

# Green Manufacturing

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# Green Manufacturing, Green Chemistry And Environmental Sustainability: A Review

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**Abstract:** This present study aims to discuss green manufacturing, green chemistry and its impact on environmental sustainability. This study is a review article that explains the concept of green manufacturing, green chemistry and environmental sustainability, and also revealed the role of green manufacturing and green chemistry and increased environmental sustainability. Based on the results of the study showed that green manufacturing and green chemistry have a role in increasing environmental sustainability. It is recommended that companies in conducting manufacturing activities adopt green manufacturing and green chemistry in carrying out their business activities.

**Index Terms:** Green Manufacturing, Green Chemistry, Environmental Sustainability

## 1 INTRODUCTION

Environmental problems lately have become a very serious problem to be addressed. The rank of Indonesia Environmental sustainability is 136 ([www.detik.com](http://www.detik.com)). In paper [1] said that the problem of environmental management can be considered as one of the main causes of natural disasters in Indonesia. Estuary of all problems the environment is development carried out without regard to environmental balance factors which in turn will cause damage and environmental pollution. The topic related to sustainability and environmental issues is rapidly emerging as one of the most important topics for manufacturing and also product development [2]. The implementation of green manufacturing and green chemistry are some of the efforts that can be done to improve the quality of the environment. The forthcoming challenges in resource, environmental, economic, and societal sustainabilities require more efficient and also scientific technologies related to chemical processing and production [3]. Green chemistry is also expected to overcome these challenges by opening up a wide and diverse scope to ultimately maximize the desired product and minimize byproducts, designs and equipment that can simplify operations in the production of greener chemicals that are inherently, environmentally, and ecologically (Li and Trost, 2008 cited by [3]). Research related to green chemistry has focused on technology that aims to reduce or eliminate the using of or producing toxic and the dangerous materials for the environment and health, and green chemistry also aims to replace non-renewable raw materials with renewable materials in order to reduce the dangers that impact negatively for the health of humans and the environment [4].

## 2 SCOPE AND RESEARCH QUESTION

The purpose of this paper to investigate the role of green manufacturing, green chemistry on environmental sustainability. The initial approach of our study was to answer the following question:

1. What is green manufacturing?
2. What is green chemistry?
3. What is environmental sustainability?
4. How does green manufacturing and green chemistry effect environmental sustainability?

## 3 METHODOLOGY

This study is an article review. We identified through a search made using the search engines for electronic databases using search strings such as "green manufacturing, green chemistry, and "environmental sustainability".

## 4 FINDING

### 4.1. Green Manufacturing

Green manufacturing (GM) is usually used as a term to describe manufacturing practices that do not harm the environment during any part of the process of manufacturing [5]. They also said that Green manufacturing is proven very valuable concept for abating industrial waste and emission. Economical benefits and competitive outcomes can be achieved from preventing waste, and the aim of green manufacturing is to enable the use of resources efficiently and also can improve the performance of the environmental [5]. Green technology also is known as the application of one or more of the science of environmental, green chemistry, environmental monitoring and electronic devices to monitor, model and the natural environment and resources conservation, and aims to protect the negative impacts of human involvement. [6]. There are two perspectives of green manufacturing: first, in the narrow perspective, green manufacturing relates to the manufacturing of the green product, such as those used in the system of energy renewable and clean technology of equipment; while in the broad sense, it refers to the greening of manufacturing with reducing the waste and saving resources [7]. The application of green manufacturing practices in the production process can be influenced by such external factors, such as policy environment, corporate consciousness, and stakeholder behavior. The implementation of green manufacturing in a firm also has a value of economic, social, and environmental effects [8]. In paper [9] said that environmental manufacturing practices such as reducing raw materials use, recycling solid waste, redesigning products can make be more environmentally sustainable. The term relates to green manufacturing is a study that reflects a new manufacturing

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paradigm that uses a variety of green strategies and techniques to be more environmentally efficient, including the creation of products / systems that consume less material and use energy, replacing input materials (eg non-toxic to toxic, renewable to non-renewable), reduce unwanted output and convert output to input or recycling [10]. The green of manufacturing can shorten the product life cycle and this can reduce the cost of the production. Due to the environmental and ecological responsibilities, the company intends to seek to reuse, reproduce and recycle used products to reduce the negative impact on the environment, especially producers of electric consumer products. Therefore, the reverse manufacturing problem, which is closely related to all stages of product development, is now a critical problem for all levels of the electricity and computer industry. An optimal inventory system was developed to understand the importance of related factors in policy and to find the influence of cost components in semi-closed green supply chains [11].

#### 4.2 Green Chemistry

Green chemistry is an approach used in overcoming environmental problems both in terms of chemicals produced, processes or the reaction stages used. This concept emphasizes a method based on reducing the use and manufacture of hazardous chemicals both in terms of design and process [12]. Chemical hazards are a part of the Green Chemistry concept include a variety of threats to human health and also to the environment, consists of toxicity, physical hazards, global climate change, and depletion of natural resources [12]. Green chemistry focuses to study on the application of a number of chemical principles in the design of using or producing chemicals in reducing the use or production of hazardous substances that can interfere with the health of living things and preserve the environment [13]. Rashmi Sanghi cited by [14] said that green chemistry is an essential part of a comprehensive program to protect human health and the environment. In general, green chemistry relates to matters in minimizing waste at the source, the use of catalysts in reactions, the use of harmless reagents, the use of renewable base materials, increased economic efficiency, solvents that are environmentally friendly and can be recycled [14]. Green chemistry is a study that aims to ameliorate the chemical industry's environmental and health impacts [15]. There are 12 principles of green chemistry [16], namely the principle of prevention: it means that it is better doing prevention of waste than to treat or clean up waste; atom economy means that synthetic methods must be designed in order maximize incorporation of materials that used from process into the final product; less hazardous chemical syntheses; designing safer chemicals; safer solvents and auxiliaries; design for energy efficiency; the use of renewable feedstocks; reduce derivatives; catalysis; design for degradation; real-time analysis for pollution prevention; inherently safer chemistry for accident prevention.

#### 4.3. Environmental Sustainability

The concept of sustainability initially emerged from a meeting and report in the 1970s and 1980s, and this concept of sustainability was driven by environmental and catastrophic incidents and concerns about the contamination of chemical and resource depletion [11]. Sustainability has also historically been based on the triple-bottom-line theory of three fields - social, economic and environmental. This theory emphasizes

that in carrying out development, it must ensure integration and balance between the economy, society and the environment [17]. Another opinion also says that, sustainability can be defined as the design of human and industrial systems by ensuring that the use of natural resources and the human cycle does not result in a decrease in the quality of life and also the decrease in quality of the environment [18]. The performance of environmental sustainability can be in the form of reducing solid / liquid waste, reducing emissions, reducing resources, and reducing the consumption of hazardous / dangerous / toxic materials, decreasing the frequency of environmental accidents, and also improving public health [19]. Sustainable development was agreed as development in order to meet current needs without compromising or sacrificing the right to meet the needs of the lives of future generations. There are two important ideas, namely (a) the first is the idea of "needs", namely the essential needs to continue human life, and (b) that is the idea of limitations arising from the technological and social organization conditions of the ability of the environment to meet current and future needs which will come [20]

#### 4.4 Linking of Green Manufacturing and Green Chemistry on Environmental Sustainability

The environmental benefits of green chemistry are significant [4]. Some previous research results indicate that the implementation of green manufacturing has a significant positive impact on environmental performance [2]. The adoption of green manufacturing can result in reduced waste, less resources and energy consumption, less environmental pollution [19]. In a sustainable concept, it is very necessary to evaluate green manufacturing processes and products, such as identifying possible sources of pollution and contamination. Some things that pollute the environment that cause danger to our future, such as greenhouse gases, harmful emissions produced by material processing and waste disposal [21]. In the chemical industry, "design for sustainability" is more than what is often manifested via sustained development of green chemical routes, process intensification, and process redesign with extensive research and development programs at all levels of chemistry and chemical engineering. All the more, sustainability has been widely endorsed as the overarching goal of environmental policy [18].

### 5 DISCUSSION

Based on the literature review review that has been done shows that green manufacturing and green chemistry have a role in improving the quality of the environment. Both green manufacturing and green chemistry have the aim to reduce the use of hazardous chemicals that have an impact on the environment and human health. Besides providing benefits to the environment, the use of green manufacturing and green chemistry also plays a role in providing economic benefits. As stated by [22] that it is possible in prediction some of the benefits of economic generated by the implementation of green chemistry in industrial chemical processes, such as the less need for investment in waste storage and treatment, as well as compensation payments for environmental damage.

### 6 CONCLUSION

Green manufacturing and green chemistry is a study that aims to reduce environmental problems. The use of green



manufacturing and green chemistry has a positive impact on the environment and human health. Therefore the implementation of green manufacturing and green chemistry is a study that needs to be implemented by various companies in carrying out their business activities.

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