Case Study:	Waste Minimisation Practices in Distillery unit

1. INTRODUCTION TO THE SECTOR

Distilleries may be considered as an allied industry of Sugar industry as it supplies the basic raw material, molasses for alcohol production. Majority of Distilleries in India use molasses as basic raw material.

Most of the distilleries are facing the environmental issue of treatment and disposal of distillery spent wash. Many technologies have been tried for the treatment of spent wash; however none of these methods are found to be effective and economically viable to achieve the standards set by the Pollution Control Boards.

"Composting" technology may be one of the best options. It could result in zero pollution and further compost process can produce valuable organic and inorganic ingredients to enhance soil fertility. However, space becomes a major constraint for adopting this method on long term basis.

2. ABOUT THE INDUSTRY

M/s. S S K Distillery, Akluj is a distillery unit producing alcohol with a production capacity of 30 KLPD.

Considering the problem of treating distillery spent wash to meet the regulatory standards the unit has adopted modified fermentation process namely "DUAL BIOFERMCEN PROCESS" to reduce the quantity of spent wash generation. This change in technology has not only reduced the spent wash generation by 40% but also increased the production capacity by 100%.

3. PRODUCTION PROCESS

Molasses obtained from sugar industry is fermented by normal yeast to produce alcohol. The sugar in the form of disaccharide in molasses gets converted to alcohol by yeast as per the reaction:

$$C_6H_{12}O_6 + \text{Yeast } 2CO_2 + 2C_2H_5OH$$

100 kg + 48.89 kg + 51.11 kg
Glucose CO_2 Ethanol

The factors affecting the fermentation reaction and their effects briefly described below:

A. Temperature

The optimum temperature of fermentation is 32^0C and the optimum temperature of reproduction for the yeast is 28^oC. The increase in temperature above 32^oC will have a tendency to reduce the fermentation process efficiency, as the yeast cannot handle higher temperatures. Furthermore, it encourages the increase in the growth of Lactobacillus, the principle microorganism that competes with yeast. Lactobacillus consumes glucose to produce lactic acid which is the second major factor affecting the yield of alcohol in fermentation.

Yeast does produce some organic acids during fermentation but their concentrations are relatively low as compared to the concentrations of acids produced by lactobacillus and other contaminating bacteria. When Lactobacillus is achieved, the generation of lactic acid substantially increases the titrable acidity and often these high acid levels will cause the yeast fermentation to reduce or slow down considerably

B· Alcohol Concentration in Fermenter

High alcohol beers have a tendency to reduce fermentation at premature stage. It has been found that when yeast is in the reproductive phase it produces alcohol thirty times faster than the normal rate.

4. CONVENTIONAL vs. "DUAL BIOFERMEN" PROCESS

Alcohol is produced by fermentation of molasses with S Pombe yeast.

In Conventional process only one fermenter is used. As alcohol concentration rises with time the reaction rate is becoming slower and the optimum alcohol concentration that could be achieved was only 7%. In DUAL BIOFERMEN process two fermenters and a spent wash holding tank are used. This resulted in faster reaction rate in first fermenter and increased alcohol concentration yield i.e. 9% in second fermenter.

The alcohol from second fermenter is part pumped to distillation column and part to filter through a strainer to remove yeast cream and recycled for use in first fermenter reducing yeast consumption. The clear fermented wash is collected in the spent wash holding tank and is pumped to distillation column for alcohol recovery.

In this process twenty five percent of spent wash from distillation column is recycled and used for fermentation, thus reduction in equivalent quantity of water utilization and effluent generation is achieved. By adopting re boiler for concentrating spent wash from distillation column another fifteen percent of effluent quantity is reduced. Thus total of forty percent waste minimization is achieved.

5. PROCESS BENEFITS

I. High fermentation efficiencies in the range of 89-90%

II. High ethanol concentration of 8- 8.5% v/v in the fermented wash

III. 25% spent wash is used for fermentation process which results in less water utilization

IV. Effluent quantity generated is less and hence the cost of treatment of spent wash can be reduced considerably

V. The filler material is wetted with distillery spent wash water and then composted. In batch process the spent wash water generation is high and the requisite amount of filler material is not available. As a result the distillery is being run for 200 days only. With the new process the reduction in spent wash water helped the unit to run the distillery for 300 days i.e. through out the year increasing overall profit.

VI. Pre-clarification of molasses is not necessary

VII. The process is simple and economical

VIII. Addition of Bakers yeast is not essential like in Batch type plant

A. Environment and Economic Benefits

Capital cost incurred on conversion of Batch type distillery to Dual Process is Rs.70 Lakhs

Benefits due to increased alcohol yield:

Increase in the yield of Alcohol	= 1000 lit of Alcohol /day (@10 lit/ton of Molasses)
Savings due to increased alcohol yield	= Rs.15, 00,000 per annum (Rs 5/Lit of Alcohol)

Benefits due to increased production time due to reduced filler for composting:

Increase in Profit due to increased production	= Rs.15, 000/per day (Rs.0.25/liter& 60 KLPD)
Thus total increase in profit available	= Rs.15, 00,000/ annum (due to 100 more production days)
Pay back period for the change in process	= 2 yrs and 4months

6. CONCLUSION

It can be summarized that conversion of Batch process distillery to Dual process is beneficial not only economically but also from the point of reduction in pollutional load which may be otherwise discharged into environment. The summary of benefits over conventional process are given in the table below:

Parameter	CONVENTIONAL	DUAL BIOFERMEN
Fermentation efficiency	80-83%	89-90%
Ethanol concentration	7%	8-8.5 % v/v
Spent wash water generation	172 m^3/day	134.5 m^3/day
% spent wash reuse	Nil	25%
Steam used	59.3 TPD	51.9TPD
Effluent Generation	450 m^3/day	240 m^3/day