ISSN No. 2456-0472
The Engineering Journal of Application & Scopes, Volume 2,Issue 1, February 2017

Scope of Power Generation from MSW of Uttarakhand State

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Abstract—The increasing industrialization, urbanization and changes in the pattern of life, which accompany the process of economic growth, give rise to generation of increasing quantities of wastes leading to increased threats to the environment. In recent years, technologies have been developed that not only help in generating substantial quantity of decentralized energy but also in reducing the quantity of waste for its safe disposal. Present paper deals with the collection and conversion of the MSW to biocoal using torrefaction. This project will also promote the Swachh Bharat Mission of Government of India and will also contribute a solution to the existing problems of power cut and unavailability of power in many places of India.

Keywords—MSW; Waste to Energy; Energy; Techno-economic; Power

I. INTRODUCTION:

Today, the world's population generates an enormous amount of waste, either in solid or in liquid form. We all generate waste, whether we come from a developed country or and developing country, are rich or poor, from big or small cities. The past belief of eternal energy resources, have changed now. Waste minimization is a major concern in the developing countries. The amount of waste produced depends on many factors like the country, type of urban district, population, city size, culture, style of life and per capita income.

With the rapid industrialization and economic development in the past few decades, some serious environmental scenarios such as illegal dumping and non-sanitary landfilling of industrial and MSWs are caused. As a result, the Environmental Protection Administrations (EPA), Taiwan began to promulgate strict regulation on the establishment of an integrated waste management system and to construct sanitary landfills and household garbage incineration plants.

The management of the municipal solid waste (MSW) is a major concern in the developing and developed cities due to increasing population, urbanization and limited available land space. The traditional dumping and treatment methods of the MSW have some major environmental challenges. When such environmental challenges combine with political, social and economic issues, they lead to some major concerns, to be addressed in the land evaluation and management. While on the other hand, due to increased population, the consumption of the conventional fuels i.e. fossil fuels increase and correspondingly increase in energy and fuel demands and also Green House Gas (GHG) emissions. By converting solid waste into biomass energy, we provide an option to produce a cleaner energy resource with controlled GHG emission rates.

Many considerable research studies are conducted on the utilization options of the MSW. A few of these conducted studies mainly focused on conversion of the solid waste into energy and economic assessment of these techniques. Other techniques provide the current developments and possibilities for some notified regions only. Life Cycle Assessment (LCA) and Environmental impact are also the focus of many research studies, while few other studies look upon the suitable locations for solid waste disposal using the Geographical Information System (GIS). However, no thorough information is obtainable concerning the solid waste conversion facility site selection. Fig. 1 depicts the cycle of MSW generation and management.

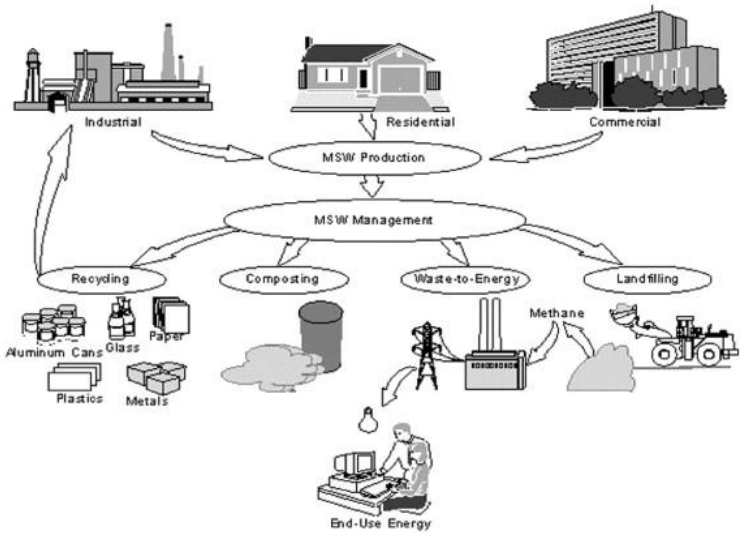

Fig 1: MSW generation and management cycle

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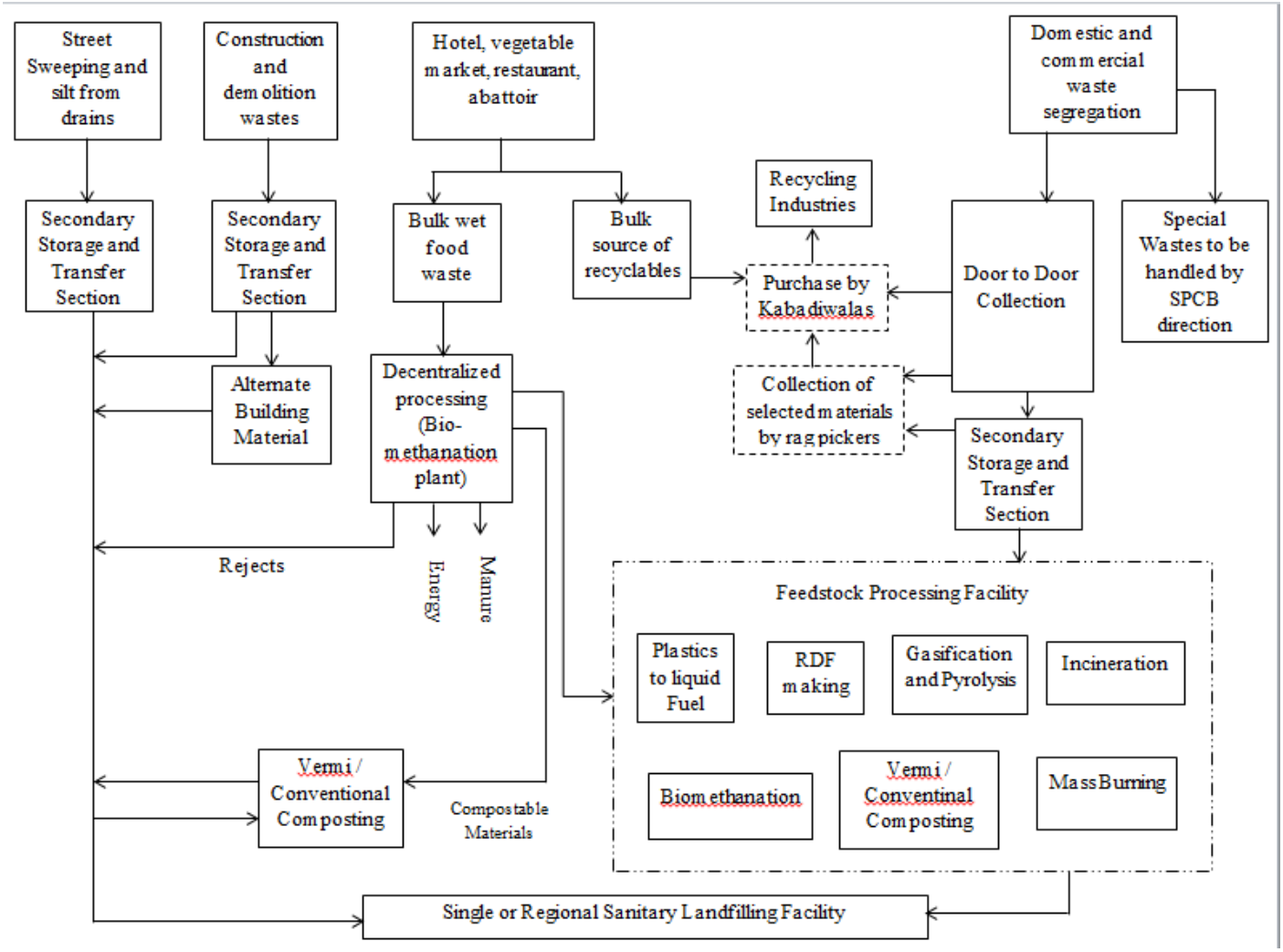

Fig 2: Integrated MSW Management System for the Cities of Population more than 2 Million

The U.S. Environmental Protection Agency [USEPA] defines that MSW includes durable goods, containers, packaging material, food wastes, yard wastes, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources excluding industrial waste, agricultural waste, sewage sludge and all types of hazardous wastes including batteries, bio-hazardous and medical wastes.

The disposal of solid waste is a very complicated problem in itself but a proper management system can utilize the solid waste to get many profits. Since variety of materials are present in the solid waste, by knowing the proper chemical composition and the characteristics of the MSW we can manage and utilize it properly and eventually reduce the solid waste and the hazards and can also develop profits for the society. The management of MSW can be done in many ways, depending upon its chemical and physical composition.

In 2010, Urban India generated nearly 188,500 tons per day of MSW at a per capita waste generation rate of 500 grams/person/day. India openly dumps 90% of the total MSW generated. Fig. 2 depicts the composition of MSW in India. Fig 3 shows the total MSW generated in 59 Indian Cities and estimated values

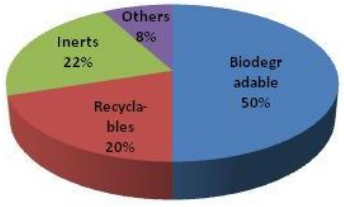

Fig 3: Composition of MSW in India

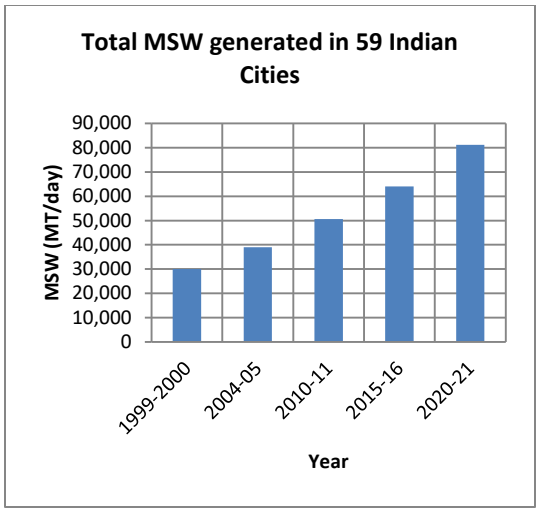

Fig 4: Total MSW generated in 59 Indian Cities and estimated values

Haridwar is also a big generation city of MSW. The population of Haridwar city as per the census 2001 is 5 lakh. Since Haridwar is a holy place, it is difficult to say the exact population of Haridwar and the waste generation per day is 213 metric tons per day [9]. So the per capita generation of waste is around 0.43 kg per day. The source-wise distribution of the solid waste generated in Haridwar is illustrated in Table 1.

TABLE 1: SOURCE-WISE DISTRIBUTION OF SOLID WASTE OF HARIDWAR [9]

S.No.	Source Category	Quantity of Waste (MT/day)
1	Domestic Waste	106
2	Commercial Waste	68
3	Street Sweeping	39
	TOTAL	213

At present, Haridwar city is dumping all its MSW in a nearby village dumping site. This dumped waste is either incinerated i.e. burned into ashes, which has adverse effects on the environment or left as it is to decompose. The dumped waste which is left untreated in dumping sites decomposes to form Methane (CH4), a Green House Gas (GHG). The CH4 emitted leads to air pollution and the decomposed waste pollutes the landfills.

In 2000, the Ministry of Environment and Forests (MoEF) notified the Municipal Solid Waste (Management and Handling) [MSW (M&H)] rules for all Indian cities. The rules included directions to establish a proper waste management system with a timeline for installing waste disposal and processing facilities till the end of 2003, for all urban local bodies.

The following directions were established to improvise the municipal solid waste management (MSWM) in all Indian Cities:

• Prohibition of littering on the streets by ensuring storage of waste at source in two separate bins for biodegradable and non-biodegradable material respectively.

• Collection of segregated waste (biodegradable and non-biodegradable waste) from the doorstep (including slums and squatter areas), at pre-informed timings on a day-to-day basis using containerized tri-cycle/hand carts/pick up vans.

• Street sweeping covering all the residential and commercial areas on all the days of the year irrespective of Sundays and public holidays.

• Abolition of open waste storage depots and provision of covered containers or closed body waste storage depots.

• Transportation of waste in covered vehicles on a day to day basis.

• Treatment of biodegradable waste using composting or waste to energy technologies meeting the stipulated standards.

• Minimize the waste going to scientifically engineered landfills (SLFs) and dispose of only rejects from the treatment plants and inert material at the landfills as per the standards laid down in the rules.

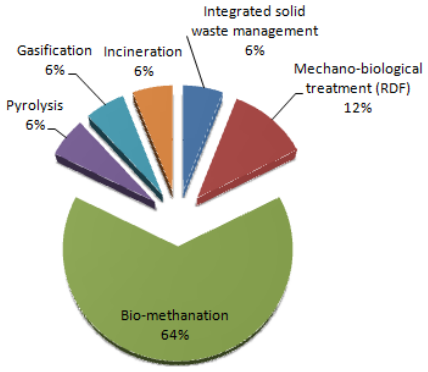

Fig 5: Distribution of WtE Technologies in India

II. PRESENT SCENARIO OF MSW MANAGEMENT IN UTTARAKHAND:

In 2007, when prestigious JnNURM scheme was launched by the Government of India, Uttarakhand also initiated its striving MSW management projects for city of Dehradun, Haridwar and Nainital. These projects were awarded in year 2008-09, having a total projected cost of Rs.50.63 Crore and benefiting

approx. 9.00Lac population inhabited in these cities and nearby areas. [4, 5]

TABLE 2: APPROVED PROJECTS UNDER JNNURM [4, 5].

ULB	Population	MSW Generated (MT per day)	Project Cost (in crores)
Dehradun	583679	291.840	24.60
Haridwar	231139	218.056	16.72
Nainital	41377	20.689	9.31

A study was done by the state government officials, in order to understand the status of MSW disposal, waste and garbage segregation, waste disposal pattern, special category of waste disposal, status of sanitation system, frequency of road and drain cleaning, availability of resources for handling and management of the waste, complaints redressal mechanism, level of satisfaction amongst the stake holder, community view on current practices, need and their willingness to pay the user fee to avail their choice of services and their understanding over the penal clauses against littering and non-cooperation towards effective waste management etc. The summary of the study is as stated below:

(1) Waste Segregation: In existing practices only dry recyclables like – newspaper, glass bottles, plastic bottles and metal scrap are separated out from the waste stream at generation level, that too by 30-40% of the waste generator in order to earn some monetarily benefits sale the same to rag pickers. Whereas, commonly the entire waste is outsourced in non-segregated manner. It is also witnessed that the different type of wastes viz. biomedical, hazardous, industrial and e-waste including Construction debris all are been mixed with municipal wastes and dumped at the same site.

(2) Waste to Resource: Awareness about converting waste to resource is very less amongst the generator, thus efforts to segregate the waste at source is not made. Efforts in this direction if made will yield significant results and is very essential to take steps in this direction.

(3) Waste Disposal: No efforts are made to recover the resources from the waste. In 16 ULBs though compactor system for the recyclable waste is installed, but hardly utilized to its best to yield benefits. No compost are produced from the organic waste though at many places NADEP pits are been made. It shows either the ULBs staffs are not properly trained and motivated or there is lack of staff to operate and maintain the system. Rest ULBs are adopting the old practice of waste collection, handling and disposal at unidentified and unscientific dumpsites. Such practices could be termed as illegal waste management practices and need immediate attention, before it becomes hazardous for the surrounding flora and fauna.

(4) Waste Collection: Hardly done at few of the places, with the help of NGOs door to door waste collection approach is adopted. In most of the places the waste is disposed of directly into community bins or adjoining empty lands or drains. The collection and storage system within the ULBs are also found inadequate to receive and store the waste in a proper manner. It is witnessed that either the receptacles are very old (discarded one), small sized or placed at very far place, that travelling to that point will be too much time consuming.

(5) Complaint redressal: ULBs lack proper administrative and infrastructure setup to address the complaints lodged by the public regarding the waste disposal. Because of this no proper records are maintained and followed.

(6) Satisfaction Level: The unhygienic and unaesthetic surroundings with deteriorating health and environmental conditions have put the public satisfaction level to its least. The poor waste management infrastructure and administrative setup of ULBs too has worsened the situation further.

(7) User fee, willingness to pay and make attitudinal change: The good part of the above situations is that people who are looking for a change are willing to share some monetarily helps with ULBs in form of user fee, if the ULB approach the society/ community and provides them with some better and reliable waste management solutions. Since the existing situation not only affecting the image and economics of the ULB but also the tourists flooding in from all over the world. The old mind sets, that waste is the responsibility of the ULB only has also now slowly getting changed. People are not accepting it as their own responsibility to safely store and get it disposed through legalized means. The IEC activities will surely help in bringing vast attitudinal change towards waste management.

III. ACTION PLAN AND STRATEGIES REQUIRED TO OVERCOME THE MSW MANAGEMENT:

To overcome the present challenges faced by the state government during the management of the municipal sloid waste, below stated steps could be taken into account [4, 5]:

- Recover energy from the waste stream after material recycling and through proven advanced technologies like – Biomethanation, Gasification, Torrefaction, Pyrolysis, Mechanical Composting, Refuse Derived Fuels (RDF) etc.
- Diversion of Construction Debris to another site for future application

- O&M funding to make Waste Management financially sustainable
- Implement disposal bans on materials that limit opportunities to achieve reuse, recycling or energy recovery
- Expand the monitoring and enforcement of disposal bans and enhance with effective communications to raise awareness of the bans
- Investigate financial and regulatory barriers which prevent or discourage the reuse of materials
- Developing a Community Education and outreach services plan to solicit Public Inputs
- Rigorous IEC activities in all the ULBs to create community awareness regarding effective waste management
- Providing necessary infrastructure, tools and equipment to all ULBs for effective SWM management
- Capacity building of ULBs, Governance Roles and Responsibilities
- State to provide technical and administrative support to the ULBs in compliance with the Environmental Acts and Rules
- Defining the role and responsibility of Stake holders, State Level Committee and having quarterly review meetings
- Stringent Monitoring in the field to ensure effective compliance operation
- Strict implementation of supporting acts and rules like – Plastic Waste (Management and Handling) Rules, 2011; Biomedical Waste (Management and Handling) Rules, 1998; Hazardous & E-Waste Management and Handling Rules; UP Municipality / Environment Act and Rules
- Notifying of the supporting bills/ legislation to fill the gap, if there any like – Anti Littering and Anti Spitting Bill; Construction Debris Management and Handling Bill
- Waste research and audits at frequent intervals, to introduce newer technologies which are ecologically and economically viable and ease to operate
- Environmental Plan Management etc.,
- Waste Segregation at Source
- Maximize reuse, recycling and material recovery and
- Adopting Pyramid Approach for effective waste management

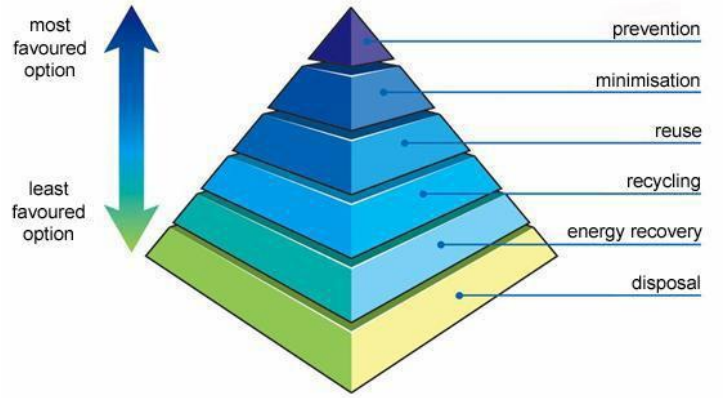

Fig 6: Waste Management Practices.

IV. WTE PROJECTS PROPOSED IN UTTARAKHAND :

Recently, using a German based Gasification technology which treats the unsegregated waste at very high temperatures in absence of oxygen to produce synthetic gas, which is used to produce 25 Megawatt of electricity every day using only 500 Metric tons of waste. The plant requires a capital investment of Rs.500 crore to run throughout the year, collecting wastes from Dehradun, Haridwar, Roorkee, Rishikesh and other nearby cities. The plant is proposed to be set up in Roorkee, under the leadership and guidance of the State Industrial Development Corporation of Uttarakhand (SIDCUL). The electricity generated would cost Rs.10 per kilowatt, which will be sold by them to UPCL. All kinds of wastes, including hazardous, biomedical, agricultural, slaughter can be included in the process of making the energy. However, construction waste and demolition and radioactive waste, inert materials will be excluded.

V. CONCLUSION:

This paper deals with the present scenario and future aspects of the waste disposal, segregation and handling in the state of Uttarakhand. The present ways adopted by the government are very harmful and toxic to the environment as the waste collected is generally just landfilled. These landfills emit methane (CH4), a Green House Gas (GHG) on a very large scale. To avoid this harmful and environment degrading techniques and improve the MSW

management techniques used by the state government, a few strategies were discussed in the paper. The paper also discusses the technologies to convert the collected waste into a useful energy form i.e. electricity using the Waste to Energy (WtE) technologies. This paper also supports the Swachh Bharat Mission initiated by the Central Government of India and will also contribute a solution to the existing problems of power cut and unavailability of power in many places of India.

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