Analysis of Pb Content in Leaves of Covering Plants in Various Roads in Palembang City

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Analysis of Pb Content in Leaves of Covering Plants in Various Roads in Palembang City

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Abstract

Alternative Decree of the Director General of Oil and Gas No. 3674K/24/DJM/2006 dated March 17, 2006 concerning Standards and Quality (Specifications) of Gasoline-Type Fuel Oil Marketed Domestically where in the attachment to the Specification for Gasoline-Type Fuel Oil RON 91 and RON 95 (Pertamax) still contains Pb of 0.013 grams per liter. The exhaust gas produced by motorized vehicles using leaded fuel emits Pb into the environment and has the potential to be absorbed into the leaf tissue of road shade plants. The aim of this study was to examine the Pb content in the leaves and determine the effect of the Pb content in the ambient air on the Pb content in the leaves of various cover crops on Jalan Raya Palembang City. The research samples were leaves of mahogany, umbrella tree, burmese rosewood, bullet wood tree, and rain tree which were dominant and had similarities on Jl. Soekarno Hatta – Alamsyah Ratu Prawiranegara, Jl. Cabbage. H. Burlian, Jl. Jend. Sudirman, Jl. Jend. Basuki Rahmad, Jl. Jend. R. Soekanto, Jl. Jend. Ahmad Yani. Jl. governor HA. Bastari. Analysis of the Pb content in leaves and air using the AAS (Atomic Absorption Spectrophotometer) method. The results of the study found that the highest Pb content in the leaves of the Mahogany plant was on Jl. Jend. Basuki Rahmad 0.112 mg/kg while the lowest was on Jl. governor HA. Bastari <0.081 mg/kg. Pb content in umbrella tree plants in all roads < 0.081 mg/kg. The highest Pb content in burmese rosewood plants is on Jl. Jend. Basuki Rahmad 0.116 mg/kg while the lowest was on Jl. governor HA. Bastari <0.081 mg/kg. The highest Pb content in bullet wood tree Jl. Jend. Basuki Rahmad 0.099 mg/kg while the lowest is on Jl. governor HA. Bastari <0.081 mg/kg. The highest Pb content in rain tree is on Jl. Jend. Basuki Rahmad 0.089 mg/kg while the lowest is on Jl. governor HA. Bastari <0.081 mg/kg. The highest Pb content in ambient air is on Jl. Jend. Basuki Rahmad 0.06 µg/Nm3 while the lowest is on Jl. Jend. R. Soekarno. The Pb content in the ambient air affects the Pb content in the leaves.

Keywords : Pb content in leaves, Covering Plants, South Sumatra.

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1. Introduction

In Indonesia, the Government has issued strict regulations against the use of leaded fuel. This can be seen in the regulations issued by the Ministry of Energy and Mineral Resources (ESDM) through Decree of the Director General of Oil and Gas no 0486.K/10/ DJM.S/ 2017 concerning Specifications for Gasoline Type 90 Fuel Oil for Domestic Market. In the attachment to the quality standards, it is indicated that Ron 90 fuel oil is a fuel that does not contain Lead (Pb). However, ESDM Regulation No. 0487.K/10/DJM.S/2017 is only devoted to the RON 90 quality standard for fuel oil. As for fuel above RON 91 or RON 92 (Pertamax), it still refers to the Decree of the Director General of Oil and Gas No. 3674K / 24/ DJM/ 2006 dated 17 March 2006 concerning Specifications for Gasoline Fuel Oil Marketed Domestically where in the attachment to the Specification for Fuel Oil for Gasoline Type RON 91 and specifically RON 95 (Pertamax) there is still Pb of 0.013 grams per liter. And until now, Pertamax is

still available and is a good choice of fuel for motorized vehicles.

In KepMen LH No. Kep.02/Men-KLH/1988, the definition of air pollution is the entry or inclusion of substances, living things, energy and or other components into the air and changes in air quality by human activities or natural processes that cause air quality to decrease [13]. Then based on Minister of Environment and Forestry Regulation number 11 of 2021 the definition of environmental pollution is the entry of substances, energy and or other components into the ambient air by human activities so that they exceed the ambient air quality standards.

An example of air pollution is air pollution caused by heavy metals in the form of lead (Pb) which are produced from motorized vehicles. According to research from the Environment Project Agency, approximately 25% of the heavy metal Lead (Pb) remains in vehicle engines while 75% will exit into the environment and will pollute the air as smoke coming from the exhaust.

Bioaccumulation of Pb in plants occurs in plants that grow on the roadside where the traffic is busy with motorized vehicles [11]. The ability of plants to adapt to different environments causes different levels of sensitivity in plants. The sensitivity of this plant is closely related to its ability to absorb and accumulate heavy metals. One method for observing or monitoring air pollution is to use plants. Therefore plants are good bio indicators for pollution [1].

In the Periodic System, Lead (Pb) enters the IVA heavy metal group. It has atomic number 82 and atomic weight 207.2. Lead is solid at room temperature, has a melting point of 327.4 0C and has a specific gravity of 11.4/l or 11.34 gr/cm3. Pb is almost not found in nature in a free state but is compounded with other molecules, for example in the form of PbBr2 and $PbCl_2$ [14]. Pb metal is usually used as a packing material, basic material for water pipes, household appliances and various kinds of jewelry. The heavy metal Pb is commonly used as a coloring agent in various industries such as the cosmetic industry and the ceramics industry, most of which are produced from the equipment used in everyday life. In the form of air particles enter the body through breathing or food exposed to Pb metal. Pb metal will accumulate in the body for a long time, while the process of removing it occurs in a very long time.

The effects on health depend on the concentration of exposure. Pb has a toxic effect on the brain, kidneys, reproductive system [15]. It can even exacerbate intellectual function, namely decreased IQ and brain damage [8], [10]. Other symptoms such as poisoning that can be seen include dizziness, loss of appetite, headache, lack of red blood cells, insomnia, lack of enthusiasm. And changing the shape and size of red blood cells.

Various types of trees have been known to be excellent pollutant absorbers, including Nutmeg, Tamarind and Johar, Damar, Mahogany, Jamuju, Nutmeg, Tamarind and Johar. Sulistiana stated that Puring leaves are plants that are able to absorb pollutants better than other plants in absorbing lead (Pb) from the air, namely 44.33μg/g [5].

The part of the plant that is sensitive and that comes in contact with pollutant sources is the leaf [3]. The indicator of air pollution is the leaves, characterized by physical and chemical changes in the leaves. Physical changes in macroscopic and microscopic forms. According to Siregar [12] macroscopically plant leaves experience chlorosis and necrosis, while microscopically plant leaves experience changes in the size and number of stomata on the leaves. Chemical changes seen in the accumulation and content of elements in the leaves. Even so, the physical changes that occur in the leaves are not enough to determine the plant as an indicator of air pollution, especially Pb, because there are many other factors that cause changes in the physical appearance of plants. Therefore it is necessary to carry out laboratory scale analysis to determine the accumulation or amount of Pb content in plant leaves using the AAS (Atomic Absorption Spectrophotometer) method [6].

Plant leaves have the ability to bioabsorb and accumulate pollutants or contaminants [4]. The Pb absorption process is highly dependent on the dust absorption process carried out by the leaves. Leaves are vital organs and organs that are sensitive to the environment compared to other plant organs. On the leaf surface there is a leaf mouth or stomata. The leaf mouth or stomata is a flat-shaped layer which is part of the epidermal tissue with transparent cells and has a waxy cuticle [9].

Stomata are found on the underside of the leaves and also on the stems, especially in spice plants. Stomata are the entry point for pollutants in the leaves. Stomata are the parts of the plant where pollutant absorption takes place and directly interacts with the mesophyll tissue [12].

Leaves consist of epidermal tissue, mesophyll, and vascular bundles. If pollutants enter the mesophyll in large quantities, it can cause the process of photosynthesis to be disrupted [12].

2. Materials and Methods

Plant Materials

Based on observations of the types of cover plants on several roads in the city of Palembang, there are similarities in the types of trees on different roads. There are five similar types of trees on several roads in the city of Palembang, namely mahogany, umbrella tree, burmese rosewood, bullet wood tree, and rain tree. The leaves of these plants will be analyzed in the laboratory to find out how much heavy metal Pb is in the leaves of these trees. Mahogany, umbrella tree, burmese rosewood, bullet wood tree, and rain tree leaves of the plant were taken from several roads in Palembang, namely Alamsyah Ratu Prawiranegara

and Sokarno Hatta road, Kol. H. Burlian road, Jend. Sudirman road, Jend. Basuki Rachmat road, Jend. R. Soekamto road, Jend. Ahmad Yani road, Gub. H.A Bastari road.

Methods

Analysis of Heavy Metals (Pb) in Leaves

Sample leaves were taken from the specified plants. Each leaf is taken from a stem which has relatively the same height and stem diameter. Leaf samples were taken from leaves that were directly facing the source of Pb pollutant in the air, and were not covered by other leaves. The leaves taken are mature enough leaves, have opened perfectly, are green in color. Leaf samples were taken as much as 100 grams from each sample.

Analysis of Heavy Metals (Pb) in the Air

The Pb content in the air is closely related to the dust in the ambient [7]. The air sampling method is a high volume sampler (HVS). When testing the HVS, the test is turned on for 24 hours. Monitor and record air flow rate and temperature hourly, ensuring air flow rate is between 1.1 m3/min to 1.7 m3/min.

3. Results and Discussion

The results showed that the value of the Pb content in the leaves on various roads in the city of Palembang varied greatly [16] according to the type of plant and the roads.

Table 1. Results of Pb Analysis in Mahogany Leaves

Road	Pb in leaves (mg/kg)	Heavy metal (Pb) in the air (µg/Nm3)
Alamsyah Ratu Prawiranegara Road and Soekarno Hatta Road	0.095	0.03
Kol. H. Burlian Road	0.087	0.03
Jend. Sudirman Road	0.097	0.04
Jend. Basuki Rachmat Road	0.112	0.06
Jend. R. Soekamto Road	0.082	0.02
Jend. Ahmad Yani Road	0.087	0.03
Gub. H.A Bastari Road	< 0.081	0.03

Table 2. Pb Analysis Results in Umbrella Tree Leaves

Road	Pb in leaves (mg/kg)	Heavy metal (Pb) in the air (µg/Nm3)
Alamsyah Ratu Prawiranegara Road and Soekarno Hatta Road	< 0.081	0.03
Kol. H. Burlian Road	< 0.081	0.03
Jend. Sudirman Road	< 0.081	0.04
Jend. Basuki Rachmat Road	< 0.081	0.06
Jend. R. Soekamto Road	< 0.081	0.02
Jend. Ahmad Yani Road	< 0.081	0.03
Gub. H.A Bastari Road	< 0.081	0.03

Table 3. Results of Pb Analysis of Burmese Rosewood Leaves

Road	Pb in leaves (mg/kg)	Heavy metal (Pb) in the air (µg/Nm3)
Alamsyah Ratu Prawiranegara Road and Soekarno Hatta Road	0.095	0.03
Kol. H. Burlian Road	0.095	0.03
Jend. Sudirman Road	0.097	0.04
Jend. Basuki Rachmat Road	0.116	0.06
Jend. R. Soekamto Road	0.082	0.02
Jend. Ahmad Yani Road	0.087	0.03
Gub. H.A Bastari Road	< 0.081	0.03

Table 4. Pb Analysis Results in Bullet Wood Tree Leaves

Road	Pb in leaves (mg/kg)	Heavy metal (Pb) in the air (µg/Nm3)
Alamsyah Ratu Prawiranegara Road and Soekarno Hatta Road	0.095	0.03
Kol. H. Burlian Road	0.091	0.03
Jend. Sudirman Road	0.096	0.04
Jend. Basuki Rachmat Road	0.099	0.06
Jend. R. Soekamto Road	< 0.081	0.02
Jend. Ahmad Yani Road	< 0.081	0.03
Gub. H.A Bastari Road	< 0.081	0.03

Table 5. Pb Analysis Results in Rain Tree Leaves

Road	Pb in leaves (mg/kg)	Heavy metal (Pb) in the air (µg/Nm3)
Alamsyah Ratu Prawiranegara Road and Soekarno Hatta Road	0.084	0.03
Kol. H. Burlian Road	0.082	0.03
Jend. Sudirman Road	0.087	0.04
Jend. Basuki Rachmat Road	0.089	0.06
Jend. R. Soekamto Road	< 0.081	0.02
Jend. Ahmad Yani Road	< 0.081	0.03
Gub. H.A Bastari Road	< 0.081	0.03

From the results of the assessment it can be concluded that the Pb content in the air affects the Pb content in the leaves [2].

4. Conclusion

From the results of the analysis of Pb content in various plants on various roads in the city of Palembang, conclusions can be drawn, including:

1. There is a Pb content in plants on various Palembang city roads with values ranging from <0.081 mg/kg – 0.116 mg/kg and there is a Pb content in ambient air on various Palembang city roads with values ranging: 0.02 µg/Nm^3– 0.06 µg/Nm^3
2. The Pb content in the ambient air of various roads in Palembang City affects the Pb content in the leaves. The greater the Pb value in ambient air, the greater the Pb content in the leaves.

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References

[1] Andika Wijaya K. (2009). Penggunaan Tumbuhan Sebagai Bioindikator Dalam Pemantauan Pencemaran Uudara. 41.

[2] Azmat. R.. Haider. S.. Nasreen. H.. Aziz. F.. & Riaz. M. (2009). A Viable Alternative Mechanism In Adapting the Plants to Heavy Metal Environment. Pakistan Journal of Botany. 41(6). 2729–2738.

[3] Haryanto. Mukaromah. I. Firdaus. F. D. & Hernahadini. (2020). Struktur Daun Tanaman Fitoremidiasi Hanjuang (Cordyline sp) yang Terpapar Logam Berat TimbaL (PB II). Journal of Science. Technology and Enterpreneurship (In Press). Pb II. 1–6.

[4] Hendrasarie. N. (2007). Kajian Efektifitas Tanaman Dalam Menjerap Kandungan Pb Di Udara. Jurnal Rekayasa Perencanaan. 3(2). 1–15.

[5] Hindratmo. B.. Junaidi. E.. Fauzi. R.. Hidayat. M. Y.. & Masitoh. S. (2019). Kemampuan 11 (sebelas) Tanaman Yang Dominan Pada RTH (Ruang Terbuka Hijau) Dalam Menyerap Logam Berat (Pb). Jurnal Ecolab. 13(1). 29–38.

[6] Istiaroh. P. D. Nana Kariada Tri Martuti. & Bodijanto. F. P. M. H. (2014). Uji Kandungan Timbal (Pb) dalam Daun Tanaman Peneduh di Jalan Protokol Kota Semarang. Biosaintifika: Journal of Biology & Biology Education. 6(1). 60–66.

[7] Kameswaran. S.. Gunavathi. Y.. & Krishna. P. G. (2019). Dust Pollution and Its Influence on Vegetation – a Critical Analysis. Research Journal of Life Sciences. Bioinformatics. Pharmaceutical and Chemical Sciences. 5(1). 341–363.

[8] Kaya. G.. Okumus. N.. & Yaman. M. (2010). Lead. Cadmium and Coper concentrations in leaves of Nerium oleander L . AND Robinia pseudoacacia L . as Biomonitors of Atmospheric Polution. 19(4). 669–675.

[9] Pallavi Sharma and Rama Shanker Dubey. Lead Toxicity in Plants

[10] Reffiane. F.. Arifin. M. N.. & Santoso. B. (2012). Dampat Kandungan Timbal (Pb) Dalam Udara Terhadap Kecerdasan Anak Sekolah Dasar.

[11] Sihaloho. A. A.. Krisdianto. & Adriani. M. (2020). Prosiding Seminar Nasional Simbiosis V. Madiun. 28 Oktober 2020 p-ISSN : 9772599121008 e-ISSN : 9772613950003. 331–338.

[12] Siregar. E. B. M. (2005). Pencemaran Udara. Respon Tanaman dan Pengaruhnya Terhadap Manusia. 2. 18.

[13] Siregar. E. B. M. (2017). Hutan-edi batara13. Pencemaran Udara. Respon Tanaman Dan Pengaruhnya Pada Manusia.

[14] Smith. W. H. (2012). Journal of the Air Pollution Control Association Lead Contamination of the Roadside Ecosystem 2470 (1976).

[15] Suryatini. K. Y.. Gusti. I.. & Rai. A. (2018). Logam Berat Timbal (Pb) dan Efeknya pada Sistem Reproduksi. Emasains. 7(1). 1.

[16] Zhang. J.. Guan. Y.. Lin. Q.. Wang. Y.. Wu. B.. Liu. X.. Wang. B.. & Xia. D. (2022). Spatiotemporal Differences and Ecological Risk Assessment of Heavy Metal Pollution of Roadside Plant Leaves in Baoji City . China.

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