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INTRODUCTION OF SMOG-EATING TECHNOLOGY FOR MALAYSIA'S CLIMATE TO REDUCE AIR POLLUTION

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Abstract:

In Malaysia, the statistic of the air pollution is quite high due to the modernization phase. Government had invested a lot to deal with the excessive emission of pollutants in terms of energy and money. Therefore, a new green technology, called Smog-Eating Technology is suggested to be implemented in Malaysia as it can be categorized as the passive technologies which help to break down the particles of the pollutants naturally. Titanium oxide is the main and crucial element in this technology since the infusion of titanium oxide with building components will enhance their ability to react with pollutant's particle and break it into salt which then will be washed away by rain. Since this technology is new to Malaysia and hails from abroad, this paper will focus on the introduction of smog-eating technology for Malaysia's climate and its function to reduce air pollution.

Keywords: Air pollution; Smog-eating technology; Titanium oxide; Warm-humid climate

1.0 INTRODUCTION

Malaysia is one of the countries that faces rapid urbanization. To be at par with other modern countries, our country has taken a lot of initiatives in term of technology, facilities, accommodation and other aspects to fulfill the demand and at the same time to strive towards high technology country in future. However, the urban development, land use patterns and activities not only influence the volume of emissions into the ambient air environment but also affect the ability of the urban ecosystem to purify the air (Ling et al., 2010). More pollutants will be emitted to air from vehicles, air-conditioning and various other sources. Air pollution is the main concern nowadays especially for those who are working outdoor: they are being exposed to the polluted air for a long time. The government had spent a lot of money to deal with this issue and some of the actions taken were green campaign, talks, recycle centers, air purifying, restriction of open burning, air filter for factories and etc. The expenditure had increased from year to year. In 2013, the government spent about RM2.237 billion and it increased by 0.3% in 2014 which was about RM2.244 billion. Compared to other aspects in Environmental Protection Expenditure, pollution prevention recorded the highest expenditure of RM763.5 million (Department Statistic of Malaysia, 2016). However, these actions seem unable to reduce the effect of air pollution. Therefore, the implementation new technology called Smog-Eating Technology may become one of the best solutions to provide the cleaner environment for Malaysian citizen. The objectives of this research are to determine the requirement of the technology to be implemented in Malaysia: the main issue is to find out whether or not it can fit our climate, to analyze the factors that contribute to the air pollution in Malaysia and to propose the concept of this technology which fit to the Malaysian's climate.

2.0 LITERATURE REVIEW

Smog-eating technologies are widely used nowadays due to the effectiveness of the technology to reduce the composition of air pollution. Many researches had been done regarding this technology in term of the requirement, final products, chemical reaction and many more.

2.1 Requirement of smog-eating technology that related to climate

Since this technology originates from abroad, it is important to know the requirements needed especially on how the technology can be adjusted to the Malaysian climate. This technology works by absorbing the sun rays and other ultraviolet that help to break down the pollutants molecule. The most famous building that uses this kind of technology is at Mexico City's Manuel Gea Gonzalez Hospital which applied this technology in in from of building façade. Other example can be seen at Milan's Palazzo Italia building which use smog-eating concrete. The climates for both countries are slightly different from Malaysia. Therefore, it is crucial to know the suitability of this technology to the Malaysian climate

2.2 Factors that contribute to air pollution in Malaysia

Our world has been dealing with air pollution issues for decades. More than 2 million premature deaths each year can be attributed to the effects of the urban outdoor air pollution and indoor pollution. More than half of these fatal diseases is borne by the population of developing countries Malaysia, as one of the developing countries also as been facing this issue for a long time until now. This issue become the main concern by the government and it has spend a lot to reduce the rate of air pollution. The factors that contribute to air pollution in Malaysia can be varied. Local causes of pollution are attributed to the emission of harmful pollutants from vehicles on road, emission of harmful gases from electrical appliances such as air-conditioner, illegal open burning and even the smoke from the cigarettes.

2.3 Smog-eating technology concept

By applying the new innovation technology (nanotechnology), smog-eating technology can be categorized as passive design strategies because it can work while remain static which save operation energy. This technology can be incorporated either in the form of building façade, concrete and cement. The process involved known as photocatalysis. The photocatalysis consists of different steps: the photoactive TiO_2 at the surface of the material is activated under the influence of ultraviolet light and, subsequently, the pollutants are oxidized due to the presence of the photocatalyst and it precipitated on the surface of the material. Finally, they can be removed from the surface by the rain or cleaning/washing with water (Adnan et al., 2016). Smog-eating technology more suitable to be installed outdoor because it requires sufficient amount of sun rays to fully functional.

3.0 METHODOLOGY

The main method used to conduct this research is through critical review by reviewing a lot of previous research regarding the same topic or relevant topics that are related to this technology. 5 research papers and 4 official websites are being reviewed throughout the research. Since smog-eating technology is new to Malaysia, therefore the example and information regarding this technology mostly will be based on worldwide researched.

4.0 ANALYSIS AND FINDINGS

4.1 Malaysia's Climate

Photocatalysis is the main process in smog-eating technology where the absorption of sunrays by the TiO_2 so that the purification process can be done. Therefore, the rate of sunrays is very crucial. Malaysia naturally receives abundant amount of sunshine and at the same time solar radiation. Even though there is drought, it is rare to have a full day with completely clear sky because the sky is constantly covered by clouds. On average, Malaysia receives about 6 hours of sunshine per day. However, the amount of sunshine received will be different according to the seasonal variation. For example, the areas that are located on east side like Kuching only receives 5 hours on the average compare to Kota Bharu and Alor Setar which receive about 7 hours per day of sunshine. After the

pollutant molecule being purify, it need to be washed away by the rain. Luckily the rainfall in Malaysia is quite heavy and with an average of 250 centimeters or 98 inch a year.

Since the temperature is quite high, the rain usually occurs in the form of thunderstorms. The determination of the quantity of rainfall depends on the wind flows. The seasonal wind flow pattern and local topographic features determine the rainfall distribution patterns over the country. During the northeast monsoon seasons, the exposed area such as the east coast Peninsular Malaysia, Western Sarawak and the northeast coastal experienced heavy rainfall which the area that have mountain topography are not very affected by the monsoon. There are differences between the seasonal variation of rainfall in Peninsular Malaysia and Sabah and Sarawak.

4.2 *The rate of air pollution in Malaysia is quite high*

Malaysia has faced air pollution issues for a decade. It is getting worse from year to year due to the urbanization process. In 2012, Malaysia suffered from 160,693 of lives lost in the year 2012 as a result of air pollution. The main factors that lead to the issues are excessive emission of pollutants from cars, factory, open burning and so forth. The total emission of pollutants to the atmosphere are 3,070,182 tonnes which the industrial emission is about 27.1% from total amount. Nowadays, there are a lot of factories built to fulfill the demand for certain products in the nation or worldwide. Normally, there is a long tube called chimney erected high into the air to release the smoke from the production process. Some of the chimneys are being installed with a smoke filter to ensure that the smoke release in the air is safe. However, most of the factories disobey the rule. As a result, the smoke consists of high level of carbon monoxide, organic compound and chemical. When unfiltered smoke is released into the air, it will pollute the surrounding air.

Other than that, burning of fossil fuels is also one of the major contributions to air pollution. Transportation has become the important aspect in our lives. People need transportation to go from one place to another. For example, cars, motorcycles, lorries and airplanes burn a lot amount of fossil fuels to operate. This is one factor that is really difficult to manage because humans really need transportation to transport people, goods and services. Because of that, the demand for transportation has increased from year to year. For example, the graph in Figure 1 below shows the number of vehicles registered in Malaysia.

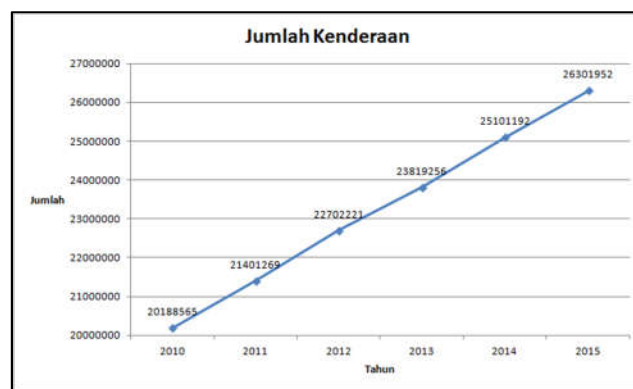


Figure 1. Statistics of vehicles on road in Malaysia from year 2010 till 2015

Source: Official Portal of Road Transport Department Malaysia

On the other hand, Malaysia also experienced haze due to the forest fires in Indonesia from 1994 till 2015. On 15 September 2015, 34 areas in the country recorded unhealthy air quality status for the first time in Malaysia's history since 1997. The highest API reading was 211 which was very unhealthy in Banting Selangor on 14 September 2015.

4.3 *Nanotechnology is the new approach in green construction*

Due to innovation and technological advancement, construction activities have been subjected to alteration, modifications and changes in attempt for the industry to meet the demands and aspiration of their client. One of the technologies that is gaining popularity in the industry, especially in the developed ones, is nanotechnology (Oke et al.,2017). Nanotechnology is the main application being used in smog-eating technology. Titanium oxide is the most important photocatalyst used for purifying applications (Zouzelka & Rathousky 2017). The titanium oxide in the material will be active through absorption of sunrays or other ultraviolet. It then will break down the particles of the pollutants into not harmful salt. Then, the salt will be washed away by the rain. This process happens without any energy consumption because it acts naturally. The amount of reduction in pollutant is fully depends on the size of exposed smog-eating components. For example, the smog-eating façade that being installed at Mexico City's Manuel Gea Gonzalez Hospital able to negating the effects of up to 1,000 cars a day according to its developers. Considering their various environmental application, the main advantages of photocatalytic TiO₂-based coatings is that they can be applied to various construction materials used in buildings, pavement, walls and tunnels, among the surface. Because of the demanding operation conditions, such as highly polluted air, air-borne dust, or variations between freezing and hot weather, or rainy and extremely dry periods, the long-term photocatalytic performance and mechanical durability of such photocatalytic coatings are of the utmost importance (Zouzelka & Rathousky 2017).

5.0 CONCLUSION

The smog-eating technology is the best solution to fight the critical issues of air pollution nowadays. From the research that is being done by researcher for past few years, people worldwide should be aware about this technologies and try to study and carry out more studies. . Malaysia has met the requirement that needed to implement this kind of technology. Due to the high rate of air pollution in Malaysia, the smog-eating technology is most effective solution for Malaysia to overcome the problem which is worthy for a long term.

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