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Cleaner Production in Sugar Unit

Engineering

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Payal F Sumara

Lecturer, Chemical Engineering Department, Government Polytechnic, Gandhinagar

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 drawback 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 Sugar, Flowsheet of manufacturing of Sugar, 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 is presented. It has been concluded that there exists a very good scope for implementing "Cleaner Production and Cleaner Technology" in any "Sugar Manufacturing Unit"

INTRODUCTION OF CLEANER PRODUCTION [1],[2],[3]

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.

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.

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.

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.

CASE STUDY: SUGAR MANUFACTURING PROCESS [4]

Cane is weighed on weighbridge and dumped in cane carrier. Cane is cut in small chips with the help of revolving knives. Prepared cane is crushed and juice and bagasse are separated.

Each mill has three rollers and mills are driven by steam turbines. Bagasse coming out from mills is sent to boiler. It is used as fuel for steam generation. Screened juice (Called Raw Juice) from mill is weighed in automatic weighing scale.

Phosphoric acid is added in weighed in automatic weighing scale. Phosphoric acid is added in weighed juice to make up P205 content.

Raw juice is heated 30 Degree Centigrade to 70 Degree Centigrade in heat exchangers called Juice Heater. In heated juice, milk of lime and SO2 are mixed and 7.1 pH maintained. This juice is called as Sulphited Juice.

Sulphited Juice is heated from 70 to 105 Degree Centigrade in other set of heat exchangers. Heated juice is sent to continuous settler called Dorr.

Clear juice and settlings (Called Muddy Juice) are separated. Muddy juice is mixed with fine Bagasse particles and subjected to vacuum filtration to separate solids from liquids. Solids are called Filter Cake and liquids are called Filtrates.

Filter Cake is a by-product. Filter cake is washed with hot water. Clear Juice containing 85% water is evaporated in multiple effect evaporated in multiple effect evaporators. Thick Juice coming out contains 40% water. It is called Syrup. Syrup is Sulphited up to 5.2 to 5.4 pH by SO2 gas to bleach coloring maters. In vacuum pan, syrup is evaporated till water contented are grown.

Mixture of crystals and mother liquor is grown massecuite. Normally three types of strikes of massecuite are boiled. In centrifugal machines, mother liquor and sugar crystals are separated. Water and steam are applied to remove molasses layer on sugar.

Hot air is blown on sugar conveyors called hopers for drying then cold air blown for cooling sugar crystals. Sugar and hoper is hydrogenous.

It is screened through set of screen of different opening to separate crystals of different sizes. Screens are vibrated by electric motors. The different sizes sugar send to sugar bins for automatic weighment where 100 kg net sugar is feed in gunny bags.

Feed gunny bags enclosed on stitching machines. Grade and serial no of that particular bag is marked and send to sugar godown for storage. Molasses separated out (at centrifugals) from last grade massecuite is called final molasses it is by product for alcohol distillery. It is stored in M.S.Tanks.

FLOWSHEET OF SUGAR MANUFACTURING

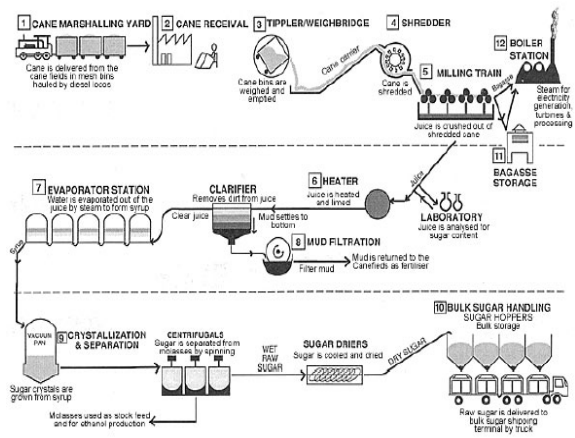

Figure 1: Process Flow sheet of Alcohol Manufacturing

SUMMARY OF COST BENEFIT ANALYSIS AT A GLANCE

Table 1: Cost Benefit at a Glance

SR. No.	C.P. Option	Annual Monetary Savings (Rs.)	Investment (Rs.)	Simple Payback Period (Years.)
1	Reduction of sugar (POL) loss in mud by prior washing of sugarcane before milling	4070592	4000000	1
2	Energy savings by incorporating of no load energy saver in kicker motors of WIL & B/W streams	22690.8	45576	2
3	Reduction of sugar (POL) loss in bagasse by additional diffusion washing of bagasse after last stage milling	17910604.8	18000000	1
4	Reduction in Bagasse loss during transportation to boilers through conveyors	25359	800000	32
5	It would however be required to ensure that an additional head of around 60 mWC be provided for the mixed juice transfer pumps (after mills) to cater to pressure drop across heater; which would amount to around 52 KW additional load on each of these pumps [Combined Raw Juice Pumps Detail (B/W Mill + WIL Mill)]	443000s	100000	0.2

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6	It is recommended to install no-load energy saver on the packaged sugar conveyor belt from sugar yard to the adjacent yard (2 HP) to reduce electricity consumption during idle operation of the belt.	8924	6000	0.7
7	The old design of injection-spray condenser requires pumps to operate totaling a power consumption of 900 kW. Newer more efficient designs would bring down this consumption to 450 KW. Here the ejector-jet design and the fine mist spray through efficient nozzles gives better and more stable vacuum (in evaporators and pans) besides consuming less water.	11345400	15000000	1.3
8	It is recommended to replace the existing air compressors being used for sulphur furnace combustion system with air blowers. This would entail reduction of power from existing 15.5kW of air compressor vis-à-vis 5 kW of air blower.	40000	264726	0.151
9	It is suggested to reduce discharge pressure by adjusting pneumatic setting from existing 6.3-7.0 kg/cm^2 (g) to 4.3–5.0 kg/cm^2 (g). This would directly result in reduced power consumption to the tune of 10 kW during load cycle (unload cycle time being 10% of total cycle time).	226908	Nil	Immediate
10	Replacement of all Fluorescent tube lights (FTL) in office and plant area with T5's. This would result in lighting power consumption to the tune of 50% (for 24 hrs, day and night).	92129.4	114250	1.2
11	To provide transparent roofing in order to maximize use of natural lighting during day time with associated saving in lighting energy consumption to the tune of 10% (in plant area)	17911	50000	2.8
12	It is recommended to reduce specific steam consumption from existing level of 46% on cane to 35% on cane by incorporating efficient state-of-the-art evaporators (6- effect) and pans (vertical modular).	8301732	10000000	1.20
	Total	43841654	48016862	47.511

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 Sugar Unit, which produces Sugar from Sugarcane. We study Sugar Manufacturing Process in detail. We found some kind of problems, so by this plant could not working efficiently and consumption of heat and energy would be higher than required.

By applying different methods and technique, we suggest some Cleaner Production Options, shown calculation of annual monetary savings, cost of Investment, and simple payback period. We show them Economical, Technical and Environmental Impact. From this they will do Implementation on the bases of calculation.

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