

## **ANALYSIS OF SOLID WASTE MANAGEMENT OF SUGAR INDUSTRY (Studies at The Sugar Industry X In East Java)**

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### **Abstract**

Sugar industry activities produce large quantities of organic solid waste and by-products (e.g. leaves from cane, molasses from the final crystallization, bagasse fiber from the cane, and filter cake), fly ash, and bottom ash. Solid waste has potential to pollute the environment and negative impact to public health. The study aim to analyze management of solid waste from sugar industry. This research design was descriptive observation approach. Filter cake is usually used by nearby farmers as organic fertilizer although in some cases its application as organic fertilizer is preceded by biocomposting. Bagasse is used as fuel for boilers. It is estimated that 70% of the power requirements of sugar mills is fulfilled in this way. Bagasse is also used for chip-board and paper manufacture.

Keywords : *management, solid waste, sugar industry.*

### **Introduction**

Sugar industry have an important role in supporting the development and economic growth. The main product of sugar industry are sugar and molasses by-product that is the material to produce alcohol, spirits, and food flavoring. However, the activity of a sugar industry also produces gas, solid, and liquid waste that may have an impact on the environment and public health. Solid waste generated by the Sugar Industry X has a fairly large volume every day. Solid waste generated by the Sugar Industry X are sugar bagasse, filter cake, litter, boiler ash, and sludge. Problems encountered due to the generation of solid waste of Sugar Industry X is the accumulating volume of solid waste if not managed properly. Solid waste associated with the safety, health and environmental protection. Solid waste greatly influence the ecology of surface water, air, and farmland. Lack of policy and implementation of solid waste management system causing a variety of negative impacts on human health and long-term pollution of surface water, air and parasitic and bacterial infections. Solid waste is a substrate and media for the growth of the sources of human diseases derived from flies, rats and other germs [1].

Waste management is the responsibility of the Sugar Industry X so as not to cause negative impacts on the environment and public health. Solid waste management of Sugar

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Industry X cooperate with various stakeholders including local communities around Sugar Industry X. While the solid waste in the form of boiler ash (fly ash and bottom ash) and filter cake are collected in the landfill and partly used by the community as a fuel.

It is expected that the solid waste management that has been done can maintain the condition of the surrounding environment from pollution and can minimize the potential of negative impact on public health. The purpose of this study was to analyze the solid waste management of the Sugar Industry X in East Java Province.

## **Method**

The study was a descriptive observational study that aims to make systematic observations, factual, and accurate from the data in the field. The data used in this study were primary and secondary data. Primary data obtained directly from the informants and the object through interviews and observation. Secondary data from archives and documents of Sugar Industry X, as well as laboratory analysis of environmental data results. The study was conducted in September-December 2011.

## **Results and Discussion**

### **Overview of Sugar Production Industry X**

The main raw material is sugar cane (*Saccharum officinarum L.*). As an additional ingredient in the process of sugar production, chemicals are required to clean sap, improve product quality, and expedite the production process. Chemicals used in the production of sugar are a phosphoric acid, milk of lime, sulfur, flocculants (poliakrimida), disinfectants, NaOH, Na<sub>2</sub>CO<sub>3</sub>, and HCL with the composition of 30-35%, 6-8%, and 3.5% [2].

The sugar cane processed in Sugar Industry X consists from private sugarcane (TS) and community sugarcane (TR). Milling performance data of Sugar Industry X in 5 (five) years which includes the amount of sugar cane milled and sugar produced can be seen in the table below.

Table 1 Milling Performance of Sugar Industry X in The Last Five Years

No.	Description		2006 (Qui)	2007 (Qui)	2008 (Qui)	2009 (Qui)	2010 (Qui)
1	Quintals of sugarcane milled	TS	5.339.632	6.399.659	5.546.696	5.758.017	6.812.362
		TR	4.318.820	4.783.471	4.856.636	4.166.021	3.906.141
	Total		9.658.452	11.183.130	10.403.130	9.924.038	10.718.503
2	Sugar Owned	PG	498.987	540.782	552.231	527.042	445.694
		TR	183.396	192.281	229.998	172.989	141.135
	Total		682.383	733.063	782.229	700.031	586.829

*Sources: Processed Secondary Data*

Based on the table above, it shows that the highest production of sugar produced in 2008, ie 782 229 quintals with raw sugarcane by weight of 10,403,130 quintals. Factors that significantly affect the production of sugar are the amount of sugarcane, rendemen, and labor (Santoso and Pratiwi, 2008). Sugarcane is the main raw material in sugar production, so its availability greatly affect the production activities (Widarwati, 2008).

### Sources of Solid Waste

Solid waste in sugar Industry include bagasse, filter cake, filter paper, boiler ash, sludge, and filter paper containing Pb. Bagasse is the solid waste that comes from mill station (the extraction of sap). Bagasse produced estimated at 30 percent from total weight of sugar cane [2]. It can be assumed for example in 2010 a number of sugar cane milled 10,718,503 quintals, so Bagasse generated approximately 3,215,550.9 quintals.

Filter cake is solid waste that comes from the screening process (filtration) in sap purification station. By using a belt conveyor, filter cake from rotary vacuum filter palced in the truck and dumped into landfill sites. Filter cake waste ranged between 3-4 percent of the weight of cane, so that by the year 2010 can be estimated filter cake amount produced is about 321.555-428.740 quintal.

Gas fumes that come out through the chimney brings the boiler ash particle, to overcome this it used damping technology "Wet scrubber" so that the particles coming out the chimney becomes minimal. Making a clear standard oprating procedure (SOP), in order to facilitate everyone to read. Calories contained in the exhaust gas used as heating / drying the bagasse so it can increase the calories present in the bagasse.

In general, the quality of solid waste generated at the Sugar Industry X still below the quality standard. Solid Wastes are generally collected at the landfill, while filter cake used as fertilizers in sugarcane plantations. In general, the quality of the solid waste of sugar Industry can be seen in the table below.

Table 2 Analysis Results of The Solid Waste Quality in the Sugar Industry X

No.	Parameter	Unit	Types of Test Sample				Detection Limit
			Solids 1	Solids 2	Sludge	Filter cake	
1	Sulphur (S)	%	0,02241	0,04887	-	-	0,000085
2	Calsium Okside	%	0,1000	1,1576	-	-	0,0028
3	Silica (SiO <sub>2</sub> )	%	6,895	4,522	-	-	0,001
4	Nitrogen (N)	%	-	-	1,3483	0,3524	0,0014
5	Phosporus (P)	%	-	-	0,39532	0,51679	0,000044
6	Calium (K)	%	-	-	0,06755	0,29452	0,000021
7	Carbon (K)	%	-	-	14,5074	16,3381	0,0114
8	Mercury (Hg)	mg/l	0,0033	<LD	<LD		0,0014
9	Plumbum (Pb)	mg/l	<LD	0,3353	<LD		0,0405
10	Cadmium (Cd)	mg/l	<LD	0,0405	<LD		0,0100
11	Chrome (Cr)	mg/l	<LD	0,2021	<LD		0,0198
12	Copper (Cu)	mg/l	<LD	0,2118	0,3512		0,0196

Sources: *Processed Secondary Data*

Description:

1. Solids 1, Laboratory No. 10973-Boilers Ash
2. Solids 2, Laboratory No. 10974-Evaporator crust
3. Sludge, Laboratory No. 10975-Sludge UPLC
4. Filter cake, Laboratory No. 10976-Filter cake

Boiler uses fuel from bagasse, coal, alternative fuels (wood) so apart from forming exhaust gases which brings the parameters of particles (soot, tulatu), it will also form the boiler ash. Boiler Ash can be divided into fly ash and bottom ash. Fly ash produced from burning coal is about 1-3 percent from total coal burned. While the bottom ash was approximately from 0.2 to 0.6 percent.

Activity in the laboratory analyze the sugar content in the sap. On this analysis, chemicals that is used is Pb-acetate (CH<sub>3</sub>COOPb). During the milling, Pb-acetate is used about 60 pounds' or 50 kg as Pb retained on the filter paper. During this time the filter paper was collected for a while and then sent to a 3rd party who licensed from Environment Ministry of Indonesia.

### **Impact of Solid Waste**

The impact from boiler ash, especially the impact from land disposal (landfill). During the dry season, the dry ash that is not covered by the soil yet are likely to fly in the wind and increase the quality of dust in the ambient air. In addition, land disposal that is not properly managed can cause harm to people through the disposal site (such as fall into hot ashes).

The unpleasant sour odours that are characteristic of piles of filter cake left to ferment without artificial aeration [3]. Filter cake heap will form leachate that is acidic and an organic material with a relatively high biological oxygen demand (BOD) content. Infiltration from leachate will have an impact on shallow groundwater such as the emergence of odor and yellowish color. So far no complaints from the public in residential areas around the landfill on water quality of the well or it can be assumed the filter cake impact in the form of leachate is very small.

Pb included in the criteria for heavy metals or B3 material (hazardous and toxic materials) that is material because of the nature and or concentration and or amount, either directly or indirectly, can pollute or damage the environment, and or may endanger the environment, health, the survival of humans and other living creatures. In accordance with the provisions of government regulations No. 18/ 1999 jo goverment regulations No. 85/1999, solids or ash from Pb is a waste to be managed carefully in accordance with applicable regulations.

### **Waste Management**

Some solid waste can be managed with clean production approach. As a starting point for all waste management is to implement good house keeping so as to minimize the leaks during the production process. Sugarcane waste originating from sugarcane harvesting such as the top rod can be used as fodder, dry leaves can be used as boiler fuel. Bagasse is normally used in boilers for fuels, but it may be used to produce other products such as paper, wallboard, and furfural [4]. Bagasse is a fuel of varying composition, consistency, and heating value. The characteristics depend on the climate, type of soil upon which cane grown, variety of cane, harvesting method, amount of cane washing, and the efficiency of the milling plant.in general, bagasse has a heating value between 1,600 and 2,200 kcal/kg on a wet, as-fired basis [4].

Filter cake from the purification process has been collected and disposed of to landfill or requested by the public in accordance with the requirements of the standard operating procedure (SOP) that has been agreed between the parties. The fact is, most filter cake requested by the public. In the landfill, the activity of microorganisms in filter cake containing organic material to form leachate (leachate) and smells. The entry of smell ( $\text{NH}_3$  and  $\text{H}_2\text{S}$ ) into the ambient air will degrade the quality of ambient air surrounding the disposal site.

Filter cake, can be used as raw material for organic fertilizer (composting) because its contain of heavy metals is far below the environmental quality standard. The content of heavy metals (Hg, Pb, Cd, Cr, and Cu) is far below the quality standard. Filter cake consists mainly of sugarcane fibers that are C-organic compounds [5]. Filter cake contain some specific nutrients that is high enough so that filter cake has advantages over other organic fertilizer materials, filter cake can improve soil physical as well as a source of nutrients. Filter cake can contribute macro nutrients such as N, P, K, and Mg, and micro nutrients such as Fe, Mn, Zn, Mo, and B into the soil [6]. Filter cake also can be used as a firewood substitute by made as filter cake briquettes. Filter cake briquettes have higher heat and its use should be until the end. Filter cake briquettes is often used by small industries, such as industrial tofu, soybean cake and brick makers [7].

Boiler Ash (non-coal) periodically dumped into landfill after it first cooled with sprayed water. While the boiler ash originating from coal will be stored and then sent to a 3rd party who licensed by the Ministry of Environment, some are also used as materials for paving block, but it should permit the utilization of B3 waste to the Ministry of Environment. Special for the boiler ash derived from coal, it should not be mixed between the fly ash and bottom ash [8]. Non-coal boiler Ash can be used as a filter cake mixture to be processed into compost [9]. Filter cake Ash and bagasse ash can also be used as materials for solid concrete brick and hollow concrete brick [10]. Bagasse fly ash obtained from the local sugar industry is an inexpensive and effective adsorbent for the removal of cadmium and nickel from wastewater [11].

## **Conclusions**

1. Solid waste in sugar Industry include bagasse, filter cake, filter paper, boiler ash, sludge, and filter paper containing Pb.
2. Some solid waste can be managed with clean production approach.

3. Bagasse is normally used in boilers for fuels, but it may be used to produce other products such as paper, wallboard.
4. Filter cake, can be used as raw material for organic fertilizer, biomass fuel as briquettes, etc.
5. Non hazardous solid waste disposal by sanitary landfill system.
6. Hazardous solid waste to be managed carefully in accordance with applicable regulations.

## References

- [1] Ign. Suharto, *Limbah Kimia dalam Pencemaran Udara dan Air*. Yogyakarta, Penerbit Andi, 2011.
- [2] N.S. Indrasti and A.M. Fauzi, *Produksi Bersih*. Bogor, IPB Press, 2009.
- [3] H.W. Bernhardt and P. Notcutt, *Composting of filter cake from a sugar factory*. Proceedings of The South African Sugar Technologists Association- June 1993.
- [4] U.S Environmental Protection Agency, *Emission Factor Documentation For AP-42 Section 1.8 Bagasse Combustion In Sugar Mills*, Research Triangle Park, NC 2771, April 1993.
- [5] Chairani, *Pengaruh Pemberian Pupuk Organik Blotong dan Pupuk Sulfomag Plus Terhadap Sifat Kimia Tanah, Pertumbuhan, dan Produksi Tanaman Jagung (*Zea mays L.*) Pada Tanah Typic Paleudult*. Jurnal Penelitian Bidang Ilmu Pertanian, Vol.3 (3), December 2005.
- [6] J.K. Baon, *Blotong Sebagai Sumber Bahan Organik dan Harga Bagi Tanaman Kakao*. Prasad. Balai Penelitian Perkebunan Jember, 1984.
- [7] M. Hamawi, *Blotong, Limbah Busuk Berenergi*. Salam, 11 Juni, 2005.
- [8] Asisten Deputi Urusan Pengkajian Dampak Lingkungan Deputi Menlh Bidang Tata Lingkungan Kementerian Lingkungan Hidup, *Panduan Penilaian AMDAL atau UKL/UPL untuk Kegiatan Pembangunan PLTU Batubara*, Jakarta, 2007.
- [9] Syafrudin and A.D. Astuti, *Studi Pengelolaan Limbah Pabrik Gula (Studi Kasus Pabrik Gula PT. Kebon Agung Di Trangkil Pati)*, Jurnal Presipitasi, Vol.2 (1), March, 2007.
- [10] M.Moenir, E. Prilyani, S. Wahyuningsih, *Bata Beton Limbah, Salah Satu Alternatif Pengolahan Limbah Padat Industri Gula*, Bulletin Litbang Industri, No. 23, 1997.
- [11] V.K. Gupta, C.K. Jain, I. Ali, M. Sharma, V.K. Saina, *Removal of cadmium and nickel from wastewater using bagasse fly ash-a sugar industry waste*, Water Research 37, 2003. [www.elsevier.com](http://www.elsevier.com).