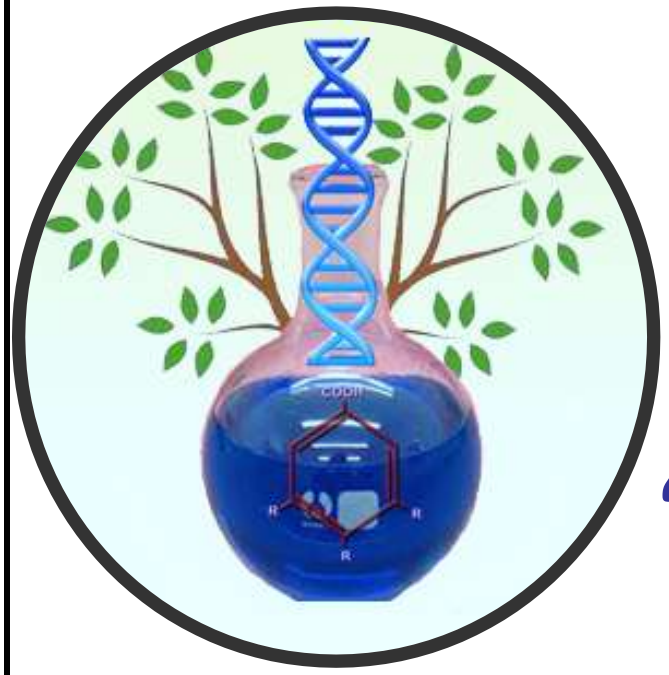

SUSTAINABLE RESOURCE (MSW) MANAGEMENT "THE BIOLOGICAL WAY"

KETAN MEHTA
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3rd International Brainstorming Workshop on

"Sustainable Municipal Solid Waste Management in India"

Waste to Energy Research & Technology Council (WTERT), India.

29 – 30 January 2015, Hyderabad, India.

STRUCTURE OF PRESENTATION

- Food Production / Productivity – Food Security Challenges
- Soil Health
- Aerobic Composting - Basics
- Odour Management & Speed Composting - Treatment at

Collection Sites

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CLEAN INDIA CAMPAIGN - BUZZWORDS

SUSTAINABLE DEVELOPMENT

CLIMATE CHANGE

FOOD, FUEL & WATER SECURITY

RESOURCE MANAGEMENT

INTEGRATED CROP NUTRITION

SOIL HEALTH

FOOD SAFETY

BIO-FUELS

WASTE 2 WEALTH

ORGANIC FOOD

CARBON CREDITS

CARBON FOOTPRINT

PRODUCT STEWARDSHIP

GREEN CHEMISTRY

RENEWABLE ENERGY

BIOTECHNOLOGY

SEGREGATION AT SOURCE

POLLUTER PAYS

WASTE/RESOURCE AGGREGATORS

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World Average Yields of Major Crops – Cereals, Pulses, Oilseeds

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The 2030 Challenge for INDIA

Change in Food Consumption Patterns in Developing Countries – (UN - FAO)

- Rice will Decrease
- Wheat will Increase
- Coarse Cereals No Change
- **Pulses No Change**
- Sugar will Increase
- Fruits will Increase
- Oilseeds/ Vegetable Oils will Increase Geometrically
- Meat will Increase Geometrically
- Dairy will Increase Geometrically

FAO estimates that in order for South Asia to avoid a Food Crisis:

Wheat Yields will have to increase by 28%

Rice Yields will have to increase by 23%

Pulses Yields will have to increase by 52%

Oilseeds Yields will have to increase by 48%

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A NATION THAT DESTROYS ITS SOILS, DESTROYS ITSELF.

- Franklin D. Roosevelt

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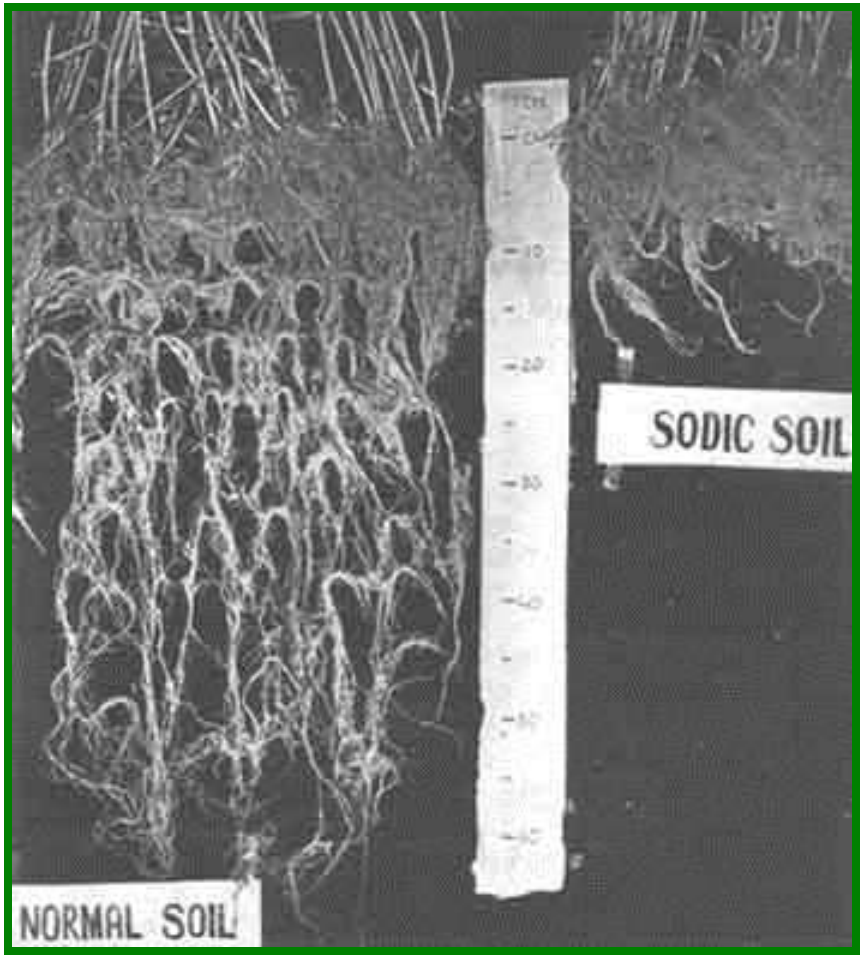
FAO EXPERIMENT ROOT DEVELOPMENT- ’92 -Punjab



Ideal Characteristics for Agricultural Soils

Parameter	Value
Organic Carbon	0.5 – 0.75 %
Available Nitrogen	280 – 560 Kg/ha
Available Phosphorus	10 – 25 Kg/ha
Available Potassium	110 – 280 Kg/ha
pH	6.0 – 8.5
Electrical Conductivity	1 – 3

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Nutrient Deficiency in Indian Soils

Nitrogen : 63 % were Low, 26 % Medium, 11 % High

Phosphorus : 42 % Low, 38 % Medium, 20 % High.

Potassium : 13 % Low, 37 % Medium, 50 % High.

Organic Carbon : 29 % Low, 51 % Medium, 20 % High

Sample Size : 3.65 Million Soil Samples (NPK), 35,000 Soil Samples (OC).

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Some How to Suggestions

- India has 13.42 million Ha of Cultivable Waste Lands as of 2010.
- Improve Soil Health/ Productivity of these Lands – Use City Compost.
- Supplement use of Chemical Fertilizers with Biological Fertilizers.
- Provide Quality GM Seeds with Desirable Traits like Drought Tolerance, Disease Resistance, Nitrogen Fixation,
- World-class Seed Care using Bio-Controls.
- Use Bio-Technology to provide effective Low A.I. Dose Products.

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Avg. Composition of MSW in Semi-Urban India (100 MT/day)

Ingredient	Percentage
Paper	6.4%
Plastic	11%
Metals	0.35%
Cotton	0.98%
Rubber	0.78%
Glass	2.80%
Wood	3.27%
Moisture	0.91%
Organic/ Biodegradable	73.6%

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AEROBIC COMPOSTING - BASICS

- Biological decomposition of the biodegradable organic fraction of MSW under controlled conditions, to a stable state, for hazard-free storage, handling, transportation and safe use on land.
- Air exchange is a must.
- Volume reduction of upto 50%, whilst consuming about 50% organic mass (dry wt.), by releasing mainly CO_2 and Water.
- Break down of easily bio-degradable plant/ animal tissues.
- Composting cannot break down difficult Organics (like wood, leather, polymers) and Inorganics (like dirt, glass, ceramics & metals).

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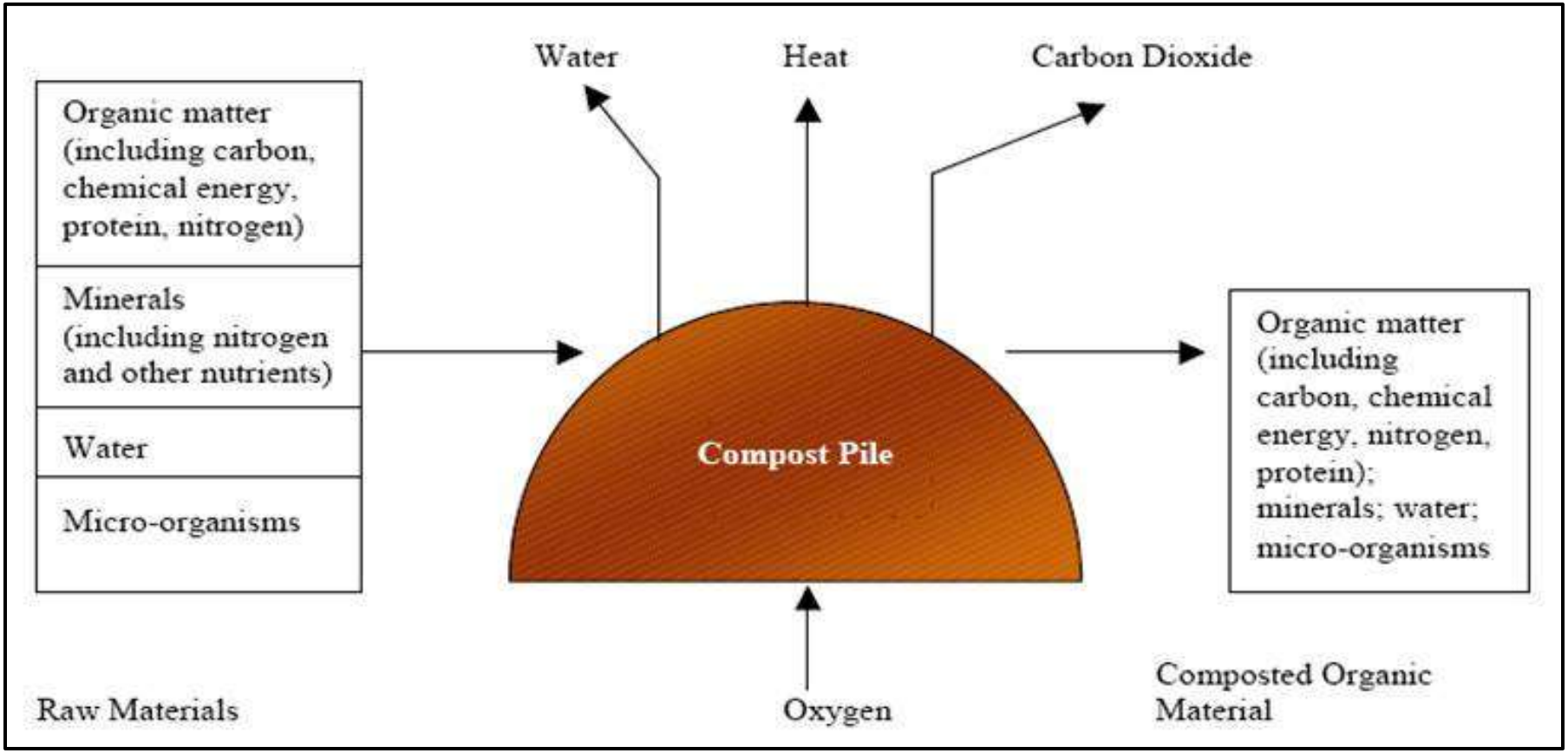
COMPOST PILE SCIENCE & OPERATION

Oxygen	Temperature	Moisture	pH
C:N Ratio	Odour	Colour	Stability



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Advantages of Composting

- Sustainable & Renewable Process (Recyle)
- Utilizing Dump Sites (Land Resources)
- Toxic Leachates (Reduce)
- Methane Gas Emission (Reduce)
- Effective Resource Management (Reuse)
- Agricultural Soil Enrichment (Resource)
- Rag-Pickers (Human Resource)

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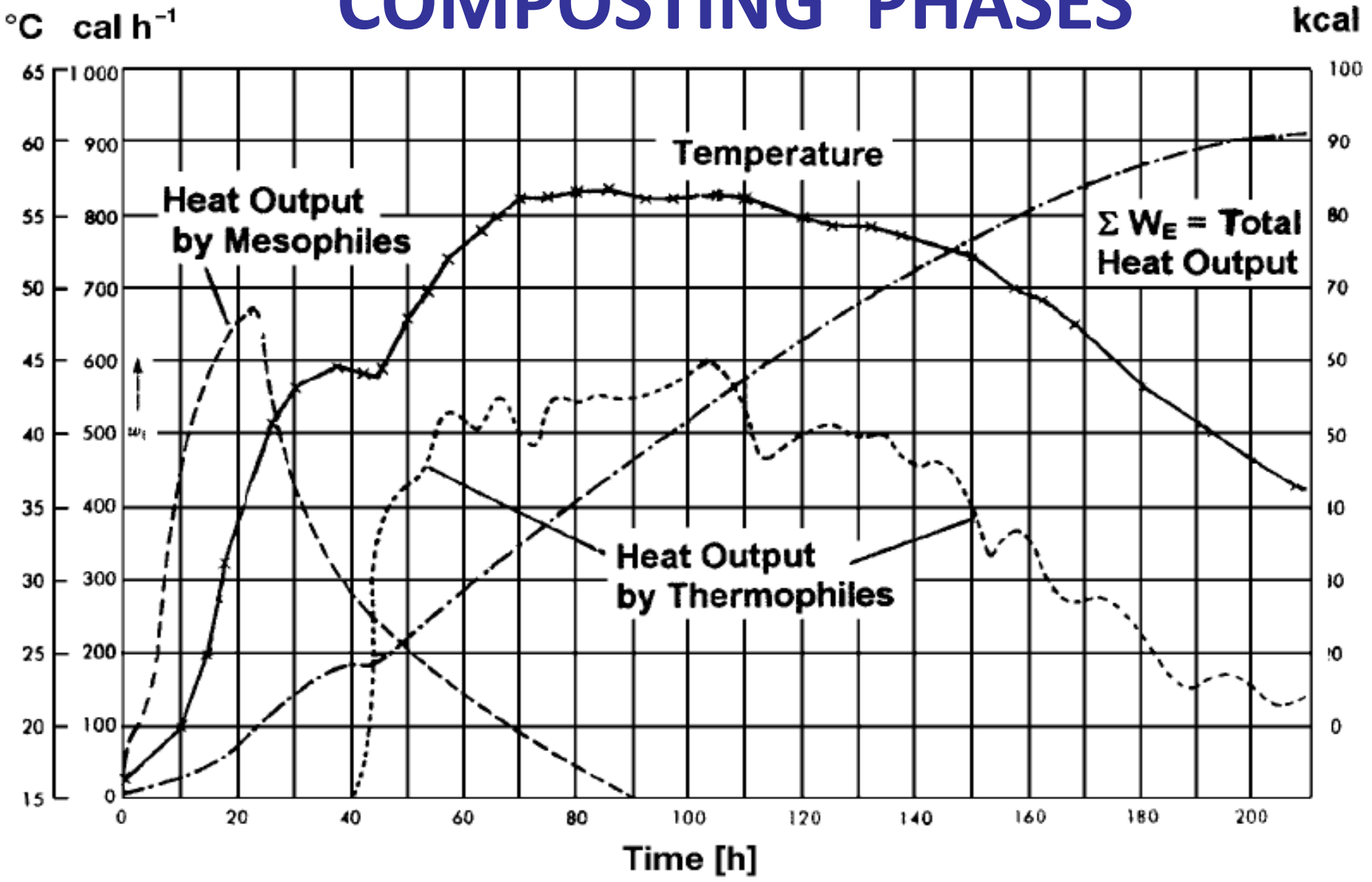
COMPOSTING PHASES



Temperature course during the composting of urban garbage: four phases, *mesophilic, thermophilic, stationary, and maturation*.

COMPOSTING PHASE – 1 : *Lag*

- Diverse population of ***"mesophilic"*** bacteria and fungi proliferate in the piles.
- Degradation of solubles & readily degradable compounds takes place.
- Temperature rises to about 45^0C.
- At this point their activities cease, the vegetative cells and hyphae die
- Eventually lyses and only heat resistant spores survive.

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COMPOSTING PHASE – 2 : *Active*

- After a short lag period then a second phase of a steep rise of temperature.
- In this phase ***"thermophilic"*** microbial population develops: mainly, actinomycetes, bacteria and fungi.
- These microbes thrive at temperatures of 50-65^{0}C.
- Activity of these microbes terminates at 70-80^{0}C.

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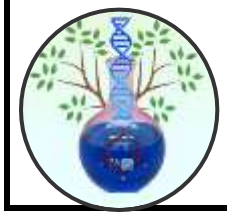
COMPOSTING PHASE – 3 : *Plateau/ Stationary*

- This is a stationary period with no major change in temperature.
- Microbial heat production and heat dissipation are now balanced.
- The microbial population continues to consist of *"thermophilic" bacteria*, *actinomycets* and *fungi*.
- Many plant and human pathogenic microbes are destroyed.
- Temperatures over about 65^0C, kill many forms of microbes and limit the rate of decomposition.
- During thermophilic phase, high temperatures accelerate the breakdown of Proteins, Fats and complex Carbohydrates like cellulose and hemicellulose.



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COMPOSTING PHASE – 4 : *Maturation/ Curing*

- This is a gradual decline in temperature.
- This is the “maturation phase” of composting process
- *“Mesophilic”* microbes survive the high temperature phase and invade the cooling down material from the outside,
- *“Thermophiles”* are replaced by *“Mesophiles”*, the degradation process extends as far as it is intended, to the remaining organic matter.

THE BIOLOGY OF COMPOSTING

- The process of biochemical conversion is done by *"mesophilic"* and *"thermophilic"* microbes.
- The organisms that are actively involved in composting can be classified in to 6 (Six) broad groups :-
    - i) Bacteria
    - ii) Actinomycetes
    - iii) Fungi
    - iv) Protozoa
    - v) Worms
    - vi) Larvae

TREATMENT AT COLLECTION SITE - GOALS

- Reduction in foul odour at compactor site.
- Reduction in waste volume post treatment.
- Decrease in bulk density of treated waste.
- Softening of the material post treatment.
- Rise in Temperature upto 60 – 70 ^{o} C.
- Waste changes Colour to Blackish–Brown.

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GOALS ACHIEVED

Odour Reduction :

Even at Deonar dump yard, the most important observation was, there was no foul smell emanating from the treated waste, this was reported & realised by the drivers and duty officers.

Volume Reduction :

Compactor carrying volume increased by 50%.

Decrease in Bulk Density of Treated Waste :

Bulk density Before : 0.6108 gm/ml. After : 0.7449 gm/ml.

Softening of Garbage :

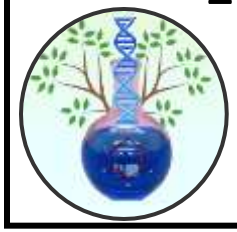
Sample of material unloaded at Deonar, had softened within 18 hrs.

Rise in Temperature :

Before treatment – temperature range was 29-34^{o}C.

1 Hour after treatment – temperature range was 31-40^{o}C.

16 Hours after treatment - temperature range was 40-50^{o}C.



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SAVINGS ACHIEVED

- Man-hours by Bio-conversion of MSW to organic manure.
- Man power i.e., no. of people involved in Bio-conversion process.
- Quantity of Inoculum/ Microbes used for Bio-conversion.
- Transportation cost of the compactor lesser no. of trips.
- Treatment @ Collection site -Resource Opimitzation (human/money)
- Dump Site Land Requirement – Increased Efficiency of Resources.
- Rag-Pickers are not be exposed to harmful pathogens.
- Methane generation is reduced, carbon credits, fire hazard lowered.

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COMPOST – A SUPPLEMENT TO CHEMICAL FERTILISERS

- Aids Plant uptake of Nutrients like Nitrogen, Phosphorus & Potassium.
- Increase the yield by 20-25 % when supplemented with Chemical Fertilisers.
- Average Cost-Benefit Ratio for Cereals (Paddy/ Wheat) is 10.
- Economical to the farmer.
- Enhances Root Development, Vegetative Growth and Flowering, (auxins, vitamins & hormones).
- Improves soil health & productivity & survival of beneficial Soil microbes.
- Environmental friendly, Renewable source of Nutrients.
- Reduces Carbon Footprint.
- Major Earnings via Carbon Credits

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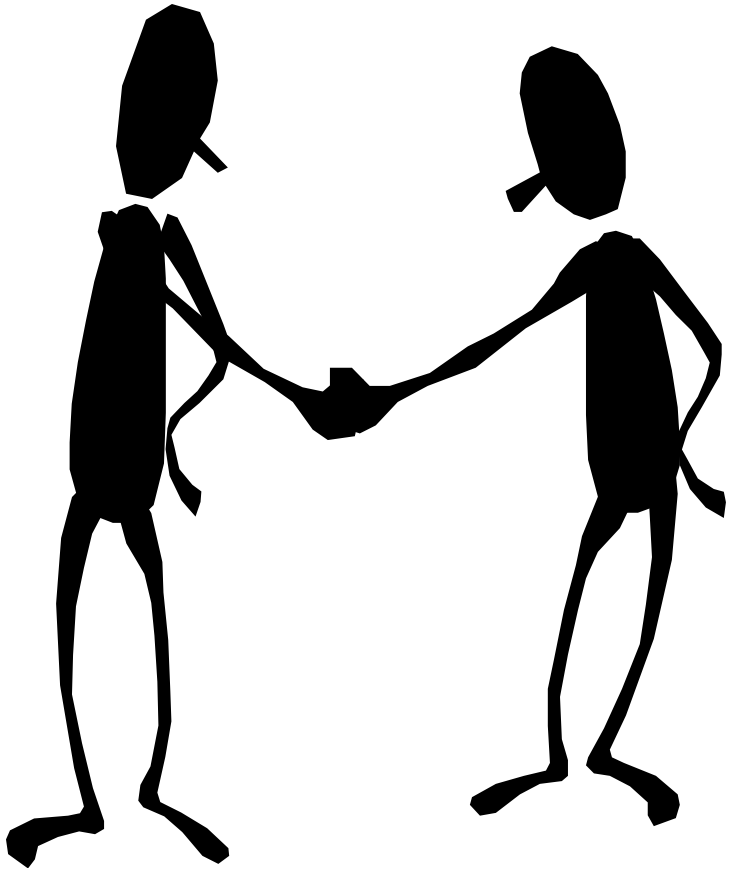

Thank You

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