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CAR POLLUTION MEASUREMENT (A STUDY ON 'HEALTH' ENVIRONMENT)

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ABSTRACT

A fact that vehicles, especially cars both which use gasoline or diesel fuel significantly effect air pollution. Such a condition needs a measurement of the air pollution intensity as a basic of solution of the air pollution increase. Therefore the aim of this article is to study the measurements of: (1) engine CARB test; (2) constant volume sampling system (CVS); (3) driving cycle for emission test; and (4) engine exhause smoke. The method used is the study of the CARB test to measure gas emissions, where the cars are arranged on the chassis dynamometer that can stimulate the attraction following the road and cars are tensioned moisture; CVS system, in which a positive displacement fan draw air into the aqueous and mixing with the flue gas; then cycle for emission test, where the car is placed on a chassis dynamometer, starting from a cold engine and driven through the 23-minute driving cycle, and the engine smoke measurement performed on an experimental place, and the machine is turned on and then gassed, no load. The result of this study shows that for: (1) engine CARB test results a condition stimulation of continously speed and load vehicles in an engine test; (2) CVS with constituent results a light exhaust gas with a higher clean volume air, a less pollutant, and a good calculation and accurate; (3) driving cycle of emission test results a tighter emission control development; (4) smoke of engine for a certain speed and a maximum load results smoke concentration more accurate.

KEY WORDS : Car, CARB tests, CVS, steering cycle, and smoke

INTRODUCTION

The compounds of carbon monoxide (CO), hydrocarbons (HC) are not soluble, and nitrogen oxide (NO) is released motor vehicles (cars intended, pen). Is a serious problem in the most big city. Soerjani *et al.* (1987) and Suparmoko (2008), then showed a fact, that the presence of a car in the cities of the world are a major source of air pollution and increasing noticeably by the number of community who use cars or motor vehicle. Even Sastrawijaya (2009); and Alphada (1994) as well as Soemarwoto (2009) mentions, that the fuel in the car is more than half of the causes of pollution (read: pollution) air, which by Basri K. and Cunha (2004) and Basri K. (1996) will affect health. Thus, Ryadi [(1986); compare also Slamet (2011); Hardjasoemantri (2005); Basri K. (2004)], and Soemarwoto (1994), as well as Kusnoputranto (1985) considers the car exhaust is a huge source of pollution run things.

Based on these facts, it is from within the car itself needs more serious treatment to ward off further deterioration of the release of waste material. Even against a reality that requires the need for measurement of car pollution. The development of a tool or instrument to accurately measure the concentration of automobile exhaust pollution, which is discussed Haslett (1978) and other experts, be the basis of a review of this study, in which the discussion has become an urgent need to be applied in each country. And that should be given priority is

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how to use pollution measurement methods appropriate for all types of needs, both in the calculation of the attractiveness of the car itself as well as in the operation of equipment used in the measurement of car pollution.

Similarly, measurement of smoke that specifically compared with measurements of compounds CO, HC insoluble, NO need to be carried out in accordance with the standards recommended by each state Haslett (1978); compare also Arismunandar and Tsuda (2002); well as Ryadi (1986).

Referring to the above background and the scope of the discussion on the measurement of car pollution, specifically the paper aims to examine measures to: (1) CARB test for car engines, (2) a system of constant volume sampling (CVS); (3) steering cycle for emission tests, and (4) the engine fumes.

REVIEW

CARB Test Measurements for Car Engine

Compounds CO, HC insoluble, and NO is the main target of car exhaust emissions regulations, because the danger potential to human health. In addition, the density of a metropolitan city surrounded by skyscrapers in the streets are relatively narrow, it is possible the emergence of bottlenecks or stagnation (see Ryadi, 1986). Because often seen on the streets of the city a sort of whitish smoke termed the terminology smog. The smoke is actually a result of what is called photochemical smog (Ryadi, 1986; Ryanto *et al.*, 1985).

Instruments have been developed to accurately measure the concentration of the compounds in car exhaust, in order to control the quantity of air pollution released. Where not only depend on the combustion of fuel, but also the way the car constantly on acceleration and deceleration. Data on this, presented the results of research Basri K. (2004) measurements, particularly CO, on top of (inside) the car that was crossing some roads in Makassar, as in Table 1 that show below.

As for Table 2, it is also summarized some of concentrations of automobile exhaust gases in a wide variety of operations in Makassar street.

Data Tables 1 and 2, when associated with a diesel engine, this does not pose a serious problem, as long as the transient can be estimated with a certain engine speed conditions. Therefore, when the machine is placed on a spot test (a test bed) with a dynamometer containing a load, then emissions can be measured according to the load and speed and is calculated according to the frequency at which the emission occurs when the car is driven.

Cycle Mode of tests CARB (California Air Resources Board), it further indicated by Haslett (1978) in Fig. 1. Each mode is over 10 minutes and the level of concentration of HC emissions, CO, and NO were measured during the last minute. To reach level g h^{-1}, the concentration of emissions for each mode is multiplied by a constant and the flow rate of the gases that are emitted expressed in lb^{-1}.

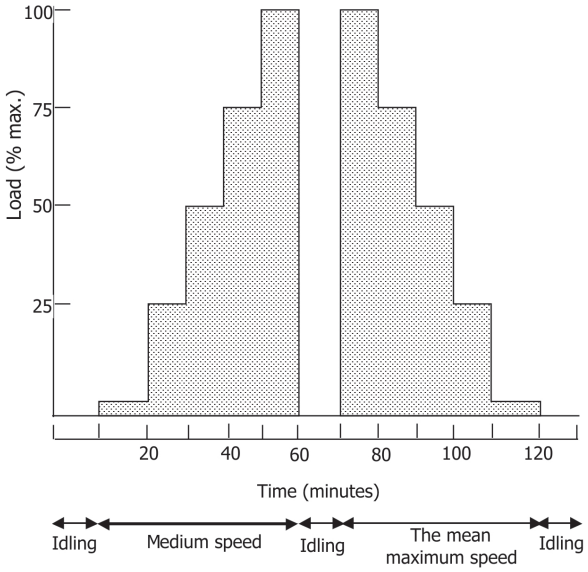

Fig. 1. CARB test for diesel engines

Discussion about the CARB test measurements for the engine in terms of pollution formation in gasoline engines as described Haslett (1978) above, basically describes how transient engine adds the amount of CO, HC insoluble unbalanced, compared with steady driving (engine life continues-continuous).

To measure gas emissions, the cars are arranged on a chassis dynamometer that can stimulated attractiveness and humidity following the path of a car that follow. Perhaps due to such conditions that led to the data as shown in Tables 1 and 2.

Measurement System Constant Volume Sampling (CVS)

To determine the amount of emissions of a car, it is necessary to measure the concentration of pollutants in the flow of gas and air flow through the engine. Too bad there is no proper air flow meter that can be

Table 1. The results of measurements of the mean concentration of CO in the vehicle at various operations

No.	Wide operating	The mean concentration of CO in the way (ppm)				
		A	B	C	D	E
1.	The engine stopped car	11.41	11.71	11.19	11.52	11.70
2.	Car runs (regular way)	9.72	9.93	9.06	10.80	10.30
3.	Speed increased (accelerated)	7.92	8.20	7.64	8.15	8.13
4.	Lowered speed (slowed)	9.75	9.04	8.1	9.42	9.19

Description Road: A = A.P. Pettarani; B = Urip Sumohardjo; C = Perintis Kemerdekan; D= Sultan Alauddin; E=Veteran.

Table 2. The composition of the exhaust gases in the combustion engine cars in a variety of operations

Wide operating	Unburned HC °/oo	CO °/oo	NO °/oo	H%	CO_2 %	Air %
Roads in places	0.750	5.2	0.030	1.7	9.5	13.0
Ordinary road	0.300	0.8	1.500	0.20	12.5	13.1
Be accelerated	0.400	5.2	3.000	1.2	10.2	13.2
Slowed	4.000	4.2	0.006	1.7	9.5	13.0

easily mounted on the engine air cleaner without affecting carburizing. Nonetheless, it seems the United States has adopted a more brilliant idea to overcome this problem, the so-called constant volume sampling system (CVS).

CVS equipment operation is shown in Fig. 2, where a positive displacement fan draw air into the dilute and mix with the exhaust gases. A small sample is continuously extracted and stored in a bag to be analyzed at the end of the test. An additional sample was taken from the ambient air entering the CVS equipment, to form a gas measurements.

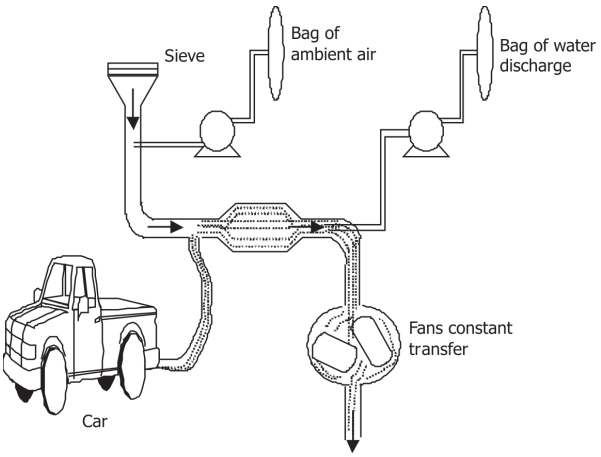

Fig. 2. Measurement pollution petrol car (System CVS)

Constituent exhaust gas during the first six minutes of the emissions testing. When the car is turned on from a cold engine, the exhaust concentration of CO gas in this case is quite high, but decreased when dicok after the first two minutes. Explosion HC emissions occur during the acceleration and deceleration of the car. NO concentration depends on the opening of the valve cover: when the car accelerated, higher NO [Haslett (1978); compare with the data Reksohadiprodjo and Brodjonegoro (1998) in Table 2], but at very low levels when the car slowed.

Steering Cycle Measurement for Emissions Tests

For an emission test (Fig. 3), the car was placed on a chassis dynamometer, starting from a cold engine and driven through a 23-minute driving cycle. Continuously diluted exhaust gas samples stored in plastic bags. The car was then stopped for 10 minutes, started again, and eight and a half minutes of the first round is repeated. The diluted samples are stored in the other bag. Samples of these emissions are measured, the total pollutants in the

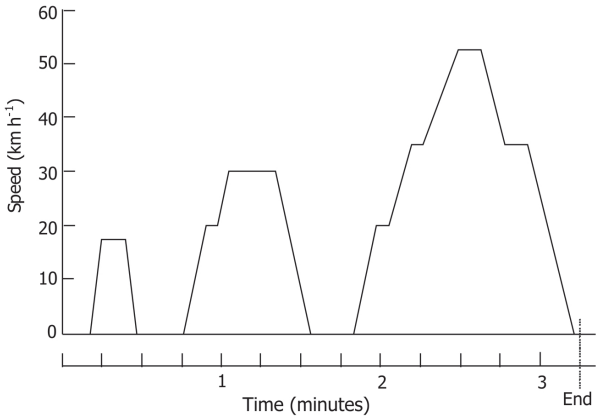

Fig. 3. Steering cycle for emission tests on gasoline cars (Haslett, 1978[14])

exhaust gas on each each flue gas calculated in each bag. Then summed to determine the total emissions for that round.

Cars run four times through this cycle and all discharges unburned HC and CO are released by cars was measured after testing by determining the average of each of these elements in the bag and measure the volume of flue gas with a gas meter. By multiplying the results obtained, it will produce a number of emissions and g per test (Haslett, 1978).

The weakness of the steering cycle procedure for the emissions test, is not NO can easily catch fire. Thus, descriptions of the various emissions testing is not at all complete. Regulations governing all of this testing is very complicated.

Car Engine Smoke Measurement

The combination of the tools through which the exhaust gases to leave the machine called exhaust system. Exhaust system is used to carry the exhaust gases from the engine cylinders through the exhaust or exhaust pipe into the atmosphere by releasing gases or fumes (Haryono, 1989; Chaeruddin, 1993). Furthermore Ryadi (1986) and Ryanto *et al.,* (1985) mentioned, that smoke is actually is a result of what is called photochemical smog, which is considered Tatta (1989) and Basri K. (2003) as an aerosol consisting of solid particles (dust, smoke, moisture, fume and mists) as a result of incomplete combustion, which by Parkins (1974) and Suharsono (1991) interpreted as a mass through the process of dispersion in gas or air media.

Lots of techniques for measuring the smoke machine, but the only technique that involves a complete cycle, is the technique of the U.S. Federal Authorities as shown in Fig. 4.

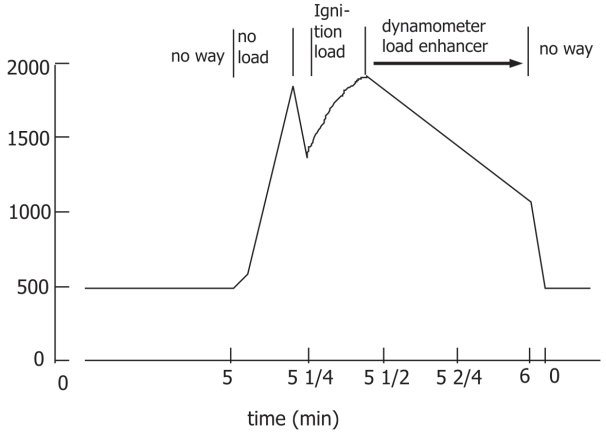

Fig. 4. Certification procedures for diesel engine exhaust fumes (Haslett, 1978[14])

This technique is done on an experimental place, and the machine is turned on and then gassed, no load. Further accelerated more slowly freely over 2,000 rev min^{-1}, and then the dynamometer torque increased slowly, which in turn lowers the speed. Last regarded as lugging mode (Haslett, 1978).

The maximum concentration of smoke that can be achieved during this test is 40% capacity in acceleration mode and 20% in the capacity of lugging mode. ECE method (steering cycle for emission tests) in terms of the measurement of smoke is more simple, and only consists of measurements at constant speed with a full load. Testing ECE also contains a measurement of the smoke-free acceleration, in which the engine is operated with no load full, except moisture flywheels Haslett (1978); see also Parker and Bryant, 1978).

With the above facts and taking into account the color of the exhaust gases, can be expected to occur in the combustion process in the cylinder and can also be measured against the causes and emergency repairs.

The colors of the exhaust gases that need further measurements, are as follows:

1. *Exhaust colour black*

The main causes black exhaust gases is due to the fuel-air mixture is too rich (Arismunandar and Hirao, 1998; see also Chaeruddin, 1993) and contains a lot of CO_2 and the elements of C (Warsowiwoho, 1982), so it can not burn completely. In order to assess objectively the smoke limit, it is necessary to measure quantitatively the level of state smoke. There are three ways that can be used for the measurement of smoke, as shown Arismunandar and Tsuda (2002) in Fig. 5.

Measurement method with filter paper by Bosch (as quoted Arismunandar and Tsuda, 2002), performed by taking samples of exhaust gas is passed through a certain filter paper. Then the adapter is equipped with a light source and photoelectric cells form a ring, the filter paper was exposed. Rays that are not absorbed must be reflected. Current flow is measured by a photoelectric cell with a micro-ampemeter, giving the gauge on the filter paper in the form of a lot of dirt color. The color was then compared with several standard colors available.

In the measurement method according to UTAC and Hartridge (in Arismunandar and Tsuda, 2002), light emitted through the exhaust gases, then the

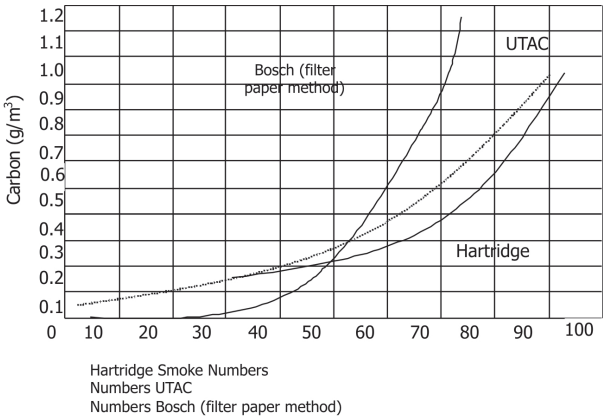

Fig. 5. Comparison between the results of measurements of exhaust gas fumes (Arismunandar and Tsuda, 2002[15])

transmitted light measured photoelectric, where the method UTAC examine all flue gases, while at Hartridge method only checks carried out on some of the gas waste.

Bosch method standardized in Germany, the UK, and so on; methods UTAC in France, was Hartridge method in the UK, and other countries. The method used in the United States PHS. Figures smoke limit for the car engine is not the same for some countries, for example, 2.5 (Bosch) for countries that have tough laws, but in other countries are allowed up to 5.5.

Measurement of automobile engine exhaust done on a particular round and the maximum load. This is done to determine more closely the smoke situation. And for the examination of the causes and emergency repairs are more practical with several possibilities: (a) a clogged air filter, (b) the air valve (choke) closed, (c) broken carburetor; (d) fuel injection is interrupted (technically, see Arismunandar and Hirao, 1998, or Daryanto, 2005).

1. *White exhaust*

Exhaust gas will be white if too much lubricating oil flow into the combustion chamber (Arismunandar and Hirao, 1998), and contains a lot of H_2O and H_2 (Warsowiwoho, 1982). It can be caused by the piston, piston rings, cylinder walls, valves, or roads damaged valve.

In addition, it can also be due to a slight leak in the gasket-cylinder head gasket, so the water can get into the combustion chamber. Water vapor occurs because the heat of combustion will be visible to the outside with the exhaust gases (in white). However, can usually distinguish between the colors white and white steam vapor lubricating oil. White lubricating oil vapors and odors are typical.

Taking the measurements carried out by examining the causes and emergency repairs done when the car is started, but the use of lubricating oil would be wasteful once.

CONCLUSION

With reference to the purposes and on the basis of assessment of automobile pollution measurements, it can be concluded:

1. measurement (test) CARB to car engines is done by calculating the transient-transient and steady driving in mengstimulasi car speed and load conditions continuously in a trial where the machine;
2. CVS measurements with exhaust gas constituent which dilute with clean air volume is greater, the concentration of pollutants in a more minimal sample dilution, and doubling the volume of pollutants to the proper calculation and precision;
3. measurement of emissions test cycle for steering a raw emissions of exhaust emission control work resulted in the development of the engine and guide the major modes of knowledge such emissions; and
4. measurement of car fumes, smoke hartridge either method, UTAC, and the filter paper method possible (Bosch) is performed on a particular round and the maximum load will result in the level/concentration of smoke more carefully, which enables further determine the solution of causes.

REFERENCES

Soerjani, M., Ahmad, R. and Munir, R. 1987. *Environment: Natural Resources and Population in Development*. Jakarta: UI-Press.

Suparmoko, M. 2008. *Natural Resource and Environmental Economics*. Yogyakarta: Inter University Center - Economic Studies, Gadjah Mada University.

Sastrawijaya, A.T. 2009. *Environmental Pollution*. Jakarta: Rineka Cipta.

Alphada, S. 1994. Land Transport - Australian Approach to Environmental Challenges. *Bulletin Amerta*. 3 (9): 7.

Soemarwoto, Otto. 2009. *Indonesia in the Arena of Global Environmental Issues*. Jakarta: PT. Gramedia Pustaka Utama.

Basri K. and Cunha, T. 2004. COHb concentration in the blood motorists. *Journal of the Chemical Review*, 7 (3): 108.

Basri K. 1996. Effect of waste material on the driver's motor vehicle. *Journal Hygiene Company and Safety*, XXIX (4): 9-10.

Ryadi, A.L. Slamet. 1986. *Introduction to Environmental Health & Overview of the Conceptual Dimensions*. Surabaya: Usaha Nasional.

Slamet, Juli Soemirat. 2011. *Environmental Health*. Yogyakarta: Gadjah Mada University Press.

Hardjasoemantri, Koesnadi. 2005. *Environmental Law*. Yogyakarta: Gadjah Mada University Press.

Basri K. 2004. Analysis of the concentration of carbon monoxide (CO) motor vehicle. *Journal Media of Exact*, 5 (1a): 409-410, 414.

Soemarwoto, Otto. 1994. *Ecology, Environment, and Development*. Jakarta: Djambatan.

Kusnoputranto, H. (editor). 1985. *Environmental Health*. Jakarta: Ministry of Education and Culture, University of Indonesia, Faculty of Public Health.

Haslett, R.A. 1978. Road Vehicles. *in* Parker, A. (ed). *Industrial Air Pollution Handbook*. London: McGRAW-HILL Book Company (UK) Limited.

Arismunandar, Wiranto and Tsuda, Korchi. 2002. *Diesel Motor Height Round*. Jakarta: Pradnya Paramita.

Ryanto, Nurkin, B., Palenewan, J.L., Jodjo, H., Suwondo, Delmi, A.,.Renwarin, J., Kleden, P., Rahman, M.N., and Hatta, G.M. 1985. *Basic Ecology I*. Ujung Pandang: Cooperation Agency State Universities Eastern Indonesia.

Reksohadiprodjo, S. and Brodjonegoro, A.B.P. 1998. *Environmental Economics (An Introduction)*. Yogyakarta: BPFE.

Haryono, G. 1989. *Regarding the Practical Description of Motor Fuel*. Semarang: Aneka Ilmu.

Chaeruddin, A. 1993. *Study on Environmental Impact of Work in the Automotive Workshop at Ujung Pandang Municipalities*. Ujung Pandang: Graduate Program, University of Hasanuddin.

Tatta, Usman. 1989. *Analysis of Impact on Air Quality*. Ujung Pandang: Center for Environmental Studies, University of Hasanuddin.

Basri K. 2003. Description the driver of the vehicle smoke. *Bulletin Research and Development*, 4 (2): 28.

Parkins, H.C. 1974. *Air Pollution*. Tokyo: McGRAW-HILL Kogushuka Ltd.

Suharsono, H. 1991. *Methods and Techniques of Air Quality and Noise Analysis*. Bogor: Bogor Academy of Chemical Analysis - Guidance and Training Center, Department of Industry.

Parker, A. and Bryant, P.M. 1978. Legislative Control. *in* Parker, A. (ed). *Industrial Air Pollution Handbook*. London: McGRAW-HILL Book Company (UK) Limited.

Arismunandar, Wiranto and Hirao, Osamu. 1998. *Guidelines for Finding Resources Damage, Caring, and Run Motor Vehicle*. Jakarta: Pradnya Paramita.

Warsowiwoho. 1982. *Fuels, Lubricants, Lubricants Service*. Jakarta: Pradnya Paramita.

Daryanto. 2005. *Car Servicing Techniques*. Jakarta: Rineka Cipta.

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