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Green Manufacturing - An overview

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Abstract— *Data on energy consumption, global warming, and carbon di-oxide levels in the environment, industrial pollution, and population is growing extensively which means there are more and more challenges with less sustainability, which leads to think about Green Manufacturing. Consumerism driven consumption in developed countries and population in developing countries is leading to tremendous demand for goods and services. Fulfilling such ever increasing global demands is putting up the pressures on limited resources viz materials and energy. Unfortunately rate of depletion of material and energy has outgrown the rate at which nature recovers stroke restores them back. With this ever widening gap the day is not far for our future generations to strive for basic needs. To overcome this challenge society must embrace sustainable methodologies and practices. Being the source of maximum industrial pollution manufacturing industries must lead the way toward Green Manufacturing. The paper gives an overview of Green Manufacturing, drivers of Green manufacturing, and case studies of Green manufacturing.*

Keywords— Green Manufacturing, energy consumption, global warming, industrial pollution.

I. INTRODUCTION

Green manufacturing is bit of misnomer. It does not restrict itself to just manufacturing. Manufacturing of product involves all the stages from design to recycling of that product.

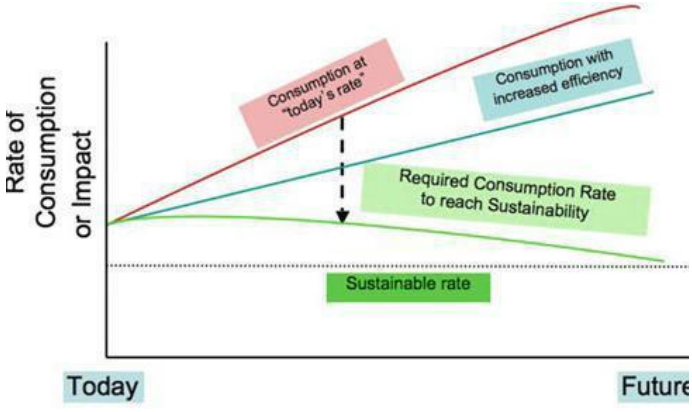

Fig.1: Illustration of consumption and impact over time [9]

What is Green Manufacturing?

Green manufacturing is bit of misnomer. It does not restrict itself to just manufacturing. Manufacturing of product involves all the stages from design to recycling of that product. At every stage there is a waste generation. So Green manufacturing is application of environment friendly consideration at every stage of product life cycle. This includes Green design, Green production, Green distribution, Green usage and Disposal. The entire objective of Green Manufacturing is to a) bare minimum use of resources (material and energy) while manufacturing b) Leaving minimum residual after the disposal.

It can be defined as "the creation of manufacturing products that use materials and processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound" [1].

E waste:

Electronic wastes are E wastes. E wastes are great challenge to develop and developing countries and threaten to the globe. E wastes are one the fast growing waste. Recycling and disposal of e waste is a tedious job. E waste contains 60% of metals such as Copper, Aluminum and Gold and pollutants are of 2.7%. By extracting of these metals though special processes are risky because these metals are attached with ceramics and plastics but simultaneously creates business opportunity. E wastes are created by many ways such as product reach its completion of cycle time, second is over the period of time, like obsolesce of mobiles phones, computers, and desktops. E wastes may be internally manufactured or imported from other countries in the form of new or used product. Some developed countries have legislation such as used products has to be collected and taken back from the country at the products' cycle end [4].

Hazardous waste in E waste:

Hazardous wastes create negative impact on the earth, environment especially on human being, animal and plants. Instead of proper segregation and processing of wastes, it's been dumped, buried, and burnt in open air. This pollutes the soil, air and water very seriously and makes soil infertile. Some component in Air conditioners, refrigerators, mobiles and many other electronic goods

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need to have special process on end of life (EOL) Particularly mercury, Arsenic, Plastics which are not decomposed, lead, chromium, dioxins and furans compounds. Every year 50million Tons of e wastes are produced out of that few percentage are being recycled [5]
Major problem of E waste is toxic component (as mentioned above). E wastes need special treatment for recycling operation, if not, this will lead to wide effect on the environment and also to human being. Land filling and incineration of the used products create many problems. As quoted by Juliet Duff, Irish Doctors Environmental Association, "incineration does not solve the problem of waste, it only reduces waste to approximately 30 – 50 % of the original compressed waste mass, and this is converted into an ash that contains some of the most toxic concentrations of substances, such as dioxins and heavy metals". When this toxins mix with other toxin in atmosphere turn out as water bodies and spoil soil. [6]

Effect of E wastes on human health and Environment:
World health Organization (WHO) warns short span exposure of concentrated toxins may tend to patches of dark skin, making disorder in liver function, skin deceases. If its long span of time of high levels of toxins may create problem in reproduction system, immune system nervous system and can lead to cancer.

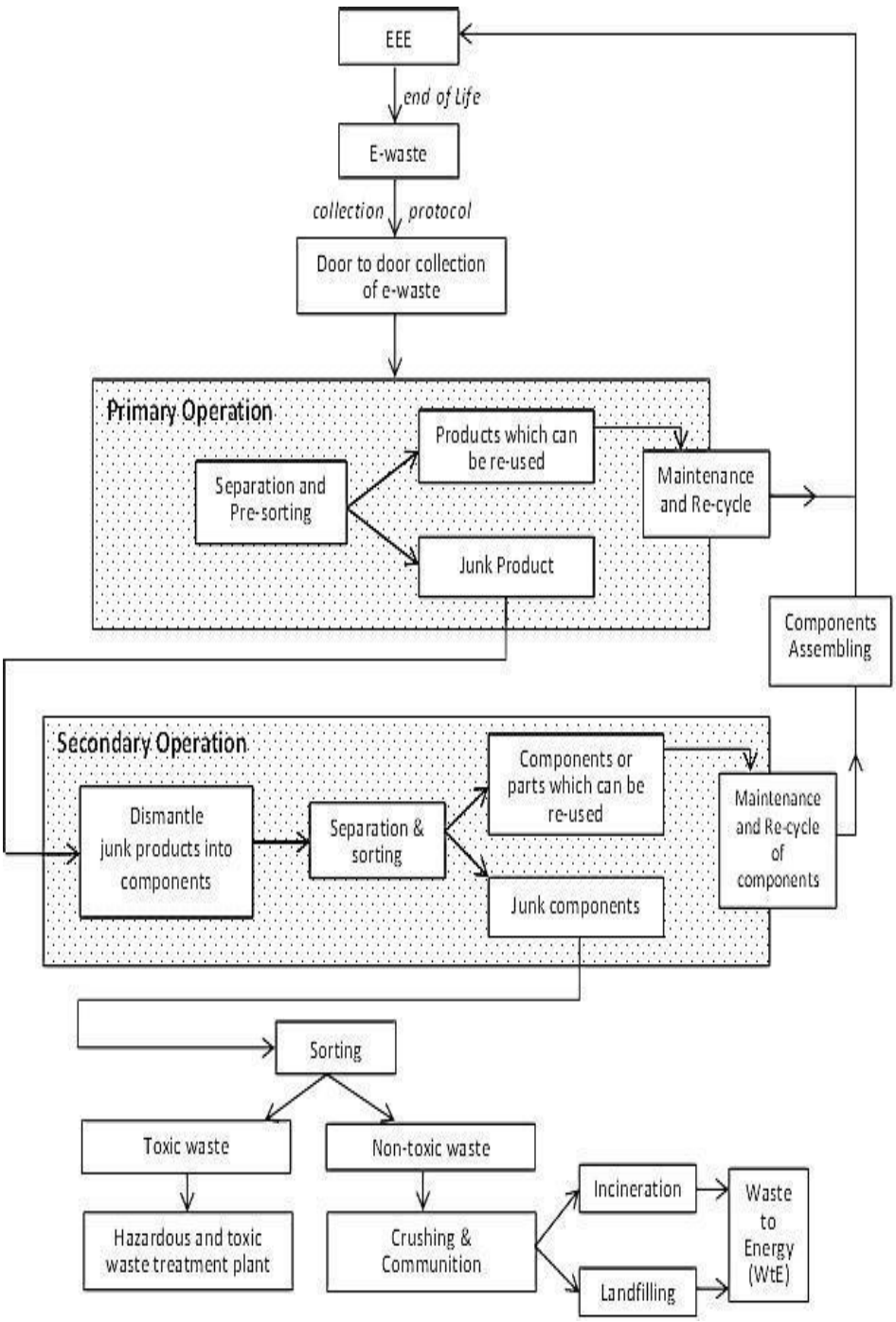

Fig.2: A 'green' framework for Waste Electric and Electronic Equipment (WEEE) handling [5]

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Introduction of Green Approach in Information technology:

Due to sudden development in Information technology has emerged enormous e wastes in the globe. Handling and organizing of e waste is a green approach or environment responsive approach. Collection, sorting, segregation, recycling processes and rest of the e wastes go to land filling and incineration. In recycling process recovering of reusable component separated out of set of waste components. So the manufacturers have to have different system to do this operation, reusable component alone should be collected from the assembly or all the components should put together, out of that, only reusable has to be separated.

To regulate the Green approach, country makes polices on collection of e waste. Collection of e waste is the first stage and this is CSR Corporate Social Responsibility. Manufacturers has to collect the used component (e waste) from the customer at free of cost in Europe Union Nation. But in other countries such as Greece and Japan, "Withdrawal on charge" Customer has to pay sum of money to Traders [3]

In the next stage, Primary step is to find out reusable and recyclable component and send it for reuse, after some repair work, if needed. Remaining component need to send to the secondary operation. In that 1. Dismantling component from junk subassembly, and from the components metals has to separate by special processes. This can be used for production of new component.

Next stage sorting component by its nature and separates useful metal. Apart from all the Producers Responsibility is when the component is hazardous to the environment and human being, company has to restrict the usage of that component and look for alternate.

Green Manufacturing: Food Industry

Food Industries produces wastes are those byproducts produced during processing and are not recycled or reused. Large amount of wastes are produced in food industries in the form of solids and liquid during manufacturing, preparing and consuming food. This causes environmental pollution and lot of wastage of nutrients.

Wastages in Food Industry- It contains proteins, carbohydrates and lipids, depending on source it may contain suspended solids and large amount of water also Biochemical oxygen demand or chemical oxygen demand. Biological oxygen demand is quantity of oxygen required to breakdown organic material by aerobic biological organisms in a given water sample at given temperature over a specific time period. Solid waste may involve both organic waste as well as packaging waste. Organic waste can be biodegradable and remaining waste like plastic, rubber etc should be disposed of carefully. [2]

A case study carried out at Vasundhara Dairy, Nagpur is selected as a Food Industry. Milk and milk products are produced at this dairy. Following are some of the steps taken and results of the case study [10].

In this Case study 12 factors have been considered. These factors again split in to sub factors and survey has been conducted with help of thirty managers after implementation of GM practices.

12 GM Practices are 1) Organisational Capabilities, 2) Green Design Initiatives 3) Green Standards Adoption 4) Supplier management 5) Technology Innovation 6) G M Planning 7) Green Purchasing and Marketing 8) Implementing RL 9) Top Management Commitment 10) Customer Focus 11) Green Disposal Initiatives 12) Process Management

Responses collected from managers analysed, items grouped together and grand mean obtained. Marks achieved after analysis = 79% and Grade B.

Achievements of case study are optimisation of selected process parameters, measureable saving in operational cost, and improvement in bottom line result. Through GM implementation company's weak areas were identified for further improvement.

Driving Forces for Green Manufacturing

According to a case study held at Amul Dairy Commercial saving, Employment generation, Conventional pollution prevention are some of the driving forces to Implement GM.[10].

Green Manufacturing implementation creates positive impact on environment. Key drivers to implement GM are mainly customers .According to joint BCG-MIT survey over 40% of the total companies have given preference to customer for sustainable products as main reason to implement Green Manufacturing. Apart from this resource scarcity has legislative, requirements from partners along value chain, owner's demand for broader value chain are few more key drivers[11]

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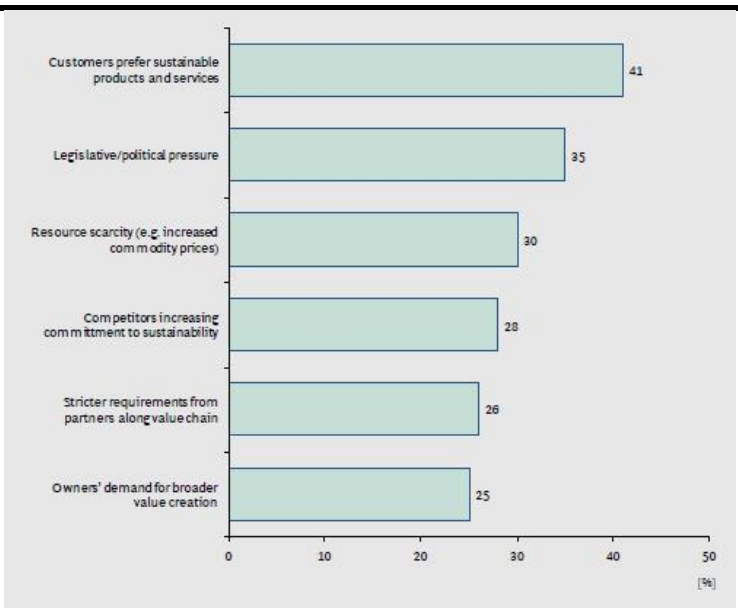

Fig.3: BCG-MIT sustainability survry 2011 report [11]

According to TCS report green regulations Green Business drivers are Green Regulations, Green Consumers, Investor Focus, Business Initiatives, and corporate Social Responsibility (CSR)

Barriers to Green Manufacturing:

Though many drivers are there to implement Green Manufacturing, still some obstacles restricts implementation of Green manufacturing. Those are as follows:

1. Weak Legislation ,
2. Low Enforcement
3. Low Public Pressure,
4. Low Customer Demand,
5. Low Top Management Commitment, Lack of Organizational Resources,
6. Lack of awareness sustainability concepts,
7. No tax benefit or other rewards from government Less support from the employees
8. Lack of funds for green projects
9. Difficulty for operation and maintenance

II. CONCLUSION

This paper is based on discussion and results on survey and analysis on green manufacturing. For continuous improvement (Green manufacturing), some standard has to be followed in manufacturing and service sector. For study on wastes, food waste and E wastes been considered and also has discussed implementation of green manufacturing in these field. One of the initiative step in creating awareness in people is Green approach, eco- friendly approach. Eco friendly products are the current requirement of consumers and entire world is marching towards restriction of use hazardous components due to the consequences on earth and living creature including human being. That's how green manufacturing has entered into the manufacturing and waste management. Green manufacturing has been studied carefully for various applications. Some barriers are also been considered before executing development activities.

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