



INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 6.078

(Volume 6, Issue 5)

Available online at: www.ijariit.com

Energy recovery from solid waste and sustainable leachate treatment at waste-processing units

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ABSTRACT

Bruhat Bengaluru Mahanagara Palike (BBMP) Bngalore to set up leachate treatment plants at two waste processing units - Kannahalli on Magadi Road and Chikkanagamangala near Anekal taluk. The treatment plants, once set up, removes ammonia and other contaminants from the leachate, formed when the rainwater mixes with waste. We observed that "Leachate is dangerous and can deter vegetation on the land. BBMP officials took a decision to set up plants to get rid of leachate and save the soil which it gets mixed with. The treated effluent can be utilised in many ways like washing, industries among others." The civic agency will send the proposal to the Urban Development Department and once approved, it taken up by the empowered SWM panel set up by the Palike.

Keywords: BBMP, solid waste, Leachate, sustainability

1. INTRODUCTION

It was observed that each plant has adopted more or less similar (Composting & RDF) technology and MSW is being transported by BBMP to the new plants on trial basis. So far, each plant is receiving only 100 to 150 MT of MSW at their plant premises and it is expected to take at least 2-3 months for these plants to process waste at their maximum potential. To ensure reliable operation of these six MSW processing units, operators with previous experience of successfully running MSW plants were been selected through tendering process. Payment agreement with the operators was made on the basis of support fee to be paid for the by-products, which the processing units will generate. The new plants are linked to the different zones of BBMP, to minimise transportation cost and also waste from the respective zones will feed to the processing units. In order to ensure smooth running of these units, the government has ordered escrow accounts to be opened (maintained by BBMP) and the support fee to be paid for the by-products, which the processing units will generate. The six plants, which are catering one of essential service for BBMP, will be closely monitored to ensure that they function as per the required objectives and environmental regulations. Detailed action plan has been drawn for periodic maintenance, regular up-gradation and troubleshooting problems.

SWM PLANTS-PLANT & EQUIPMENT-CHIKKANAGAMANGALA (500 TPD)

WORKING CONDITION	WORKING	IDLE
AMC	EXISTING	LAPSED
INSURANCE	EXISTING	NO INSURANCE

All staff, plant facilities and utilities are provided



2. CHIKKANAGAMANGALA PLANT

Our expert group visited at 12 pm to Municipals Solid Waste Processing Facility was 88.99 sq. m capacity of 15 TPH of two lines. This plant equipped with 35mm and 16 mm trommels for secondary segregation composted material. In the plant also Installed air density separators for segregation of light combustible materials and multiport distribution to conveyor to distribute material in to designated silos for curing. Plant is also equipped with 4 mm trommel magnetic separator and de-stoner. Final screened material transported to the designated storage area. Fine compost from refinement section will be stored and packed for selling to farmers. Unfortunately, all work stopped at plant as there was management problem.



The RDF stored at front side of the plant was engulfed by fire since two days. 20 to 30 tones of RDF and dry garbage was burning with smoke. Previous day they douse it by fire engine. When expert visited to the spot we removed few layers of garbage and douse it and douse fire balls. Inside the plant windrows pads were also about to catch fire for precautionary step they poured water to not catch fire. RDF was stored in plant B and almost 40 to 50 tons burnt and ashes were found.

Expert committee observed that lack of staff and management of plant. Expert were also thinking form one separate corporation to garbage management in Bangalore and checks and balance should be there.

To add to the garbage woes, the Chikkanagamangala plant is not functioning effectively and its efficiency had reduced to a mere 16 per cent. The BBMP has slapped a notice against the Morgan Solid Waste company holding Limited, which is running a waste processing plant at Chikkanagamangala for not adhering to standard operating procedure (SOP) and also for causing unrest among

citizens in the city and in areas surrounding the processing plant. After the notice, the company has partially complied with the SOP and rules. But failure on their part to follow the rules completely has created problems with the BBMP at other plants too. A written compliance report has been sought and a meeting arranged with the higher-ups of the company to ensure such lapses don't recur. A notice issued from the office of BBMP stated that although the plant has been running for the last five months with the capacity to process 500 Metric Tonnes (MT) per day, the plant was processing only 83 MT, which is a mere 16.6 per cent of the capacity of the plant.

Not following the instructions of the BBMP has resulted in protests from the surrounding villagers, for which the BBMP had to take unnecessary blame from the public for no fault of the BBMP. The villagers have been complaining that the leachate generated is being disposed into the quarry pit in the plant, which is leading to contamination of ground water, causing unbearable stench and making life miserable. The operating system has become bad and this cannot be tolerated. Repeated inspections by the Experts and BBMP officials have proved that the plant is either short- staffed or despite the direction to post adequate manpower for the effective functioning of the plant in shifts, this is not being done. There are days when compactors are left outside the plant overnight and as few as just 10 workers, working at the plant. This shows that the plant run by Morgan SWM company is not functioning as per the agreement, the notice stated

SWM PLANTS-PLANT & EQUIPMENT –LINGADEERANAHALLI (200 TPD)

WORKING CONDITION	WORKING	IDLE
	16TPD	
AMC	EXISTING	LAPSED
INSURANCE	EXISTING	NO INSURANCE



3. LINGADHEERANAHALLI PLANT

At 3 pm expert team visited plant. This plant objectives were to establish an efficient effective Municipal Solid Waste treatment compost with MSW rules. The ultimate goal of this plant is Maximum resource recovery from MSW compost RDF and recyclable reduced land filling in closed shed and pit system for waste receiving. This plant was equipped with transfer of material by chain belt conveyors. And also equipped with segregation by trommel air density separators aerobic composting in windrow platform and reversible conveyors to avoid spillage. This plant supported Shredders and bailers for better quality of RDF and de-stoners and magnetic separators for better quality compost were managed in this plant. Till these days plant was not running because stay was there in Supreme court and plant was not functioning and no production of compost. Problems from neighbors about smell and odor and adjacent to plant Banashankari BDA layout is there. This was opened ten days back and case was there in Supreme court and stay vacated ten days back. Work now started in the plant run by IL&FS, trucks were transferring RDF to Vaadi Cement factory near Gulbarga. Each truck ten wheelers were carrying about ten to twelve tones. Plant was filled with dray waste since non function of plant and RDF was stored were disposing by vehicles.

The plot area is nine acres at RR Nagar Zone and capacity was 200 tons per day. For other facilities this plant is equipped with laboratory for development of inoculum and quality tests and MSW byproducts and multiple layers of plant for improved environment esthetics. For cleaning and regular maintenance of vehicles and installed high mast lamps effective lightning. Protected by all around the shed to prevent fire accident with fire hydrant system. They made provisions for installation of solar panels to harvest solar energy. For effective and efficient monitoring CCTC s installed. RWH also built for waste conservation.



SWM PLANTS-PLANT & EQUIPMENT –SUBBARANAPALAYA

WORKING CONDITION	WORKING	IDLE
AMC	EXISTING	LAPSED
INSURANCE	EXISTING	NO INSURANCE

4. SUBBARAYANAPLYA PLANT

Plant was not functioning because plant was initially run by Morgan. His contract was terminated one year back stopped in July 2016. Since then functioning of plant was stopped. Huge RDF was filed up in the plant shredded and bailed out. Almost thirty staff working in the plant. Fully dried 200mm to 4 mm compost was stocked in the plant. No power supply was there in the plant. Plant staff complaining notorious people problem. Trespassers also entered into the plant by broken wall. If old stock goes then only this plant receives fresh garbage. No CCTVs installed, fire hydrant system completely collapsed, electrical wires and boxes were corroded.



SWM PLANTS-OPERATIONS-COMPOST



Composting: Pure wet waste from the city residences can be taken by farmers, however the wet waste collected from BBMP is not fully segregated and not pure, hence farmers may not be interested to take it. Plastic content in wet waste renders it ineligible for composting. During experts tour to waste processing units looked after by IL&FS - Seegehalli, Kannahalli - the manager of IL&FS had said that segregated wet and dry waste was accepted and processed separately at the plants. When asked about this not happening in the waste processing units,: “These units were basically for processing mixed waste. BBMP wanted to propagate waste segregation and process only wet waste in the new units. But segregation is not picking up yet. Therefore, mixed waste too is processed in the new plants. BBMP will improve the functioning pattern of these plants by implementing odour controlling mechanisms.” BBMP implementing strict odour control in the plants processing mixed waste. However, the people residing near the infamous Karnataka Compost Development Corporation (KCDC) unit at Kudlu Gate near H S R Layout can vouch for the hollowness of such promises. Bio-filter (odour control mechanism) which the BBMP had installed at KCDC unit long back, but not functioning yet. “BBMP has given deadline after deadline from the BBMP on implementing odour control system in KCDC plant. But the system is not operational yet and BBMP continue to suffer from the stench emanating from the plant,” protest by HSR Layout residents in last November, asking for the closure of KCDC. Yes, bio-filter system had installed at KCDC now. The contractor has unnecessarily delayed in installing the system,”



Marketing of compost is a major concern for these operators. Most of the plants are facing a problem of marketing the compost due to an ineffective marketing mechanism. Lack of awareness among the neighborhood farmers in above mentioned seven plants

farmers regarding the benefits of using compost is an impediment to its sale. Also, there is a need to market the product near the compost site to minimize transportation cost.



SWM PLANTS-OPERATIONS-LEACHATE

- Presently Leachate is sent to BWSSB
- To set up the Leachate Treatment Plant (LTP) – RR Nagar Location approved, Work order to be issued

BBMP to set up leachate treatment plants at waste-processing units

Bruhat Bengaluru Mahanagara Palike (BBMP) is planning to set up leachate treatment plants at two waste processing units - Kannahalli on Magadi Road and Chikkanagamangala near Anekal taluk. The treatment plants, once set up, will remove ammonia and other contaminants from the leachate, formed when the rainwater mixes with waste. We observed that "Leachate is dangerous and can deter vegetation on the land. BBMP officials took a decision to set up plants to get rid of leachate and save the soil which it gets mixed with. The treated effluent can be utilised in many ways like washing, industries among others." The civic agency will send the proposal to the Urban Development Department and once approved, it will be taken up by the empowered SWM panel set up by the Palike..During the expert visit to plants, BBMP need to set up CCTVs with Internet facility at all plants was felt. Washing of compactors after every disposal was also recommended. disposal of temporary leachate of each plant at five locations. BBMP approached the Bangalore Water Supply and Sewerage Board (BWSSB) for permission for disposing of the leachate. "To start off with BBMP started at Kannahalli and Chikkanagamangala. BBMP will set up leachate plants at other units in a phased manner," Localities were also complaining about "Presently, leachate flows into shoulder drains from the garbage processing unit. BBMP expect little help from the civic agency. It is to be seen whether the leachate plant will be a success or not." In a first-of-its-kind initiative, the Bruhat Bengaluru Mahanagara Palike (BBMP) is planning to set up leachate treatment plants at two waste processing units - Kannahalli on Magadi Road and Chikkanagamangala near Anekal taluk.





Odour management and groundwater contamination control remains the biggest challenge in mixed waste management plants.

5. INCINERATION NOT NEEDED

Bengaluru does not need this technology. If segregation and recycling is implemented effectively, composting and recycling of the entire volume of garbage will be possible. At present, the city has a processing capacity of about 2,000 tonnes, which meets close to half of its requirements. Once the new garbage collection contracts are issued, the volume of non-biodegradable waste available for incineration will also reduce. "The disposal of non-biodegradable waste will be left to the communities who will manage it through the city's 175 dry-waste collection centers. This will reduce the volume of dry and mixed waste. In such a scenario, the city will not have enough dry waste for the proposed incineration plants.

Viability and safety

Incineration technologies have a high potential for pollution. Burning chlorinated plastics such as PVC releases toxic dioxins and furans into the atmosphere. Experts observed that monitoring these toxins is expensive, and no pollution control board in the country is equipped to do it. "Unless CPCB sets standards, and all state pollution control boards are ready, nothing can justify going ahead with incineration plants."

Besides, there are fears over the design of the proposed incineration plants. Experts opined that its technology involves temperatures ranging from 2500C to 1,1000C, which is not enough. "The temperature at which garbage is incinerated should be at least 1,6000C to ensure environment safety,". Experts believe that instead of obsessing over incinerators, BBMP should invest in composting.

Expert team felt planning should have initiated an information and education program early in the plan formulation stages, and the public information plan should continue through implementation of the entire plan. Print and electronic media can play vital role in creating awareness and educating the public. News releases, films, articles, and speakers, for example, can help develop public awareness and aid in approval of solid waste management plans and programs and provide jobs for local villagers to curb problems from neighbor villagers.

Water quality monitoring / ambient air quality monitoring

The BBMP and KSPCB is monitoring the water quality of leachate and ambient air quality from the regional officers as per MSW Rules, 2000. The compilation of the analysis report indicates that water quality in the adjacent bore wells are contaminated around certain landfill sites.

The ambient air quality monitoring conducted by the Board indicates that, there is no significant change in the air quality except for odour/smell. However, Birds and animal nuisance are continued to be the common problems in all the local bodies. Now, the KSPCB has proposed priority action to insist all the local bodies to start the processing activity and scientific disposal in all the places. The integrated facility with land filling are the major concern for these monitoring in future. There are some public protest against the establishment of sites in their areas, which may be due to the political reason or maybe due to the experience of maintenance of existing landfill sites by the BBMP/local bodies.

Action Plan to be insisted for BBMP to adopt the following issues

6. ADMINISTRATIVE ISSUES

- Environmental Engineers/Scientists shall be compulsorily posted to all the local bodies in BBMP area and four in each of the BBMP zone to understand and comply with the provisions of water act and air act for environmental protection act and rules amended from time to time.

- b) Public Complaint Redressal committee shall be established for all the plants, Landfill Sites/Water Bodies consisting of local Panchayath members, NGO, officers of the local body and the KSPCB representative to involve the local residence in the monitoring and operations of such processing plants.
- c) All Environmental engineers/scientist and chief officers shall attend the training programmes at least twice in a year conducted by central/state regulatory authorities and administrative authorities to upgrade the knowledge on the technical and legal aspects.

Mandatory segregation of solid waste at source by Citizens to reduce RDF in plants

Bengaluru city produces about 3500 tons of Solid waste every day. The Collection of waste, street sweeping, transportation & disposal of waste has to be done as per MSW Rules 2000. In the past as the waste was not segregated at source, the mixed waste was disposed in the processing units which couldn't be processed completely, the situation worsened in 2012 when the people of surrounding villages strongly protested against improper management. As scientifically processing of the mixed waste is very difficult, management of waste in the jurisdiction of BBMP has become very complex. Hence source segregation is more stressed upon and the public has been asked to segregate the waste at source. In this direction many awareness programme has been conducted. In order to process/reuse the segregated wet & dry waste 13

Bio-methanization units, 189 dry waste collection centers (minimum 1 dry waste collection unit per ward) have been established. Except M/s Terra-Pharma & M/s M.S.G.P processing plants where in mixed waste is being processed, the other plants viz K.C.D.C, Mavallipura and newly established 6 plants of BBMP are accepting only segregated waste. Hence it becomes necessary to segregate at source for scientific processing in these plants

As the problem of waste disposal can be solved only by segregating the waste at source, proper collection and scientific management citizens are required to compulsorily segregate the waste at the household level and at commercial establishment into wet, dry and domestic hazardous wastes (Bio & Sanitary). BBMP here by mandate on source segregation, citizen are requested to join hands with BBMP and segregate the waste at the source by keeping segregated wet waste in Green Bins, dry waste in Blue bins and harmful waste in Red bins. Otherwise, as per the KMC amendment act 2013 the imposition of fines will be intensified.

S no.	Wet Waste	Dry Waste	Domestic Hazardous wastes (Bio & Sanitary Waste)
1	Vegetables, Fruits, Fruit peel, Tea powder, Coffee Powder, Flowers, Match sticks, Hair, Food, Cereals & other compostable wastes	Plastic: Bags, Dolls, Bottles, Milk Covers Paper: Cotton boxes, Plates, Newspapers, Packing materials. Metal: Cans, Bottle Caps, Tetrapacks Others: Thermocol, Styrofoam, Batteries, Bulbs, Tube lights, CD's, DVDs, Cassettes etc.,	Diapers, Syringe, Blade, Buds, Bandages, Napkins, expired medicines, Animal bones, etc., BBMP here by mandate on source segregation, citizen are requested to join hands with BBMP and segregate the waste at the source by keeping segregated wet waste in Green Bins, dry waste in Blue bins and harmful waste in Red bins. Otherwise, as per the KMC amendment act 2013 the imposition of fines will be intensified.

SL	Name of the processing unit	Technology Adopted
1	KCDC (Karnataka Compost Development Corporation Ltd.), Sy. No.39, 40, Haralakunta village, Madiwalla post, Bangalore	15 acres, 10 guntas 75 to 100 TPD using fresh segregated organic waste from BBMP for vermin Composting. Bio-fertilizer and granulated organic manure (Agri gold) of 3000 TPM. 200TPD for processing existing old dump waste of 1,65,000 Tons.

Suggestions for effective management of MSW

- Construction and operation of properly planned sanitary landfill through public private partnerships/private sector.
- Effective segregation of waste at source itself, and send the recyclable separately to the respective processing units
- It is better to concentration on energy production through anaerobic digestion and for land application rather than composting which is not economical.

Management of MSW

The following are some of the major problems for BBMP are:

- Inappropriate plan for the disposal of MSWM taking the actual quantities and its composition
- Less expertise and exposure to the urban city MSW adopting the modern techniques and best practices.
- Lack of technical and trained manpower
- Lack of community involvement
- Partial awareness creation in MSW
- Outdated management information systems
- Low budgetary provision in BBMP

Technical Treatment of MSW

- **Incineration:** It is a thermal process for burning the waste at a very high temperature. The process is not reportedly suitable under Indian conditions due to high dust and ash content of wastes, high capital costs especially for adequate control of emissions, high operation and maintenance costs and need of skilled manpower. This system is not environmentally friendly and is hence usually not recommended as solid waste disposal technique.
- **Composting:** Composting can be done by either aerobic or anaerobic process. It is a slow natural process in which bacteria, fungi, insects and worms consume plant and animal waste and convert them slowly into a soil-like substance, which is a good soil condition.
- Power generation, fuel pellets, Bio-Methanation etc; these process involve the conversion of waste into pellets/fluff/bricks etc., and are fed into the turbine for generation of power.

Key Issues in BBMP and Conclusions:

- The existing capacity of the treatment and disposal facilities is not adequate to meet the processing and disposal requirements of the waste generated in the city The key issues with respect to the current MSW management practice in BBMP are set out below:
- Segregation of different MSW streams is not being practiced in the city
- The MSW activities are being overseen by Health officers. However, collection and transportation activities are logistics oriented while treatment and disposal activities need an engineering focus.
- The tools and equipment deployed for a provision of services are not uniform across all the zones.
- The monitoring mechanism would need to be streamlined.
- The existing capacity of the treatment and disposal facilities is not adequate to meet the processing and disposal requirements of the waste generated in the city.
- Power generation, fuel pellets, Bio-Methanation etc; these technologies are expensive for composting technology
- The major problems in BBMP are due to the lack of Segregation of different MSW streams is not being practiced in the city.

Reboot SWM plants - all SWM plants have to be activated immediately

MEASURES NEEDED ON A WAR FOOTING

ORGANISATION MEASURES

- Overall SWM plant management structures to be set up
- Plant in-charge and staffing to be appointed and provided immediately
- O&M to be streamlined - pending issues, approvals to be done in an urgent time bound manner
- Plant & equipment, vehicles to be restored to working condition immediately

MATERIAL MANAGEMENT

UNPROCESSED WASTE / INERT - to start processing of this waste and improve recovery

MATERIAL OUTFLOW - RDF, compost, leachate to be dispatched immediately

WASTE INFLOW - schedule with starting date / gradual increase in quantum of waste to start - police cooperation / protection wherever necessary to be ensured

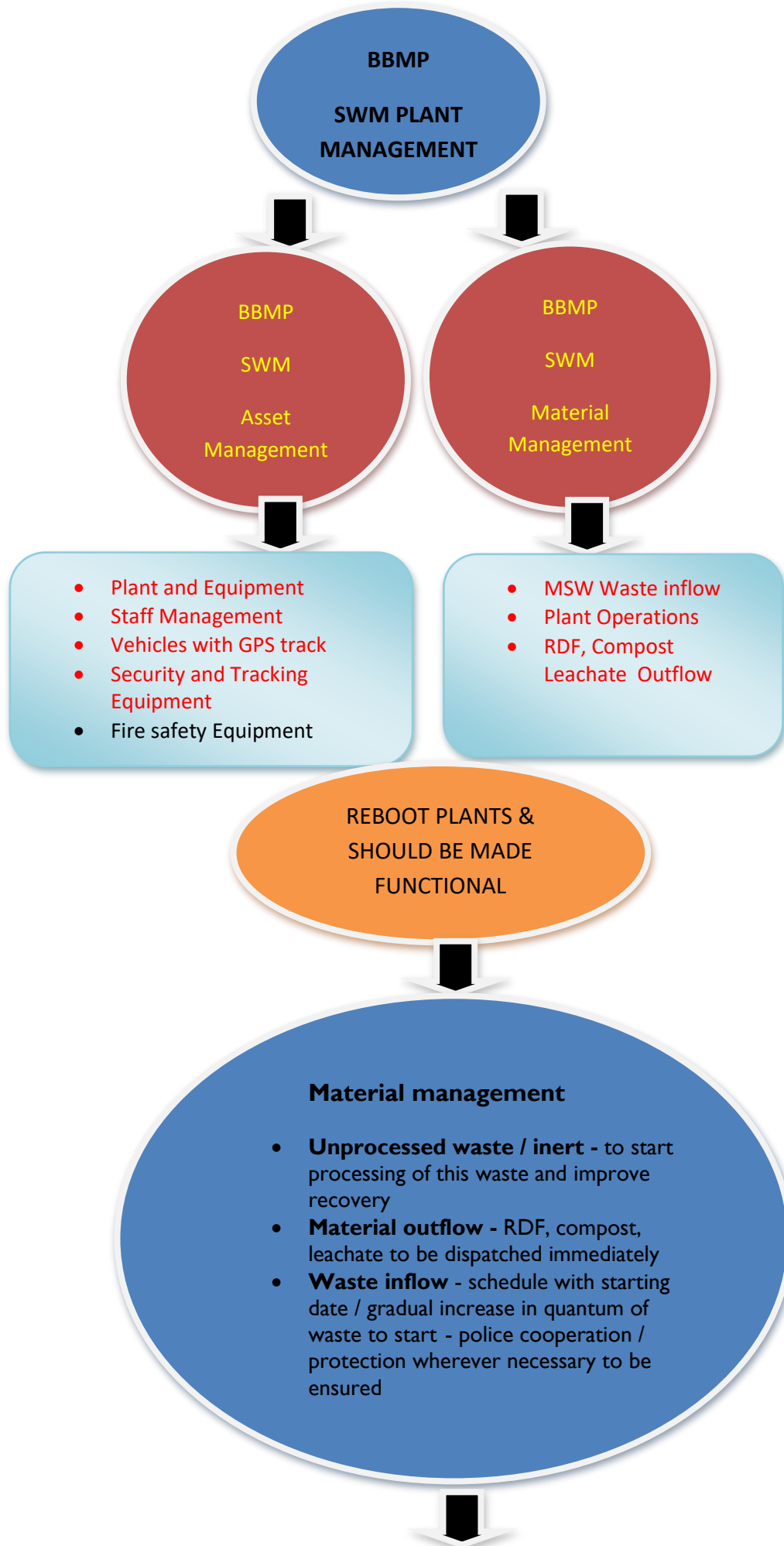
SWM PLANT MANAGEMENT

FUNCTION - ROLES AND RESPONSIBILITIES

A S S E T MANAGEMENT
New Installations / Upgrades
AMC agreements
SR rates
Insurance (Plant & equipment, vehicles, Staff)
O&M Agreements – payments
Statutory compliance- Air& water act, Factory Act, Labour laws, Fire Regulations, SWM Rules 2016

M A T E R I A L MANAGEMENT
Waste Inflow – To ensure uninterrupted , total supply of quality waste , Diversion from Quarries
Operations - Set SOPs, daily processing of the waste inflow , appointment and staff management, Repairs and maintenance, R&D
Material Outflow – Marketing and sales tie ups , Dispatch of RDF, Compost, Leachate, inert, R&D

ORGANISATIONAL MEASURES - SWM PLANT MANAGEMENT



ORGANISATION MEASURES

- Overall SWM plant management structures to be set up
- Plant in charge and staffing to be appointed and provided immediately
- O&M to be streamlined - pending issues, approvals to be done in an urgent time bound manner
- Plant & equipment, vehicles to be restored to working condition immediately

SWM PLANTS- MATERIAL MANAGEMENT

MATERIAL OUTFLOW	
TYPES	
COMPOST :	Dispatch To Director Of Agriculture, Farmers Direct
COARSE ORGANICS:	
	Dispatch To Sugarcane Industry, Horticulture Department, Mines , Forest Department.
RDF:	
	Dispatch To For Plastic Roads (BBMP, NHAI, PWD) , Cement Industry
INERT :	Dispatch to landfill

SWM PLANTS-MATERIAL MANAGEMENT WASTE INFLOW

TYPES	
SEGREGATED WET WASTE	
NON RECYCLABLE DRY WASTE	
SUPPLY TO	
	Map the secondary vehicles
	RDF section of the SWM plants for shredding and dispatch to co gen plants
FROM	Daily d2d collection
	Ward - constituency aggregation centers

7. RECOMMONDATIONS

- Overall all plants are in good conditions without any technical problems.
- All plants are connected basic infrastructure, odor control is the main problem from these plants, immediately solve this problem to avoid localities agitation.
- Few plants fence should be improved.
- CCTVs installed and monitored by head (Joint Commissioner) from BBMP office.
- Vehicles should be supported with license, registration etc restored into working condition.
- Local public problem solved with police force or from some other agencies.
- Villagers who are expected to accommodate waste-processing sites within their territory must be mandatorily compensated and provide jobs to them in the plants to feel ownership of plants.

- BBMP should give a great boost to cleaner cities and more productive use of agricultural land, water and seeds, by promoting IPNM, Integrated Plant Nutrient Management using city compost in combination with chemical fertilizers to overtake regular fertilizers agencies.
- Build confidence in villagers about BBMP compost.
- Pending issues like bill payment and others should solve immediately.
- Stocked garbage should process immediately.
- Windrow pad not turning in regular period and chances of catching fire by heat generation.
- Fire monitoring should be improved through spark detecting technology
- RDF, compost and leachate disposed.
- Plant maintenance appointment of staff R&D should be boosted.
- Agreements or MoA should clear immediately.
- Spark detectors and fire hydrant should improve according to SWM rules 2016 and all SWM plants activated immediately.
- Ducting system should operational and make functional immediately at KCDC
- BBMP aim is to adopt zero waste management or reduced the quantity of inerts that goes to landfills by less than 10% by recycling other inerts wherever possible.
- Set up organization structure for better management for SWM plants under Joint Commissioner Management. **Set up Separate**

Corporation for management of BBMP plants.

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