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Original Research Paper

Environmental Audit of Distillery Industry: A Case Study of Kumbhi Kasari Distillery Factory, Kuditre, Kolhapur

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ABSTRACT

Environmental Audit is intended to quantify environmental performance and environmental position of an industry. Environmental audit report ideally contains a statement of environmental performance and position but may also aim to define what needs to be done to improve upon indicators of such performance and position. Present study is related to environmental audit of a distillery unit located near Kolhapur in Maharashtra. The environmental audit identified the various waste streams, waste minimization and treatment options in the distillery industry. The paper aims to substantiate the intension that the use of environmental audit practices help the industry to increase its productivity, and at the same time maintaining the environment.

INTRODUCTION

Audit is an analysis and evaluation of the information that have been obtained, and an analysis of the outcome vis-a-vis the goals and expectations of the initiator of the audit. This helps in identifying the areas of improvement. Environmental audit (EA) consists of a systematic periodic and complete evaluation of performance and functioning of commercial and industrial organizations and its activities with the primary aim of providing a comprehensive tool to safeguard the environment (Chaudhury 2002). Environmental audit aims not only at minimizing potential negative impacts of the company on the environment but also 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 & Thansekaran 2006). The sugar industry is one of the most 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 of 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 of SS in India (Murty & Surrender Kumar 2004). The gap existing between the developed activity generating pollutants and maintenance to a sustainable level need to be narrowed down in present day circumstances (Mehta & Sharma 1997). Environmental audit is a structured and comprehensive mechanism for ensuring that the industrial activities do not adversely affect the environmental quality, and the economy of the industrial sector improves as a consequence of improved processes and energy effectively as also the occupation health and safety (Badrinath & Raman 1993).

In order to distribute more benefits from industrial complex, the management of one of the sugar factories from Kolhapur district of Maharashtra has decided to establish a distillery based on the latest technology to produce industrial alcohol from the molasses. The distillery project is not only viable but a very attractive one as it has a capacity of 30,000 L/day production of alcohol.

MATERIALS AND METHODS

Audit approach: The EA was conducted in the Kumbhi Kasari Distillery Industry, Kuditre in Kolhapur district of Maharashtra. The audit process was differentiated into four steps. In first step i.e., audit preparation, it included choice of the audit group, collection of background information and planning of the audit orientation. This means that part preparatory activities to development of existing materials and tools. The second step i.e., review of facility, included an audit, which is considered as part of the programme of preventive environmental protection, needs to deal with the production processes and material flows. The third step i.e., reporting, involved reporting of observations of deficiencies and possible alternatives. It is important to be aware that an environmental audit by itself does not solve any problem. In fact, audits often point to the need for the change in organization and improvements in education, increased environmental responsibility and environmental protection technology. The last step was following up of the results as an important part of the audit process. This can be done as part of a continuing process of enhancing environmental protection procedures.

PROCESSES AND PRODUCTION OF ALCOHOL IN THE DISTILLERY

Distilleries use different kinds of raw material such as sugarcane molasses, sugar beet molasses, and wine or corn for production of alcohol. The cycle of raw materials starts arts from the farm, through the production of alcoholic beverages and finally spent wash. The sugar manufacturing process broadly involves the extraction, clarification and concentration of the sugarcane juice. Finally, the concentrated juice is crystallized to form crystals of sugars. The manufacturing processes produce molasses, bagasse and press mud as wastes. The manufacturing process in a distillery involves dilution of molasses with water followed by fermentation by yeast. The product is then distilled to obtain rectified spirit or neutral alcohol.

DISTILLERY EFFLUENT TREATMENT

The factory management has earlier provided the system of aerobic composting for distillery effluent. However, after careful observation of the system working during the trials, a need for upgradation was felt. In order to provide a complete system for both primary and secondary treatment, and disposal, the factory has planned for and added an anaerobic digester unit preceding the composting stage. The unit, not only reduces the organic load of second stage, but also yields biogas which contributes more than 80% to the total fuel requirement of the distillery.

Equalization tank: It is a circular tank with tapered bottom serving the purpose of equalization-cum-settling tank. Here, equalization of flow and effluent characteristics are observed. Capacity is 275 cu.m and hydraulic retention time is 18 hrs.

Buffer tank: The effluent from the equalization tank is taken into the buffer tank since the spent wash is acidic in nature. Lime is used for adjustment of pH as well as temperature is controlled by metallic plate to achieve heat exchange. The essential nutrients such as diaminophosphate and urea are also added.

Digester: Effluent from buffer tank is fed at the bottom of the digester through eight distribution lines. The digester has been constructed in RCC with a volume of 2800 cu.m. It contains about 1000 tons of active sludge. This helps in decaying the organic matter. The fed spent wash remains in contact with sludge and forms the blanket after organic decay, and methanogenesis is completed. Biogas generated comes up and gets stored. The stored biogas from the gas holders is passed through foam traps and sedimentary trap, and collected in the gas holder having volume of 1565 cu.m. Biogas from the gas holder is taken to boiler where 0.5 cu.m gas is generated and 1kg of COD gets reduced.

Recirculation tank: The purpose of having this tank is to increase the efficiency because in one single passage to digester efficiency is not much attained. BOD reduction is achieved to about 85% and COD reduction to about 65% of the spent wash. The effluent discharged from the digester is carried to the composting unit.

Primary treatment (Anaerobic digestion): Disposal of liquid wastes from distilleries fermenting molasses has presented one of the most serious environmental problems (Sen & Bhaskaran 1962). Because of the high concentration of volatile solids and BOD in distillery waste together with low nitrogen content, the spent wash presents difficulties in treatment. For that, anaerobic digestion is a good method to minimize this waste. The main factors affecting the overall performance of the anaerobic digestion are agitation, biomass ratio, geometric configuration of the reactor and the feeding strategy (Farina et al. 2002). In anaerobic digestion process the spent wash from distillery is collected in equalization tank having capacity 125 m^3. In initial stage the pH of spent wash was 4.2-4.5. In equalization tank the spent wash was allowed to equalize and then transferred to buffer tank having capacity 175 m^3. In buffer tank, the addition of lime and nutrients was carried out to neutralize the waste. The retention time of buffer tank is 12 hrs. After neutralization process the waste was transferred into the digester having capacity 2852 m^3. The anaerobic digestion process is affected significantly by the operating conditions. As the process involves the formation of volatile acids, it is important that the rate of reaction be such that there is no accumulation of acids, which would result in the failure of the digester (Medhat & Usama 2004). The anaerobic digestion is carried out by microorganisms that can only live in an oxygen free environment. The decomposition of biowaste occurs in four stages: hydrolysis, acidogenesis, acetogenesis and methanogenesis. After methanogenesis process, the products obtained are CH_4, CO_2 and treated water. The gas collected in the gas holder is used for boiler and treated effluent is transferred to the secondary composting. Some part is transferred to the buffer tank. Anaerobic digestion shows good reliability for the wastewater from distillery.

Secondary treatment (Composting): Composting plant is situated at Satarde village, 8 km away from the sugar factory. The area covered for composting is 25 acre, and the composting is done by wind row method. For wind row composting, the required raw material having 70-80%

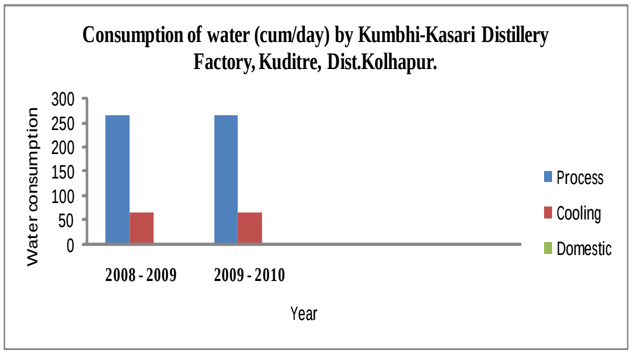

Fig. 1: Consumption of water in the factory.

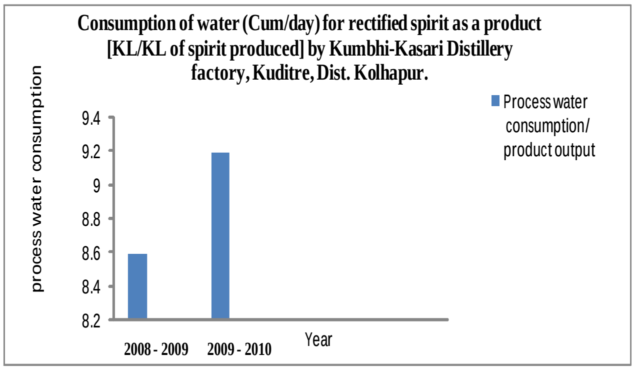

Fig. 2: Consumption of water (cum/day) for rectified spirit as a product (kL/kL of spirit produced) by the factory.

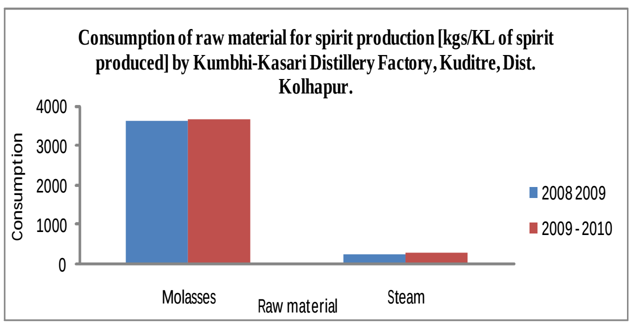

Fig. 3: Consumption of raw material for spirit production (kg/kL of spirit produced) by the factory.

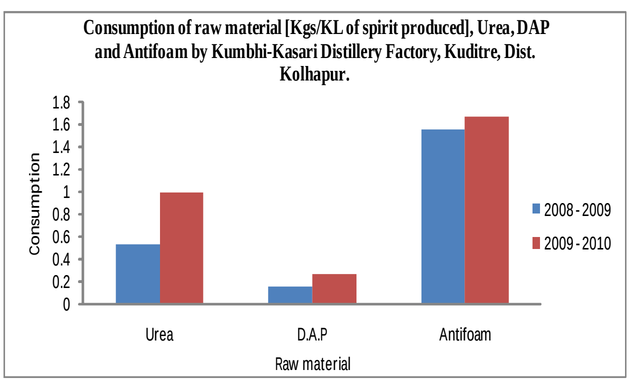

Fig. 4: Consumption of raw material (kg/kL of spirit produced) urea, DAP and antifoam by the factory.

Table 1: Consumption of water by Kumbhi-Kasari distillery factory for various purposes.

Year	Process	Cooling	Domestic
2008-2009	266	66	2
2009-2010	266	66	2

(Values expressed as cum/day)

Table 2: Consumption of water (cum/day) for rectified spirit as a product (kL/kL of spirit produced) by Kumbhi-Kasari distillery factory.

Year	Process water consumption/product output
2008-2009	8.59
2009-2010	9.19

Table 3: Consumption of raw material for spirit production (kg/kL of spirit produced) by Kumbhi-Kasari distillery factory.

Year	Molasses	Steam
2008-2009	3618.73	278.725
2009-2010	3677.62	310.988

Table 4: Consumption of raw material (kg/kL of spirit produced) urea, DAP and antifoam by Kumbhi-Kasari distillery factory.

Year	Urea	D.A.P	Antifoam
2008-2009	0.52	0.152	1.555
2009-2010	0.99	0.261	1.662

Table 5: Total quantity of rectified spirit produced (kL) by Kumbhi-Kasari distillery factory.

Year	Rectified spirit
2008-2009	4581.204
2009-2010	3818.820

Table 6: Consumption of power (kW/MT of cane crushed) by Kumbhi-Kasari, distillery factory.

Year	Power consumption (kW/MT of cane crushed)
2008-2009	79.06
2008-2010	104.96

moisture, is taken to the compost yard. Compost machine (aero tiller) is run over to reduce the moisture to 40-50 %. Microbial inoculum at 1kg/ton to composting plant is added and mixed with the wind row uniformly. The compost machine is run on alternate days and spent wash is sprayed over the wind rows daily using aerotiller. Before aerating the wind row, the temperature was noted to see its rise. The

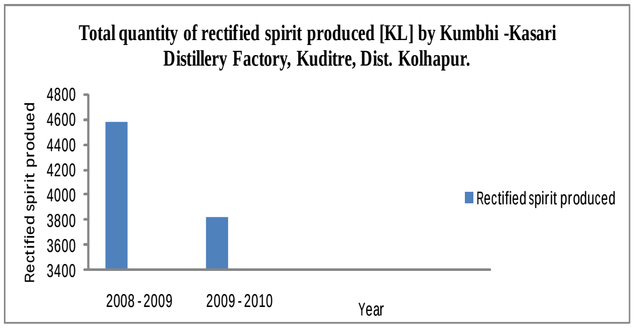

Fig. 5: Total quantity of rectified spirit produced (kL) by the factory.

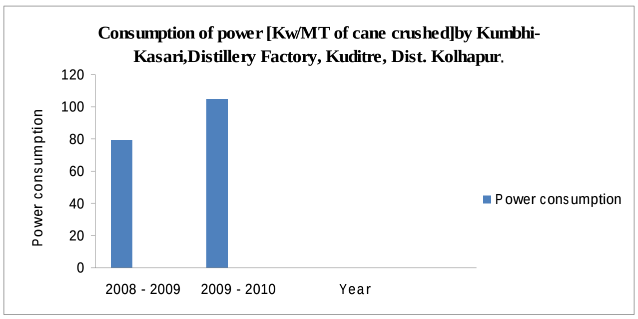

Fig. 6: Consumption of power (kW/MT of cane crushed) by the factory.

moisture content reduces below 50% and additions of spent wash restore it to 70%. After 5 days, the temperature rises to 60-70°C and this is maintained for at least one week. After third week the temperature continues to decrease towards 45°C. As the decline trend is noticed spraying of spent wash is stopped. Finally, after 30 days the wind row is left as such for curing without adding spent wash, but aerotiller is run for aerating and reducing the moisture. The high temperature of 70°C is reached during the decomposition process, which leads to the complete elimination of disease causing organisms.

Disposal: The treated effluent from sugar factory is applied on land for fertile irrigation and subjected to composting process with press mud from sugar factory, as the base material and then the compost prepared is sold out to member farmers as a low cost manure.

Audit process: Audit process is divided into three parts, mainly Pre audit, Onsite audit and Post audit. In case of pre audit, the background information of the distillery industry was collected and a questionnaire was prepared for future process. After the completion of the pre audit procedure, the onsite audit was conducted. For this the questionnaire is used and the information is collected. In post audit the information, which is collected during the onsite audit, is put in the environment audit format Form V and results and conclusion are given based on the information collected.

RESULTS

The environmental audit data are presented in Tables 1-6 and Figs. 1-6. The total water consumption of Kumbhi-Kasari Distillery Factory in the year 2009-2010 is same as that of year 2008-2009, whereas process water consumption increased in production of rectified spirit in the year 2009-2010.

The rectified spirit produced as a product in the year 2008-2009 was 4581.204 kL, and in the year 2009-2010 was 3818.820 kL. The use of molasses and also all other raw materials was more in the year 2009-2010 as compared to previous financial year, and yet the total quantity of rectified spirit produced was less in the financial year 2009-2010. The fuel oil is also one product produced, and it was 26.0 kL in the year 2008-2009, while in the year 2009-2010 it was 40.0 kL. It was also found that the use of steam and power was consumed more in the year 2009-2010. It is clear that consumption of raw material (kg/kL of spirit), urea, DAP and antifoam was increased in the year 2009-2010.

Though the raw material consumption is more, the product produced is less. Thus, from the results, it is clear that the industry is using more raw materials than the quantity of rectified spirit produced. It is also clear that the consumption of water, raw materials, steam and power is more, but in turn the total quantity of rectified spirit produced is less.

CONCLUSION

Kumbhi-Kasari Distillery Factory is one of the good distillery factories, which was established in 1993. The production capacity of rectified spirit is 30 kL per day. 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 nearly 2000 tree saplings in the premises indicating its concern towards the environment. The spent wash is used to produce biogas and compost, which is one of the best ways to reduce pollution. Here, the spent wash is treated based on anaerobic digester as primary treatment and composting as the secondary treatment. Also the yeast sludge is used for composting process which minimizes the quantity of waste.

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