

Survey on qualitative characteristics of compost and Bio-compost fertilizers

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Abstract: In all of aspects of wastes management, observance of rules and standards is vital and necessary in protection of environment and biosphere. In creation, developing and processing management of compost and biocompost industries, observance of scientific standards and controlling the qualitative characteristics of products are inevitable. So economic and health consideration initiated a study aiming to investigation on qualitative characteristics of compost and biocompost in Shiraz city of Iran. For identifying quality of those fertilizers samples collected in winter and summer of 2008 and physical and chemical characteristics have been investigated. The results showed that concentration of nutrients such as nitrogen, phosphorus, calcium and potassium are in normal level. In contrast concentration of heavy metals such as nickel, plumb and cadmium are not in proper levels and humidity percent of fertilizers are below the normal limit due to evaporation and high temperature of summer season. Totally, the quality of biocompost is higher than compost because of higher percentage of organic materials and keeping compost and biocompost in desired quality requires more protection especially in high temperature seasons.

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1. Introduction

Today the discussion of environmental pollution which is one of the consequences of technology and industry development, would be one of the difficulties that human faces. One of the most important problems in this current century is wastes management “(Omrani, 2003)”. This management in most cities of Iran is limited to collecting, dumping and or inappropriate burial in out of town that results pollution of environment and destructions of thousands of hectares. With regard to the increasing number of population and especial attention which must be paid to environment protection, collecting, recycling and reusing of wastes have become important topics. Fifty percent reduction of the volume of wastes as a result of waste processing, also prevention of green house gases by compost & biocompost production, saving 3 to 4 hectares in burial land by recycling processing all together cause today societies work toward improvement of recycling processing and reusing of wastes“(YRM, 2006)”. Organic materials that existing in wastes is responsible for nearly 70% of whole solid wastes and recycling of these materials could save raw materials and energy “(Omrani, 2003)”. Nowadays by using new methods and tools it's possible to produce biological fertilizers which could be used in agricultural activities, Compost and biocompost fertilizers are the most important and the most famous

of these fertilizers “(Brinton, 2005)” & “(Scott, 2006)”. Compost is one of the biological fertilizers which comes from biological processes and activity of microscopic organisms such as fungi and bacteria on foods waste, plants and... is obtained and biocompost is a biological fertilizer which can be obtained from fermentation process of food wastes and organic materials, unlike the compost, it lacks foreign and artificial elements “(Raddle, 2002)”. During the years in shiraz the plan of teaching the separation of organic wastes, the plan of none-recycled wastes processing with method of reducing the physical and biological volume were done and simultaneously necessary actions for implementation the biocompost project and wastes processing project in shiraz city, also training studies for separation dry recycled wastes and wastes collecting management were done. The place of Producing of compost & biocompost is BARM-E-SHOUR with 25000 tones capacity yearly“(YRM, 2006)”. Now these products are consuming in agricultural activities. Population of shiraz is 1727333 person that they are producing 950 tons wastes daily and the cost of every person (for municipality activities) is 94996 Rial yearly“(YRM, 2006)”. Therefore exploitation of Shiraz recycling project reduces related cost of burial and yet from the view of environmental principals and regulations appear to be essential “(YRM, 2006)”. With regard to yearly production of 25000 tones compost and biocompost

and consumption of fertilizers by urban green space and agricultural lands and outskirts of Shiraz, also sending fertilizers to nearby provinces, study the quality of fertilizers parameters produced by Shiraz recycling organization to determine the regulations of separation between waste components from the origin, and planning in order to improve the urban waste management as well as increasing the quality of the productions which come out of wastes seem necessary and so vital.

2. Material and Methods

The essence of study is descriptive-analytical and this method is based on sampling during two seasons (winter and summer 2008) from mass of fertilizer and doing physical and chemical analysis and study of different quality of fertilizers during the year of 2008. According to the scheduled planning for mass analysis and fermentation process of mass fertilizers and the pattern of giving air and moisture to the compost and biocompost fertilizers at the place of the factory in Shiraz. Also because of the changes of regional weather conditions which could affect on the quality of soil and fertilizers in both summer and winter, therefore, the study and sampling were done only in these two seasons. Eventually 9 sampling based on the method of randomly-regular from masses of compost and biocompost fertilizers were taken separately in summer and winter. Nitrogen by a method called Kjeldal, phosphorous by spectrophotometer method, potassium by flame photometer method, organic carbon by titration, humidity by weight measuring, electrical conductivity meter, PH by PH meter and ions of calcium,

magnesium, iron, zinc, copper, manganese and heavy metals such as nickel, lead, cadmium and chrome by atomic absorption were measured. The bacterial and fungal analysis of compost and biocompost fertilizers performed by a method called LGP01101 provided by standard method of measurement "(Pears, 2000)" & "(Bilitewski, 1999)". It has to be mentioned that all statistical figures and numbers was performed by Spss software "(Schwedt, 2002)".

3. Results

In this section the results of samplings analysis of compost and biocompost fertilizers are separately shown based on type and season: According to this statistical calculations, the average concentration of total nitrogen, total phosphorus and potassium as the most important nutrients in the winter of 2008 in compost 1.4% dry material, 0.4% dry material and 1.45% dry material and in biocompost 2% dry material, 0.76% dry material, 1% dry material were measured. Organic carbon and organic elements as criteria to determine organic material of fertilizer in winter of 2008, in compost 12.8% dry material, 19.5% dry material and in biocompost 21.2% and 30.2% dry material were recorded. Statistical studies on fertilizer masses in the summer of 2008 indicated that total nitrogen, total phosphorus and potassium in the compost respectively are 0.88%, 0.53%, 1.2% dry material and in biocompost these figures respectively are 1.4%, 0.89% and 2% dry material. The amount of carbon and organic material existed in compost and biocompost in the summer of 2008 respectively were measured 40%, 0.28%, 20.3% and 47.2%. (Table 1)

Table 1. Results of Physical & Chemical Analysis of Compost & Biocompost (Winter & Summer 2008)

Parameter	Compos (winter 2008)	Biocompost (winter 2008)	Compost (summer 2008)	Biocompost (summer 2008)
Nitrogen (%)	1.4	2	0.88	1.4
Phosphorus (%)	0.4	0.76	0.53	0.89
Potassium (%)	1.45	1	1.2	2
Calcium (%)	2.5	2.2	4.5	5.5
Magnesium (%)	0.53	0.53	0.6	0.68
Sodium (%)	1.48	1.52	2.08	1.7
Organic carbon (%)	12.8	21.2	40	20.3
Humidity (%)	18.16	19.3	9.2	14.01
EC ($\mu\text{s}/\text{cm}$)	4.07	3.75	29.8	40.7
PH	8.61	8.46	7.3	7.3
C/N	8.8	11.4	14.69	21.7
Organic material (%)	19.5	30.2	0.28	47.2

In (Table 2) we can see the statistical analysis of the most important heavy metals found in soil and fertilizers. In the winter of 2008 the concentration of nickel, lead and cadmium as the major soil pollutants in compost fertilizer were determined respectively as

the following figures: 43 mg/kg, 99 mg/kg, and 3 mg/kg and as long as for biocompost concerns these figures respectively are: 29 mg/kg, 43.5 mg/kg and 2.2 mg/kg. Statistical calculations in summer of 2008 showed the average concentration of heavy metals,

nickel, lead and cadmium in compost fertilizer respectively 47 mg/kg, 58 mg/kg and 7.5 mg/kg and in biocompost fertilizer respectively 20 mg/kg, 45.6 mg/kg and 4.9 mg/kg. (Table 2) Also released fungal and bacteria analysis from biocompost and compost

fertilizers that no bacteria contamination exists in fertilizers masses and fertilizers from this point of view are clean and clear. Also the samples of compost and biocompost fertilizers don't contain any seeds of weeds.

Table 2. Analysis of Compost & Biocompost (Winter & Summer 2008)

Parameter	Compost (winter 2008)	Biocompost (winter 2008)	Compost (summer 2008)	Biocompost (summer 2008)
Ni (mg/kg)	43	29	47	20
Pb (mg/kg)	99	43.5	58	45.6
Cd (mg/kg)	3	2.2	7.5	4.9
Cr (mg/kg)	37.1	55.12	39	59
Mn (mg/kg)	297	203	365	245
Zn (mg/kg)	708.2	305	658	358
Cu (mg/kg)	194.5	44.9	240	48

4. Discussions

With regard to production mechanism of compost and biocompost fertilizers at the factory of shiraz that includes two stages (first stage 4 to 6 weeks and second stage 5 to 10 weeks), also with evaluating the results of qualitative analysis of fertilizers and comparing with international standards of physical and chemical quality of fertilizers in (Table 3), It was found out the quality of fertilizers is pretty desirable. The physical analysis of Shiraz household wastes showed 80% of these wastes are recyclable. From this amount, 69% is formed from organic wastes and this is a nice scientific-economic justification to establish and open a factory that produces fertilizers from household wastes. Nitrogen concentration, phosphorus and potassium are among the most important nutrients in the fertilizers are in the range of proposed standards. Also concentration of other ions in compost and biocompost fertilizers is in appropriate range which demonstrates proper fermentation and decomposition of organic waste materials by micro organisms. But overall concentration and percentage of these elements in the summer due to the change in diet of households and increasing of general volume of wastes and organic materials in the wastes, compare to winter is better and more appropriate. Organic carbon percentage and organic materials in biocompost is better than in compost. Absence of inorganic materials and separation from origin which happens in biocompost fertilizers is the main reason for high existence of organic materials in biocompost The ratio of carbon to nitrogen in summer season is due to the change in diet and the increase of organic materials such as fruits and increasing of organic wastes percentage in household wastes is higher with regard to winter. In winter season because of reduced evaporation from the surface of fertilizers and the increase of atmospheric raining that raises the amount of moisture

in fertilizer masses, the ions concentration is reduced and consequently the increase of PH is observed, in two samples of tested fertilizer, the measured PH in winter is greater than 8 and in winter the amount of PH is less than summer. Even though the type of regional soil and the climate have alkaline trend with considering the fact that it has a great impact on alkali fertilizers. Concentration of heavy metals in biocompost fertilizers is less than compost and this is due to the separation of waste in the origin but since the compost fertilizer comes from the processing of regular waste in the factory, Due to the lack of proper separation of machineries and relatively the high diameter of riddle holes (8 mm) that cause small and mixed metals cause the mixing of them with riddled fertilizers and sometimes the lack of attention by the workers in separating the wastes, some foreign materials such as various metals remain in the wastes and this will be the major source for heavy metals in compost. But in general except for cadmium, the concentration of heavy metals in compost and biocompost fertilizers is considered as standard. In general the use of screen with smaller diameters (2 & 5 mm) can improve the formation of fertilizers as well as decrease the mixture of inorganic materials in fertilizers. The average cadmium concentrations in the summer in compost is 7.5 mg/kg, compared to the standard which is 6 mg/kg seems to be high. Studies show nickel cadmium batteries are the main reason for increasing of cadmium concentrations in fertilizers, paying more attention in separation and segregation of metal elements especially batteries from wastes and making sure that the magnets of absorbing metals machineries are working properly, could reduce a lot of our problems in this area. Yet the biggest problem of fertilizers is the high concentration of minerals and subsequently high electrical conductivity and salinity of fertilizer masses. The major reason for this problem is high electrical conductivity and salty water which is

used to give moisture to fertilizers and high evaporation from fertilizers surface. Electrical conductivity of water used is approximately 5000 milizimenc on millimeter which indicates high concentration of anions and cations in the water. In the summer because of high evaporation from the surface of fertilizers, the concentration of minerals in fertilizers increases so that the salinity and electrical conductivity reaches higher than standard limit. Sample of biocompost in the summer with the average of 40.7 $\mu\text{s}/\text{cm}$ shows the highest electrical conductivity. The change in the source of water and the selection of water with lower electrical conductivity can reduce the problem of salty water and high electrical conductivity of fertilizers especially in summer. In some tough situation when the air humidity decreases and the high temperature

increases evaporation, the use of felt coverage in order to decrease the evaporation from the surface of fertilizers can be considered as a good solution. In some cases by adding lime or sulfur with regard to salinity of fertilizers, it is possible to control salinity and also preserve the PH of masses in standard level. Totally after analyzing and observation of the results, it can be concluded that the quality of fertilizers in the summer due to the condition of regional climate, high temperature, high wind and less rain is worse than the winter. The quality of biocompost fertilizers because of separation processing from the origin by households and high amount of organic material is higher than the quality of compost fertilizers. So by Buying advanced machineries such as glass and intake screen (2mm), the quality of compost fertilizer could be better and better.

Table 3. Characteristics of Compost & Biocompost Components (International Standards, 2008)

Number	Parameter	scale	Value
1	Dry material	Percentage of fresh materials	55-70
2	Organic carbon	Percentage of dry materials	20-40
3	Carbon/Nitrogen	-	10-20
4	PH	-	7-8
5	Humidity	Percentage of volume	35-65
6	Nitrogen	Percentage of dry materials	0.4-1.8
7	Phosphorus	Percentage of dry materials	0.8-2.8
8	Potassium	Percentage of dry materials	0.6-2
9	Nitrogen	Mg/lit of fresh materials	400-500
10	Magnesium	Mg/lit of fresh materials	150-350
11	Mercury	mg/kg	5
12	Zinc	mg/kg	1300
13	Plumb	mg/kg	150
14	Cadmium	mg/kg	6
15	Nickel	mg/kg	120
16	Chrome	mg/kg	100

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