Green Manufacturing

Green Manufacturing is practised recently to meet the demand of nature. Frequent major disasters of late have triggered the alarm and alerted all manufacturers of natures’ vulnerability and wraith. With more and more environmental legislation being approved, companies have no option but to adopt the green policy. Green Manufacturing actually offers a lot of benefits, not just from the economical point of view but from other aspects as well. This paper will cover a brief introduction to Green Manufacturing, its benefits from environmental, company and technological point of view, the way it is implemented and the challenges that Green Manufacturers might face.

1. Introduction

Green Manufacturing is a method for manufacturing that minimizes waste and pollution. These goals are realized through product and process design. Green Manufacturing is actually more of a philosophy rather than an adopted process or standard [1]. In Green Manufacturing, environmental impact of all stages of production is considered. The manufacturer will not use any materials which are harmful to the ecosystem in the design, production, field application and end of life disposal stages of the product [2]. The goal of Green Manufacturing is to support future generations by attaining sustainability by preserving natural resources [3].
Why Green Manufacturing is so important? Due to the recent global climate, humans have started to realise the vulnerability of nature and the disasters it may bring as a response of our negligence. The following are the recent stresses on our environment [4]:

- As much fresh water has been withdrawn in the last 30 years as in the last three centuries.
- Globally, there is a 160 billion cubic meter overdraft of groundwater per year.
- The rate of increase in atmospheric carbon dioxide between 1970 and 2000 is nearly double that between 1960 and 1970 (1.5 ppm vs. 0.88 ppm per year).
- Carbon emissions have increased by more than 1.5 times since 1970.
- The U.S., EU and Japan are by far the world’s biggest producers of solid waste, with the U.S. at about 14 times that of Japan and the EU combined.
- Solid waste strategies: In Japan, it’s "Minimize at source"; In Europe, it’s "Producer responsibility"; In the U.S., it’s "There’s always more space."

Manufacturers have been neglecting their social responsibility and focused too much on their profit. It is time to reflect and take environmental effects of their activity into consideration.

Examples of Green Manufacturing sub disciplines include scheduling and process optimization, advanced fabrication techniques, minimization of waste stream volume and toxicity, and improved energy efficiency [5].

As stated by Manufacturing & Technology News [4], Green Manufacturing will become one of industry’s greatest strategic challenges, not only from an engineering perspective, but from a business and marketing perspective as well.
2. Benefits

2.1 Environmental Benefits

Green Manufacturing will have a substantial impact on the environment. Nearly 80% of toxic waste is from the electrical and electronics industry. The goal of Green Manufacturing is to reduce waste to zero. This will definitely improves the ecology and stop pollution, especially the green house effect that is affecting the Earth more and more as a result of 50 years of manufacturing without taking any environmental consideration.

2.2 Company Benefits

A company that practises Green Manufacturing creates a great image to the public. With the public getting more and more aware of the green house effects, going green is an action much appreciated and supported by the public. In the viewers’ eyes, the company is said to have social responsibility and this reputation means a lot to the company.

The society now is fonder to environmental friendly products. According to Manufacturing & Technology News [4], this is the current market trend. A company which could develop a similar, greener product will certainly have the competitive edge. For example, car users now are more interested in buying energy efficient cars that emit less carbon monoxide rather than energy consuming high powered vehicles. Therefore, the company that is able to produce the greener car will record better sales.

While it is costly to change from the present manufacturing method to a greener method, practising Green Manufacturing may actually be cost saving. Zero waste policy means companies can optimise their resource and save their money on waste
management later on. There will also be a cost reduction resulted from improved energy efficiency and better process control.

2.3 Technological Benefits

Green Manufacturing spins off a lot of research and development projects. Each of this projects enhances our technology. For example, the car industry. With the increasing development of hybrid cars, it is bound to replace all fuel powered cars. The need for a greener product has produced a more advanced technology. As the saying goes, necessity is the mother of all inventions.

3. Implementation

3.1 Production Process

Production process here involves the product design and process design. Both plays vital role in implementing Green Manufacturing. Manufacturers have to develop greener product design. This means that manufacturers have to consider the life cycle of the product and also the virgin material used. To reduce waste, biodegradable and recyclable materials should be used. Materials must also be non-toxic. Besides that, product must be designed for disassembly and remanufacturing. This means modular product design and snap fit or push fit instead of glue and screws.

In the process design, manufacturers have to move from the traditional end-of-pipe control to new technologies such as pollution prevention, production process modernization and materials substitution. Process optimization should be implemented to minimize losses and wastes in energy and materials throughout the production process [5]. Virgin materials can be recycled through the process of
distillation and filtering. The distilled or filtered materials could be reintroduced in the life cycle wherever new materials aren't required. Waste will be reduced on the spot. Manufacturers must also improve the end-of-life management of the products. Some of the choices are repair, refurbishment and reuse; remanufacturing; recycle with disassembly; recycle without disassembly; and disposal to landfill.

As stated by Richard Florida in California Management [6], companies should invest in production process improvements rather than control technology. "Corporate companies spent $7.2 billion in pollution abatement and control expenditure of which $3.2 billion were on production process enhancement."

Besides that, according to Robin Bergstorm [7], companies should quit ‘leapfrogging from lily to lily pad.’ It means that they should not jump on every chemical that initially describes itself as more environmentally safe but later on it creates even more problems than the original material. They should conduct more research to validate its effectiveness in protecting the environment before deciding on its usage.

3.2 International Organization for Standardization

The ISO 14000 environmental management standards exist to help organizations minimize how their operations negatively affect the environment (cause adverse changes to air, water, or land), comply with applicable laws, regulations, and other environmentally oriented requirements, and continually improve on the above. ISO 14000 is similar to ISO 9000 quality management in that both pertain to the process (the comprehensive outcome of how a product is produced) rather than to the product itself. The overall idea is to establish an organized approach to systematically reduce the impact of the environmental aspects which an organization can control. Effective
tools for the analysis of environmental aspects of an organization and for the generation of options for improvement are provided by the concept of Cleaner Production.

ISO 14001 is an internationally accepted specification for an environmental management system (EMS). It specifies requirements for establishing an environmental policy, determining environmental aspects and impacts of products/activities/services, planning environmental objectives and measurable targets, implementation and operation of programs to meet objectives and targets, checking and corrective action, and management review. In order to obtain ISO 14001 certification, the following criteria have to be fulfilled: reduced release of pollutants; energy saving; resources saving such as water saving and paper recycling; and prevention of potential hazards to the environment.

3.3 Regulations

Here are some of the regulations of green production around the globe:

- EU - Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS), End of Life Vehicle (ELV) directives
- Japan - Japanese Home Electronics Recycling Law
- USA - Some state activities, nothing federal
- China - WEEE directives (under preparation), RoHS like law (Information Electronics Production pollution control and management)

materials from use in manufacturing process. End of Life Vehicle (ELV) Directive establishes a framework to ensure that vehicles are designed and manufactured in a way that optimizes opportunities for reuse, recycling and recovery.

4. Challenges

4.1 Long Term Effort

In realizing Green Manufacturing, it requires a lot of determination from the manufacturer. Green Manufacturing is not just a short term effort as results will not show in a short period. Essential and proper education and training must be provided to ensure the success of Green Manufacturing.

4.2 Investment

Companies must invest a large amount of cash in water treatment, waste treatment and emission control. As these field increases production cost, setting a higher allocation for them might result in a lower profit margin. Green Manufacturing also requires expenditure in testing, capital equipment and certification of ISO.

4.3 Increase in Production Cost

With all the spending in the above mentioned field, there will surely be an increase in production cost. Besides that, since green material is not widely accepted yet by the industry, there will be less choice to choose from and few suppliers. This results higher material cost which consequently increases the production cost.

4.4 Engineers

The real challenge is posed to the engineers. They have to weigh between product reliability and disassembly/assembly during the designing of the product. Besides that,
they have to figure out methods to increase component by two times to improve its life cycle. Engineers will experience a tight process management under the Green Manufacturing policy and have to monitor the supply chain. Engineers will not only bear the responsibility given by their company but the social responsibility as well.

5. Conclusion

Green Manufacturing is vital in preserving our natural resources for future generations. It may be costly and requires a lot of determination but many companies have taken the initiative to go green. For example, Nissan Motor Co. Ltd has launched a green marketing campaign, Nissan Green Program 2010 to meet upcoming U.S. and European emissions standards and the development of various alternative-power technologies [11]. On top of that, Airbus’ progress towards environmentally conscious management and manufacturing has been recognized and awarded in 2003 by Aircraft Economics, an aircraft industry magazine. It is time that other companies, be it large or small recognize their role in making the Earth greener and take up the Green Manufacturing challenge. The benefits are plenty especially if the company adopts Green Manufacturing now. Having such few companies that truly is green, achieving the status now will prove the companies strength, capability and reliability.

Each creature has its purpose. Maggots clean up decomposed bodies. Planktons exist as food for the mighty whale. Leeches which was once thought only as blood suckers has proven its worth in the medical field. As humans, we have the thinking capability which separates us from beasts. Therefore, we must start thinking of the consequences of our
actions and begin fulfilling our most important purpose that is preserving the Earth from future destruction.

6. References


2) Hong Kong Green Manufacturing Alliance

3) Oslo Roundtable On Sustainable Production and Consumption
   <http://www.iisd.ca/linkages/consume/oslo006.html>

4) Manufacturing & Technology News, Sept 15 2000, v7, No. 16

5) Handy, Roy, “Introduction to Green Manufacturing and Sustainability”


10) Wikipedia.org