

## [MAN 24] GREEN MANUFACTURING INDUSTRY: SOLVING OF MINIMIZATION OF POLLUTION AND WASTE IN KEDAH

Tan Hooi Shan<sup>1</sup> & Nurul Azita Salleh<sup>2</sup>

<sup>1-2</sup>*School of Technology Management and Logistics, College of Business, Universiti Utara Malaysia, 06010 UUM Sintok, Kedah*  
*tanhooishan@yahoo.com<sup>1</sup>*

### ABSTRACT

*This study aims to minimize pollution and waste in manufacturing industry. Manufacturing industry benefits in economic growth. However, it contributes the negative impact to environment. Thus, this study focused on identifying the types, factors and solution of industry pollution in manufacturing industry based on the manufacturers' perspective in Kedah. This study design used qualitative research methods. The respondents are the manufacturers which located in Kedah. The results showed that manufacturing industries have various types of pollution such as noise, water, air, soil, heat and radioactive. Meanwhile, the pollution caused by the lack of stringent policies to control the pollution, unplanned industry growth, using of outdated technologies, inefficient waste disposal, leaching of resources from natural, exhausting and from processes from industries. The results of this study provide the solution which occurred in manufacturing industries such as adopt the 3R's waste hierarchy, wastewater treatment process, prevention and control of pollution, conserve and protect water, NPI data, control radioactive pollution and improve the industrial exhaust system. As implications, this study raises awareness of manufacturer in reducing the use of hazardous materials during the production process and improve the knowledge of manufacturer and the environment agency on the smart in conserving and preserving the environment.*

**Keywords:** *green manufacturing, pollution, type, factor, Kedah*

### INTRODUCTION

The manufacturing industry is an important component in the economic growth for all the country. This is because manufacturing industry is responsible for converting the raw materials into the finished goods for consumers use. Indeed, manufacturing industry is one of the sector that's brings the benefit to the country. According to the Hydrant (2016), the Gross Domestic Product (GDP) in Malaysia was expended about 22.7% in 2016 compared with 2015 and it was making the largest sector of the economy. In brief, manufacturing industry area benefits to the world, but also can bring the negative impact to the environment if not well controlled.

### PROBLEM STATEMENT

Manufacturing industry has a potential to bring the advantages to human life, but it can cause the drawbacks to environmental too such as air, water, and land pollution.

According to Utusan Online (December 4, 2014), water pollution caused by the activity of the manufacturing industry. As proof, a poultry slaughter industry in Kedah doesn't use the sewage treatment before being discharged into the nearby swamp. It causes a foul odour in the surrounding area and the causes the pollution to the water.

Mohammad (2011) also stated that the polythenes typically used by manufacturing packaging industry in Malaysia will caused the land pollution happens. In details, the manufacturer will throw the broken or finished used of polythenes into anywhere which including the underground, it may lead the pollution happens. This fact also supported by Buzzle (2015), every manufacturer was generated over 3285 pounds of hazardous waste in annually and some of them will dump it into underground. Actually, it's a serious problem and can get the negative impact to the earth. According to Nurul, Oliver and Dasimah (2014), manufacturing industry is a large contributor to the air pollution in Malaysia. This is because the industry released the chemicals, dust, organic to the air in daily that will cause the pollution happens.

In brief, the activity of manufacturing industry contributed a lot of pollution to the environment. Actually, according to Rinkesh (2016), it should stop happens from now because it's one of the biggest killers. Thus, the significant of this study that can give the information to environment agency how to reduce the waste to zero effect and also improve the ecology to our environment. Therefore, the objective of study which required identify the types and factors of pollution cause by manufacturing industry in Kedah and solve the industry pollution problem based on manufacturer perspective.

## **LITERATURE REVIEW**

Based on previous study, the manufacturing activity have more disadvantage than the advantage because it contributes the several type and factor of pollution to the environment. Therefore, the manufacturer must solve the problem in different ways to minimise the pollution happen.

### **Types of pollution in manufacturing industry**

Among the types of pollution that occurs in the manufacturing industry likely:

#### *a) Noise pollution*

According to the Rinkesh (2016), the manufacturing industry uses the big machine (compressors, exhaust fans and grinding mills) for production which's ability to produce a large amount of noise. Hence, the big noise of production cause the residential disable to concentrate their work as well. Furthermore, it harmful to the environmental and cause the health problem, likely the permanent hearing damage.

#### *b) Water pollution*

According to Kumar and Lee (2012), the manufacturer released the waste products into the rivers. It cause the marine life are no longer hospitable. As evidence, about 370,000 manufacturing facility use the huge quantity of freshwater to carry away the waste that's can affect the water pollution happen. As results, the bacteria and viruses can carry into the surface and groundwater and causes health hazards to human.

*c) Air pollution*

Air pollution caused by the emission smoke by the manufacturing industry. The smoke from burning of an industry which contains the sulphur dioxide and carbon monoxide are harmful to the environment. When the air pollution becomes serious, the health of human possible danger. Indeed, usually a human breathe about 12-20 times per minute and will add up to 17,000-30,000 breaths per day. When they breathe, they might face lung cancer, allergies and several of the breathing problem. The flora and fauna will be damaged too (Nowak, Hirabayashi, Bodine & Hoehn, 2013).

*d) Soil pollution*

Improper management of solid waste causes the environmental pollution. As evidence, the heavy metal from the manufacturing industry has produced wastes that are deposited into landfills without special precautions. Besides that, according to Mashhood and Arsalan (2011), soil contamination happens when the chemicals from industry are released from the spill which include methyl tertiary butyl ether (MTBE) and chlorinated hydrocarbons which can pollute to the land and leads to bad crops happens.

*e) Thermal pollution*

Thermal pollution able increasing the temperature of a water system. Manufacturing plants are the biggest source of thermal pollution. Normally, manufacturing industry uses the water as a coolant in the processes. Thus, it can increase of temperature of the water while decrease in DO (Dissolved Oxygen) levels. As a result, it can harm the plants and animals which may give rise to anaerobic conditions (Rosen, Bulucea, Mastorakis, Jeles & Brindusa, 2015).

*f) Radioactive pollution*

According to Achim, Monfort, Le, Gross, Douysset and Moulin (2012), radioactive pollution is increasing due to the waste products that are left behind after the use of radioactive substances. Radioactive waste is the product of a nuclear process. Indeed, the substances able to emit the high-energy particles such as alpha and beta particles and gamma rays. Thus, it's unstable in nature and is ceaselessly release these particles in order to gain some stability which can pollute to an environment.

**Factors of manufacturing industry pollution**

The pollution in the manufacturing industry due to certain factors such as lack of stringent policies to control the pollution, unplanned industry growth, using of outdated technologies, inefficient waste disposal, leaching of resources from our natural, exhausting from industries and processes from industries.

*Lack of stringent policies to control the pollution*

The stringent of policies important in the workplaces because it ensures the industry is working towards a high level of environmental protection. Thus, it can minimises environmental footprint and also increases the sustainability. According to the Rinkesh (2016), the lack of effective policies in the industry which can lead the mass scale pollution in the environment and affected lives of peoples. In fact, in particular nations in Asia and North America arae where industries have persistently released toxic wastes and poisonous gases into the environment.

a) Unplanned industry growth

According to Discoli and Martini (2012), the growth of manufacturing industry has increased the lead to the waste also increases. The lack of proper waste disposal sites cause air pollution happens. Besides that, it contributes to the derisory wastewater and causes to the water pollution. This situation can degradation of this aquatic system.

b) Using of outdated technologies

Most of the manufacturing industry still using the outdated technology for production. This is because the modern technology required the high cost. Conversely, the outdated technology which generates a large amount of the waste instead of green technologies. This is because the outdated technology which is less efficient and frequent operational failures in production (Bourreau, Cambini & Dogan, 2011).

c) Inefficient waste disposal

Every year, large quantities of the waste are generated from the growing of manufacturing industry. Although the problem becomes serious, but there are no adequate treatment and disposal facilities to avoid the problem continues happens. According to the Oates, Despeisse, Ball, Evans, Greenough, Hope, Levers, Lunt, Quincey, Shao, Walt Niel, Wheatley and Wright (2012), the inefficiency of waste disposal easy to cause the water and soil pollution. Otherwise, the long-term exposure to polluted air and water, it causes the chronic health problems and respiratory disorders.

d) Leaching of resources from our natural

Manufacturing industry requires the fresh raw material (metals, minerals, trees, oils) which to transform them into finished products. Indeed, according to Davide and Antoine (2015), the raw materials require extracting from beneath the earth. But after extracted, the resources of the land and water can deplete at the same time. Consequently, when the extraction of processes is ongoing, the toxic of the materials can release into the environment. It causes pollution to the soil and water.

e) Exhausting from industries

All of the manufacturing industry consists of long tubes that's called "chimneys", it erected high into the air with lots of fumes coming out of it. When heating the raw material and transform those into more useful form, the fumes can come out from it. It will cause the industry release a large amount of fumes which including carbon monoxide (CO) into the Earth's atmosphere. The main danger with CO is that's cannot easily be detected. As a result, it doesn't give the victims any advanced warning (Mohan, Thiyagarajan, & Balakrishna, 2013).

f) Processes from industries

According to Segal (2016), the waste from the processes released into the rivers and lakes causes the pollutants to the water. This is because the processes contain toxic chemicals (such as lead, mercury, sulphur, asbestos, nitrates) which can cause the pollution and damage to human and our environment. For example, some of the manufacturers which process the paper and textile are using the chemicals such as chlorine and benzene which can contribute to water pollution.

### **The problem solving of pollution in manufacturer perspective**

Pollution is a serious problem and it can bring the discomfort to every human. For that reason, the problem solving are required to be adopted by the manufacturer based on their perspective.

#### *a) Wastewater treatment processes*

The industrial waste contains various types of pollutants, namely biochemical oxygen demand (BOD), suspended solids, heavy metals, and more. However, with use the wastewater treatment process, it can make the improvements in the wastewater (Seetharam & Santosh, 2013). This treatment capable of removing 97% of suspended solids. Next, the oxidation and nitrification can achieve and the solids and liquids easily for separation. In brief, wastewater treatment process able to increase the efficiency of sewage treatment by using a multiplex filter comprising activated carbon and zeolite (Anbukumar, Technological, Prasad & Kumar, 2014).

#### *b) Pollution prevention or pollution control*

Manufacturing industry can reduce the emissions either using the pollution prevention or pollution control. According to Rinkesh (2016), pollution prevention is changing the methods of manufacturing and produces the little pollutant. It can reduce the waste by altering the processes and use less the toxic substances in processing. In contrast, pollution control involves installing the equipment that can capture pollutants before they enter the environment. Besides that, a lot of different kind of trees should plant in the surrounding the industries because the trees in the surrounding area of the industries can help for bear the environmental pollution up to the certain limit.

#### *c) Conserve and protect water*

Water conservation lead the water to be clean and pure from the waste likely chemical compounds. Thus, the manufacturer needed to save the water with using several methods, such as educate the employees in the industry and must build the understanding between the employees about the important water in our life. In addition, the routine checks the water by the supervisor in the industry is the better way for conservation the water. The manufacturer also required to monitoring the action of employees in workplaces to make sure they don't pollute the water after processes (Perfect Pollucon Services, 2014).

#### *d) Adopt the 3R's waste hierarchy*

The manufacturer required to adopting the 3R's concept waste hierarchy in industry. The first R's is reduce. The concept of reducing are important, if there is less waste, it means there is less to recycle or reuse. Thus, the manufacturer must reduce the waste without undermining the effectiveness of the process. Besides that, the second R's is reuse. It defined as "to re-using again". In particular, many of the waste from manufacturing still can be reused again before dump it. Therefore, the manufacturer required reuse them for the same purpose or creating new items. Furthermore, the last R's is recycling. The manufacturer must reprocess of the disposed materials that appear in the industry such as glass (unbroken), paper, paper tubes and so on. According to Ninlawan, Seksan, Tossapol and Pilada (2010), the disposed materials after recycled, it can transform again into a raw material that can be used into a new item or useful product. In addition, recycling can keep from harm from the environment and ensure the well-being to our next generations.

*e) NPI data*

According to Ninlawan et al. (2010), the manufacturer can use NPI (National Pollutant Inventory) data to improve the processes in industry. NPI is an internet-based database. It provides the free information about an industry on the emissions. It also can transfer the substance to our environment. With using the NPI data, it can benchmark their emissions that's against similar facilities in the industry.

*f) Control radioactive pollution*

The radioactive pollution can be controlled by the manufacturers by stored the radioactive materials into the safe places. It must be changed into a harmless form when in manufacturing the industry. Indeed, Perfect Pollucon Services (2014) stated that the radioactive wastes required to a very low radiation where needed to put into the sewage. In additions, the extreme precautions should be taken when disposal of industrial wastes which are containing the radionuclides.

*g) Improve the industrial exhaust systems*

According to Kellens, Dewulf, Overcash, Hauschild and Duflou (2011), the exhaust system needs to the installation of components. The several different of the components must be combined, so that can form a properly functioning of an exhaust system. With having digital controls, these components all can monitor by a singular unit namely "capture hood ". The capture hood can be installed in an unsafe location such as a duct or exhaust pipe. It can collect and monitors the vapours to ensure the proper amount of filtration is achieved and reduce the air pollutions happens.

## **RESEARCH METHODOLOGY**

### **Research design**

The purpose of research design has used in this study is the qualitative method which including primary data and secondary data. This study are using the structured technique which will set a list of question aims to ask respondents. Indeed, the qualitative method does not involve numerical data while it usually involves words or language. Therefore, the qualitative method required to make an interview in the manufacturing industry for getting the more detail information. All of the interviews must be recorded to obtain as evidence and writing the report after analysis the data. In brief, this study involves in searching some information from the secondary data that are related from journal, article, internet, newspapers, book published and reports. Moreover, the qualitative data are found from the interview with the supervisor and top management (likely Director and Marketing Director) of the 3 manufacturing industry in Kedah. Actually, the aim of collecting data analysis is to identify the type, factor and problem solving of pollution that happened in the manufacturing industry.

### **Analysis data**

Data analysis involves the process of developing answers to questions through the interpretation of data. In this study are using the "NVIVO 9" software to develop a different kind of question.

## FINDINGS

The findings of this qualitative study were carried out on factory in Kedah. The 3 of the factories involved as respondent for this interview session was labelled as Factory 1 (F1), Factory 2 (F2) and Factory 3 (F3). In addition, the researcher encodes categories for the type of pollution in manufacturing industry by the symbol "A", the factor of manufacturing industry pollution as a symbol "B" and the problem solving of pollution in manufacturer perspective by the symbol "C".

### **A) Type of pollution in manufacturing industry**

The results of interviews were conducted with the factories (F1, F2 and F3) already prove that the type of pollution in the industry, likely noise, air, water, soil, radioactive and smell pollution. Regarding to the results interview from the factories on which of the pollution are most serious in the industry has shown the different perception such as F2 stated all the pollution are serious, but F1 and F3 mentioned that the air and noise pollution are serious. The example of excerption for the types of pollution is “(Ermmmm...) *Noise pollution and air pollution only.*” (F1: A: Q1).

### **B) Factor of manufacturing industry pollution**

This study also found that the factor of pollution in the factories of F1, F2 and F3 is unplanned industry growth, use of outdated technologies, inefficient waste disposal, do not use filtering smoke and lack of stringent policies to control the pollution which can cause the pollution in the manufacturing industry. Furthermore, the outcome from the factories which related to what kind of the machine is more polluted in the industry have the different judgement, likely the F1 stated that is grinding rice machine because it'll cause a lot of dust released into the workplaces and F2 stated that is machine of processing the paper because the old machine contribute lot of waste, while F3 stated that is cutting machine because it provide thunderous of noise. On the other hands, the next judgement from the 3 factories about what is the main cause pollution in the factory are “huller machine” and “separator husk, copper corrosion and carbon monoxide. Moreover, the result from the factories regarding which is the pollution are more stress for the workers in working area by F1 is the working environment and operator department more stress to the workers, but the result of F2 and F3 mentioned that the noise pollution more stress to the workers. Besides that, there are the different outcome which from the factories about the pollution will get the complaint from residential. In details, the F1 and F3 stated wouldn't get the complaint from residential except F2 stated that get the complaint from residential. The example of excerption for the factors of pollution is “*Lack of stringent policies to control the pollution causes the pollution happens in the industry.*” (F3: B: Q1).

### **C) Problem solving of the industry pollution based on manufacturer perspective**

The results from factories (F1, F2 and F3) proven that the good way to solve the pollution problem are pollution control, adopt the 3R's waste hierarchy in the industry, follow the rule that set by the government such as “Akta Kualiti Alam Sekeliling, wastewater treatment processes and analysis of domestic sound levels. Thus, the others ways to solve the pollution problem from the result of 3 factories are “Amalan Industri Hijau Sektor Pengilangan Beras”, adopt the 5S, good housekeeping, make an improvement and implement the good practice in the industry and also involving in soundproofing buildings and Machine-Quality Maintenance. However, the consideration from the factories are different which F1 and F3 agree the ways in above

that's a better way to minimize / avoid the pollution happens, contrarily the F2 mentioned that the factory still required to follow the rule and regulation, such as ISO 9001. In addition, the results of F1 and F3 simultaneous stated that have a pollution control in before, while F2 don't have pollution control in before. Indeed, when the pollution in an industry become serious, the results of the factories stated that have to monitor the different kinds of pollution at present such as ask a supervisor for monthly inspection, monthly maintenance and service to enhance efficiency all of the machines, keep following the pollution in industry by implement the solution to reduce the pollution that continues happens and adopt the sound level meter and HVAC (Heating, Ventilation and Air Conditioning). Moreover, the results of the 3 factories is different about minimize the waste and pollution in the manufacturing industry, such as the F2 will encourage all the employees to do good practice activity in every month, F3 ensure company is following ISO 9002, but the F1 stated that the factory is always improving year by year since 1995. Next, when the pollution occur in the industry, the Person-In-Charge (PIC) of F1, F2 and F3 are simultaneously agree concern the pollution by implementing preventive action and corrective the action to avoid the pollution in industry. In fact, the results of F2 and F3 simultaneously stated that got operate a transfer station for non-hazardous waste in the industry except the F1 do not operate it in the industry. The example of excerption for the problem solving of pollution based on manufacturer perspective is "*Analysis of domestic sound levels is good way to solve the pollution.*" (F3: C: Q1).

## DISCUSSION AND CONCLUSION

Regarding the problems in this study, the research has been done to achieve the objectives set. Hereby, the data was collected through interviews from the manufacturer in Kedah which aims to minimization of pollution and waste that's happened in the manufacturing industry.

### **The type of pollution in manufacturing industry**

This study states that the type of pollution in the manufacturing industry is noise, air, water, soil, radioactive and smell pollution. Indeed, this study was conducted in parallel with Rinkesh (2016), Kumar and Lee (2012), Nowak et al. (2013), Mashhood (2011) and Achim et al. (2012) in which Rinkesh stated that the pollution in industry is noise pollution, Kumar and Lee stated is water pollution, Nowak et al. mentioned that is soil pollution, Mashhood stated that is soil pollution and lastly is Achim et al. stated that is radioactive pollution. Contrarily, some of the findings were not consistent with the results of a study conducted by past researchers, namely Rosen et al. (2015) which mentioned that the pollution in industry is thermal pollution. On the other hand, based on which of the pollution are most serious in the industry, but all of the findings are not parallel with the past researchers.

### **The factor of manufacturing industry pollution**

This study states that the factor of manufacturing industry pollution involve unplanned industry growth, use of outdated technologies, inefficient waste disposal, do not use filtering smoke and lack of stringent policies to control the pollution. This study results in line with Rinkesh (2016) which is lack of stringent policies to control the pollution, Discoli and Martini (2012) stated that unplanned industry growth causes the pollution, Bourreau et al. (2011) mentioned that using of outdated technologies will maximize the



pollution happens and Oates et al. (2012) stated that about the inefficient waste disposal will cause the pollution happen in the industry. On the contract, this study is not in line with the past researches who are Davide and Antoine (2015), Mohan et al. (2013) and Segal (2016) because the Davide and Antoine stated that the factor of pollution is leaching of resources from our natural, while the Mohan et al. mentioned that the exhausting from industries occur the pollution and Segal stated that is process from industries is the factor of pollution. In addition, regarding what kind of the machine are more polluted, what is the main product of polluted, which is the pollution are more stress for the workers in working area and the pollution in an industry will get the complaint from residential also do not parallel with the past research.

### **The problem solving of pollution in manufacturer perspective**

This study states that the problem solving of pollution in manufacturer perspective is pollution control, adopt the 3R's waste hierarchy (Reduce, Reuse and Recycle), follow the rule that set by the government such as "Akta Kualiti Alam Sekeliling", wastewater treatment processes and analysis of domestic sound levels. This study parallels with the past researchers as Rinkesh (2016), Ninlawan et al. (2010), Seetharam et al. (2013), Anbukumar et al. (2014). In details, the problem solving of pollution by Rinkesh is pollution prevention or pollution control, while the Ninlawan et al. is mentioned that NPI data and adopt the 3R's waste hierarchy is the better ways the reduce the pollution and lastly is Seetharam et al. and Anbukumar et al. which stated the waste treatment process is good way for reduce the pollution in the industry. Instead, some of the findings about the problem solving were not consistent with the results of a study conducted by past researchers, namely Perfect Pollucon Services (2014) which required to conserve and protect water and control radioactive pollution, while Kellens et al. (2011) stated the improve of industrial exhaust systems is important to reduce the pollution happens. Moreover, based on the others way for problem-solving of pollution from manufacturer perspective, is it the better way to minimize or avoid the pollution happens, pollution control in before, how to monitor the different kinds of pollution at present, how to manage the waste to avoid the pollution, the improvement plan in the next 5 years, did the person in charge (PIC) concern about the pollution, did the PIC monitor the every process of the industry, did the company operate Material Recycling Facility (MRF), did the company operate a transfer station for non-hazardous waste and did the company operate a facility where was disposed / processed in the industry totally does not equidistant with the study.

### **Conclusion**

This study proves that the processing of the manufacturing industry causes the different type of pollution in our environment. This is because of the certain factors prevailing in the industry. However, prevention is better than cure, all people especially the manufacturer must protect the environment for no longer contaminated. Indeed, this study suggested the future research to creating a new technology to reduce the pollution and waste in the manufacturing industry. Thus, the researchers can be more focus on using the quantitative method for bring more accurate data from the large numbers of factory. On the other hands, the implication of this study that can improve the knowledge of the manufacturer and Environmental Agency about the smart ways to conserve and preserve our environment.

## REFERENCES

- Achim, P., Monfort, M., Le Petit, G., Gross, P., Douysset, G., Taffary, T., Blanchard, & X., Moulin, C. (2012). Analysis of Radionuclide Releases from the Fukushima Nuclear Power Plant Accident, <http://dx.doi.org/10.1007/s00024-012-0578-1>.
- Anbukumar, S., Technological, D., Prasad, N. M., & Kumar, A. M. (2014). Effluent Treatment for Sago Industry Using Zeolite and Activated Carbon. *Open Journal of Water Pollution and Treatment*, 1(2), 18-26. doi:10.15764/WPT.2014.02003.
- Bourreau, M., Cambini, C., & Dogan, P. (2011). Access Pricing, Competition, and Incentives to Migrate from “Old” to “New” Technology. Harvard Kennedy School of Government, Working Paper No. 11–029, July, Cambridge (MA).
- Buzzle. (2015, May 11). Water Pollution Statistics. Retrieved September 23, 2016, from <http://www.buzzle.com/articles/water-pollution-statistics.html>.
- Davide, C., & Antoine, A. (2015, October 20). Microfluidic Leaching of Soil Minerals: Release of K from K Feldspar. doi:10.1371/journal.pone.0139979.
- Discoli, C., & Martini, I. (2012). Unplanned Urban Growth and its Effect on the Sustainability. *Resources and Environment*, doi:10.5923/j.re.20120203.05.
- Hydrant (2016). Malaysian Manufacturing Sector Expanding but Faces Challenges. Retrieved November 11, 2016, from <https://www.oxfordbusinessgroup.com/overview/growth-leader-manufacturing-sector-expanding-faces-challenges>.
- Kumar Reddy D. H., & Lee S. M. (2012). Water Pollution and Treatment Technologies. *J Environ Anal Toxicol* 2. doi:10.4172/2161-0525.1000e103.
- Mashhood, A. K., & Arsalan, M. G. (2011). Environmental Pollution: Its Effects on Life and Its Remedie. *Journal of Arts, Science & Commerce*, 2(2), 2.
- Mohammad, N. (2011). Urban Environmental Pollution in Malaysia: A Case Study. *British Journal of Humanities and Social Sciences*, 3(1), 46-57.
- Mohan, D., Thiyagarajan, D., & Balakrishna Murthy, P. (2013). Toxicity of Exhaust Nanoparticles. *African Journal of Pharmacy and Pharmacology*, 7(7), 318-331. doi:10.5897/AJPPX12.005.
- Ninlawan, C., Seksan, P., Tassapol, K., & Pilada, W. (2010). The Implementation of Green Supply Chain. Proceedings of the International MultiConference of Engineers and Computer Scientists 2010 Vol III, 1-5.
- Nowak, D. J., Hirabayashi, S., Bodine, A., & Hoehn, R. (2013). Modeled PM2.5 Removal by Trees in Ten U.S. Cities and Associated Health Effects. 178, 395-402.

- Nurul, A. M., Oliver, L. H. L., & Dashimah, O. (2014). Human Health and Wellbeing: Human health effect of air pollution. Built & Natural Environment, Universiti Teknologi MARA, 40450 Shah Alam, Malaysia.
- Oates, M. R., Despeisse, M., Ball, P. D., Evans, S., Greenough, R. M., Hope, S. B., Levers, A., Lunt, P., Quincey, R., Shao, L., Walt Niel, T., Wheatley, C., Wright, A. J., 2012. Design of Sustainable Industrial Systems by Integrated Modelling of Factory Building and Manufacturing Processes, Istanbul, Turkey, 1-8.
- Perfect Pollucon Services. (2014). Ways to Save Water in Industries. Retrieved from <http://www.ppsthane.com/blog/ways-to-save-water-in-industries>.
- Rinkesh. (2016, January 17). Sources and Causes of Water Pollution - Conserve Energy Future. Retrieved September 23, 2016, from Pollution, <http://www.conserve-energy-future.com/sources-and-causes-of-water-pollution.php>.
- Rosen, M. A., Bulucea, C. A., Mastorakis, N. E., Jeles, A. C., & Brindusa, C. C. (2015). Evaluating the Thermal Pollution Caused by Wastewaters Discharged from a Chain of Coal-Fired Power Plants along a River. *Sustainability*, 7(5), 5920-5943. doi:10.3390/su7055920.
- Seetharam, C. J., & Santosh, K. M. (2013). Wastewater Treatment and Reuse: Consilience. *The Journal of Sustainable Development*, 1-15.
- Utusan Malaysia. (2014, December 4). Bau Busuk Pusat Sembelih Ayam Bakal Selesai. Retrieved August 23, 2016, from <https://www.utusan.com.my/berita/wilayah/bau-busuk-pusat-sembelih-8232-ayam-bakal-selesai-1.32237>.