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Air Quality Analysis of SO₂, NO₂ and CO in Palembang City

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Abstract

Population activity which tends to centralized in certain area cause decrease in air quality due to exhaust gas from transportation vehicle. From 2011–2014, Palembang city transport growth 3-5% per year comprise of passenger transportation, buses, truck, motorcycle and special vehicle. The increase of vehicle in Palembang gave the city air pollution potential. Transportation is the main source of air pollution in big city with 70% contribution. Exhaust gas from transport activity consists of 60% CO and 15% incomplete combustion of hydrocarbons such as NO_x and SO_x. The aim of the research is to analyze air quality in Palembang city. Samples were taken and subject to analysis for SO₂, NO₂ and CO. Sample location were determined by using purposive sampling. Location was chosen by means of traffic density at least for one hour and took place at Charitas crossroads, Patal intersection, Mesjid Agung circle, Lemabang crossroad and Plaju intersection. The Result of analysis showed SO₂ level is at range 112–208 µg/Nm³/hour. NO₂ level between 45–227 µg/Nm³/hour and CO at range 12.595–18.320 µg/Nm³/hour. All parameter of air quality obtained are below threshold value defined by government regulation (GR) on air quality No 41 year 1999.

Keywords: Air quality, SO₂, NO₂, CO

Abstrak (Indonesian)

Suatu daerah apabila terjadi pemusatan aktivitas penduduk akan menyebabkan terjadi pencemaran kualitas udara yang disebabkan transportasi. Dari data tahun 2011-2014 transportasi kota Palembang mengalami kenaikan sekitar 3-5% tiap tahunnya terdiri dari mobil penumpang, bus, truk, sepeda motor dan kendaraan khusus (Laporan Data Kendaraan Bermotor Kota Palembang, 2013). Transportasi di kota-kota besar merupakan sumber pencemaran udara yang terbesar, dimana 70% pencemaran udara perkotaan disebabkan oleh aktivitas kendaraan bermotor. Kendaraan bermotor mengandung zat pencemaran, 60% dari pencemar yang dihasilkan terdiri dari CO dan sekitar 15% terdiri dari hidrokarbon yang tidak terbakar sempurna, NO_x dan SO_x. Tujuan penelitian untuk menganalisa kondisi kualitas udara di Kota Palembang. Pengambilan sampel udara dilakukan pengukuran parameter SO₂, NO₂ dan CO. Metode lokasi penelitian dilakukan dengan *purposive sampling*. Pemilihan lokasi pengambilan sampel yang berpotensi tercemar yaitu padat lalu lintas dan dilakukan selama satu jam di setiap lokasi pengambilan sampel meliputi Simpang Empat Charitas, Simpang Patal, Bundaran Mesjid Agung, Simpang Empat Lemabang dan Simpang Empat Plaju. Hasil pengukuran kualitas udara kadar SO₂ menunjukkan kisaran nilai 112-208 µg/Nm³/Jam. Hasil pengukuran kadar NO₂ menunjukkan nilai 45-227 µg/Nm³/Jam. Hasil pengukuran kualitas udara ambient karbon monoksida (CO) menunjukkan kisaran nilai 12.595-18.320 µg/Nm³/Jam. Hasil pengukuran SO₂, NO₂, dan CO menunjukkan jika di lima lokasi sampel berada dibawah nilai ambang batas yang ditetapkan berdasarkan peraturan pemerintah RI No. 41 Tahun 1999.

Kata Kunci: Kualitas udara, SO₂, NO₂, CO

INTRODUCTION

Air is very important for human and other creatures hence its quality must be maintained. According to

government regulation no 41 year 1999, air is considered polluted if foreign substances are inserted into its body due to human activity which reduced its quality to a

certain level and cannot be used properly. The foreign substances are called pollutant and generally, it has a toxic effect to living organisms.

Increase in a number of vehicles in Palembang would raise environmental concern especially air pollution. Air pollution is a typical problem a city must face due to large number vehicle and other transportation used by the population. Heavily polluted air not only reduces comfort ability life of citizen but also causes several health problems such as respiratory disorders, eye irritation and lung problem [1].

Air pollution due to transportation exhaust fumes increased by two fold at 2000 based on 1999 condition and are estimated 10 times at 2020 [2]. The growth of transportation sector is projected to be 6-8% per year but at 1999 the vehicle grew almost 15% in the major city. At this rate, fuel use in transportation increase by 2.1 times at 1999, 4.6 times at 2008 and 9 times at 2018. Here we report an evaluation of air condition at Palembang city due to automobile emission by measuring SO₂, NO₂ and CO concentration. The result of measurement was evaluated according to air pollutant threshold regulation.

EXPERIMENTAL SECTION

Air sampling was conducted according to standard procedure for analyzing SO₂, NO₂ and CO. Sampling location was chosen by means of purposive sampling. The location was considered to be polluted due to heavy traffic and the air sample was taken at least an hour for each location.

Table 1. Air sampling location

No.	Sampling Location	Coordinate
1	Charitas crossroads	E : 104° 45'14.07" S : 02° 58'37.17"
2	Patal intersection	E : 114° 46'05.11" S : 02° 56'59.54"
3	Mesjid Agung circle	E : 104° 45'39.38" S : 02° 59'17.69"
4	Lemabang crossroads	E : 104° 47'00.69" S : 02° 58'18.11"
5	Plaju intersection	E : 104° 46'50.62" S : 03° 00'01.89"

Measurement of several parameters in the samples was carried out. Methods of measurement are display on

Table 2 along with reference document and standard threshold.

Table 2. Air sample parameter measurement and method of analysis

Parameter	Unit	Analysis Method	Standard threshold	Ref. document
SO ₂	µg/Nm ³ /hour	Pararosa nilin	900	[3]
NO ₂	µg/Nm ³ /hour	Saltzamn	400	[4]
CO	µg/Nm ³ /hour	NDIR	30.000	[5]

Source : Peraturan Pemerintah RI No.41 Tahun 1999 Tentang Pengendalian Pencemaran Udara

RESULT AND DISCUSSION

Sulphur Dioxide (SO₂)

The measurement result of SO₂ in air sample at 5 different location exhibited range value 112-208 µg/Nm³/hours. Data detail as displayed on Table 3 confirmed that all 5 locations have SO₂ contamination below threshold value assigned by GR no 41 1999 at 900 µg/Nm³.

Table 3. Measurement result of SO₂

Location	SO ₂ µg/Nm ³ /hours	Note
Charitas crossroads	189	GR no. 41 1999 on threshold value of ambient air quality; SO ₂ : 900 µg/Nm ³ /hours
Patal intersection	173	
Mesjid Agung circle	191	
Lemabang crossroads	112	
Plaju intersection	208	

Nitrogen Dioxide (NO₂)

Measurement result of NO₂ on air sample showed that all 5 locations have average value at 45-227 µg/Nm³/hours. Table 4 exhibit air qualities by means of NO₂ at five locations still has value below standard threshold approved by regulation (Government regulation no. 41 year 1999) which is 400 µg/Nm³.

Carbon Monoxide (CO)

Air quality measurement result in term of CO indicates that all 5 locations have the average value between 12,595-18,320 µg/Nm³/hour. Table 5 show CO in the air as other measurement result is below standard

threshold 30.000 $\mu\text{g}/\text{Nm}^3$ approved by GR no. 41 year 1999.

Table 4. Measurement result of NO_2

Location	NO_2 $\mu\text{g}/\text{Nm}^3/\text{Hours}$	Explanation Keterangan
Charitas crossroads	159	GR no. 41 1999 on threshold value of ambient air quality; NO_2 : $\mu\text{g}/\text{Nm}^3/\text{hour}$
Patal intersection	161	
Mesjid Agung circle	183	
Lemabang crossroads	45	
Plaju intersection	227	

Table 5. Measurement result of carbon monoxide

Location	CO $\mu\text{g}/\text{Nm}^3/\text{hour}$	Explanation
Charitas crossroads	12,595	GR no. 41 1999 on threshold value of ambient air quality; CO : $\mu\text{g}/\text{Nm}^3/\text{hour}$
Patal intersection	14,885	
Mesjid Agung circle	18,320	
Lemabang crossroads	12,595	
Plaju intersection	18,320	

Meteorological Factors

Along with SO_2 , NO_2 and CO measurement, several parameters of meteorological factors were also determined at the locations which are air temperature, humidity, and wind velocity and weather condition. The results are shown in Table 6 and 7.

Table 6. Measurement result of air temperature and humidity

Location	Air temperature ($^{\circ}\text{C}$)	Humidity (%Rh)
Charitas crossroads	29.6	57.7
Patal intersection	34.4	41.7
Mesjid Agung circle	32.4	54.4
Lemabang crossroads	26.6	71.5
Plaju intersection	29.8	57.7

Table 7. Measurement result of wind velocity and weather condition

Location	Wind velocity (m/s)	Weather condition
Charitas crossroads	0.8	Sunny
Patal intersection	1.8	Sunny
Mesjid Agung circle	2.1	Cloudy
Lemabang crossroads	0.8	Sunny
Plaju intersection	1.8	Sunny

According to the data table 6, highest air temperature was detected at Patal intersection i.e. 34.4°C . Pollutant tends to increase its amount at higher temperature [9]. The wind velocity was detected at 0.8-2.1 m/s. At some point, air and pollutant mixing is assisted with high velocity of wind and make certain area increase its pollution level compare to other [10, 11].

A report of air quality at Palembang city during September 2012 has decreased caused by haze from land fires [12]. Haze was spread across nations which triggered flight delays, disturbed office and school activities and even several health problems to the citizen such as eye irritation, cough, and acute respiratory infections.

CONCLUSION

Air quality measurement result showed that Plaju intersection has SO_2 , NO_2 and CO contamination higher than other location. All five locations have pollutant measurement result below standard threshold approved by the government regulation No 41 year 1999.

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