be used for cooking purposes.

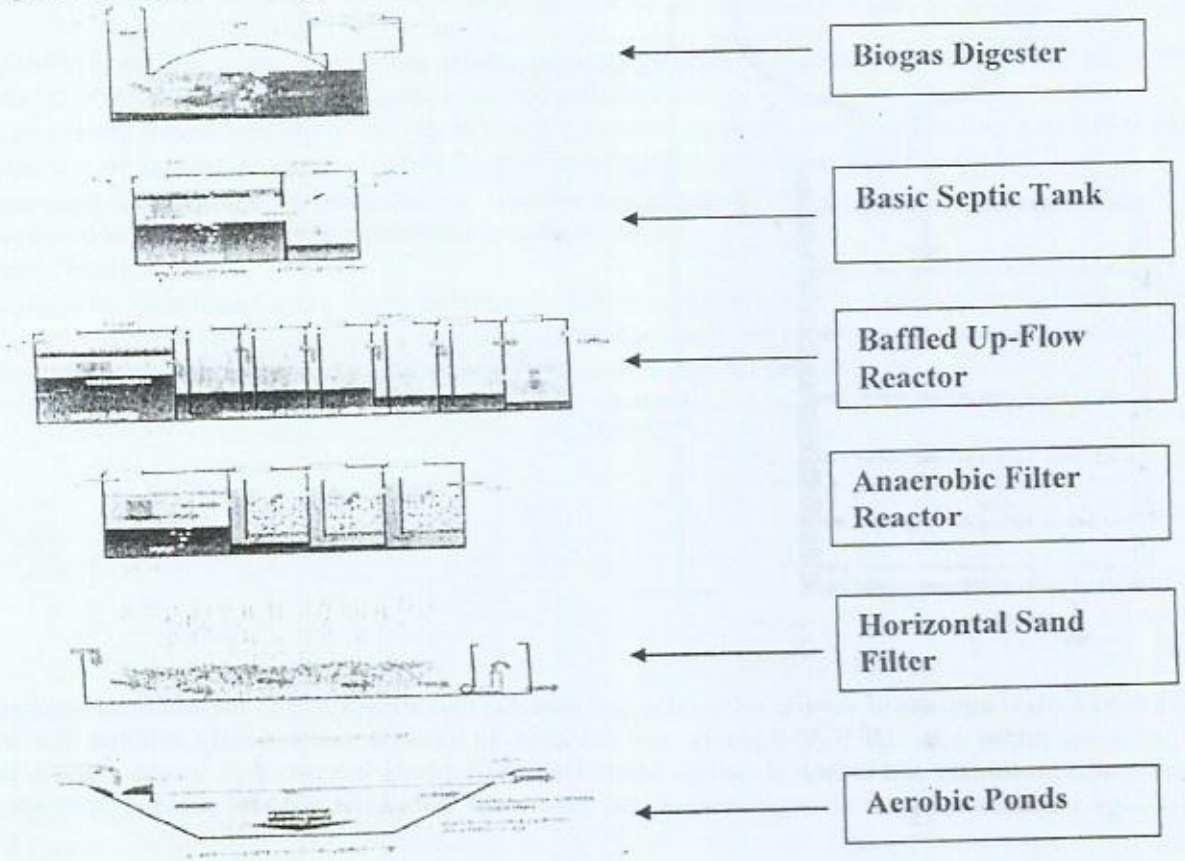
Components of DEWATS System. (see diagram 3)

- BIOGAS DIGESTER-An air-tight plastered fixed dome plant (compound), used as a separate settlement bed for influents with low water content.
- BASIC SEPTIC TANK-Used as the sedimentation tank and sludge stabilization base.
- BAFFLED UP-FLOW REACTOR-Used to direct incoming wastewater to pass through active bacteria sludge in each baffle. The integrated settler design prevents large solids from entering the baffled section.
- ANAEROBIC FILTER REACTOR-Used to direct incoming wastewater to pass through a surplus of active bacterial mass located on filter-material surface.
- HORIZONTAL SAND FILTER-This provides the aerobic treatment of the pre-treated wastewater. The effective composition of the filter substrate allows a reduction of phosphate content in wastewater to up to 80%.
- AEROBIC PONDS-Used for aerobic degradation. It has a high pathogen removal rate and is simply constructed. It has a natural and environmental reliability in its performance, while providing the possibilities for it to be included as landscaping element to beautify the environment.

Some advantages of the DEWATS system over other wastewater treatment systems are:-

- Providing treatment for both domestic and industrial uses.
- Reliable and long lasting application, tolerant of inflow fluctuations.
- Does not require sophisticated maintenance.
- Low maintenance and operation costs.
- Does not allow for ground water pollution.
- Has long de-sludging intervals.
- Compatibility with local construction materials and methods.
- Non-dependence on energy to function.
- Possibility of resource recovery.
- The system blends with the landscape.

Diagram 3:- Schematic Diagram of DEWATS Components



CONCLUSION

The example of Indonesia clearly shows that the concept of decentralized waste management is not only cost effective, but environmentally sound. This system has improved the health and safety of not only the inhabitants but also the environment. That it is an adaptable system implies that it can be customized to suit communities the world over especially the developing world and Africa in particular with its myriad of social and economic problems. Most urban centres in Nigeria, lack centralized sewage treatment systems and where they do exist, they are either broken down or inadequate. The introduction of decentralized sewage treatment systems in these areas would help in no small way to sanitize the environment, ensure a healthy living for the populace as well as curbing the menace of soil and ground water pollution.

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