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Title: **GREEN MANUFACTURING IN MACHINERY INDUSTRY**

The following quotes is supplemented by the apostrophe character(“”).

“Green manufacturing paradigm covers the whole life cycle of product, from requirements specification, design, manufacturing, and maintenance to final discarding. Research topics in green manufacturing include [1]:

- *Green design (also called design for environment) considers the product’s impact on the environment during the design process, designing a product that causes minimal pollution. Multi-life-cycle design, which considers multiple uses of most parts and recycling one-time-use parts, has received much attention.*
- *Green materials involve development of materials that can be easily recycled.*
- *Green production involves developing methods to reduce wastes during the production process.*
- *Green disposal: developing new methods to recycle the discarded products”*

“Green or Environment conscious manufacturing (ECM) is an emerging discipline that is concerned with developing methods for manufacturing new products from conceptual design to final delivery, and ultimately to end-of-life disposal, that satisfy environmental standards and requirements” [2].

“Green manufacturing cuts across every aspect of manufacturing including product development, process technologies, energy consumption and material flow. Many of the decisions manufacturers make are based on cost, function, and quality. Now there is another dimension to consider – environmental sustainability” [3].

“Green manufacturing is a key component of operating a sustainable business that helps to uncover hidden value for business, and create value for the environment. There is very serious interest in green manufacturing within the manufacturing community. Becoming green can be viewed as a process where start using more eco-friendly manufacturing resources that have low embedded energy and come from renewable resources”.[4]

“Many manufacturing firms use a variety of management system standards and business excellence frameworks to effectively manage their processes for eco-efficiency. Reducing energy and water use are the most common and simplest places to start when it comes to turning plant green. Eliminating all wastes from all business practices is an important mid-term goal” [4].

"Speaking about wastes that comes from machinery industry it is important to mention that there is four-level waste strategy exists. Four levels, being – in order of preference:
1. Waste reduction (such as extending product durability, common goal of GM);
2. Waste reuse (such as remanufacturing products for a second life, life extension);
3. Waste recovery (such as raw material recycling), and lastly;
4. Waste landfill (as the last resort).
There are only two possible long-term fates for waste materials: reuse (closed loop) or dissipative loss (open loop). This is a straightforward implication of the law of conservation of mass" [5].

"Reuse means to use an item more than once. This includes conventional reuse where the item is used again for the same function and new-life reuse where it is used for a new function. Reuse helps us save time, money, energy and resources and offers quality products to people and organizations with limited means" [6].

"Repairing is the most logical approach to closing the loop on product use – simply to repair and extend the product's life. Repairing is the rectification of found faults in a product. In general, the quality of repaired products is lower compared to remanufactured and reconditioned alternatives" [5].

"Reconditioning involves less work content than remanufacturing, but more than repairing procedures. This is because reconditioning usually requires the rebuilding of major units to a working condition that is generally expected to be inferior to that of the original model. All major components that have failed or that are on the point of failure will be rebuilt or replaced, even where the customer has not reported or noticed faults in those components. The fact that a reconditioned product is clearly not new (and thus not offering the latest functionality or aesthetic styling of new product), it means that it has the same market acceptance issues as products that have been repaired" [5].

"the series of activities by which discarded materials are collected, sorted, processed, and used in the production of new products" [12].

"a process of bringing used products to 'like-new functional state with warranty to match'. It recovers a substantial proportion of the resource incorporated in a used product in its first manufacture, at low additional cost, thus reducing the price of the resulting product" [13].

"Current practices of recycling and remanufacturing are the basis for future environmentally-conscious engineering. In recent years, the need for new design approaches that could offer more efficient and environmentally sound products has become a high level issue for a successful design process. New methodologies such as design for manufacture and assembly (DFMA), concurrent engineering (CE) and design for disassembly (DFD) were developed. However, design for environment (DFE) has become the most promising methodology to reverse decades of environment neglect by manufacturers and engineers. DFE encompasses all the new methodologies, while focusing on the minimization of manufacturing environmental impacts by introducing modifications early in the product design process" [8].

"Many products are now marked with a variety of recycling symbols meant to help consumers and waste managers in separating recycled products and materials. Not all materials and products can be recycled, however. Those designed for disassembly or made from one material are the easiest" [9].

References are also corrected.

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