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RESEARCH ARTICLE

CLEANER PRODUCTION IN DISTILLERY UNIT

***Payal F Sumara**

Lecturer, Government Polytechnic, Gandhinagar

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ABSTRACT

Cleaner production (CP), conceived as the vital tool to increase productivity as well as achieve sustainable Development, is now being accepted worldwide as an approach to overcome the draw back of the End-of-Pipe (EOP) treatment and also to tap the potential of the minimizing the wastage, increasing profitability of the units and protecting the environment. With reference to above there appears to be good scope for studying "Cleaner Production Options" in Industrial Distillery Sector. Cleaner Production implementation will be a catalyst in achieving company's target of quality, health & safety and competitiveness. Introduction outlines briefly what is Cleaner Production, Definition of Cleaner Production, Basic Requirements of Cleaner Production, The benefits of Cleaner Production, Cleaner Production Techniques. In this paper one case study is involved which is "key-point" of this paper. This contains Manufacturing Process of Alcohol, Flowsheet of manufacturing of Alcohol, Cleaner Production Option with cost benefit analysis. Process manufacturing Flowsheet gives us better idea to understand the process in depth. In the last point conclusion and Recommendations are been presented. It has been concluded that there exists a very good scope for implementing "Cleaner Production and Cleaner Technology" in any "Alcohol Manufacturing Unit"

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INTRODUCTION OF CLEANER PRODUCTION

Cleaner Production focuses on preventing or minimizing the generation of wastes and emissions. The basic idea of Cleaner Production is that it makes more sense to avoid creating a problem altogether rather than trying to remedy the problem. It is commonly called proactive approach to waste management. Cleaner Production can be defined as: A new and creative way of thinking about products and the processes that makes them. It is achieved by the continuous application of strategies to minimize the generation of wastes and emissions. (http://www.global-enviro.com.au/cp.htm) Cleaner Production means economic savings from reduced consumption of raw materials and energy, and lower treatment costs as well as other benefits such as a better company image and better working conditions. Cleaner Production changes often reduce workers exposure to hazardous chemicals, as well as the frequency and severity of accidents and chemical releases. Products that are designed and produced with Cleaner Production concepts in mind are often less harmful for consumers to use. (Manual on Cleaner Production, National Productivity Council, Gandhinagar; Manual on Cleaner Production, National Productivity Council, New Delhi)

Corresponding author: Payal F Sumara,
Lecturer, Government Polytechnic, Gandhinagar.

CLEANER PRODUCTION TECHNIQUES

This new & creative approach to enable the production process less waste intensive is based on different techniques.

A. Source Reduction

The relevant techniques of CP are briefly discussed below:

a) Good Housekeeping

Good Housekeeping usually means changing existing practices or introducing new ways of operating and maintaining equipment. Appropriate provisions to prevent spills and to encourage good workplace attitudes are included in this category of Cleaner Production options.

b) Process Change

Under this head, four CP techniques are covered:

i) Input Material Change
Input material change includes the use of less hazardous materials or raw materials of higher quality, both of which may reduce the generation of waste in the process.

The following elements are covered under the head of input material change.

Material Purification

- Efficient material substitution
- Use of less toxic material
- Use of renewable material

ii) Better Process Control

Modifications of the working procedures, machine-operating instructions and process record keeping in order to run the processes at higher efficiency and with lower waste generation and emissions.

iii) Equipment Modification

Modification of existing production equipment and utilities, for instance by the addition of measuring and controlling devices, in order to run the processes at higher efficiency and lower waste and emission generation rates. Many a time, simple and inexpensive modifications can help to ensure that materials are not wasted.

The following elements are covered under the head of equipment modification.

- Equipment improvement
- Layout changes
- Technology Change

Replacement of the technology, processing sequence and/or synthesis pathway in order to minimize waste and emission generation during production are the CP interventions under the Technology Change technique.

B. On-Site Recycling

On-site recycling techniques are sub-divided into

- Use as a raw material
- Material recovery and
- Useful application

i) On-site Recovery and Reuse

Reuse of wasted materials in the same process or for another useful application within the company

ii) Production of Useful by-product

Modification of the waste generation process in order to transform the wasted material into a material that can be reused or recycled for another application within or outside the company.

C. Product Modification

Characteristics of the product can be modified to minimize the environmental impacts of its production or those of the product itself during or after its use (disposal).

This can be done either by Product Reformulation or Change in product composition.

THE BENEFITS OF CLEANER PRODUCTION

- Conservation of Raw Material and Energy
- Lower Cost
- Improved Environment. (Manual on Cleaner Production, National Productivity Council, Gandhinagar; Manual on Cleaner Production, National Productivity Council, New Delhi)

CASE STUDY

ALCOHOL MANUFACTURING PROCESS

Water is added to the molasses to bring down the Distillery concentration to the desired level (usually 30to 40 percent). A measured quantity of acid is then added so as to adjust the pH on the acidic side. Meanwhile a charge of the selected yeast (about 5% of the total volume) has been growing in the yeast tub on a corn barley malt mash which has been previously sterilized under pressure and cooled. Bacteriologists have cultivated a strain of yeast that thrives under acid conditions whereas wild yeast and bacteria do not.

The mash is pumped into the fermentor and the yeast added as soon as 10 % of the malt has been pumped. The initial pH is adjusted to 4.8 to 5.0 with sulfuric acid and/or stillage. As the reaction indicates, fermentation is exothermic, so cooling may be necessary to ensure that the maximum temperature does not exceed 32 degree Celsius. The time of the fermentation cycle may vary from 40 to 72 hr.

The liquors in the fermenters, after the action is finished, are called beer. The alcohol is separated by the distillation. The beer, containing from 6.5% to 11% alcohol by volume, is pumped to the upper sections of the beer still, after passing several heat exchangers. As the beer passes down the column, it gradually losses its lighter boiling constituents. The liquid discharge from the bottom of the still through a heat exchanger is known as stillage. It carries proteins, residual Distillery, and in some instances, vitamin products so it is frequently evaporated in and used as a constituents of animal feed. The overhead containing alcohol, water and aldehydes passes through a heat exchanger to the partial condenser, or dephlegmator, which condenses sufficient of the vapors to afford a reflux and also to strengthen the vapors that pass through to the condenser, where about 50% alcohol, containing volatiles, or aldehydes, is condensed. This condensate, frequently known as the high wines, is conducted into the aldehydes, or heads, column, from which the low boiling impurities are separated as an overhead. The effluent liquor from part way down the aldehydes column flows into the rectifying column.

In this third column the alcohol is brought to strength and finally purified in the following manner: the overhead passing through a dephlegmator is partly condensed to keep the stronger alcohol in this column and to provide reflux for the upper plates. The more volatile products, which may still

contain a trace of aldehydes and of course alcohol, are totally condensed and carried back to the upper part of the aldehydes still. Near the top of the column 95 to 95.6% alcohol is taken off through a condenser for storage and sale. Further down the column, the higher boiling fusel oils are run off through a cooler and separator to a special still, where they are rectified from any alcohol they may carry before being sold as an impure amyl alcohol for solvent purposes. The bottom of this rectifying column discharges water.

Alcohol-water mixtures are rectified to increase the strength of the alcohol component by virtue of the composition of the vapors being stronger in the more volatile constituents than the liquid from which these vapors arise. However, alcohol can not be made stronger than 95.6% by rectification, because water forms binary constant-boiling mixture of this composition which boils slightly lower than absolute, or anhydrous alcohol. (Mfg. Process of Ethanol, 1995)

FLOWSHEET OF ALCOHOL MANUFACTURING

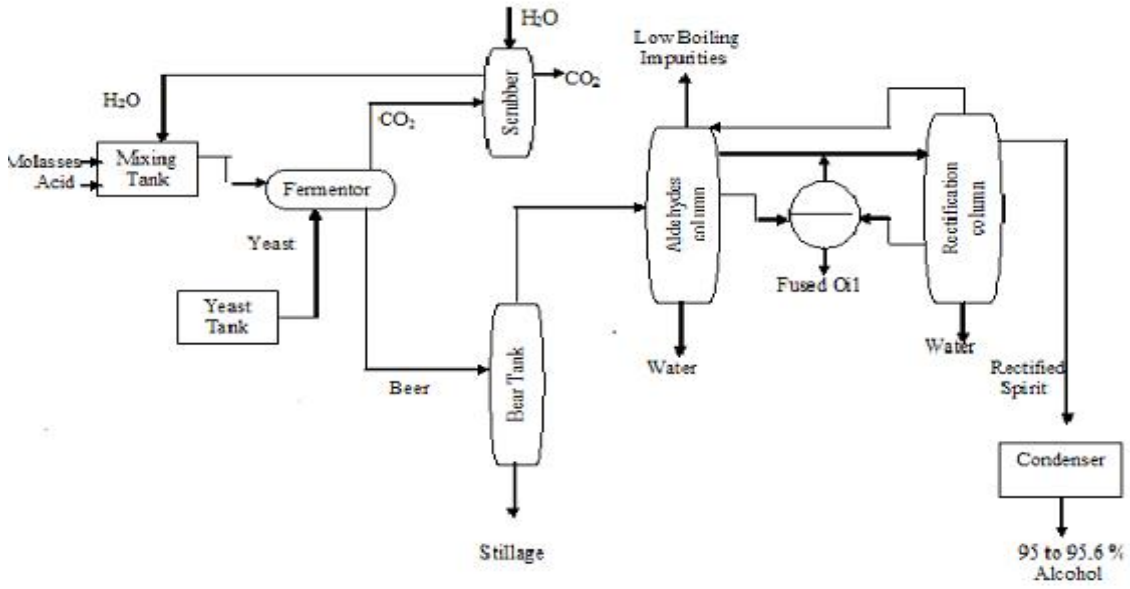

Figure 1. Process Flow sheet of Alcohol Manufacturing

SUMMARY OF COST BENEFIT ANALYSIS AT A GLANCE

Table 1. Cost Benefit at a Glance

S. No.	CP Option Ref.	Annual Energy Savings		Annual Monetary Savings (Rs./Yr)	Investment (Rs.)	Simple Pay Back Period (Months)
		Steam (kg/Yr)	Electricity (kWh/Yr)			
1	Energy savings through transport of hot RS vapours directly from rectification column to ethanol molecular sieve plant. 95% Rectified Spirit vapours at 98 º C from rectification column is presently been cooled and sent to 95% alcohol storage tank. Cooling is necessary before storage as hot liquid would mean loss of alcohol by vaporization. From the 95% alcohol storage tank, the required quantity of RS is drawn for making Ethanol (99.9% alcohol). This process again requires heating of RS from normal temperature to 95 º C (which is done by steam) before entering the ethanol molecular sieve plant. So it is recommended to directly send hot RS vapours directly from rectification column to ethanol molecular sieve plant for energy savings.	3682200	-	1472880	300000	2.44
2	Replacement of all Fluorescent tube lights (FTL) in office and plant area with T5's.	-	5320	29260	52250	21
3	Replacement of all existing HPMV's lamps with energy efficient HPSV lamps.	-	12372	68046	258000	45.6
4	Energy Savings by installing Variable Frequency Drives for Gear Pump	-	2400	13200	10071	9
5	Energy Savings by reducing the speed of air compressors prime movers	-	7200	900000	33570	0.48
6	Energy Savings by reducing the discharge pressure of compressor as it is mainly being used for instrument air and does not required this level of high pressure.	-	32123	176677	Nil	Immediate
7	Energy Savings by increasing the air blow frequency of the Rotex moisture removal device	-	7200	39600	Nil	Immediate
8	Recovery of water drain – 100 litres/hr from T-335 recirculation pump gland water sealing- to main water tank thus saving cost of water	-	-	2400	50000	249.6
9	The entire steam to the evaporator to the tune of 800 kg/hr after condensation is being drained. If we collect the condensate, we can save the energy.	-	-	698182	Nil	Immediate
TOTAL		-	-	3856245	703891	328

Conclusion

Cleaner Production is useful pollution control technology for reducing waste treatment, transport and disposal. Cleaner Production is concentrate on whole the process, from raw material to final product. Cleaner Production is minimize waste generation, while other pollution control technology is minimize waste by waste treatment & waste disposal methods after generation of waste.

Cleaner Production is Very useful concept for protecting environment. Through Cleaner Production, wastes can be reduced and profitability improved, without major intervention in the process. Cleaner Production minimizes the amount and toxicity of waste and emissions. The direct effect is that the pollution load on the environment is decreased and environmental quality is improved. Therefore, it is important to realize the wide scope of Cleaner Production concept. It can be implemented at process or product design phase, during operation or during modernization or expansion phase.

Cleaner Production implementation will be a catalyst in achieving company's target of quality, health & safety and competitiveness. From the study of cleaner production in Distillery Unit, We conclude that by using Cleaner Production Technique we can minimize the waste generation, also we can made the plant working very efficiently, minimize the consumption of heat and energy.

We study about Distillery Unit, which produces alcohol from molasses. We study Alcohol Manufacturing Process in detail. By applying different methods and technique, we suggest some Cleaner Production Options with Savings, cost of Investment, and simple payback period. Form whole study by applying Cleaner Production Technology, we can reduce waste treatment, transport and disposal and protect our environment.

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