What Is Environmental Manufacturing?

ENVIRONMENTAL MANUFACTURING is becoming more important as our resources and energy supplies decrease and the demands placed on the environment grow with the population. Environmental manufacturing relates to the beginning of a product design as well as to its manufacturing, distribution, and end-of-life status. It can address all of these aspects of manufacturing to minimize the negative impact on the environment.

Objective:

Describe environmental manufacturing.

Key Terms:

energy expenditure
environmental manufacturing
International Organization for Standardization (ISO)
IO relations
transporters

Environmental Manufacturing

Environmental manufacturing is a manufacturing process that takes into consideration its impact on the natural environment, energy use, materials, and sustainability. In general, it is concerned with creating optimized energy efficiency throughout the production process. It has a minimal amount of impact on the environment.

As a basic concept for products, this includes creating a connection between design and manufacturing that address issues of material, energy usage in production and delivery, waste products, and maintenance. This includes sustainable product design, development, and manufacturing.

SUSTAINABLE AND LIFECYCLE MANUFACTURING

Sustainable and lifecycle manufacturing is becoming a critical element of environmental manufacturing. It addresses the full life of a product, including the machines and processes of manufacturing in terms of construction, material, and lifecycle. It can include the entire process and organization of machining within a facility to how a product may be recycled or reused as part of its design.

Sustainable manufacturing includes limiting the energy used in a manufacturing facility. Many smart grid fixtures are becoming available for use in manufacturing facilities. These can automatically control the complete range of energy used by the building's systems or for product fabrication. Sustainable manufacturing addresses how products are tooled with various jigs or fixtures. In addition, criteria can be established to determine how long they last, how much energy they require, and how much waste they produce through their design.

The recycling or reusing of heat can be a significant source of energy in many manufacturing plants. This reuse of energy can benefit a range of local buildings or may be used to generate electricity. Recycling or reusing material waste is a critical issue in environmental manufacturing. The manufacturing process can be designed to create minimal waste. The discarded waste can be recycled within the facility or sent to other manufacturers to use.

FIGURE 1. Sustainable and lifecycle manufacturing is becoming an important part of manufacturing technology in part due to the large amount of out-of-date and old technology products being created every year.

STANDARDS AND PERFORMANCE REGULATIONS

Environmental manufacturing is influenced by government regulations and rating systems. Standards are necessary for internal and external assessment of manufacturing processes and facilities. The standards for performance and regulations, in terms of environmental manufacturing, are still being developed.

Given the impact of large manufacturing internationally, standards are required with an exact set of criteria that the world can use. The **International Organization for Standardization (ISO)** is a group of representatives from various standard organizations around the world that develops and administers worldwide industrial and commercial standards that can relate to the procedures and performance of product design and development.

FURTHER EXPLORATION...

ONLINE CONNECTION: Greening the Manufacturing Function: Environmentally Conscious Manufacturing

Understanding the need for environmental manufacturing and its applications can be difficult given everything involved in the production of goods. To learn more about how businesses today are changing their strategies and plans to meet global environmental concerns, visit the following Web link:

http://findarticles.com/p/articles/mi_m1038/is_n5_v38/ai_17565133/

These standards can be used by local governments to create laws or criteria for the evaluation of procedures with an environmental index or reference. They are being used to establish international environmental regulations that steer business plans and production. The standards for environmental manufacturing are used for internal monitoring, allowing companies to specifically relay to consumers and shareholders how they are environmental manufacturers.

Many performance standards—internally developed by a company or by government codes—require specific environmental business plans to be developed. Traditional business plans usually had a limited set of criteria (e.g., maximum profit with minimum cost). However, environmental manufacturing considers layers and layers of criteria to determine business goals.

ALTERNATIVE PRODUCT AND PRODUCTION PLANS

Manufacturing that considers the environment requires alternative product and production plans. The use of green technology within product design and production can address environmental issues on every level. All of the technology required for manufacturing and production should be considered in terms of its efficiency in energy, material use, and waste. The actual energy required or used by the final product is an important consideration.

Product maintenance needs to be considered in long-term environmental production plans. This includes the maintenance of the actual final product being manufactured as well as the equipment being used in manufacturing.

FIGURE 2. Historically, industrial plants had limited regulations that controlled waste byproducts. New environmental manufacturing strategies are addressing these issues to control areas such as heat and waste emissions.

The product and production plans need to be organized around how manufacturing can utilize the most efficient use of energy and material. This requires creating a model that can quantify input-output (IO) relations. **IO relations** are relationships that examine every stage of the manufacturing process relative to the input (e.g., materials, supplies, fuels, and maintenance) and the output (e.g., final product, recoverable and non-recoverable byproducts, heat, and waste emissions).

ENVIRONMENTALLY BENIGN MANUFACTURING

Environmentally benign manufacturing is an approach that minimizes the impact specific manufacturing steps have on the environment. If necessary, some steps may need to be replaced with steps that have less hazardous results. These steps include machining processes (e.g., metal casting, metal forming, metal joining, and plastics injection molding) and potentially can include all aspects of manufacturing.

RESOURCE AND SUPPLY CHAIN

In environmental manufacturing, the entire resource and supply chain needs to be taken into consideration. This includes the energy required to collect the raw resources and to ship them and the energy to deliver all necessary supplies. The energy required to distribute manufactured products to consumers is also a consideration.

In the manufacturing industry, various tier one and tier two suppliers can exist. The main manufacturer must qualify its environmental performance. Its role in the supply chain needs to instill responsible means.

Transporters are people or businesses that move supplies and products from one point to the next in the supply chain. They are closely looked at for energy expenditure per unit of delivery. The **energy expenditure** per unit of delivery is the amount of total energy used for each unit delivered per transportation mode. This requires analyzing energy use and cost between highway, rail, air, water, and pipeline.

The material resources used in the manufacturing process, whether natural or artificial, are chosen relative to their effects on

FIGURE 3. This shipping port displays the large-scale nature of the resource and supply chains that can become huge consumers of energy and resources. Environmental manufacturing is a strategy to limit negative impacts on the environment.

the environment. Some of the standards used assess the material's sustainability, embodied energy, and any physical effects to the environment from harvesting.

GENERAL ENVIRONMENTAL MANUFACTURING

Many environmental manufacturing companies try to limit the negative impact their operations have on the environment. They usually rely on a rating system based on the overall steps a company is taking. These steps are given a value and are then added up. They can include energy use for heating and cooling or the amount of emissions released into the air compared to the number of products made. The total carbon data can be collected in terms of the complete energy and material used, lost, or replaced during the life of the product. They can then use this data for analyzing some of the potential hazards to the environment.

Many manufacturing facilities require large amounts of water and may pollute water supplies. The water use and pollution can be directly monitored and analyzed to insure minimal impact on the environment.

Waste products can have layers of effect on the environment over time. Some waste products are burnt, and some are sent to landfills. Both have negative consequences. Some of these products are non-biodegradable, and some release toxic chemicals into the earth. Environmental manufacturing takes these issues into consideration while trying to have the least negative impact on the natural world.

Summary:

Environmental manufacturing is a manufacturing process that considers its impact on the natural environment. Sustainable and lifecycle manufacturing is one consideration that addresses the full life of a product, including the machines and processes of manufacturing in terms of construction, material, and lifecycle.

Environmental manufacturing is influenced by government regulations and rating systems. Environmental manufacturing takes into consideration layers and layers of criteria to determine business goals. This also requires alternative product and production plans.

Environmentally benign manufacturing is an approach that minimizes the impact that specific manufacturing steps have on the environment, which may consider the entire resource and supply chain, including the energy required to collect the raw resources, ship them, and deliver them.

Many environmental manufacturing companies try to limit the negative impact their operations have on the environment. They usually rely on a rating system based on the overall steps a company is taking.

Checking Your Knowledge:

1. What regulations influence environmental manufacturing?
2. What is the ISO?
3. Who is responsible for moving supplies and products from one point to the next in the supply chain?
4. What term is used to describe the amount of total energy used for each unit delivered per transportation mode?
5. What is minimized through environmentally benign manufacturing?

Expanding Your Knowledge:

More companies are becoming interested in (and/or are required by certain codes) developing environmentally friendly processes. Plan a trip to a local manufacturing plant. Create a list of questions addressing environmental issues today. Share your findings with your classmates.

Web Links:

Environmental Manufacturing
http://www.environmentalmanufacturing.com/

Environmental Management
http://www.epa.gov/osem/historical.htm

Environmental Manufacturing Solutions
http://www.enviromfg.com/