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Green Manufacturing in Sugar, Foundries and Solar Steam Generation

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Abstract: ***The Green Manufacturing deals with conserving natural resources for future generation and recycling of material by improvements in production process than in control technology. The purpose of this paper is to present research finding that should be incorporated in sugar factories and foundries for the concern of green manufacturing. Currently problems like air pollution, degradation of sources of energy, usage of natural resources in industry are increasing. This research technology presented in paper claims about increase in economic progress rate while decrease in resource depletion, waste generation and pollution. The paper presents the green technology used over traditional way as it promotes green design and development of innovative manufacturing system. The paper informs about cost reduction and improved quality of product which is useful for industry purpose.***

Keywords: ***Manufacturing, sugarcane, foundries, economic progress rate, resource depletion, waste generation, pollution***

I. INTRODUCTION

In this global world environment, resources and population are major problems. Environment is crucial one with and change in climate at any point leads to the imbalance of the earth. The ISO has proposed the new quality management system for products and even for Environment management system. The main era is to minimize the environmental damage due to industries. There is a need of new manufacturing process i.e. Green Manufacturing which is suitable a sustainable development strategic. The cost of energy and resources are constantly increasing due to rising demand and limited supply. Furthermore, price trends can hardly be forecasted, so companies aim to successfully produce within large price ranges of energy and resources. One strategy to accommodate price fluctuations consists of passing mark ups to the customer. However, a price mark-up may require that improvements be made to the product. Alternatively, stable prices may be facilitated with increased production efficiency, which can be achieved by reducing resource consumption and improving the organization of the manufacturing system. The companies practicing green manufacturing know the importance of implementation factors, but have failed to accomplish them today in totality.

A. Green Manufacturing

The GM includes comprehensive meanings. Firstly, the concept of 'manufacture' relates to the total life circle of product. So the 'manufacture' here is a generalized concept. Secondly, the environmental problems relate to every counts of the manufacture process. So many relevant concepts such as green design, ecological process planning, green manufacture and so on are brought out. Thirdly, GM is a complicated system engineering problem. It needs to be surveyed from the view of system engineering. Finally, the essence of GM is a kind of sustainable development in the field of modem manufacturing. So GM is the only solution of sustainable development and it is also the enterprise's responsibility for the society. Green manufacturing (GM) is a term used to describe manufacturing practices that do not harm the environment during any part of the manufacturing process. It emphasis the manufacturing processes that do not pollute the environment or harm consumers, employees, or other members of community. GM stresses on reducing parts, rationalizing materials and reducing components, to help make products more efficient to build. Green manufacturing highlights the road map of the industries for achieving performance improvement through sustainable development and its impact of organizational competitive outcomes. It also points out strength and weaknesses of sustainable development practices and overall organizational competitive outcomes using developed research instrument.

B. Sustainable Development

The word "sustainable" is coined from the term sustainable development, as introduced in a report published by the United Nations' World Commission on Environment and Development, it is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs", sustainable development's goal is preventing unnecessary

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and further environmental degradation. Manufacturers are becoming increasingly concerned about the issue of sustainability. A system might be thought of as unsustainable when society consumes resources and produces wastes at a rate that exceeds nature's ability to transform industry and society wastes into environmental nutrients and resources.

Hence, Sustainable development is a concept, which involves social, ecological and economic objectives, and requires to sustain the integrity of resources exploitation, the direction of investments, the orientation of technological development and institutional change. Some of the benefits of green manufacturing are listed below:

1) Controls and reduces material waste in manufacturing cycles,

2) Preserves capital and saves money,

3) Improves productivity and increases cost savings,

4) Help drive and influence corporate behaviour both internal and external to ensure sustainability,

5) Easy adaptability to changing rules in environmental.

C. Cleaner Production

Cleaner Production (CP) is used in conjunction with other elements of environmental management; it is a practical method for protecting human and environmental health, and for supporting the goal of sustainable development. CP can reduce environmental risks and liabilities and lead to greater competitiveness. By demonstrating a commitment to Cleaner Production, companies can also improve their public image and gain the confidence of consumers. It aims at avoiding the generation of waste and emissions, by making more efficient use of materials and energy, through modifications in the production processes, input materials, operating practices and/or products and services. Major industrial machineries runs on the electricity. Except hydraulic power plants, all other methods of production of electricity consumes high energy. High pressurized steam generation requires major quantity of fossils fuels. But the production of steam can be done in effectively and efficiently by the use of the solar energy in the regions which receives ample quantity of solar heat. Produced steam can not only be used for electricity generation but also for domestic applications and running steam turbines. This system would reduce the dependency of industries on fossils fuels and ultimately would lead to the greener environment. Few of projects are running on this idea, but till date it has alongway to go. Waste products formed after the manufacturing of finished products, has a lot of headache in its disposal and management. But lot of by products can be used for the other purposes, like for production of heat energy. Byproducts formed by Agro based company can be further used for fodder of cattle and also rich fertile fertiliser can be manufactured. Using such waste management we assuredly can reduce the stress on the conventional fuels. Cleaner and greener environment can be easily achieved. Foundry sector in which casting technology is applied to process and give shapes to metals is one of the major industry sectors. Casting is used for various products from jewelry to manufacturing of heavy industry products. Foundries have long looked at themselves as the nation's recyclers. Since metals were first poured, it was recognized that recycling old iron castings was the easiest manner to remake another casting and reuse society's unwanted cast articles. Later steel and other metal scrape was introduced into our change mixes as an additional feedstock to achieve the same goal. Today because of recycling of metals, most foundries have long considered themselves as a part of green technology, but in reality foundry industry has yet to achieve the higher level of sustainability that the future will demand. The pollution related to foundries are important due to their high potential risk to environment and human health. The main waste from casting is the spent foundry sand, which is generated at very large quantities during core and mold preparation. This paper main objective is to bringing the attention of the manufacturer who are manufacturing the product with the mass production. We have seen that a lot of energy is using day by day and lots of waste is available, the waste are hazardous and can lead the human being to a termination point. Toxic hazards are really crucial for human being. This paper points all the waste and the methodology of green manufacturing that we can applied and can reduce the wastage and increase the use of sustainable energy. The implementation of Green Manufacturing may not only be good for the environment — it is often good business, as well. The same is often true of other efforts to reduce the energy- and material-intensiveness of manufacturing processes; what is good for the environment is typically good for the balance sheet as well.

D. Green Production Of Electricity From Sugarcane Bagasse

The main waste product of sugarcane production is a material known as bagasse. Bagasse is the fibrous residue that remains in large quantities upon the crushing of sugarcane to remove the sugar juices. For each ton of sugarcane crushed, about 300 kg of bagasse is retrieved. 1 Ton sugarcane = 300 Kg of bagasse Pith is cellulose but not fibrous, and must be removed from bagasse in order to make good quality pulp from which to produce paper. Bagasse pith is usually removed in a process known as "moist de-pithing' in the sugar factory itself.

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Following are the advantages of briquetting bagasse:

1) High calorific value ranges between 3,500-5,000 Kcal/Kg
2) Moisture percentage is very less (2-5%) compared to lignite, firewood & coal where it is 25-30%
3) Economic to users compared to other forms
4) Briquettes can be produced with a density of 1.2g/cm³ from loose biomass of bulk density 0.1 to 0.2 g / cm³.
5) Easy in handling and storage due to its size.
6) Consistent quality.

a) Co-Firing Method Of Generation Of Heat From Bagasse

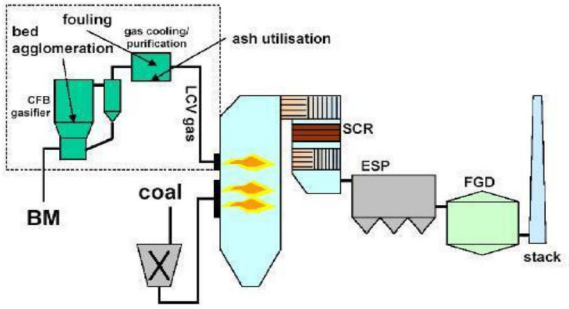

Fig.2.CO-Firing Method of Generation of Heat from Bagasse

The biomass is prepared separately from the coal and injected into the boiler without impacting the coal delivery process. The first approach, in general, is used with less than 5 wt. % co-firing.

b) Production Of Bio-Ethanol From Sugar Molasses Using Saccharomyces Cerevisiae

i) *Experimental methods:* A known quantity of sugar molasses and Baker's Yeast (*saccharomyces cerevisiae*) were taken in fermentation flask and kept in a constant temperature shaker. An anaerobic condition was maintained for four days and during this period, the strain converts sugar into bio-ethanol with the evolution of CO2. A known fermented sample was collected for every 12 h interval. The same procedure was repeated to optimize the parameters such as pH, Temperature, substrate concentration and yeast concentration. Further, produced high pressured steam is used to run steam turbines, from which electricity can be generated after the application of generator. Produced bio ethanol can be used to run engines generator sets to produce electricity.

Table 1: Comparison between traditional way and greenway

Challenges	Traditional approach	Modern approach
Resource used	LPG gas, gasoline, diesel	Bagasse
Waste generation	Ash, hot water containing high salt concentrations, disposable problem of bagasse	Ash, hot water containing high salt concentrations
Environment pollution	Air pollution, water pollution	Air pollution, water pollution but at lesser extent.

This method used is not actually a total green manufacturing process. But, when we adopt this way of production of electricity the disposable problem of bagasse gets reduce to the greater extent. And also the electricity gets generated at lower cost and in efficiently manner.

E. Green Production Of Steam From Solar Energy

A parabolic type concentrating solar steam cooking system was commissioned at Shri Saibaba Sansthan, Shirdi on 24th May, 2002. This system received financial assistance of 50 % of the total project cost from the Ministry of Non-Conventional Energy Sources, Goi. This is the first of its kind in Maharashtra. It cooks food for about 3000 devotees.The 40 nos. of solar parabolic concentrators raise the water temperature to 550C to 650C and convert it into steam for cooking purposes. This system is integrated with the existing boiler to ensure continued cooking even at night and during rain or cloudy weather. The solar cooking system installed at Shirdi follows the thermosiphon principle and so does not need electrical power or pump.

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1) *Introduction:* Shirdi is a religious pilgrimage centre and thousands of devotees visit the Shirdi Sai Baba temple daily. Shri Sai Baba Sansthan at Shirdi is an autonomous body (Trust) to provide facilities to the devotees. Shirdi is located near Nasik. Other nearby cities include Mumbai, Pune, Ahmednagar and Aurangabad. The latitude of Shirdi: 19.5 degrees north The longitude of Shirdi: 74.5 degrees East.
2) *Goals:* Before the installation of the solar cooking system, the steam for cooking at Sansthan was LPG gas firing in the boiler.

a) The main goal of the system was to reduce LPG gas consumption by 50 %.

b) Another important goal beside financial benefits due to saving LPG gas was to use as much natural energy as possible to promote environment protection, its conservation and rejuvenation by using renewable and clean energy.

3) *Technical Description Of System*

a) The solar steam cooking system installed at Shirdi has 40 parabolic concentrators / dishes (called Scheffler dishes after its inventor) placed on the terrace of Sai Prasad Building No.2.

b) They reflect and concentrate the solar rays on the 40 receivers placed in focus. Water coming from the steam headers placed above the header centers is received from bottom of the receiver, gets heated up to due to heat generated (about 5500C) due to concentration of solar rays on the receivers and get pushed up via top pipe of receiver into the header. The principle of anything that gets heated is pushed up is called thermo-siphon principle. The advantage of thermosiphon principle is no pumping (thus no electricity) is needed to create circulation since the heated water is pushed into the header and water from the same headers come into the receivers for heating. The cycle continues till it reaches 1000C and gets converted into steam.

c) The header is only filled and thus steam generated gets accumulated in the upper half of the steam header. The temperature and pressure of steam generated keeps on increasing and heat is stored till the steam is drawn for cooking into the kitchen.

d) All the 40 dishes rotate continuously along with the movement of the sun, always concentrating the solar rays on the receivers. This movement of concentrators is called tracking, which is continuous and is controlled by the fully automatic timer mechanism.

e) Only once during the day i.e. in the early morning the dishes have to be turned manually onto the morning position, subsequently the automatic tracking takes over.

Table 2: Comparison of traditional way and Green way

Challenges	Traditional Approach	Modern Approach
Resource Utilized	LPS gas, gasoline (Non-renewable)	Solar radiations (Renewable)
Waste Generation	Ash	Nothing
Environmental Pollution	Air pollution and emission contains Sulphur	Nothing

Steam Produced in this procedure can be further utilized in rotating steam turbines to produce electricity etc.

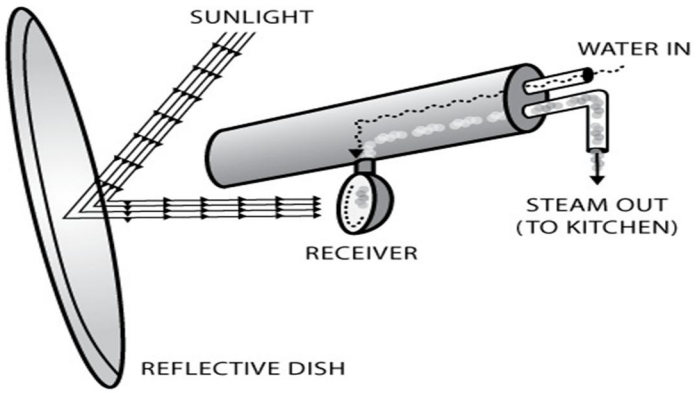

Fig.1.Steam Production from Solar Energy

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F. Green Manufacturing In Foundries

In green manufacturing process we should not forget one thing that every area in the foundry operations is a fertile ground for green savings to make a foundry green the following are some of the processes:

1) Energy savings
2) Core systems
3) Pollution control

Table 3: Energy Saving Processes

Processes	Disadvantages	Advantages
Melting	Sheared scraps (rusty and contains non -metallic particles.) consumes 1.5-2 times more energy.	Shredded scraps (no non- metallic particles) consumes 15-20% less energy to melt.
Sand reclamation	Many of industries don't have sand reclamation plant and most of them have fully electrically controlled.	Using themal sand reclaimer and pneumatic/mechanical sand reclaimer save about three percent of the energy used in this section.
Machining	Motors and bench grinding machining tools consumes more electrical energy.	High & Ultra high efficiency motors can save upto 2-5 % of the operating energy. Pneumatic controlled machines saves electrical energy and cost.
Lab	Using incandescent bulb and old model electrical testing machine consumes more energy.	Using advance m/c, CFL saves up to 2% of electric energy and using transparent roofing sheets we can avoid day lighting.
Core Reclamation System (Core system)	Most of the foundries don't make use of core reclamation system	The installation of the polygon sieve core reclamation plant may save the core sand to be dumped outside.

Table 4: Pollution Control

Processes	Disadvantages	Advantages
Core making	During formation of core lots of sand get spilled down and wastage of sand takes place and makes core section dirty.	Using automatic core shooting m/c spillage of sand is reduced and also makes a green environment.
Moulding	Jolting m/c makes more noise and squeezes out sand which creates pollution.	Fully automatic m/c makes less noise and enhances the mould hardness.
Pouring	Hot molten metal reacts with the dust particles which creates the pollution due to manual pouring of metal	Auto pourer m/c reduces pollution causing due to the reaction of dust particle with molten metal.
Machining	Old m/c creates large noise that creates pollution.	Sound absorber are used to reduce noise pollution.

II. CONCLUSIONS

This study concluded that there was lot of work carried out in the field of GM and sustainable development but still we need to go further. Green manufacturing is proven very valuable concept for abating industrial waste and emission. Economical benefits and competitive out comes can be achieved from preventing waste. The aim of the GM is to enable the efficient use of resources and improve the environmental performance of sugarcane factory and foundry companies. Steam Production from solar energy can be considered as ideal example of GM relative to the challenges in GM.

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The benefits of implementing GM at foundry companies were ascertained, these include;

1) Reducing waste through efficient use of energy and raw materials.
2) Enhancing productivity and increasing product yield through greater efficiency.
3) Increasing profitability and quality of products.
4) Reducing the risks of environmental accidents and avoiding regulatory compliance costs leading to insurance saving.

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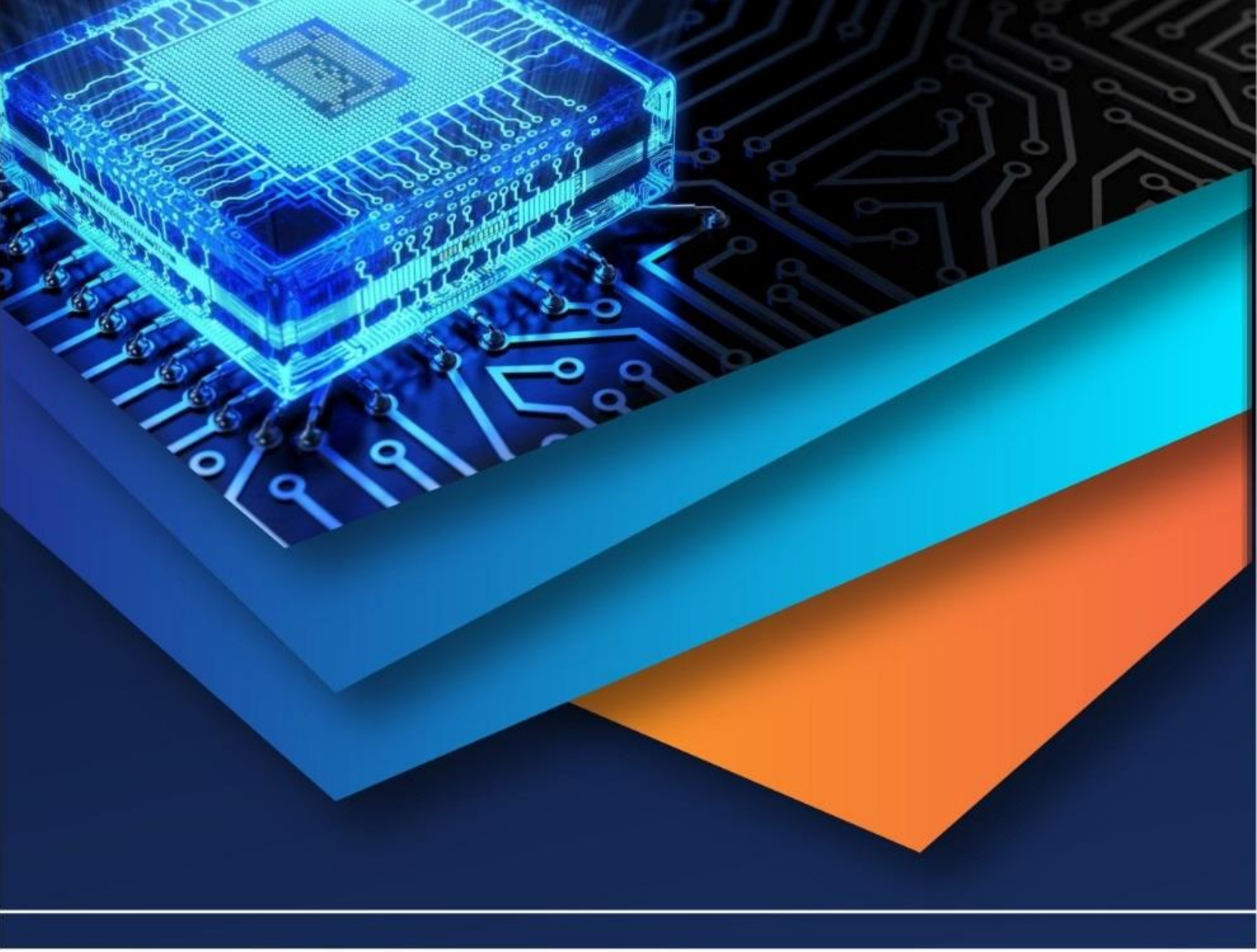

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