Suitability of urban waste compost for agricultural purpose- A case study of Pune city

[1]Aarti Patil, [2]V. U.Khanapure

[1]Student, [2]Professor
Department of civil engineering, Sinhgad College of engineering
Savitribai Phule Pune University
Pune, Maharashtra, India

***Abstract*: Municipal solid waste management has become a serious problem in urban areas and the major portion is organic matter, almost 40-60% component of waste organic matter. As per the Municipal Solid Waste (management and Handling) Rules 2000, many cities are making compost. Before applying MSWC for agricultural uses, it is important to know quality of compost to assess its toxicity. The use of compost for agricultural purpose can be sustainable option of waste disposal. The objective of the study is to check the feasibility of compost produced in Pune city for agricultural purpose. The compost sample were selected from 3 different MSW plants. As per the result C:N ratio, Moisture content, Organic carbon, and pH were not within limits of Hadpsar site compost sample. TO enhance the quality of compost different additives were added in compost. The combination of sludge and rock phosphate with MSW compost gives the maximum nitrogen. Samples have shown the decrease in C: N ratio with maturation period of 30 days. The results show that quality of compost can improve by adding different additives.**

***IndexTerms*: Urban waste compost, Heavy metals, Nutrient potential, Co-composting, additives, organic farming, suitability**

I. INTRODUCTION

In India disposal of urban solid waste is major challenge for municipal authorities. More than 90% of these waste is used for land filling and dumping on outside of town and cities, which have serious environmental problem (1).In India, composting of organic waste is mandatory by the Supreme Court. Municipal solid waste (management and handling rules 2000, also encourage this (ManjuRawat, AL.Ramanthan, T. Kuriakose. 2013).
The most feasible way of organic waste is composting. Because it is not that much suitable for refuse derived fuel, pyrolysis, incineration etc. (3). The interest in composting has resulted in development of regulations to control the contaminants (4). Compost quality refers to know the overall state of compost with regard to physical, chemical and biological characteristics (5).
The various characteristics which determines the quality of composts are moisture, various nutrients, heavy metals, water holding capacity, organic matter, various pathogens etc.(6).
So the objective of the study is to know the suitability of urban waste compost for agricultural purpose.
To enhance the quality of compost from MSW compost plants from Pune city the study was done.Pune is the 8th largest city in India and the 2nd largest in the state of Maharashtra, Population is about 4 million And the Area of city is 244 sq. kms.aroundAlmost45-50% waste is organic waste generates in Pune City.

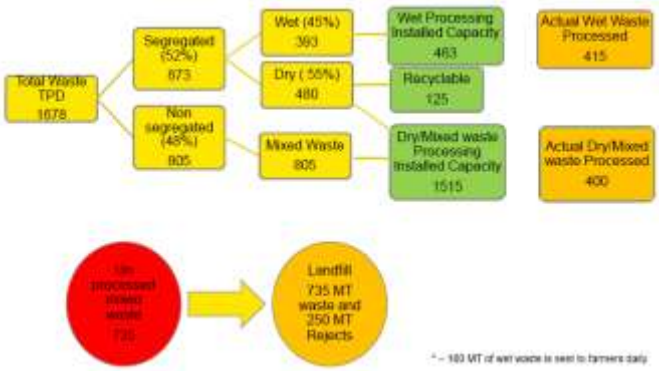


Fig 1: Processing of waste in Pune city.

.

II. MATERIALS AND METHODS

Three urban waste samples were collected from various composting plants operating under the municipal corporation in different locations in Pune on a month of January 2018.The samples were collected once from each plant by using grab samples. Details were also collected along with samples.

Table -1: Selected plants for compost sampling

Location	***Plant capacity (tons/day)***	***Segregation status***	***Method of composting***
Aundh	2	PS	Mechanical composting
Hadpsar	250	PS	Windrow composting
Peshwe park	10	PS	Windrow composting

PS-Partially segregated.

Table -2: Physical and Chemical characteristics of sample

Location	***W%***	***pH***	***EC***	***C***	***C:N***
limits	15-25	6.5-7.5	<4	>16	20:1
Aundh	17.13	7.69	1.29	42.74	63.14
Hadpsar	38.16	6.08	1.89	13.51	43.3
Peshve park	29.73	7.68	2.13	50.55	22.4

Table- 3: Major Nutrients

Location	***N***	***P***	***K***
limits	0.5 min	0.5 min	1 min
Aundh	0.68	1.67	3.93
Hadpsar	0.31	0.91	3.07
Peshve park	2.26	0.88	2.8

Table- 4: Micro Nutrients

Location	***Cu***	***Zn***
limits	300mg/kg	1000mg/kg
Aundh	1.994	2.503
Hadpsar	19.7	3.984
Peshve park	5.98	2.89

Table- 5: Heavy metals

Location	***Pb***	***Cd***
limits	100mg/kg	5mg/kg
Aundh	0.416	0.258
Hadpsar	1.296	1.109
Peshve park	0.77	0.12

To know the importance of parameter weighing factor is used The weighing factor was maximum for organic carbon due to its important role in improving soil quality weighing factor is varied in 1 to 10, depending on their potential in improving soil health(C.Lathika and M.P Sujatha 2015).

In heavy metals which is clean index the weighing factor is 10 for cadmium due to its high level of toxity. Lower the weighing factor lower will be the toxity level of heavy metal (10).

Table- 6: Weighing Factor

parameters	***Weighing factor***
Moisture(%)	1
pH	8
EC(ds/m)	2
OC(%)	10
N(%)	8
C:N ratio	8
P(%)	7
K(%)	6
Ca(%)	4
Mg(%)	4
Fe(ppm)	3
Cu(ppm)	3
Mn(ppm)	3
Zn(ppm)	3
Cd(ppm)	10
Pb(ppm)	8
Cr(ppm)	8
Ni(ppm)	5

EC, pH, organic carbon and C:N ratio were analyzed and the data are given in table 3.The highest pH was seen in the sample of from Peshve Park which is 7.69. The high value is noted in 2 samples might be due to improper handling of compost.Electrical conductivity were within limit thus they are found suited for organic farming under Pune condition.

Carbon content was low in the sample of Hadpsar site which should be > 16. C: N ratio is consider as chemical indicator for compost maturity with respect to organic matter and N cycling. C: N ratio varied from 20:1 upto 63.3 which was highest.

Nitrogen, Phosphorus and potassium are the major nutrients taken by the plant from the soil. Only nitrogen was less than the required in the hadpsar sample. Remaining all were within permissible limit according to fertilizer control odour 1985.
Content of micro nutrients Cu and Zn in the samples ranged between 1-20, 2-4 respectively.

Contamination composts with heavy metals is considered as undesirable quality parameters In the present study Pb and Cd are within prescribed limits of fertilizer control odour,1985. Which is not harmful for the use of organic farming.

As per the analysis the Quality of compost from the hadpsar site is lowest and medium from the Aundh site and good quality of compost from the Peshve park site.

III. EXPERIMENTAL INVESTIGATION

The experiment design was completely randomized design with six treatments. The experiment is designed for co-compost by adding different additives in MSW compost of Hadpsarsite,Pune, Maharashtra, India.

Table-7 :Additives

Additives	***Nitrogen availability***	***Dose per kg for compost***
Cattle dung	0.3-0.4	15gm
Rice straw	0.58	9.524gm
Rock phosphate	0.31	15gm
Neem	5.2	1.067gm
Raw bone	3-4	9.459gm

Experiment was conducted on April 25,2018.
Nine different pots were collected and filled with compost. In every pot 1 Kg of compost were
The Experiment plan was on 6 treatment (different additives types).
9 different types of compost samples were made.
S1-Rock phosphate (2%) + Sludge (33%)
S2- Rise straw (1.78%) + Bone meal (1.77) + Rock phosphate (2%)
S3- Neem 0.20%) + Cow manure (2.82%) + Rock phosphate (2.82gm)
S4-Rock phosphate (3.84gm) + Sludge (32.05%)
S5- Rise straw (3.35%) + Bone meal (3.33%) + Rock phosphate (5.28%)
S6- Neem (0.40%) + Cow manure (5.33%) + Rock phosphate (5.33%)
S7-Rock phosphate(0.99%) + Sludge(33%)
S8- Rise straw (0.92%) + Bone meal(0.91%) + Rock phosphate (1.45%)
S9- Neem (0.10%) + Cow manure(1.45%)+ Rock phosphate (1.45%)
After the preparation of samples the Moisture content was maintained for 1 month upto40-60%. The water was sprinkled on compost 2 times in a week.
The test conducted for the sample was 3 times after 2 weeks, 4 weeks and 6 weeks to see the variation in the results.
The various test conducted for the sample was Ph, moisture, C:N ratio in the laboratory.

Fig 1-Co-composting

IV. RESULT AND DISCUSSION:

Table-8:15 Days result for 6 samples

Sample no	***Nitrogen***	***Organic Carbon***	***pH***	***Moisture***	***C:N ratio***
S1	0.62	12.29	6.19	10.02	19.82
S2	0.56	13.48	5.93	12.3	24.07
S3	0.74	14.02	6.03	15.08	18.94
S4	0.78	13.54	6.54	15.86	17.35
S5	0.82	15.40	6.01	18.32	18.78
S6	0.47	12.98	5.97	11.76	28.45

The tests were conducted after the 15 days of mixing .The Nitrogen was slightly increased and the maximum nitrogen increased in the sample no 5. Organic Carbon was increased only in a sample no S5, and decreased in sample no 1. While pH was decreased in the sample no 2 and increased in sample no S4.Moisture content was less than the required because of high temperature C:N ratio was within limit.

Table-9: 30 days result for 9 samples

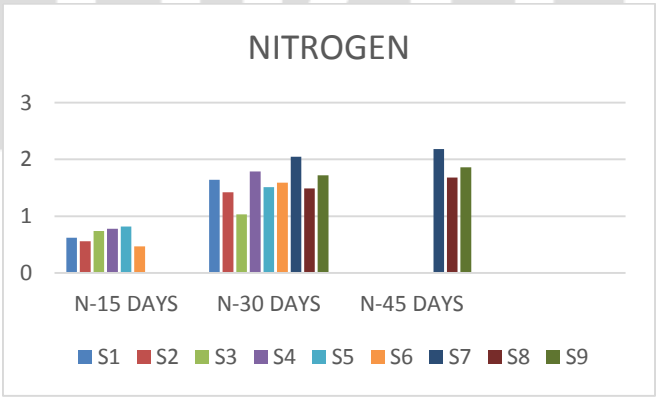
Sample no	*Nitrogen*	*Organic Carbon*	*pH*	*Moisture*	*C:N ratio*
S1	1.64	13.80	6.7	18.91	8.41
S2	1.42	11.60	6.03	21.07	8.16
S3	1.03	13.36	5.99	17.07	12.97
S4	1.79	11.90	7.03	12.98	6.64
S5	1.51	14.08	6.52	10.02	9.26
S6	1.59	15.68	7.23	18.20	9.86
S7	2.05	13.50	6.51	20.18	6.58
S8	1.49	12.60	6.01	15.09	8.45
S9	1.72	14.02	6.09	16.70	8.15

The tests were conducted after the 30 days of mixing. The Nitrogen was increased in the Sample no 7. Organic Carbon was increased only in a sample no S6, and decreased in sample no 2. While Ph was decreased in the sample no 6 and increased in sample no S6. Moisture content was maintained by spreading water 2 times in a week to improve the microbial growth and the moisture content was within limit. C: N ratio was slightly decreased.

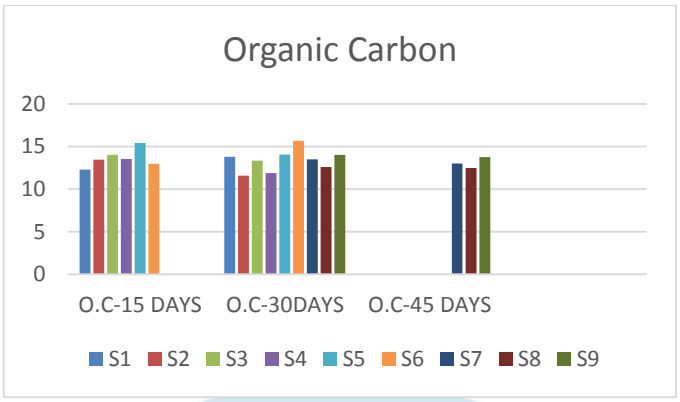
Table- 10: 45 days result for 3 samples

Sample no	*Nitrogen*	*Organic carbon*	*pH*	*Moisture*	*C:N Ratio*
S7	2.18	13.01	7.01	18.92	5.96
S8	1.68	12.50	6.32	14.07	7.44
S9	1.86	13.78	6.98	15.60	7.40

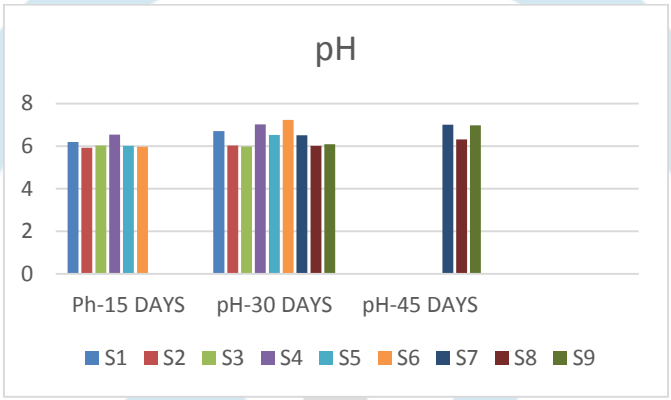
The tests were conducted after the 45 days of mixing. The Nitrogen was increased in the Sample no 7. Organic Carbon was increased only in a sample no S9. While pH was within limit. Moisture content was maintained by spreading water 2 times in a week to improve the microbial growth and the moisture content was within limit. C: N ratio was decreased.



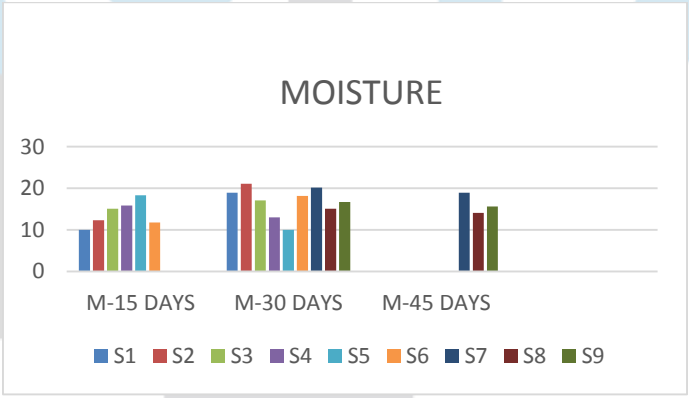
Graph 1: Nitrogen level



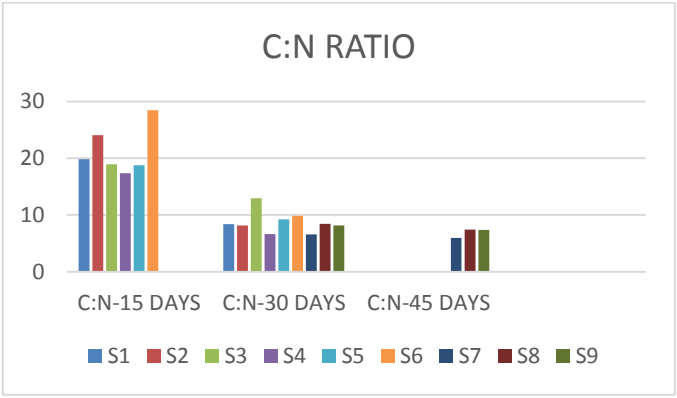
Graph 2: Organic carbon level



Graph 3: ph level



Graph 4: Moisture level



Graph 5: C:N ratio level

V. COST ANALYSIS

As per the results the good quality of compost can be achieved by adding the combination of rock phosphate and sludge mixture in MSW Compost.
MSW compost of Hadpsar site cost 2500 Rs/tonne.
Cost of Rock phosphate per kg is 40 Rs.
For the 1 tonne of good quality compost 16 kg rock phosphate is needed which costs-600 rs
The sludge which produced in any Sewage treatment plant requires 500 kg for 1 tonne. Which is free of cost.
Compost cost(2500)+Rock phosphate(600) =3100 Rs/tonne good quality compost.

VI. CONCLUSION

It can be concluded from present study that addition of sludge with 33%& rock phosphate with 0.99% helps to increase nitrogen there by reduces C:N ratio.
The maximum increase is found to be 1.8% for 30 days maturation period by maintain moisture content for additives rock phosphate and sludge combination.
The amount of additives added helps to increase the quality of compost produced.
Hence making it is beneficial to cope up nutrient requirement.
On the other hand the use of urban waste compost not only solves one of today's major problems of disposal of urban waste but also provides nutrition to plants and soil.

References

[1] Rizwan AHMAD1, Ghulam JILANI2*, Muhammad ARSHAD3, Zahir A. ZAHIR3, Azeem KHALID3Bio-conversion of organic wastes for their recycling in agriculture: An overview of perspectives and prospects**,**Research gate 57(4) 471-479-2007.

[2] ESTHER VANLALMAWII, MAMTA AWASTHI,Municipal Solid Waste Composting- A Review, International Journal of Advances in Science Engineering and Technology, ISSN: 2321-9009, Vol-4, Iss-2, Spl. Issue-1 Apr.-2016)

[3] Aeslina Abdul Kadir1, NurWahidah Azhari1 and SitiNoratifahJamaludin,An Overview of Organic Waste in Composting,,Owned by the authors, published by EDP Sciences,2016

[4] JinHee Park, Dane Lamb, PeriyasamyPaneerselvam, Girish Choppala, Nanthi Bolan, Jae-Woo Chung,Role of organic amendments on enhanced bioremediation of heavy metal (loid)contaminated soils,Journal of Hazardous Materials 185(2011)549-574.

[5] Shyamala D.C, Belagali S.L; Studies on Variations in Physico-Chemical and Biological Characteristics at Different Maturity Stages of Municipal Solid Waste Compost INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 2, No 4, 2012, ISSN 0976 – 4402)

[6] ManjuRawat*, AL. Ramanathan, T. Kuriakose,Characterisation of Municipal Solid Waste Compost (MSWC) from Selected Indian Cities—A Case Study for Its Sustainable Utilisation, Journal of Environmental Protection, 2013, 4, 163-171)

[7] IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT Suitability of Urban Waste Composts for Organic Farming: - An Assessment through Quality Indices Based Approach in Kerala, India e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 9, Issue 4 Ver. III (Apr. 2015), PP 01-07

[8] S. O. Mutairi, A. M. Ghoneim, A. S. Modaihsh, M. O. Mahjoub& R. A. Abdel-Aziz, The characterization and composting of the municipal solid waste of Riyadh city, Saudi Arabia WIT Transactions on Ecology and The Environment, Vol 180,©2014 ,ISSN 1743-3541.

[9] S.P. Gautam, P.S. Bundela, A.K. Pandey, M.K.Awasthi and S. Sarsaiya, Composting of Municipal Solid Waste of Jabalpur City Global Journal of Environmental Research 4 (1): 43-46, 2010 ISSN 1990-925X © IDOSI Publications, 2010.

[10] (FarshadGolbabaeiKootenaei, Hasan Aminirad* and MaedehRamezani, Composting of Sewage Sludge and Municipal Solid Waste, Nature Environment and Pollution Technology an International Quarterly Scientific Journal, ISSN: 0972-6268, No. 3, Vol-13, 2014.

[11] SEEMA JILANI Department of Science, Municipal Solid Waste Composting and its Assessment for Reuse in Plant Production Textile Institute of Pakistan, City Campus: 10F, Block-6, PECHS, Karachi-75400, Pakistan. Pak. J. Bot., 39(1): 271-277, 2007.

[12] M.H.Hasanimehr, H.AminiRad, V.BabaeeandM.Sharifzadehbaei, Use of Municipal Solid Waste Compost and Waste Water Bio solids with Co-Composting Process World Applied Sciences Journal 14 (Special Issue of Food and Environment): 60-66, 2011 ISSN 1818-4952.