



MANAGEMENT OF SOLID WASTE IN SUGAR INDUSTRY

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ABSTRACT

Sugar industry are mainly based on agricultural crops like sugarcane and beet. These industries at the time of processing raw cane generates very big amount of solid waste in the form of simple to complex in nature. These industries generating 258.74 kg of bagasse, 33.77 kg of press mud, 0.0142 kg of sludge, 34.30 kg of molasses per metric tone of sugarcane crushed respectively. Near about 2% ash is generated after burning of 1 kg bagasse. These all solid waste is organic in nature and highly degradable so as it is commonly disposed on the ground. This unscientific disposal of solid waste creates land, air, water and soil pollution problems as well as ground water pollution.

KEYWORDS: Solid waste, Bagasse, molasses, press mud, pollution, management.



INTRODUCTION:

From the end of 20th and beginning of 21st century sugar industries are becoming hen of golden egg for farmers in Maharashtra. As on today more than 173 co-operative and 23 number of private sugar industries in Maharashtra. These all sugar industries are crushing about 67.13 million tons of sugarcane per year. This all sugar manufacturing industries are producing various types of solid waste and it is disposed or dumped on ground unscientifically which further becomes the cause of environmental pollution. This solid waste primarily in the form of organic and

inorganic in nature and it is generated in different sugar manufacturing sections in sugar industry. Some of the following major sources are generating solid waste in sugar industry.

Sources of solid waste in sugar industry:

a) Milling section – In this section cutted piece of sugarcane is converted into fibers are crushed and juice is extracted. Here the juice (liquid) and fibrous solid material (bagasse) is generated. This bagasse is a organic waste and it is hugely generated in sugar industry.

b) Juice filtration section – Separated sugarcane juice contains huge amount of fine

bagasse particles, volatile and colloidal particles which separated with the help of cloth filtration where juice and solids are separated. Separated solids contain juice hence it is again sent to de-juicing section where all juice is extracted and separate the impurities in the form of solids are called press mud.

c) Crystallization Section – After evaporating juice, it is converted into syrup and then this syrup is feeded to crystallizer where granulated sugar is produced. Produced sugar is separated and sent it for bagging. At the end of sugar separation small quantity of semi liquid dark brown colored waste (Molasses) is generated in this section.

d) Metallic Solid Waste – From the unloading section of sugarcane to sugar production section there are so many sub-sections and from this sections lots of metallic scrap is

generated.

e) Boiler Section- In this section huge amount of bagasse is used as fuel and after burning of bagasse it produce bagasse ash as a solid waste in the sugar industry.

f) Another type of solid waste - like Plastic bag, PVC waste, Rubber pipes, Thermocol, e-waste and Fiber waste is generated in industry.

g) Sludge- At the last where waste water is treated in effluent treatment plant (E.T.P.), from this unit vast quantity of sludge is generated which is dried in sludge drying bed and converted into dry sludge cake as solid waste.

Above this all type of solid waste is not properly and scientifically managed by the sugar industries. This unscientific management practices of solid waste results into pollution of air, water, land, soil and affects animal and plant health. Now technology has made development to convert this type of solid waste into economic resources through its reuse, recycle, reduce and reconvert (4R) them into raw material for further use. This practice are highly needed for sustainable development and keeping our earth safe and clean.

MATERIAL AND METHODS :

For the present study on solid waste management in sugar industry, field visits are made for various sugar industries and observations are made for types of solid waste and their management practices. Some data and information's are collected from their register and some information's collected through interviews of unit in-charge of sugar industry. For understanding the further uses of various types of solid waste, subsidiary sites where these solids are used that sites also visited and related information's are collected from its users. The processed compost sample was collected and analyzed in laboratory for physico-chemical characteristics with the help of methods prescribed by APHA (1998). Another byproduct and their related economic recovery information's are collected from concerned managers.

RESULTS AND DISCUSSION :

Sugarcane is main raw material required to sugar industry which is produced by the farmers. After its harvesting it is transported to sugar industry and here after unloading, it is processed for cutting in small pieces and further it sent for converting into fiber in fiber section. These fibers then after processed in milling section with addition of water to extract maximum juice and here the juice and bagasse is separated. The quantity of bagasse 285.74 kg is produced per metric ton of sugarcane crushed. Then this juice is filtered for separation of colloidal, volatile and soil particles where bagasse is directly dumped on dumping land site with the help of conveyor belt and this is the first solid waste is generated by sugar industry (Photo plate 2).

From the juice filtration which solids are collected, they contains juice and to achieve more recovery of sugar production, these solids re-again processed in rotary vacuum where juice and solids are separated and it is second most important solid waste generated about 33.77 kg/MT of sugarcane crushed by sugar industry and it is called as press mud (Photo plate 1).

After processing of sugarcane juice with addition of various chemicals it sent for evaporation where it is converted into dark brown color syrup and then it is feeded to crystallizers where white granulated sugar is produced. In this section after separation of sugar, small quantity of brown colored syrup remains inside the pan which is poor in carbohydrates is separately collected and stored. It is third important solid waste generated by the sugar industry and it is called as molasses (Photo plate 3) Near about 34.30 kg. of molasses is generated per metric ton of sugarcane crushed.

Above these solids are considered as solid waste but today these waste must be considered as a byproduct because with the help of scientific development in technology it is made possible to convert them into economic product for their further uses. Following table 1. Shows types and quantity of solid waste generated by sugar industry. The another type of solid waste is generated in sugar industry is ash. The main sources of ash produced in sugar industry from boiler house and co-generation plant. In these two units sugar industries are using bagasse as fuel and from the burning of 1kg of bagasse it generates near about 2% ash in sugar industry. Generally this ash is used or dumped for land filling purpose which further becomes cause of soil, water and air pollution.

Table 1 : Types and quantity of solid waste generated by sugar industry.

Sr. No	Types of solid waste	Quantity of solid waste in kg/MT of sugarcane crushed.
1	Bagasse	285.74
2	Press mud	33.77
3	Molasses	34.30
4	Sludge from ETP	0.0142
5	Ash	2% /kg of bagasse burning

Source: From sugar industry office record.

SCIENTIFIC MANAGEMENT OF SUGAR INDUSTRY SOLID WASTE :

Above this waste are traditionally disposed on ground or used for land filling and this unscientific solid waste management practices are harmful to environment and ecosystem. They make air pollution, land pollution and water pollution. So it is now needed to manage them scientifically to avoid environmental degradation. For scientific use and management of press mud it is treated with different bacterial culture about 36 to 40 days with maintaining temperature in between 50-60°C. and it is converted into best quality of compost. This compost contains 32-37% moisture, black in color, odour free and it is highly applicable in any crop field for improving soil fertility and crop yield. Following table 2 shows the physico-chemical characteristics of compost. These characteristics of compost are idle and very much needed to meet the requirement of crop. It also helps to maintain soil pH, its fertility and productivity as well as it helps to avoid soil salinity with increasing water holding capacity of soil. It is best substitute organic manure for avoiding use of chemical fertilizers and achieve more economy of the crop yield. This ready compost is sold by compost producers in market at Rs. 300-400/MT. Photo plate No. 1 shows the manufacturing process of compost with using spent wash which is generated in distillery industries.



Photo plate 1: Manufacturing process of compost with using press mud and spent wash.

Table No. 2 : Physico-chemical characteristics of Compost.

Sr. No	Parameters	Values
1	Color	Black
2	Odor	Odorless
3	Conductivity (μ Mhos/S)	1280-1415
4	Moisture (%)	32-37
5	Ash(%)	32-34
6	pH	7.4-7.6
7	Chlorides (mg/l)	285-390
8	COD (mg/l)	210-258
9	BOD (mg/l)	55-65
10	Nitrogen (%)	1.7- 2.30
11	P as P ₂ O ₅ (%)	1.8-1.9
12	K as K ₂ O (%)	2.3- 3.4
13	Organic Carbon (%)	25.0-28.20

In the view of scientific management practices of solid waste, bagasse have high calorific value and its availability on site, it is used by the sugar industry as a fuel for boiler house for generating steam. As on today most of the sugar industries are self-sufficient in electric power requirement due to establishment of their own co-generation power plant. This co-generation plant mainly based on use of bagasse as a fuel. The advance development in scientific technology made it possible to use of the bagasse as a fuel in co-generation plant to produce steam and this steam is supplied to the turbines to produce electric power. The excess bagasse remains with them is sold in market at cost of Rs. 1800-2000/MT and it is used in manufacturing of particle board by particle board manufacturers (Photo plate-2and 6). After burning of bagasse in boiler house and in co-generation unit, the vast quantity of ash is produced and it is separately collected and stored on site.

**Photo plate 2 : Bagasse is sent to particle board manufacturing industries.**

The low quality bagasse i.e. bagasse dust remains on site which is highly required by the soil bricks manufacturers where they are mixing it with soil and homogenize it. The use of bagasse dust in soil works as a binding material. Photo plate 4 and 5 shows the use and mixing of bagasse dust in soil by bricks manufacturers.



Photo plate 4 : Bagasse dust is used in manufacture of soil bricks.



Photo plate 5: Bagasse dust is mixed with soil mud for manufacture of soil bricks.

In sugar industry boiler house and co-generation units are producing ash as a solid waste. This ash is rich in carbon and it can be useful to farmers as a catalytic agent in farm soil practices. The another use of ash is made in manufacturing of soil bricks (Photo plate-7). Number of bricks manufacturers using ash as a binding material as well as getting fine plane surfaces to bricks and reduce the weight and minimize the soil quantity required for bricks manufacturing.



Photo plate 7 : Bagasse Ash is used in manufacture of soil bricks.



Photo plate 8 : Dry sludge cake generated from ETP.

Molasses is the final last semi solid waste is generated in sugar industry. This molasses contains 50-52 % of total reducing sugars and it is highly required by the distillery industries for the production of ethyl alcohol. This ethyl alcohol is mainly required in various industries as a preservative, for the production of other alcohol based chemicals as well as in beer and liquor manufacturing industries. Photo plate 3 shows the diluted molasses and then this diluted molasses is loaded in fermenter where it is fermented with addition of yeast. After completion of fermentation period it is sent for distillation where alcohol is stripped out and it is stored in storage tanks.

In sugar industry lots of water is used for steaming, cooling, washing and cleaning purpose. From this all processes lots of waste water is generated and it contains high amount organic and inorganic substances. Hence it is needed to treat and reduce the strength of pollutants. This waste water is treated in effluent treatment plant (ETP) where these pollutants converted into sludge. This sludge is drain out from the bottom of ETP and dried on drying bed (Photo plate-8). This dry sludge cake is rich in nutrient and it is used by the farmers as best manure in farm practices.

Above such practices are highly required in industrial sector for the scientific use and management of solid waste and environmentally sustainable development. These practices are essential for reducing air, water, soil and land pollution as well as it also helps to generate income from other sources which improves net profit of industries.

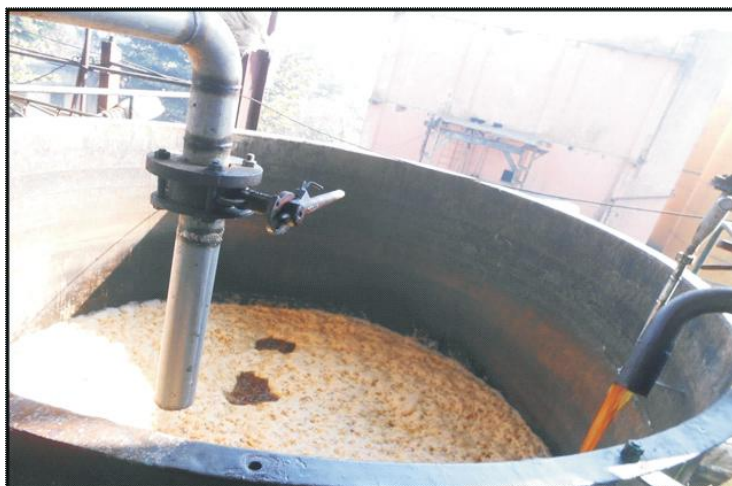


Photo plate 3 : Molasses is used in distillery industries.



Photo plate 6 : Use of bagasse in manufacture of partical boards.

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