Smart Solid Waste Management in New Capital City Amaravathi

G. Kalyan Chakravarthi, D. Satish Chandra, SS. Asadi

Abstract: ***Expanded epidemic outbreaks and spreading of infections due to inappropriate waste administration in urban areas which are having a drastic and exponential population growth. In current circumstances, the Garbage Collecting Vehicle (GCV) amasses the waste few times in a week. In this way, the issue is over streaming of wastage on the streets. Thus, to beat this restriction, in the present thesis a different scheme on smart waste management using Radio-Frequency identification devices(RFID),Machine to machine(M2M), pneumatic system, Internet of things(IOT), plasma technology are explained in detail and the best method of treating solid waste using smart solid waste management techniques is suggested basing upon the Summary of the data collected from Tullur, Rayapudi, Velagapudi, Nelapadu villages respectively, Where one of these new systems is implemented. After gathering the questionnaire, which is prepared basing upon the Quantitative survey, the results were analyzed using mathematical methods and confirm the advanced techniques in SWM Is better than traditional or conventional methods.***

Index Terms:Solid Waste Management (SWM), Machine to Machine (M2M), Internet of Things (IOT), Radio Frequency Identification Techniques (RFID), Pneumatic System, Plasma Technology, Smart Solid Waste Management (SSWM).

I. INTRODUCTION

Solid Waste Management (SWM**)** is a universal problem that the World is facing today and being no exception, over the years the New Capital city will grow significantly both in population and in density, which may result a great pressure force on the resourcesof the city [1]. The municipal solid waste of residential area and waste products of commercial area are the two major solid waste produced in the Amaravati region.

The utmost challenge for Amaravati region is the disposal of enlarging quantities of solid waste**.** The present methods of solid waste disposals in the State are not been satisfactory [2]. The wastes that are being disposed are most unscientific (land) thereby posing a great threat to environment and public health.

Waste reduction and Operational efficiency are the two advanced methods of smart solid waste management [3] by using number of technologies is presented in Figure 1.

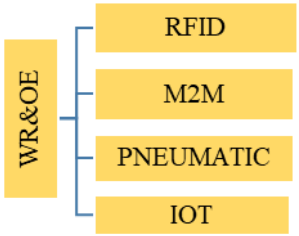

Figure 1: Waste reduction and Operation efficiency

This methods are newly innovated.By using thise methods we can get the maximum utilization of resoures while follwing the integrated soild waste management. I am considering four villages of amaravathi region that is new capital city of andra pradhashthey are Thullur, Velagapudi, Rayapudi, Nelapadu.Why I am considering this four villages are this are the four corners of the capital city of amaravathi.The information related to solid waste that are mainly corresponded to reduce, reuse, and recyclewhich is also known as 3R system is shown in Figure 2.

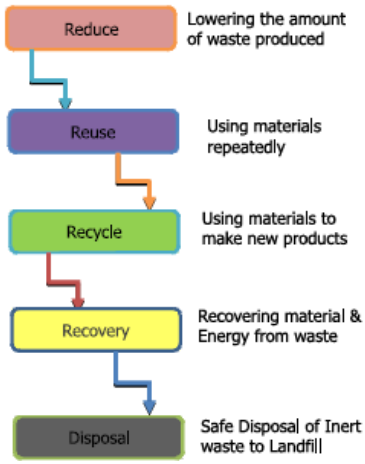

Figure 2: Solid waste management process

(Source: Amaravati concept handbook**)**

A. Reduce

The first priority of the solid waste management is to reduce the waste at the sources. If we reduce the waste then the quantity of the harmful waste gets declined. By using this reduce process the impact on environment will be reduced.

And the new methodology for the minimization of waste is to reduce the usages of packing materials and to motivate the customers to return the package materials, stir up the ecofriendly products. This system will be also useful for the reducing the usage of virgin material. The awareness camps

Revised Manuscript Received on April 09, 2019.

G.Kalyan Chakravarthi, Department of Civil Engineering,KoneruLakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur, A.P, India.

D. Satish Chandra, Department of Civil Engineering, KoneruLakshmaiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur, A.P, India.

SS.Asadi, Department of Civil Engineering, Vignan's Foundation for Science, Technology and Research, Deemed to be University, A.P, India

should be launch at the local body to educate people about the segregation of sloid waste. Segregation can be divided into organic and inorganic waste. They are also known as biological waste and lifeless waste. The biological waste includes vegetable waste, paper waste, fruit waste etc. This organic waste converted to manure and helpful for growth of plants. The lifeless waste includes plastic waste, e-waste, glasses, metals etc. This can't be converted into the manure and there is no impact on the improvement of the plant life. Segregation will be helpful easy for treatment. In the primary segregation, we have to separate the solid waste and liquid waste.

B. Recycling

A procedure by which the materials are assembled to be handled to either reuse or undergo remanufacturing. This recycling helps get rid of any kind of metropolitan or business waste to transfer or carried forward for years letting the pollution to happen, which in this way used to help save the nature from any kind of damage and also the responsibility of waste management on the officials. With proper planning methods, procedures etc. this recycling would definitely help creating jobs or rather would also create great incomes.

Although there are a lot of advantages of recycling, cost reduction and control of environmental pollution are thought to be more significant among all. And the solution would be collection of the waste produced. This collection of waste currently is being done by the informal sector through waste pickers, door to door collectors and so on. The building up or knocking down of waste constitutes most of the total solid waste which contains about 6.82% of paper and 6.03% of plastic. Coming to e-waste generation or electronic waste generation, there has been an increase of about 10% per annum, which is as observed; not being managed properly. The estimated solid waste management in 2050 is presented in Figure 3.

SOLID WASTE GENERATION FORECAST

Solid Waste Category	Total Waste (TPD) - 2050
Municipal Solid Waste	3819.73 TPD
C&D Waste	10.57 MT
E-Waste	268.11 TPD
Biomedical Waste	5.89 TPD
Household Hazardous Waste	45.84 TPD

TPD: Tons per day
MT: Metric Tons

Figure 3: Solid waste generation at 2050
(Source: Amaravati concept handbook**)**

Figure 4: Recycling waste collection center
(Source: Waste management in the eyes of an expert**)**

C. Recovery

By using municipality waste as raw material for the production process of energy in the form of electricty or heat. In the plasma techonology, we can heat the inorganic or lifeless waste to convert them into elecricty in the form of heat and this had implemented in GIFT city(gujarath international finance tec city).this is the first smart city in india.The energy can be recovered form the solid waste by the incineration process in the form of heat or eletricity.and it will be helpful for production process of RDF (refuse derived fuel).This fuel

Derived fuel is the segregation of high fraction of processed municipal solid waste .repeatedly in pellets from it is produced from combustable elementsof household and commeritial waste. It is good quality fuel from waste.If we compare incinaration vs waste to energy techonologys,in majority cases incinaration will be choosen, because the waste to energy technology is a costly process and requires high supervision with the latest technologies.The enviromental issues are raised due to plants are not operated effctively.

D. Land fill

In this process we are filling the land in different places like in the open land, ponds and pits etc. the process of dumping the waste materials consists of five phases as shown in the Figure 5.among those five phases, each phase consists of different types of solid waste. If they have filled with organic matter that can be changed like manure. If they fill inorganic matter, they are undecomposed and stay for longer period. And each phase has certain goals to accomplish the final goal. This landfill should be located outside the country side or city. Proper maintenance works should be included. And did not burn the tiers and plastic without proceedings.

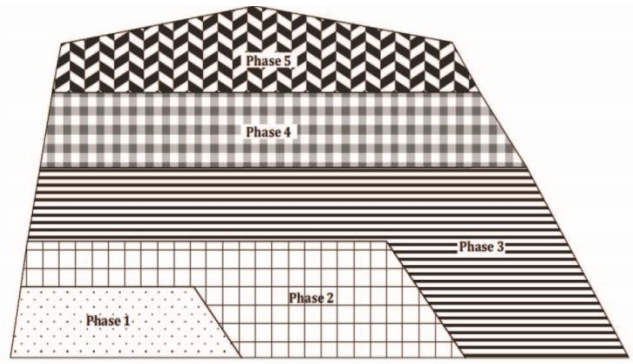

Figure 5: Land filling layers
(Source: Section of municipal solid waste management)

If it consists of electronic waste and medical waste then they should be properly disposal with certain methodologies. The location of the landfills should not be nearer to the flowing rivers.

Major drawback for the land filling is we do not use the same land for years. We have to shift the dumping land to another area with span of 20 years. This land should not be useful either for cultivation or for constructions works too.

II. RESEARCH SIGNIFICANCE

Identification of Suitable Technique to improve the Solid waste Management in the Selected Field of Study, conducting the questioners and Recommending of the Suitable technique for smart waste management in new capital city Amaravati.

III. DESCRIPTION OF WORK

This paper Explain about the Smart solid waste management system in Amaravati region new capital city of Andhra Pradesh are divided into the three zones show in theFigure 6

- Zone -1
- Zone- 2
- Zone -3

Again zone -1 can be divided into three faces of construction they are

- Phase -1
- Phase -2
- Phase -3

Each zone has one Transit Station (TS), Three Land fill station and one treatment plant.

When the zone 1 only divided into three phases why because when the total capital region government complexand seed access area in zone 1 only while starting the capital in this area of access only when another two zones comes under the LPS (Land pooling scheme).

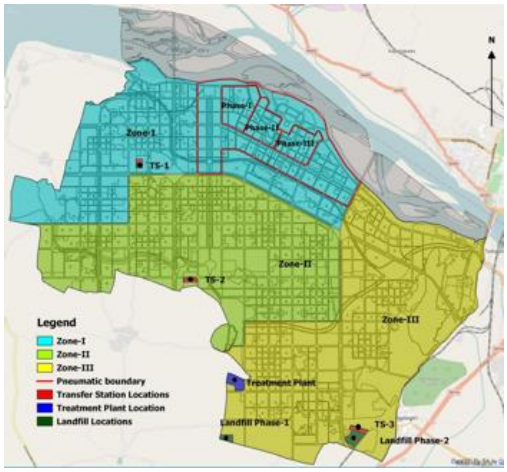

Figure 6 Master plan of capital region
(Source: Amaravati Concept Handbook)

Latest Technologies in Solid Waste Management

The latest technologies and it consists of the equipment's, scanners, devices are parts of the prescribed below they are

- RFID
- M2M
- Pneumatic
- IOT

A. RFID (Radio frequency identify devices)

The RFID playing the main role in latest technologies in solid waste management.in this system has using in different areas in waste management like *smart bins*. If the RFID tag was attached on the bottles then the smart bins are automatically open. At the same time when bottle is RFID tagged it will be identified in mixing of solid waste.Figure7 explains about the when the plastic water bottle has RFID tag while in the same time bins having the sensor when the user puts the bottle near to the bins when the plastic bin will be opened.In that same time when the glass particles and paper particles are nearer to the bins when the bins are opened by using RFID tags and sensors.

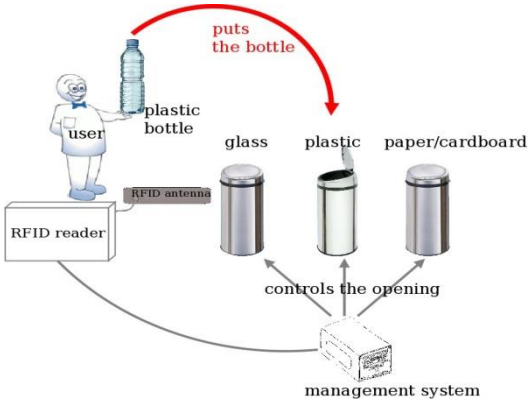

Figure 7 RFID based selective bins system
(Source: Amaravati Concept Handbook)

The RFID tagged water bottles are the mixed with the sloid waste and they have easily identified while passing through the conveyor the one machine has RFID scanner that are scanned the all the matter and picking the plastic water bottle from the solid waste and that bottle recycled shown in Figure 8.

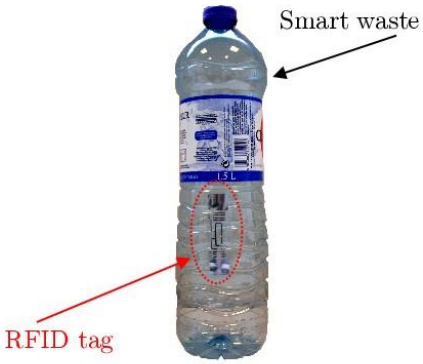

Figure 8 RFID Tagged plastic bottle
(Source: An example of a smart waste)

A. M2M (Machine to Machine)

This system is used for sorting, shredding and conveying of solid waste. Compare with the other technologies, the equipment cost in this technology will be higher, because it's totally mechanized. It is suitable for the huge amount of solid waste. The maintenance cost of the system is also higher. This system is interlinked to RFID. By attaching the magnet to the machine, it will attract all the iron particles in solid waste. This system required less man power. It is easy to operate and sustainable technology. The main advantage of machine to machine is to segregation of unsegregated (i.e. solid and liquid) waste.

B. PNEUMATIC SYSTE

Pneumatic waste collection system is a totally water & air tight system, eliminating bad smell &dirt

It is based on a network of underground pipes through which a powerful vacuum is created to transfer the waste to collecting station at 55 to 70 km/hour &stored into big container and further transferred.

Figure 9 Pneumatic system flow
(Source: Amaravati Concept Handbook)

C. IOT (Internet of Things)

Presently Indian city's struggling with the solid waste management to get rid of things by using IOT. Internet of things plays the crucial role on solid waste management. It is a cyclic process. It consists of analysis, collection, transportation, Recovery and Recycling/Disposal. The dust bins which are located at the streets are connected with Wi-Fi, once if the dust bin was full then the alert signal will send to an app. Then the workers identified the location and by using trucks intimates time to reach location. It is moderate technique. And easy to conveying the waste to the dumping yard. It is GPS based tracking solution. The truck is attached with GPS tracking system. Once the bins were full then we send the signal to the truck via mobile or computer. We can track the vehicles by using software with in a mobile or computer. Hence by using the IOT it is the best method to convey the solid waste in smart cities.

IV. RESULT AND ANALYSIS

In order to perform the questionnaire survey 30 questions had been selected from various factors which leads to cause of Municipal technical persons risks, Household risk, and Municipal workers risks. In this survey 120 responses were collected. In selected villages Tullur, Rayapudi, Velagapudi, Nelapadu.

Each response in questionnaire survey is analyzed by using Relative Importance Index (RII) [6]

RII = $\sum W/A*N$ RII= $(5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1) /A*N$

Where $\sum W = 5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1$, (1-5) is liker scale values, and (n_1, n_2, n_3, n_4, n_5)

Is the no. of responses recorded for each opinion in the questionnaire?

- Strongly agree (5)
- Moderately Agree (4)
- Agree(3)
- Disagree (2)
- Strongly disagree (1)

Table 1 -Relative Importance Index (RII) values for Household

S. No	Description	RII Value
	A. Household	
1	Awareness of Solid Waste to the Public	0.752
2	Satisfaction related to location of Garbage Dumping point	0.758
3	Separation of Dry waste and Wet waste	0.746
4	RFID Method for the Solid waste management	0.702
5	Pneumatic Method for the Solid waste management	0.868
6	M2M Method for the Solid waste management	0.606
7	IOT Method for the Solid waste management	0.842

Table 2 -Relative Importance Index (RII) values for Workers

S. No	Description	RII Value
	B.Workers	
1	Level of satisfaction for the Garbage collection from garbage point	0.861
2	Maintenance problems during routine work	0.759
3	Awareness of Solid Waste	0.889
4	RFID Method for the Solid waste management	0.623
5	Pneumatic Method for the Solid waste management	0.918
6	M2M Method for the Solid waste management	0.740
7	IOT Method for the Solid waste management	0.692

Table 3-Relative Importance Index (RII) values for engineers

C. Engineers		
S. No	**Description**	**RII Value**
1	Level of satisfaction on the existing garbage collection methods	0.806
2	Recycling Procedures for the solid waste Management	0.794
3	RFID Method for the Solid waste management	0.736
4	Pneumatic Method for the Solid waste management	0.928

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Blue Eyes Intelligence Engineering
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5	M2M Method for the Solid waste management	0.887
6	IOT Methodfor the Solid waste management	0.759

The above results and analysis among through four villages I had found out the maximum number of peoples are gone with pneumatic system and RFID comparatively majority of the people had selected pneumatic system only.

V. DISCUSSIONS

Finding out the Problems in solid waste dumping, maintenance and Recycling. And the below pie charts explain about the different systems in that four villages. Results of smart soild waste management in Tullur region is shown in Fig.10

Tullur Region:

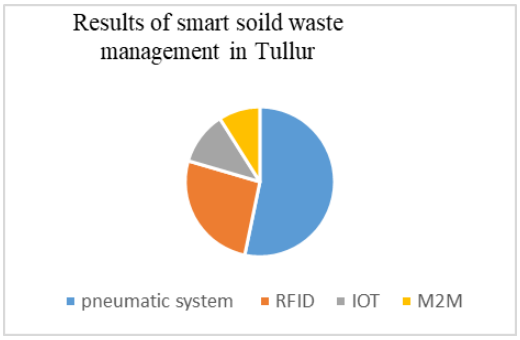

Fig. 10 SWM in Tullur Region

Majority of the thllur village people had selected the Pneumatic system. To show in chart 1 and they have some lack of Things is their like

- Daily collection of garbage.
- Garbage dumping point.
- Separation of Dry Wa ste Wet waste.

Rayapudi Region:

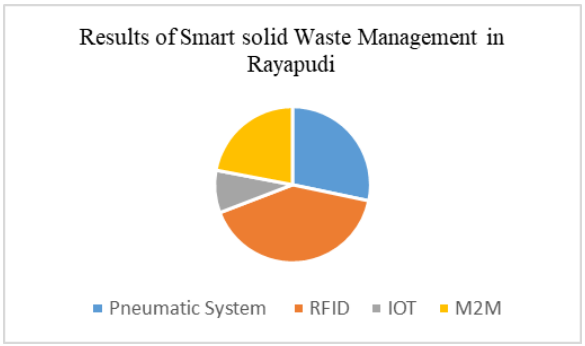

Fig. 11 SWM in Rayapudi Region

Results of Smart solid Waste Management in Rayapudi Is shown in Fig.11. Higher amount of the Rayapudi village people had selected the RFID system as parallel to the pneumatic system.to show in the second pie chart and they have some lack of Things is their like,

- Maintenance works.
- Recycling the Waste

In this village garbage collection in proper manner and the people aware about the dry waste and wet waste.

While coming to the two villages pneumatic system and RFID considering the equal importance in the nelapadu region. Results of Smart solid Waste Management in Rayapudi is shown in Fig. 12.

Nelapadu Region:

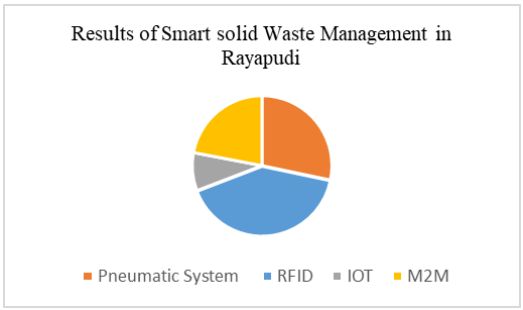

Fig. 12 SWM in Nelapadu Region

Majority of the Nelapadu village people had selected the Pneumatic system. To show in the chart 3 and they have some lack of Things is their like,

- Lack of Selection of dumping sight
- Lack of Municipality workers

Vellagapudi Region:

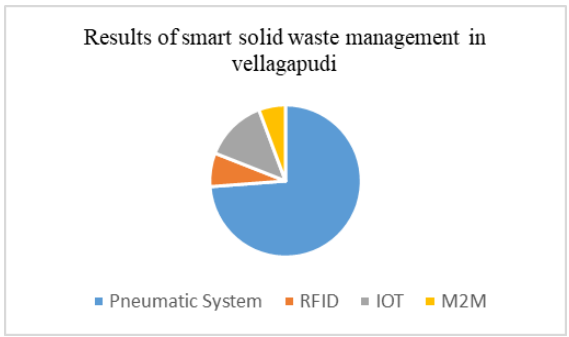

Fig. 13 SWM in Vellagapudi Region

Results of smart solid waste management in vellagapudi is shown in Fig.13. Majority amount of the vellagapudi village people had selected the pneumatic system.to show in the chart 4 and in this village have proper maintenance of solid waste and it should be useful for the next 5 years only. Why because of vellagapudi become one of the main part in the Amaravati region.

VI. CONCLUSION

Based on the questionnaire carried over the four villages in Amaravati region, it is concluded that majority of the people are using bins and trashcans for the collection of all types of waste such as organic waste (vegetable waste, leaves), inorganic waste, E-waste form the households. The deposal of this waste is carried out manually and mechanically. Four methods of solid waste deposal systems such as RFID, Pneumatic system, M2M and IOT are considered to find out which system is best suitable for the selected region. By analyzing the questionnaire survey

conducted among the various stakeholders it is found that pneumatic system is best suitable for the increasing population in the Amaravati capital city.

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AUTHOR PROFILE

G. Kalyan Chakravarthi.

I had done my bachelor of engineering in CIVIL engineering and later doing masters in KL University. I had publish one paper in Scopus in my bachelor degree only. Research work in smart solid waste management. Membership in ISRD, ID: SM3140907015. Got 1st prize in to many colleges in Guntur and Vijayawada region. Got prize in IIT Delhi fest in 2016.and attending to many workshops in Bangalore, Chennai and Delhi.

Dr. D. Satish Chandra Who completed his Bachelor of Engineering in CIVIL Engineering & later did his Masters (PG) from central Queensland University is information system. He completed his PhD from Koneru Lakshmaiah education foundation in civil engineering. He has 15 *Scopus'* indexed journals. His membership in institute of engineering's (INDIA). He has 14 years of experience in Teaching.

Dr. SS. Asadi, working in Department of civil Engineering,Vignan's Foundation for Science, Technology and Research, Deemed to be University, A.P, India. He received his Ph.d in Environmental Technology and M.Tech in Remote sensing & GIS from Jawaharlal Nehru Technological University (JNTU) Hyderabad. He has more than 22 years of teaching and Research experience in remote sensing & GIS and Environmental Technology. He has published more than 220 Research Papers in many International and National journals besides undertaking various National projects sponsored by different Government departments and organizations. He received 3 National Awards. Visited number of countries around the world and presented Research work in USA, Sweden and Japan. Presented and participated more than 100 International and National conferences, seminars, workshops. He guided research work of 3 students leading to award of Ph.D. Authored 4 books. He is the life member of various International& National professional bodies.