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Carbon Emission from Vehicular Source in Selected Industrial Areas in Malaysia

Pelepasan karbon daripada Sumber Kenderaan di Kawasan Perindustrian Terpilih di Malaysia

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ABSTRACT

Vehicle emission has been the major source of environmental pollution for the past 30 years. The urbanization, industrialization and traffic systems growth are causing more air pollution problem in the city creating an uncomfortable atmosphere to live in. Carbon emission is one of the main air pollutants causing problems in the local and global community. This paper discusses the effect of increasing vehicular traffic on the road in a few industrial sites within cities in Malaysia to the release of carbon dioxide and carbon monoxide in the atmosphere. This paper studies the traffic trend using census data from JKJR and converted into carbon emission using DEFRA GHG Conversion Factors and air quality trend from Alam Sekitar Malaysia in three selected industrial area in Malaysia, which are Shah Alam Industrial Area, Seremban-Senawang Industrial Area and Kuantan-Pekan Industrial Area. Carbon monoxide concentration trend in Shah Alam and Seremban-Senawang fluctuates with the highest concentration of 1.78ppm for Shah Alam and 0.77ppm in Seremban-Senawang in the earlier years and becoming lower in 2010 and 2011 compared to the trend in Kuantan-Pekan, which increased since 2001 to 2011 with the highest concentration of 0.54ppm. Carbon dioxide concentration is highest at Shah Alam ranging from 18067.17 to 88150.01 kg CO_2/km travelled compared to Kuantan-Pekan ranging from 3520.39 to 6953.69 kg CO_2/km travelled and Seremban-Senawang ranging from 3783.29 to 5734.30 kg CO_2/km travelled. Based on the early findings, the increasing vehicular traffic resulted in increment of carbon emission in the atmosphere.

Keywords: Carbon emission; vehicle source; industrial areas; Malaysia

ABSTRAK

Pelepasan asap kenderaan telah menjadi punca utama pencemaran alam sekitar sejak 30 tahun yang lalu. Proses perbandaran, perindustrian dan pertumbuhan sistem trafik yang menyebabkan lebih masalah pencemaran udara di bandar mewujudkan suasana tidak selesa untuk didiami. Pelepasan Karbon adalah salah satu daripada bahan pencemar udara utama yang menyebabkan masalah dalam masyarakat setempat dan global. Kertas kerja ini membincangkan kesan peningkatan kenderaan di jalan raya di beberapa kawasan industri dalam bandar di Malaysia dengan pembebasan karbon dioksida dan karbon monoksida di dalam atmosfera. Dalam kertas ini, arah aliran trafik menggunakan data banci daripada JKJR dan ditukar kepada pelepasan karbon menggunakan Penukaran Faktor DEFRA GHG dan trend kualiti udara Alam Sekitar Malaysia di tiga kawasan perindustrian di Malaysia yang dipilih iaitu Kawasan Perindustrian Shah Alam, Kawasan Perindustrian Seremban-Senawang dan Kawasan Perindustrian Kuantan-Pekan. Trend kepekatan karbon monoksida di Shah Alam dan Seremban-Senawang berkeadaan turun naik dengan kepekatan tertinggi 1.78ppm di Shah Alam dan 0.77ppm di Seremban-Senawang pada tahun-tahun sebelum ini dan menjadi lebih rendah pada tahun 2010 dan 2011 berbanding trend di Kuantan-Pekan, yang meningkat sejak tahun 2001 hingga 2011 dengan kepekatan tertinggi 0.54ppm. Kepekatan karbon dioksida adalah paling tinggi di Shah Alam dengan julat 18.067,17-88.150,01 kg CO_2 /km perjalanan berbanding Kuantan-Pekan yang terdiri 3520,39-6953,69 kg CO_2 /km perjalanan dan berbanding Seremban-Senawang terdiri 3783,29-5734,30 kg CO_2 /km perjalanan. Berdasarkan penemuan awal, kenderaan yang semakin meningkat menyebabkan kenaikan pelepasan karbon di atmosfera.

Kata kunci: Pelepasan karbon; sumber kenderaan; kawasan industry; Malaysia

INTRODUCTION

Human population growth has increases the demands on basic needs resulted into development of industrialization. As industrialization grow, transportation and accommodation. This never-ending industrial growth in meeting the needs of development of the country also resulted in the growth of transportation network (Gruden 2003) to fulfil the needs of transportation of employees

and goods. In the early development of the country, industrial area was situated far from cities as possible in the early development of the country, but as urbanization and industrialization growth took place, the industrial and urban boundaries dissolves causing the industrial area to be in around the cities as what happened in Shah Alam, Seremban, Senawang, Pasir Gudang and Pekan. The growth of industrial area in cities makes it a very vulnerable environment for people to live in.

The three major source of pollution in Malaysia are mobile sources, stationary sources and open burning sources. Although the development of transportation contributes to the human population, it is also widely recognized as the main source of air pollution worldwide (Colvile et al. 2001). For the past five years, emissions from mobile source such as motor vehicles have been the major source of air pollution, contributing at least 70 – 75 % of the total air pollution (Afroz 2002). Transport sector's share of greenhouse gases emission rose by 35% in 15 years from 1990 (European Commission 2009). Road traffic has grown distinctly over the years. Data acquired from the Department of Statistics Malaysia and Malaysian Road Traffic Volume (RTVM) has shown that the total number of on road vehicle has increased greatly from 1999 to 2011, almost 80% of the total numbers of on road vehicle are privately owned, and these vehicles mostly run on petrol and diesel.

Various researches have shown that petrol or diesel fuelled vehicle are the main source of air pollutant emission (Solyu 2007; Colvile et al. 2001; Bradley et al. 1999; Kuc et al. 2003). Carbon monoxide usually comes from 4 major sources, fossil fuel combustion, industrial combustion, biomass burning and oxidation of methane and other hydrocarbons. Transportation combustion accounted about 50% of the total industrial source of carbon monoxide especially in the urban industrial areas (Logan et al. 1981). Although Carbon dioxide are naturally accuring compound, 80% of additional carbon dioxide comes from anthropogenic sources resulted from the demand of heat, electricity and transportation (Kuc et al. 2003). Carbon dioxide concentration in an industrial and urban area has been monitored to increase during peak traffic hour (7.00-9.00am) and decreased in the afternoon and peaked again from 5.00pm in the evening (Azmi et al. 2010). The abundance carbon monoxide in the atmosphere usually leads to human health problems and also effects the oxidizing capacity of the troposphere (Bradley et al. 1999)

These increments of vehicle on road each year are causing more and more pollutant to be released into our environment causing a very unhealthy environment to live in. As development of a country to enhance the quality of living is inseparable from causing deterioration of the environment hence causing many types of health problems through unnecessary intake of pollutants into the body system (Vasconcellos et al. 2003), sustainable development is pursued to ensure that the human population can have a preferable future with a cleaner environment and healthier life, a sustained level of economic development without excessive waste and pollution and the protection of natural resources and biodiversity. Several actions should be taken to curb if not stop the pollution problems in order to ensure a development that maintains the human needs while preserving the environment for future generation.

This paper discusses the effect of expansion of road traffic in a few industrial sites within cities in Malaysia due to the urbanization and development of industrial area in Malaysia to the release of carbon dioxide and carbon monoxide in the atmosphere in three selected industrial area in Malaysia, which are Shah Alam Industrial Area, Seremban-Senawang Industrial Area and Kuantan-Pekan Industrial Area.

DATA & ANALYSIS

SAMPLING SITES

Sampling sites were chosen based on the location of the road (for RTVM) and sampling station (for ASMA) that are the closest to the selected industrial area with little topography and building disturbance as listed in the table

TABLE 1. Location of sampling station

Sampling site	ASMA sampling station	RTVM sampling station
Shah Alam Industrial Area	CA00025 SK TTDI Jaya, Shah Alam	BR813 Jalan Kuala Lumpur-Puchong-Shah Alam – 9.5km
Seremban-Senawang Industrial Area	CA00047 SMT Tuanku Jaafar, Seremban	NR511 Jalan Seremban-Senawang – 2.5km
Kuantan-Pekan Industrial Area	CA00014 SK Indera Mahkota, Pahang	CR402 Jalan Kuantan-Pekan – 12.5km

CARBON MONOXIDE

Carbon monoxide concentration data was acquired from air quality trend from Alam Sekitar Malaysia (ASMA).

The carbon monoxide reading was recorded for 8 hours daily in part per million (ppm)

CARBON DIOXIDE

Carbon dioxide concentration data was derived from the Malaysia Road Traffic Volume (RTVM) census data acquired from Road Safety Department (JKJR) of Ministry of Works Malaysia (KKR) using the Department of Environment, Food and Rural Affairs, United Kingdom (DEFRA) greenhouse gas (GHG) Conversion Factors.

Calculation for CO_2 concentration release:

1. For cars:
   No of cars (from RTVM) x 0.2162 (DEFRA GHG Conversion factor for medium petrol car)
2. For van/utilities vehicle:
   No of van/utilities (from RTVM) x 0.2635 (DEFRA GHG Conversion factor for large diesel vehicle)
3. For medium lorry:
   No of medium lorry (from RTVM) x 0.56L/km (fuel efficiency for medium truck) x 2.6304 (DEFRA GHG Conversion factor for freight transport (in L))
4. For large lorry:
   No of large lorry (from RTVM) x 0.43L/km (fuel efficiency for large truck) x 2.6304 (DEFRA GHG Conversion factor for freight transport (in L))
5. For motorcycle:
   No of motorcycle (from RTVM) x 0.0939 (DEFRA GHG conversion factor for motorcycle)
6. For bus:
   No of bus (from RTVM) x 0.0691 (DEFRA GHG conversion factor for 1 bus passenger) x 40 (no of bus passenger, assuming all busses are fully occupied)
7. For heavy vehicle:
   No of heavy vehicle (from RTVM) x 0.15L/km (fuel efficiency for heavy vehicle) x 2.6304 (DEFRA GHG Conversion factor for freight transport (in L))

The CO_2 concentration computed for each type of vehicle is added to a total CO_2 concentration recorded in kg CO_2 /km travelled

RESULTS & DISCUSSION

CARBON MONOXIDE

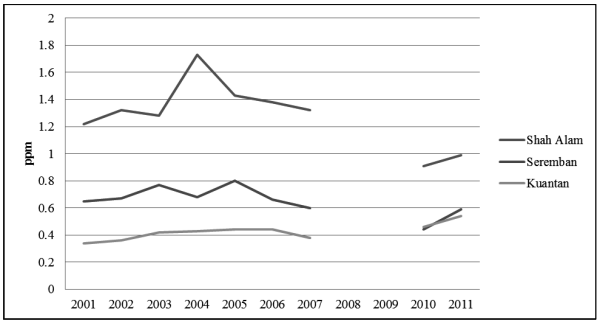

FIGURE 1. Carbon monoxide concentration in Shah Alam, Seremban and Kuantan 8 hour average daily (ppm)

Carbon monoxide concentration from the three selected industrial areas are observed highest in Shah Alam Industrial Area with the highest peak observed in 2004 with the concentration recorded at 1.78ppm in 8 hours while the lowest concentration is seen in Kuantan-Pekan Industrial Area in 2001 at 0.34ppm. Carbon monoxide concentration trend in Shah Alam and Seremban-Senawang fluctuates in the earlier years and became lower in 2010 and 2011 compared to the trend in Kuantan-Pekan, which increases since 2001 to 2011.

CARBON DIOXIDE

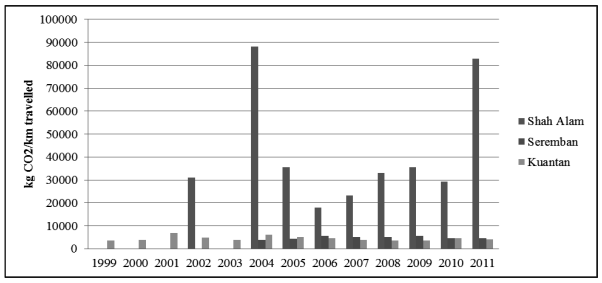

FIGURE 2. Carbon dioxide concentration in Shah Alam, Seremban and Kuantan (kg CO_2/km travelled)

Carbon dioxide concentration is observed to be highest at Shah Alam Industrial Area ranging from 18067.17 to 88150.01 kg CO_2 /km travelled with the highest concentration recorded in 2004 followed by the concentration recorded in Kuantan-Pekan Industrial Area ranging from 3520.39 to 6953.69 kg CO_2 /km travelled with the highest concentration recorded in 2001 and Seremban-Senawang Industrial Area ranging from 3783.29 to 5734.30 kg CO_2 /km travelled with the highest concentration recorded in 2006.

The concentration of carbon monoxide and carbon dioxide are generally highest at Shah Alam Industrial Area as it is the biggest industrial area with more vehicles. This shows that even though an industrial area packed with combustion activities, which also produced carbon such as in Kuantan-Pekan Industrial Area, vehicular emission is the biggest contributor of carbon presence in the atmosphere (Colvile et al. 2001). The increment of road traffic vehicle contributes to the increment of carbon in the atmosphere causing a polluted environment. However, the presence of carbon may also fluctuates from and even reduce due to emission technology upgrades (Bradley et al. 1999) and other physical factors including the climate and temperature (Soon et al. 1999)

CONCLUSION

These data suggest that the carbon monoxide and carbon dioxide concentration increase over the years and especially higher at larger cities with more transportation and industries such as Shah Alam Industrial Area compared to Seremban-Senawang Industrial Area and Kuantan-Pekan Industrial Area.

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