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Co-Composting of Treated Fecal Sludge with Municipal Wet Waste-A Review

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ABSTRACT : *Co-Composting is the process of composting the organic materials together in specified ratios, turnings and pH here composting of treated faecal sludge with municipal organic waste is taken which helps in recovering of N from faecal sludge and municipal organic waste is rich in organic carbon and moisture content. Co- composting of these two which produces enriched organic fertilizer and reduces the pathogens in faecal sludge during high temperature in Co-composting process.*

Keywords : *Co-composting, Faecal sludge, Municipal wetwaste, Organic Fertilizer*

I. INTRODUCTION

Landfill and incineration have until now been the most widely used means of solid waste disposal throughout the world, the land filling of biodegradable waste is proven to contribute to environmental degradation, mainly through the production of highly polluting leachate and methane gas. Methane constitutes one of the six greenhouse gases responsible for the global warming, which needs to be reduced, in order to tackle climate change under the Kyoto Protocol (UN, 1998). The methane emissions from landfills constitute about 30% of the global anthropogenic emissions of methane to the atmosphere (COM, 1996).

The problems are like hundreds of tones of biodegradable organic waste are being generated in cities and towns in the countries and creating disposal problems. Such as every day, grocery stores discard perishable products such as fruits, vegetables, bread, pastries, milk products, fish, seafood and other frozen products. The concept of recycling waste nutrients and organic matter back to agricultural land is feasible and desirable. Land application represents a cost effective outlet for the producers of compostable wastes and a potential cheap source of organic matter and fertilizer elements for landowners.

Composting is one of the most promising technologies to treat wastes in a more economical way, for many centuries composting has been used as a means of recycling organic matter back into the soil to improve soil structure and fertility. Composting is a natural process that turns organic material into a dark rich substance, this substance called compost is a wonderful conditioner for soil, during composting microorganisms such as bacteria and fungi break down complex organic.

II. EXCRETA CHARACTERISTICS

Excreta are a rich source of organic matter and of inorganic plant nutrients such as nitrogen, phosphorus and potassium. Each day, humans excrete in the order of 30 g of carbon (90 g of organic matter), 10-12 g of nitrogen, 2 g of phosphorus and 3 g of potassium. Most of the organic matter is contained in the faeces, while most of the nitrogen (7080 %) and potassium are contained in urine. Phosphorus is equally distributed between urine and faeces.

Table 1: The Fertilization Equivalent Of Human Excreta.

Nutrient In Kg/Cap/Year	In Urine 500l/Year	In Faeces (50l/Year)	Total	Required For 250 Kg Of Cereals
Nitrogen	4	0.5	4.5	5.6
Phosphorous	0.4	0.2	0.6	0.7
Potassium	0.9	0.3	1.2	1.2
Carbon	2.9	8.8	11.7	

Source: (Drangert 1998).

Table 1 shows that the fertilising equivalent of excreta is, in theory at least, nearly sufficient for a person to grow its own food

III. MUNICIPAL WET WASTE CHARACTERISTICS

The resource potential of mixed municipal solid waste is more variable than for excreta as it depends on the waste composition, which varies considerably from city to city and also among city districts depending on income levels and consumer habits. Low-income countries generate significantly less waste than high- income countries. Cointreau (1985) estimates average municipal solid waste generation (mixed) between 0.4 - 0.6 kg per capita per day in low-income countries, compared to 0.7 – 1.8 kg/cap and day in high-income countries.

Table 2: The fertilization equivalent of municipal solid waste(org.fraction)before waste treatment.

Nutrient	Contribution In Kg/Cap Year
Nitrogen	0.5-1.1
Phosphorous	0.2-0.4
Potassium	0.55
Carbon	16-22

Source: Cointreau (1985)

Table 2. The table shows that municipal organic solid waste although low in nutrients is particularly rich in organic matter can be thus be valued on its soil conditioning potential.

IV. HEALTH RISK RELATED TO EXCRETED PATHOGENS

The agricultural use of excreta or excreta-derived products such as stored or dewatered faecal sludge or co-compost can only result in an actual risk to public health if all of the following occur (WHO 1989):

(a) That either an infective dose of an excreted pathogen reaches the field or pond, or the pathogen (as in the case of schistosomiasis) multiplies in the field or pond to form an infective dose;
(b) That this infective dose reaches a human host;
(c) That this host becomes infected; and
(d) That this infection causes disease or further transmission.

Table 3: Pathogens survival periods in faecal sludge

Organisms	In Temperate Climate (10-15°C) Days	In Tropical Climate (20-30°C) Days
Viruses	<100	<20
Bacteria		
Salemonellae	<100	<30
Cholera	<30	<5
Fecal Coiliforms	<150	<50
Protozoa		
Amoebic Cysts	<30	<15
Helminths		
Ascaris Eggs	2-3 Years	10-12 Months
Tapeworm Eggs	12 Months	6 Months

Source: (after Feachem et.al 1983,strauss 1985 and schwartzbrod J. and L .1994)

Table 3 lists survival periods at ambient temperature in faecal sludges for temperate and tropical climates. Another important factor is the infective dose of a pathogen. It is the dose required to create disease in a human host. For helminths, protozoa (e.g. amoeba) and viruses, the infective dose is low ($< 10^2$). For bacteria, it is medium ($< 10^4$) to high ($> 10^6$).

The epidemiological evidence on the agricultural use of excreta can be stated as follows (Blum and Feachem 1985):

- Crop fertilisation with untreated excreta causes significant excess infection with intestinal nematodes in both consumers and field workers
- Excreta treatment, e.g. through thermophilic composting, extended storage and/or drying, significantly reduces or eliminates the risk of transmission of gastro-intestinal infections.

V. WHY CO-COMPOST FEACAL SLUDGE WITH MUNICIPAL SOLID WASTE?

Co-composting FS and MSW is advantageous because the two materials complement each other. The human waste is relatively high in N content and moisture and the MSW is relatively high in organic carbon (OC)content and has good bulking quality. Furthermore, both these waste materials can be converted into a useful product. High temperatures attained in the composting process are effective in inactivating excreted pathogens contained in the FS and will convert both wastes into a hygienically safe soil conditioner-cum-fertilizer.

VI. COMPOSTING SYSTEMS

Two main types of systems are generally distinguished which are: 1) open systems such as windrows and static piles and 2) closed "in-vessel" systems. In-vessel or "reactor" systems can be static or movable closed structures where aeration and moisture is controlled by mechanical means and often requires an external energy supply. Such systems are usually investment intensive and also more expensive to operate and maintain.
"Open” systems are the ones most frequently used in developing countries. They comprise:

- Windrow, heap or pile composting

The material is piled up in heaps or elongated heaps (called windrows). The size of the heaps ensure sufficient heat generation and aeration is ensured by addition of bulky materials, passive or active ventilation or regular turning. Systems with active aeration by blowers are usually referred to as forced aeration systems and when heaps are seldom turned they are referred to as static piles. Leachate control is provided by a sloped and sealed or impervious composting pads (the surface where the heaps are located) with a surrounding drainage system.

- Bin composting

Compared to windrow systems, bin systems are contained by a constructed structure on three or all four sides of the pile. The advantage of this containment is a more efficient use of space. Raw material is filled into these wood, brick or mesh compartments and aeration systems used, are similar to those of the above described windrow systems.

- Trench and pit composting

Trench and pit systems are characterised by heaps which are partly or fully contained under the soil surface. Structuring the heap with bulky material or turning is usually the choice for best aeration, although turning can be cumbersome when the heap is in a deep pit. Leachate control is difficult in trench or pit composting.

VII. KEY FACTORS OF THE COMPOSTING PROCESS

The key factors affecting the biological decomposition processes and/or the resulting compost quality are listed below. They comprise:

- Carbon to nitrogen ratio
- Moisture content
- Oxygen supply, aeration
- Particle size
- PH
- Temperature
- Turning frequency
- Microorganisms and invertebrates
- Control of pathogens
- Degree of decomposition
- Nitrogen conservation

VIII. PHASES OF COMPOSTING

1. Mesophilic phase
2. Thermophilic phase
3. Cooling phase
4. Maturing phase (Yvette B.2000).

IX. COMPOST QUALITY

Compost quality is measured by several criteria, including the following:

1. Moisture Content.
2. Nutrient Content.
3. Heavy Metal.
4. Particle Size Distribution
5. Stability.
6. Pathogen Levels.
7. Product Consistency over Time. (James, 2008)

X. BENEFITS OF USING COMPOST ON SOIL

The Composting Council (2000) summarises the benefits of compost as follows:

Improves soil structure, porosity and density thus creating a better plant root environment.
- Increases infiltration and permeability of heavy soils, thus reducing erosion and runoff.
- Improves water holding capacity thus reducing water loss and leaching in sandy soils.
- Supplies a variety of macro and micronutrients.
- May control or suppress certain soil borne plant pathogens.
- Supplies significant quantities of organic matter.
- Improves cation exchange capacities of soils and growing meadia thus proving their ability to hold nutrient for plantl use.
- Supplies beneficial microorganisms to soil and growing media.
- Improves and stabilises soil pH.
- Can bind and degrade specific pollutants.

XI. CONCLUSION

Co-composting of treated faecal sludge with municipal wet waste enables to recovering of nitrogen phosphorous and potassium from excreta and organic waste there by reducing the landfills and ground water contamination by leachate and composting helps in recycling i.e which can be used as manure in agriculture thus reducing the risk of direct exposure to pathogens by usage of untreated fecal sudge on agricultural lands and increasing the soil condition for agriculture there by creating healthy surrounding environment.

REFERENCES

[1]. Cointreau, S. J., Gunnerson, Ch. G., Huls, J. M., Seldman, N. N. Integrated Resource Recovery: Recycling from Municipal Refuse: A State-of-the-Art Review and Annotated Bibliography. (UNDP Project Management Report No. 1.), The World Bank Washington & UNDP, Washington. (1985).
[2]. Drangert, J.O. Fighting the Urine Blindness to Provide More Sanitation Options. Water South Africa, (1998). Vol. 24, No. 2.
[3]. Long, F.L., Lund, Z.F., & Hermanson, R.E. Effect of soil incorporated dairy cattle manure on runoff water quality and soil properties. Journal of Environmental Quality, (1975). 4, 163-166.
[4]. Strauss, M. Health Aspects of Nightsoil and Sludge Use in Agriculture and Aquaculture - Part II. Pathogen Survival. International (1985).
[5]. Strauss, M., Heinss, U., Montangero, A. (2000). On-Site Sanitation: When the Pits are Full – Planning for Resource Protection in Faecal Sludge Management. In: Proceedings, Int. Conference, Bad Elster, 20-24 Nov. 1998.
[6]. Yvette B. Guanzon, Robert J. Holmer, Composting of Organic Wastes: A Main Component for Successful Integrated Solid Waste Management in Philippine Cities. (2000).