



## Environmental Audit of Sugar Factory: A Case Study of Kumbhi Kasari Sugar Factory, Kuditre, Kolhapur

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### Abstract

Environmental audit is a very effective management tool, which is designed and conducted to provide information on practices which differ to the current procedures and to exercise effective management of the established system. The sugar industry plays a very important role in India's national economy. As all stages of sugar production are water intensive and discharging wastewater containing high level of oil, suspended solids, organic matter and chemicals and therefore the sugar industry is one of the most water polluting industries. Therefore conducting 'Environmental Audit' in a sugar factory is no longer an option but a sound precaution and a proactive measure in today's heavily regulated environment. Careful and watchful audit offer prospects for improvement, perfection and achievement of goals. The audit is carried out in four steps and the final report is prepared and suggestions are given. This paper reviews on Environmental Audit programme in a sugar factory of Kolhapur district of Maharashtra (India).

**Keywords:** Environmental audit, Environmental management, Pollution, Sugar factory

### 1. Introduction

Environmental audit is a systematic, independent internal review to check whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective. For the purpose a industrial organization has to determine where it should implement cleaner production and eco-efficiency improvement. It can be done only after environmental impacts have been identified and measured. A good environment management policy requires that there should be constant efforts to analyze and monitor various industrial working systems and processes, to generate and transmit this information for the inspecting authority (Mehta and Sharma, 1997).

Environmental audit investigates all possibilities of material, energy savings, improvement in occupational health and safety of industrial workers. It also helps in communicating the results of this process to the concerned management and suggests corrective steps to be followed at the early stage (Chaudhury, 2002). It aims not only at minimizing potential negative impacts of the company on the

environment but also at maximizing the positive impacts of an environmentally sound system of the company activities. Regulatory agencies considered such auditing as an important management technique because it ensures compliance with the environmental requirements and related corporate policies (Meikandaan and Thansekaran, 2006). The gap existing between the development activities generating pollutants and maintenance to a sustainable level need to be narrowed down under present day circumstances (Mehta and Sharma, 1997). The sugar industry is one of the most water polluting industries with the recently studied pollution concentrations for some factories in India with as high as 1154 mg/l of BOD, 5915 mg/l of COD, and 5759 mg/l for SS. The industry has to incur a significant cost to reduce these very high influent concentrations of pollutants to the Minimum National Standards (MINAS) of 35 mg/l of BOD, 250 mg/l of COD and 100 mg/l for SS in India (Murty and Kumar, 2004).

Sugar industry is the most advanced agro based industry in India. The sugar industry in large quantity generates wastewater at all stages of sugar

production occurring at the mill house process have, cooling pond and distillery (mills that also produced industrial alcohol from molasses) are water intensive and discharged with very high levels of oil, suspended solids, organic matter and chemicals not only that it also generates gaseous emission and solid waste that can cause pollution problem. The sugar industry is facing various challenges including deterioration of environment due to its industrial activities (AARRO,1996). The environmental challenges for the sugar mills is associated with liquid waste, gaseous emission, solid waste and noise pollution (Solomon, 2005).Therefore conducting environment audit prove to be effective risk management tool for assessing compliance with environmental legislation, Thereby assisting industries to avoid the risk of the prosecution and fines arising from potential environmental breaches. It is perceived to benefit both the industry and environment.

## 2. Project Setting

The sugarcane is subjected to preparation with the help of cane knives and fibrizor. Such prepared cane is feed to 3 rollers, 5 mill tandem where juice is extracted. After extraction of juice the left over portion that is bagasse is conveyed to boiler, where it is used as fuel. Such extracted juice from milling operation is then weighed in automatic juice weighing scale and then it is heated to 70<sup>o</sup>C. After this first heating it is allowed to react with lime milk solution and sulphur dioxide, then the sulphited juice is again subjected to second heating where it is heated up to 105<sup>o</sup>C. After second heating this juice is settled in continuous clarifier where from clear juice and muddy juice are obtained. The clear juice is then taken to multiple effect evaporators for a concentration. The muddy juice, with the help of fine particles of bagasse, is filtered through vacuum filters. The filtered juice is again taken back into the process and the solid filtered cake, which is a bi-product, is sold as manure. After concentration of clear juice, the thick syrup is again subjected to sulphitation where sulphur dioxide gas is applied.

Bleached syrup is used for a sugar boiling in vacuumed pans. The products from this sugar boiling process are higher, intermediate and lower grade massecuties. The massecuties contains sugar in crystalline form and mother liquor. In the process of centrifugation the sugar crystals are separated from mother liquor. Sugar from higher massecuties is direct, graded and bagged. The mother liquor from lower grade massecuties is taken as another bi-product, known as a final molasses. The term 'molasses' is applied to the final effluent obtained in the preparation of sugar by repeated crystallization (Hubert Olbrich, 1963).

## 3. Study Area

Kumbhi Kasari Sahakari Sakhar Karkhana at Kuditre is situated about 12 km west of Kolhapur city, basically it is a hilly area, and the climatic condition is semiarid. The factory has approximately 100 acres of land area.

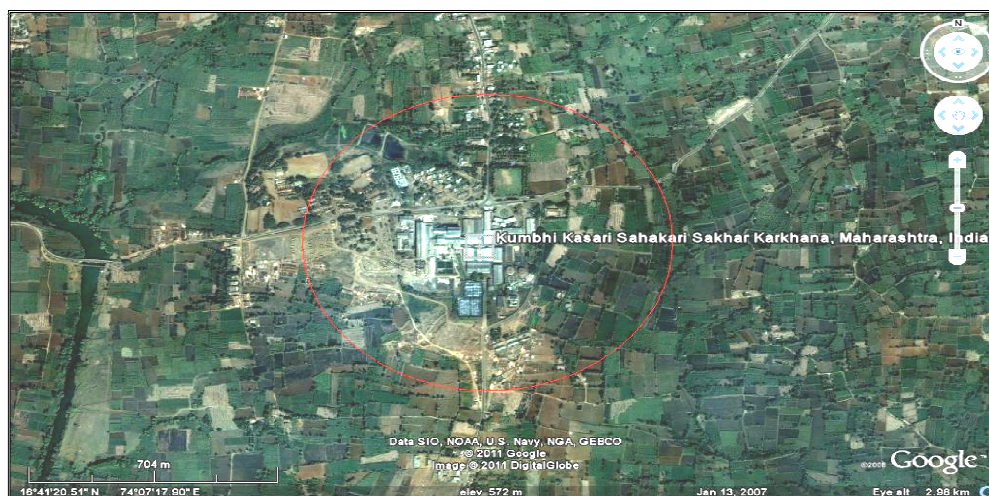
## 4. Audit Approach

The typical audit comprises of three steps as Pre Audit, onsite Audit and Post Audit.

**4.1 Pre Audit:** The Pre Audit is conducted to get the background information and making the survey by using the questionnaires. The pre audit is useful to get familiar with the company and to save time requirement for the onsite audit.

**4.2 Onsite Audit:** The onsite audit means to identify the water usage, raw material consumption, by product produced, wastewater produced, solid waste, hazardous waste generated and also analysis report is produced for all this waste as well as air, noise and sound. The water used for all the purpose within the industry is also taken into account.

**4.3 Post Audit:** The final draft is prepared for raw material, water and energy consumption and also the waste generated on the action plan the recommendation are given.



**Fig. 1 Google image of Kumbhi - Kasari Sugar Factory, Kuditre, Kolhapur**

## 5. Results and Discussion

The consumption of raw material as sugarcane which is 127.50 kg/MT crushed in the year 2009 – 10 and this quantity is less than the previous year 2008-09. It was found that though the consumption of sugarcane for production of sugar, the usage of water is more for the process. Water consumption per product output i.e. 4.02 lit/kg of sugar produced. The bagasse which is remaining part of sugarcane after juice extraction and which is used as fuel for boiler in this factory. The consumption of bagasse is also more than previous year. The power consumption in this factory in the year 2009 -10 is also more i.e. 20.17 kW/ MT of cane crushed. Consumption of Bagasse energy development was logical extension of Sugar Sectors Action Plan where in Government and the private sector participated in the restructuring process of the sugar industry given that enhanced use of by-products, including bagasse for electricity production was a key objective in the plan (Kassiap Deepchand, 2005).

### 5.1 Sugar Factory Effluent Treatment

The factory has provided and managed well equipped effluent treatment plant for handling 1500 M.Cu/day. The plant is based on extended aeration principle and gives the desired results for maintaining effluent parameters within the consented limits stipulated by Maharashtra Pollution

Control Board. The treated effluent is utilized on land for irrigation of sugarcane fields.

The wastewater is generated in a sugar factory from processing, domestic purposes and some amount of spent lees which is coming from distillery. All these wastewater treated in ETP of sugar factory treatment process. To achieve BOD reduction from 1000 mg/lit i.e. 92% treatment efficiency. There is two stage biological treatment plants. The first stage will comprises of an aerobic lagoon equipped with surface aerator and second stage is provided with conventional complete mix activated sludge process. The aerated lagoon in first phase is expected to reduce BOD by 50 % i.e. from 1000 mg/l to 500 mg/l. The second stage is activated sludge process which further provides 90% reduction in BOD resulting into an effluent having 50 mg/lit of BOD.

An oil and grease trap is incorporated to remove all free and floatable material. The flow sheet to achieve the standard required as per consent letter of Maharashtra Pollution Control Board comprises the following units.

- 1] Screen chamber
- 2] Oil and grease trap
- 3] Aerated lagoon (First stage)
- 4] Aeration tank (Second stage)
- 5] Secondary clarifier
- 6] Return sludge pumps
- 7] Sludge beds

**Table 1: Consumption of Water by Kumbhi-Kasari Sugar Factory, Kuditre for Various Purposes**

Year	Process ( cum/day)	Cooling ( cum/day)	Domestic ( cum/day)
2008-2009	1800	200	100
2009-2010	1800	200	100

**Table 3: Consumption of raw material in kg per MT of Crushed Sugarcane**

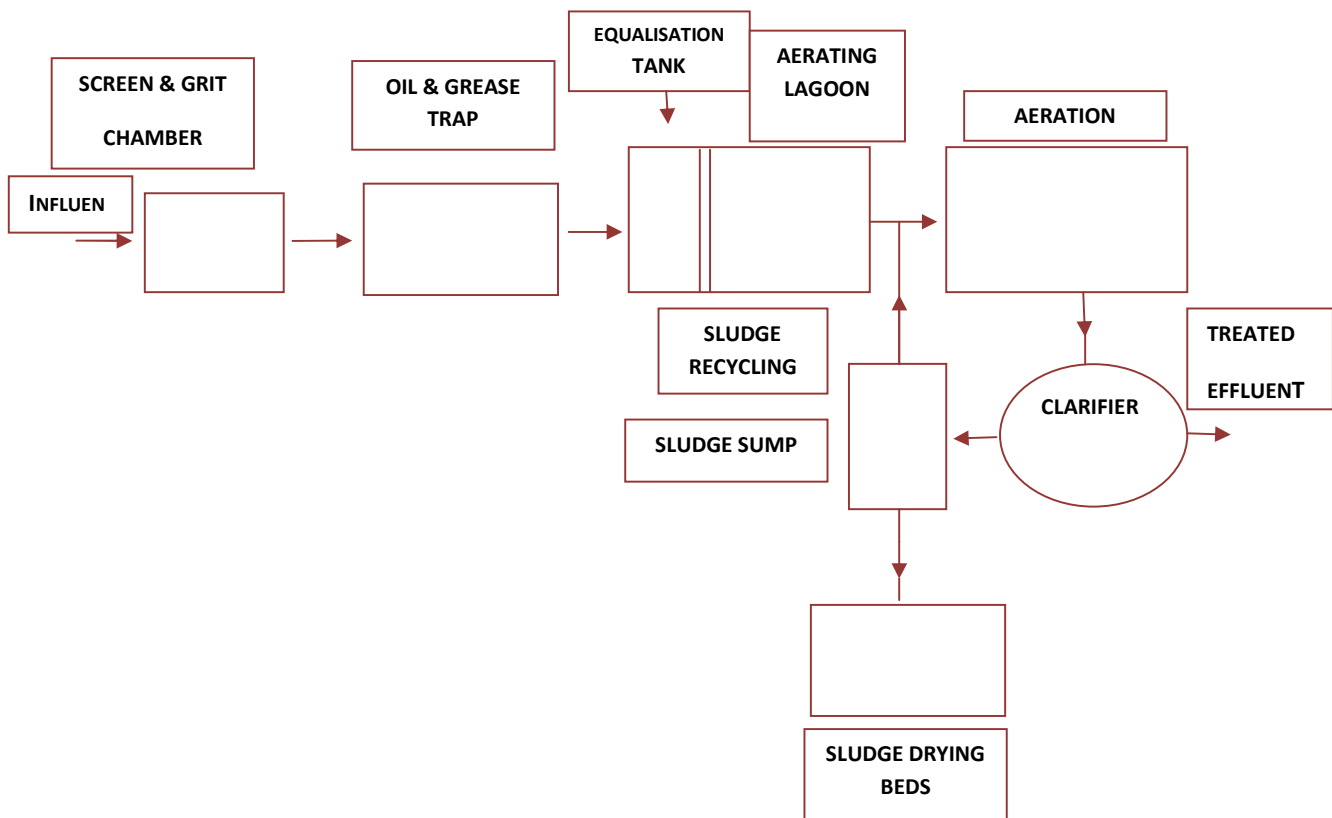
Year	Sugarcane	Bagasses as fuel
2008-2009	130.03	251.15
2009-2010	127.59	259.49

**Table 2: Consumption of Water for Sugar in lit per kg of Sugar Produced**

Year	Process water consumption/product output
2008-2009	3.53
2009-2010	4.02

**Table 4: Consumption of Power in kW per MT of Crushed Cane**

Year	Power consumption
2008-2009	19.92
2009-2010	20.17



**Fig. 2 Flow Sheet of Sugar Factory ETP**

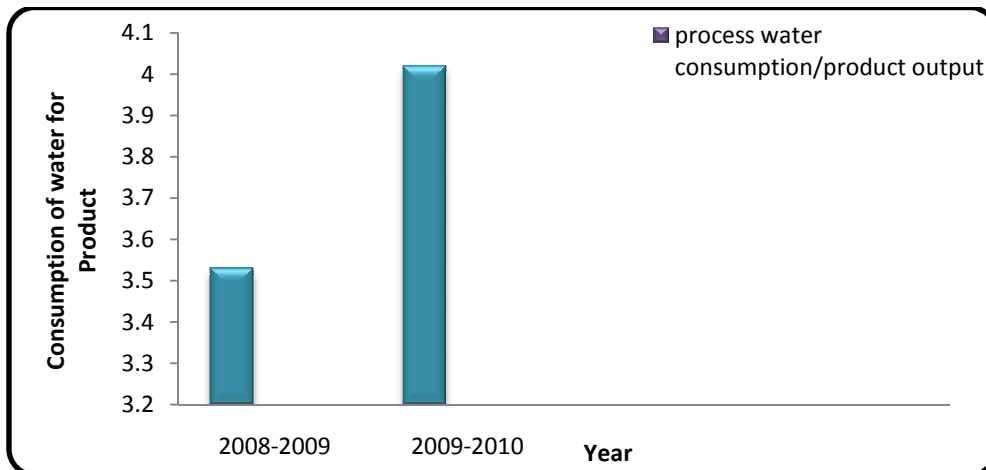


Fig. 3 Water Consumption in cum per day Values expressed in cum per day

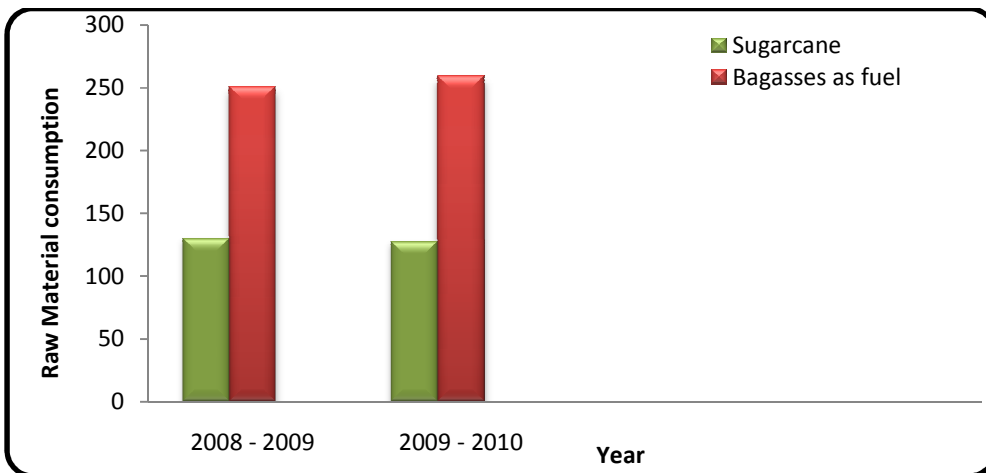


Fig. 4 Water Consumption for Sugar Production in lit per kg

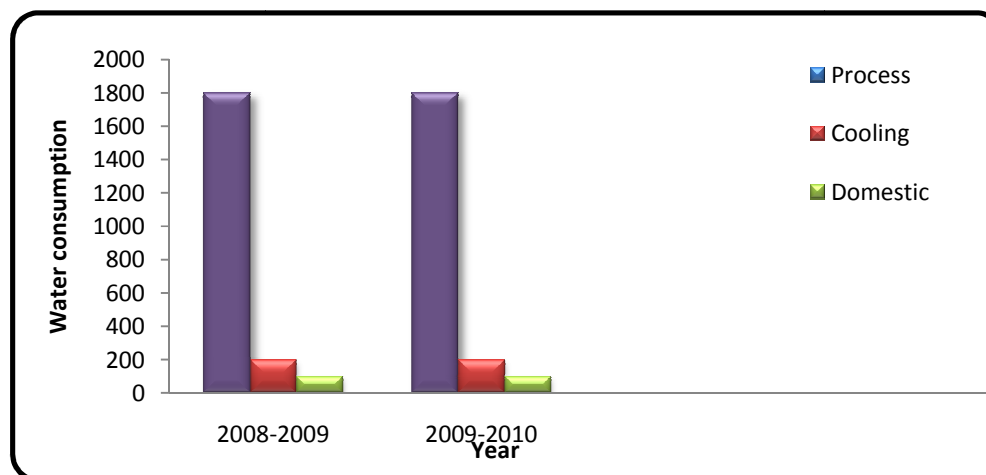


Fig. 5 Raw Material used in kg per MT of Crushed Sugarcane

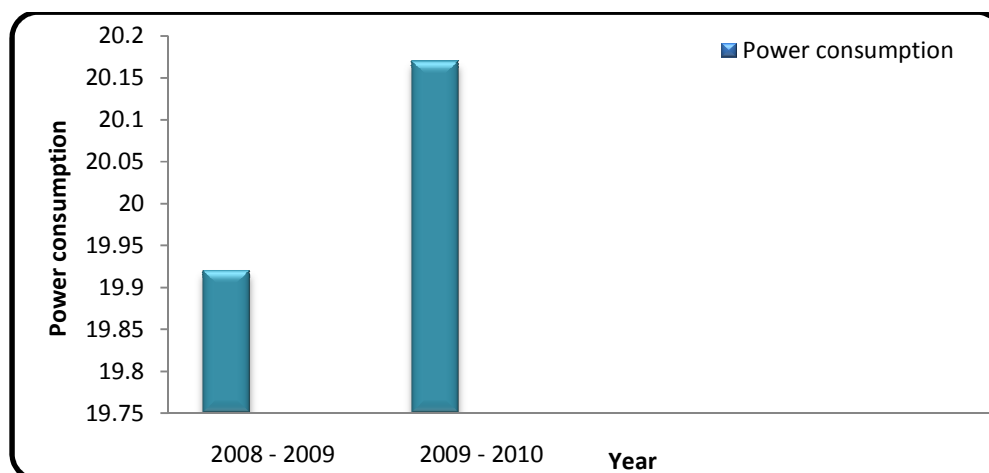


Fig. 6: Power Consumption kW per MT of Crushed Sugarcane

## 6. Conclusion

The sugar industry Kumbhi Kasari situated near Kolhapur city is one of the good factories as it has its own distillery unit in its own premises for production of alcohol from molasses, one of waste which is generated from the sugar factory. Even though the factory is taking care to avoid pollution, some of the points like good drainage facility, location of ETP near housing colony and general cleanliness of the area is to be looked after. The factory has planted around 2000 tree sapling in the premises indicates its concern towards environment. In year 2010 factory took less intake of sugarcane as compare to previous year 2009. The environmental audit conducted at Kumbhi-Kasari Sugar Factory will be effective to reduce energy consumption to reduce the consumption of the water and use bagasse as fuel. It saves the power and improved environmental protection for sustainable industrial operations.

Additional measures for environmental protection initiated by the sugar factory with some modifications in effluent treatment plant are good indicators of environmental management. Biogas produced from the spent wash as well as compost is the best output towards resource conservation. Thus, Environmental Audit plays an important role to have check on pollution control. Further studies on Environmental Audit with reference to various types of the industries are needed in order to study various process, activities and their positive or negative impact on the environment.

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## References

- 1) AARRO, (1996): Environmental Degradation and its Implication on Rural Development, Report of the International Workshop, Cairo, Egypt.
- 2) Badrinath, S.D, Raman, N.S. and Rao, N.N. (1994): Environmental Audit in Thermal Power Plants, *IJEP* 14:279- 281.
- 3) Badrinath, S.D. and Raman ,N.S. (1993): Environmental Audit- A Management Tool, *IJEP* 13: 881- 894.
- 4) Chaudhury, P.(2002): Environmental Auditing with Reference to a Bearing Industry, *IJEP* 22: 400-404.
- 5) Deepchand, K. (2005): Sugarcane Bagasse Energy Cogeneration-Lessons from Mauritius, Parliamentarian Forum on Energy Legislation and Sustainable Development, Cape Town, South Africa.1-17.
- 6) Kulkarni, V., Ramachandra, T. V. (2006): Environmental Management, Capital Publishing Company, New Delhi, 122-123.

- 7) Meikandaan, T. P and Thansekaran, K. (2006): Waste Audit of Electroplating Industries, *IJEP* 26: 640- 643.
- 8) Mehta R.M and Sharma V.K (1997), Environmental Audit – An Overview, *IJEP* 17: 212-214.
- 9) Murty M. N. and Surrender Kumar (2004), Environmental Regulation and Industrial Efficiency, 197 – 198.
- 10) [www.answers.com/topic/environmental\\_audit](http://www.answers.com/topic/environmental_audit).
- 11) Olbrich, H.(1963): The Molasses, Fermentation Technologist, Institute fur Zuckerindustrie, Berlin (Germany).
- 12) Solomon, S. K. (2005): Environmental Pollution and its Management in Sugar Industry in India: An Appraisal, Lucknow Christian College, Lucknow, India. *Sugar tech.*, 7 (1):77-81.
- 13) Vasant Dada Sugar Institute (1990): Techno-Economic Feasibility Report for 30,000 Litre of Alcohol per Day Distillery, 10 -14.