Nature Environment and Pollution Technology © Technoscience Publications	Vol. 7	No. 3	pp. 479-482	2008

A Study on Biocomposting of Concentrated Distillery Spent Wash

D. S. Mali and S. V. Ranade*
P. G. Department of Environment Management, Chhatrapati Shahu Institute of Business Education and Research (SIBER), University Road, Kolhapur-416 004, Maharashtra
*Department of Civil Engineering, Walchand College of Engineering, Sangli, Maharashtra

Key Words:
Bio-composting
Aerobic composting
Distillery spent wash
Molasses
Bagasse
Press mud
Farm yard manure

ABSTRACT

Dark colour, low pH and high organic load characterize the distillery waste called as spent wash. If spent wash is disposed off in environment without proper treatment it poses threat to it. Out of available treatment options aerobic composting of spent wash is one of the best options. The by-products of sugar industry such as press mud and bagasse were used as filler materials. The experiments were carried out in plastic containers of 20-L capacity. The press mud and bagasse were mixed in 5:1 proportion. The spent wash was added to this mixture till the moisture content was approximately 70 %. The seeding was done with the help of Farm Yard Manure (FYM). The aeration was done manually by overturning the contents for 30 days at the interval of one day. The samples were analysed for temperature of composting mass, moisture content, organic carbon, nitrogen, pH, COD, chlorides and conductivity. Reloading of spent wash was done to maintain the moisture content. It was observed that the rate of reaction was higher at the initial stages of composting. The increase in temperature was observed at the initial stage, which went on decreasing as composting of the mass was completed.

INTRODUCTION

Nearly 70 % population of India lives in villages. This population is directly or indirectly concerned with farming. The economic development of the country is based on the yield from agriculture fields. The sugar industry is one of the main agro-based industries in the country. There are about 514 sugar factories in India running at present. Many sugar factories have constructed distillery as adjacent industry for the production of alcohol (Mali 2003).

The by-product of sugar industry, molasses is utilized in the distillery as a raw material. The molasses is diluted to sugar content of about 15 % and then is fermented with yeast. After fermentation the contents are distilled for the production of alcohol. The waste generated during the distillation is called spent wash. The quantity of spent wash generated per litre of alcohol production in a bio-still type of distillery is around 9 litres. High COD, BOD values and its dissolved solid content characterize the spent wash. It has very low pH. For these reasons extensive treatment of spent wash is very much essential before its final disposal into the water body or in the environment.

The major methods, which are used for the treatment of spent wash are lagooning, anaerobic digestion with recovery of methane, concentration and incineration and composting. All these methods suffer from disadvantages like area requirement, groundwater pollution, odour nuisance and high capital investment. The most promising method out of these is aerobic composting of spent

wash (Mali 1992). In this method the spent wash is mixed with press mud and bagasse, which are also originated from the sugar industry. The press mud production will be about 3 to 5 percent and the bagasse production is 30 to 40 percent of cane crushed (Jalgaonkar 1994). These two materials are mixed in 5:1 proportion respectively to have proper gradation and desired C/N ratio. The press mud, bagasse and spent wash are mixed uniformly to have the moisture content around 70 %. The temperature of the composting mass will get increased due to microbial activity. To maintain the temperature in favourable range and for supply of oxygen, the contents are overturned frequently (Mali 1999).

Table 1. Physico-chemical characteristics of press mud.

Sr. No.	Parameter	Value
1	Colour	Muddy Brown
2	Odour	Jaggery
3	Moisture Content (%)	52
4	pH	7.10
5	COD	1064
6	Chlorides	480
7	Nitrogen (%)	1.23
8	Organic Carbon (%)	30
9	Potassium (K_2O_5) (%)	0.80
10	Total Volatile Matter (%)	78.20

All the values are in mg/L, otherwise stated. Leachate water is prepared with the help of distilled water in 1:5 proportion.

There are number of operating parameters which govern the composting process. Microorganisms or inoculum is one of them. Aerobic composting is a dynamic process in which bacteria, actinomycetes, fungi and other biological forms are actively involved. At the initial stage of composting, mesophilic organisms predominant. The aerobic composting being exothermic the temperature of composting mass increase and thermophilic bacteria become active in decomposition at latter stage. Temperature, aeration, organic matter, pH, etc. also have effect on composting (Bhide & Sundareshan 1983). It was thought worthwhile exercise to evaluate the controlling parameters of composting process.

MATERIALS AND METHODS

The experiments were carried out in plastic containers of 20-L capacity. Fresh press mud and bagasse were used as filler materials. The lumps of bagasse were broken and mixed thoroughly with the press mud. The press mud and bagasse was mixed in 5:1 proportion. The spent wash was added to this mixture till the moisture content is approximately 70 %. The seeding was done with the help of Farm Yard Manure (FYM). The aeration was carried out manually by overturning the contents for 30 days at the interval of one day. After mixing of the contents sample was taken for the analysis. The values presented are average of two sets. The analysis of press mud, bagasse and spent wash is given in Tables 1, 2 and 3 respectively.

Table 2. Physico-chemical characteristics of bagasse.

Sr. No.	Parameter	Value
1	Colour	Whitish Brown
2	Odour	Jaggery
3	Moisture Content (%)	5
4	pH	7.3
5	COD	364
6	Chlorides	30
7	Nitrogen (%)	0.83
8	Organic Carbon (%)	45
9	Potassium (K_2O_5) (%)	0.12
10	Total Volatile Matter (%)	86.8

Units as per Table 1.

The controlling parameters like pH, temperature, COD, organic carbon (OC), nitrogen (N), moisture content, chlorides (Cl), conductivity and C/N ratio were monitored during the experiment. The ambient temperature was noted for comparison purpose. Leachate was prepared by mixing one gram of dried and sieved (500 micron sieve) sample in 100 mL hot

Table 3: Characteristics of concentrated spent wash (bio-still process).

Sr. No.	Parameter	Value
1	Colour	Dark brown
2	Odour	Jaggery smell
3	pH	4.3-4.5
4	COD	200000-220000
5	BOD_5 at 20°C	90000-95000
6	Total Solids	270000-280000
7	Chlorides	13000-15000
8	Sulfate as SO_4	15000-18000
9	Nitrogen (TKN)	2000-2500
10	Potassium (K)	18000-20000
11	Sodium (Na)	300-500
12	Calcium (Ca)	2600-2700

Units as in mg/L except colour, odour and pH, otherwise stated.

distilled water. The pH, COD, chlorides and conductivity of composting mass was estimated by using the leachate. Using standard protocols of compost analysis the organic carbon and nitrogen were estimated.

RESULTS AND DISCUSSION

The quantity of press mud taken for experiment was five kilograms and that of bagasse was one kilogram. The spent wash absorbed without leaching is 10 litre within thirty days. So it can be said that the maximum loading achieved is around 1:1.67. However, in field condition the composting mass will be exposed to sun due to which the spent wash absorption may go up to 1:2. The requirement of spent wash was more at early stage of composting than that at latter stage. This can be ascertained to high rate of reaction at the beginning. The temperature rise was also more during beginning of the composting process. The maximum temperature recorded was on seventh day and it was 51°C. The spent wash loading was done on the 1st, 6th, 10th and 19th day. After each reloading the temperature rise was observed. The pH of compost becomes alkaline from acidic within first few days and it remains so till the end of composting process. The reduction in organic carbon was also observed which is due to the evolution of CO_2 during aerobic degradation of organic matter (Ingle 1999). The decline of C/N ratio is an indication of completion of composting process. Initial C/N ratio was 25 while it was 12 on the 30th day. The initial COD of leachate was 2772 mg/L but it was only 410mg/ L at the end of composting. The nitrogen was increasing while organic carbon gets decreased with time and at end C/N was close to 10, which confirms the completion of composting process. No much change was observed in chlorides and conductivity values. It can be concluded from the experiment that the composting of spent wash from bio-still process requires 30 to 35 days. The time required is same for batch process spent wash also (Mali 2002). The compost prepared will have high nutrient value and it will meet the country's demand for manure.

ACKNOWLEDGEMENT

The author (DSM) is indebted to Prof. A. D. Shinde, Founder Director & President of SIBER, Prof. R. V. Kulkarni, I/C Director, and Prof. A. R. Kulkarni, Head of the Department, for providing facilities to carry out the work. The help of laboratory assistants is also acknowledged.

Table 4. Analysis of composting mass with concentrated spent wash.

Day	Room Temp.°C	Comp. Temp.°C	Mois. (%)	OC (%)	N (%)	C/N	pH	COD (mg/L)	Cl (mg/L)	Cond. µmohs/cm
1*	27	27	67	47.0	2.13	22	6.9	2772	272	1880
2	30	39	65				7.5			
3	28	41	63				7.4			
4	26	45	63				7.6			
5	31	47	65				7.9			
6*	27	38	61	45.8	2.16	21	8.2	810	256	1630
7	26	51	70				8.2	676		
8	28	39	69				8.2			
9	27	32	65				8.3			
10*	28	31	64				8.4			
11	28	44	65	38.2	2.20	17	8.3	592	230	1590
12	28	33	63				8.2			
13	28	31	60				7.2			
14	28	30	59				7.7			
15	28	28	58				7.8			
16	28	29	55				7.8			
17	29	30	54	34.6	2.26	15	7.9	600	220	1280
18	30	29	50				7.9			
19*	30	29	48				8.1			
20	30	30	58				8.2			
21	29	31	55				7.6			
22	27	29	52	30.0	2.30	13	7.8	920	280	1600
23	26	28	52				8.9			
24	26	27	50				8.9			
25	25	26	50				7.3			
26	26	27	53				7.6			
27	27	27	52				7.8			
28	28	28	52				7.8			
29	29	29	50				7.8			
30	29	29	51	28.8	2.31	12	7.9	410	260	1400

* Loading of spent wash was done (Day 1 - 6L, Day 6 - 2L, Day 10 - 1L, Day 19 - 1L)

REFERENCES

Bhide, A.D. and Sundarshan 1983. Solid Waste Management in Developing Countries, Indian National Scientific Documentation.

Ingle, S.T. 1999. Utilization of municipal solid waste by composting. Proc. of All India Conference on Environmental Pollution Strategies for Control and Abatement. Organized by Institution of Engineers (India) Local Center, Tirupati, pp. 36-38.

Jalgaonkar, A.D. 1994. Power generation based on distillery spent wash. Proc. of Workshop held by Tata Energy Research Institute, New Delhi.

Mali, D.S. 1992. Comparative Performance Study of Different Bacterial Cultures for Spent-Wash Composting. M. E. Dissertation, Shivaji University, Kolhapur.

Mali, D.S. 1999. Study of some factors affecting aerobic composting of spent-wash. Proc. of All India Conference on Environmental Pollution Strategies for Control and Abatement. Organized by Institution of Engineers (India) Local Center, Tirupati, pp. 27-29.

Mali, D.S. 2002. Aerobic composting of spent-wash. J. Ecotoxicology & Environment Monitoring, Palani, 12(2): 101-104.

Mali, D.S. 2003. Study of spent wash composting process for distillery waste management. J. Environment & Ecology, 21(3): 692-695.