International Journal of Health Science & Medical Research

Vol 2. No. 2 (2023) : August

ANALYSIS OF AMBIENT AIR QUALITY AND GENSET EMISSIONS AT PT. REKSO NASIONAL FOOD (MC. DONALDS) GORONTALO CITY

Ekawaty Prasetya[1], Andi Makkulawu[2]
[1]Department of Public Health, Faculty Of Sports and Health, Gorontalo State University, Indonesia
[2]Department of Pharmacy, Faculty of Sports and Health, Gorontalo State University, Indonesia
email: ekawaty.prasetya@ung.ac.id,

Abstract

Air, as one of the components of the environment, is the most essential requirement in supporting life. Metabolism in the bodies of living things cannot occur without air oxygen. Air can be grouped into outdoor air and indoor air. Indoor air quality dramatically affects human health because almost 90% of human life is indoors. Indoor air quality is a problem that needs attention because it will affect human health. The emergence of poor indoor air quality is generally caused by several things, namely lack of air ventilation (52%), sources of indoor pollution (16%), outdoor pollution (10%), microbes (5%), and building materials (4 %).), others (13%). Sources of air pollution can also come from household activities, starting from the kitchen in the form of smoke. According to several studies, air pollution from kitchens contributes significantly to ARI. The novelty of this research is that it examines ambient air quality and generator emissions. The study aimed to analyze Ambient Air Quality and Generator Emissions at PT Rekso National Foods (MC Donalds) in Gorontalo City. The results showed that the surrounding air quality still met the requirements, both CO, TSP, PM10, PM 2.5 and generator emissions. However, the noise factor still does not meet the threshold standard. This study concludes that all variables still meet predetermined threshold values except for the noise variable, which exceeds the threshold value.

Keywords: *Indoor air quality; Generator emissions.*

INTRODUCTION

Air, as one of the environmental components, is essential to sustain life. Metabolism in the bodies of living things cannot occur without air oxygen. Besides oxygen, other substances are contained in the air, namely carbon monoxide, carbon dioxide, formaldehyde, fungi, viruses, etc. Human activities can cause increased concentrations of importance in the air. Air can be grouped into outdoor air and indoor air (1).

Air, which contains a certain amount of oxygen, is an essential component for life, both humans and other living things. Air is a mixture of gases, consisting of about 78% Nitrogen, 20% Oxygen, 0.93% Argon, 0.03% Carbon Dioxide (CO2), and the rest consists of Neon (Ne), Helium (He),

Received: June 14th, 2023; 1st Revised July 24th, 2023; 2nd Revised August 29th, 2023; Accepted for Publication : August 30th, 2023

Methane (CH4) and Hydrogen (H2). Air is said to be "normal" and can support human life if its composition is as mentioned above. Meanwhile, if there is the addition of other gases that cause disturbances and changes in the design, then it is said that the air has been polluted/polluted (2).

According to Rahayu (2019), Air pollution is a health problem for the world. Air pollution, apart from directly impacting human/individual health, also has an indirect impact on health. According to the Ministry of Environment, in 2010, 5 million Indonesians (57.8%) experienced health problems due to exposure to air pollution. WHO notes that around 7 million people in 2012 died due to air pollution that enters through breathing. Most of the breath that is inhaled during breathing will enter the lungs (3).

The transportation sector's air pollution problem that needs serious attention is motorized vehicles on land. Motorized vehicles have become the main contributor to air pollution, especially in Indonesia. Burning fuel oil from motorized vehicles emits pollutant elements and compounds into the air, such as total suspended particulate solids (TSP), CO, total hydrocarbons, NOX, and SOX. The exhaust gas from these motorized vehicles can insulate the earth, which becomes hot. It can cause health problems if it exceeds the threshold value (4).

Examples of air pollutants that can cause health problems contained in motorized vehicle exhaust are Carbon Monoxide (CO) gas and coarse dust particles or Total Suspended Particulate (TSP). Motorized vehicles produce significant sources of air pollution, where nearly 60% of the pollutants produced consist of CO2 gas. Carbon Monoxide in the air poses a dangerous risk if inhaled because the position of oxygen and hemoglobin will be replaced by Carbon Monoxide gas (5).

Carbon monoxide gas can cause chronic poisoning if humans have been exposed to it for a long time with low or moderate levels. In gasoline, every 5 liters can produce 1-1.5 kg of Carbon Monoxide, which can pollute the air. This can cause hemoglobin to lose its ability to bind oxygen so that blood decreases by 15% or blood loss by 0.5 liters (6).

Restaurants and restaurants are one of the catering services whose scope of activities is to provide food and drinks for the public interest. Restaurant sanitation is an effort to maintain cleanliness and health in a restaurant so that customers can eat safely and comfortably. Restaurant sanitation includes various things, such as cleaning tables, chairs, and cutlery after every customer leaves the restaurant, keeping food ingredients clean, keeping the kitchen and food storage area clean, and ensuring that everyone working in the restaurant adheres to established hygiene standards. Restaurant sanitation is essential to prevent the spread of disease and infection and maintain the quality of the food offered. Restaurant sanitation is a deliberate behavior for a culture of clean living, intended to prevent humans from coming into contact with dirt in the hope that their efforts will maintain and improve human health.

MC Donald is a fast food restaurant in the city of Gorontalo, which is a place where many people gather to eat or rest. Of course, the restaurant must also pay attention to hygiene requirements. Meanwhile, what is meant by a restaurant is a type of food service business located in part or all of a permanent building equipped with tools and equipment for making, storing, serving, and selling food and drinks to the public at the place of business. Because its function is vital to impact public health, it is deemed necessary to conduct a study on "Ambient Air Quality Analysis and Genset Emissions at PT Rekso National Foods (MC Donalds) in Gorontalo City."

RESEARCH METHOD

This research was conducted at the fast food restaurant PT. Rekso National Food (McDonald's) is located on Jl. HB. Jassin City of Gorontalo. The time of the study was carried out in April 2023. This quantitative research was carried out using a descriptive approach, namely by measuring ambient air quality, presenting the data obtained in tables, and describing them in a risk assessment. In this study, two parameters would be measured. Namely, CO was measured with an Air Quality Detector, and TSP, PM10, and PM2.5 were measured using an Aerosol Mass Monitor 831. At each location, a measurement will be carried out at 1 point for each variable, namely at 13.00

- 14.00. 00 WITA because at that hour it is a busy time for vehicles. For determining points at each location by SNI 19-7119.6-2005.

RESULTS AND DISCUSSION

Result

The results of measurements of ambient air quality, noise, and generator emissions with the McDonald's HB Jassin sampling location, Gorontalo City, with the following types of Ambien Air samples

1. Ambient Air

According to PP No. 41 of 1999 concerning air pollution control, ambient air is free air on the earth's surface in the troposphere, which is within the jurisdiction of the Republic of Indonesia and is needed and affects the health of humans, living things, and other elements of the environment. Hazardous elements that have been measured from ambient air are Carbon Monoxide (CO), Dust Particulate < 100 µm (TSP), Dust Particulate < 10 µm (PM10), Dust Particulate < 2.5 µm (PM2.5). If the air exceeds the quality standard, it will damage the surrounding environment and potentially disrupt the surrounding community's health (7).

a) Carbon Monoxide (CO)

Based on the air quality measurement results, Carbon Monoxide (CO), located at McDonald's HB Jassin, Gorontalo City, obtained a measurement result of 8018 µg/m3 with a quality standard of 10000. This indicates that the result still meets the middle or is classified as good.

b) Particulate Dust < 100 µm (TSP)

The results of measurements of dust particulates <100 µm (TSP), which were carried out on June 19, 2023, located at McDonald's HB Jassin, Gorontalo City, were 92.1, and the quality standard was 230 with units of µg/m3. This shows that the results found meet the criteria.

c) Particulate Dust < 10 µm (PM_{10})

Based on the measurements that were taken on June 19, 2023, located at McDonald's HB Jassin, City of Gorontalo, the measurement results were obtained from dust particulates < 10 µm (PM10), namely 30.3 µg/m3 with a quality standard of 75. This shows that the measurement results meet the criteria.

d) Particulate Dust < 2,5 µm ($PM_{2,5}$)

The results of measuring dust particulates < 2.5 µm (PM2.5) obtained show that the results meet the standard with the result value obtained is 9.11, and the quality standard is 55 with units of µg/m3.

2. Noise

Noise is unwanted sound from a business or activity at a certain level and at a particular time, which can cause disturbances to human health and the comfort of the surrounding environment. After measurements were taken at McDonald's HB Jassin, Gorontalo City, on June 19, 2023, a minimum noise value of 62.1 dB (A) was obtained with a maximum noise of 80.8 dB (A) and LAeq of 77.1 dB (A) with a quality standard value of 70 dB. This shows that the noise around McDonald's HB Jassin, Gorontalo City, does not meet the standards.

3. Generator Emissions

Generator emission measurements have been carried out, in this case, Carbon Monoxide (CO) located at McDonald's HB Jassin, Gorontalo City, showing the results obtained were 159.24 mg/Nm3 with a quality standard of 170. It can be seen that the results meet the criteria.

Discussion

1. Ambient Air

a) Carbon Monoxide (CO)

Based on the air quality measurement results, Carbon Monoxide (CO), located at McDonald's HB Jassin, Gorontalo City, obtained a measurement result of 8018 µg/m3 with a quality standard of 10000. This indicates that the results still meet the standard or are classified as good.

According to the Regulation of the Ministry of Environment No. 21 of 2008, it is essential to monitor air quality as a consequence for society, large industries, and activities that emit air pollutants and predict the impact of polluting air emissions on the environment. Monitoring air quality, especially ambient air, is necessary to carry out regulations that have been stipulated by the Unitary State of the Republic of Indonesia (Environmental Impact Analysis, Environmental Management Efforts, and Environmental Monitoring Efforts) (8).

Carbon monoxide (CO) is a colorless, odorless, toxic gas. CO is generally sourced from transportation activities, mainly due to incomplete combustion. CO is usually mixed with other types of gases that smell so that they can be inhaled without realizing it (9). CO has an affinity for hemoglobin 250-300 times stronger than the affinity for oxygen, and CO will form a carboxyhemoglobin bond, thus impacting oxygen distribution throughout the body's tissues. Exposure to CO in high concentrations in humans can cause shortness of breath to death (10).

This research differs from Muhammad in 2019, which stated that the CO value showed an increasing trend, but the value obtained was still below the set quality standard. Compared to the results of CO measurements in five Indonesian metropolitan cities (Jakarta, Bandung, Medan, Surabaya, and Semarang), the CO value in Lhokseumawe City is lower than in these five metropolitan cities (11). The highest increase in CO value was found at station one, which was 2,542 µg/Nm3 over four years. Based on the predicted value, if handling is not carried out in the next 22.9 years, the CO value will exceed the quality standard.

So the author assumes that the results of the analysis are influenced by the increasing number of vehicles where in the morning, this road has high activity and is traversed by various types of vehicles such as motorcycles, public transportation, buses, and trucks, as well as different other types of four-wheeled. Vehicles are the primary pollutant of carbon monoxide. This is confirmed by the theory that In urban areas, it is observed that there is a relatively high concentration of carbon monoxide during rush hour, both in the morning and in the evening. It is estimated that for every liter of fuel consumed by a vehicle, about 370 g of carbon monoxide is released as vehicle exhaust (12).

b) Particulate Dust < 100 µm (TSP)

The results of measurements of dust particulates <100 µm (TSP), which were carried out on June 19, 2023, located at McDonald's HB Jassin, Gorontalo City, were 92.1, and the quality standard was

230 with units of µg/m3. This shows that the results found meet the criteria. In general, the problem of PM100 emissions has not yet reached significant proportions, even though the impacts are dangerous. This is reflected in the lack of public awareness to reduce or protect themselves from these emissions in their daily lives.

The health effects of PM emissions will vary depending on their size. In general, smaller-sized particles tend to be more harmful to health. The reason is that particles with sizes > 10 µm can be filtered before they enter the respiratory tract and cause health problems. Particles with smaller sizes can enter the trachea and even deeper into the respiratory system. In addition, the danger to particulates is also caused by the heavy metals and organic compounds they carry. This can trigger the accumulation of heavy metals that can interfere with the nervous system and lead to cancer (13).

However, Wulandari et al. (2016) stated that although PM concentrations are still below the quality standard, it does not free the entire population from the risk of respiratory tract disorders. This is reinforced by Saputra's research (2016), which states that people who inhale dust particles exceeding the reference dose daily have a significant relationship with complaints of respiratory disorders. The data is by references, which say that dust irritates the skin, eyes, and respiratory system (14).

The author can assume that the length of stay of the exposed and unexposed groups is similar in a dusty work environment. The size of stay can affect and reduce lung function capacity in employees and other health complaints.

c) Particulate Dust < 10 µm (PM_{10})

Based on the measurements that were taken on June 19, 2023, located at McDonald's HB Jassin, City of Gorontalo, the measurement results were obtained from dust particulates < 10 µm (PM10), namely 30.3 µg/m3 with a quality standard of 75. This shows that the measurement results meet the criteria.

Meteorological factors such as wind speed affect the concentration of PM10 in the air. The higher the wind speed, the lower the pollutant concentration at a specific location. This can happen because the high wind speed causes the dust around the sampling location to move in the air and be caught by the sampling tool, and several motorized vehicles pass by when sampling. High wind speeds can cause dust and particles to be easily lifted and carried away, so it is assumed that the PM10 concentration is high at point 3 because the sampling tool raises and detects dust (15).

d) Particulate Dust < 2,5 µm ($PM_{2,5}$)

The results of measuring dust particulates < 2.5 µm (PM2.5) obtained show that the results meet the standard with the result value obtained is 9.11, and the quality standard is 55 with units of µg/m3.

Particulate Matter (PM) is a type of dangerous pollutant of various sizes, which can result in high mortality due to exposure to air pollution (16).

Particulate matter in the air is not only small particles capable of infiltrating the human body system. Often, these particles contain harmful compounds such as heavy metals, which increase the risk of damage to trees and reduce the photosynthetic ability of plants so that they indirectly inhibit their growth. However, the presence of plants is seen as an effective way to reduce the amount of particulate matter in the air (17).

Gorontalo City is one of the areas with increased transportation, especially two-wheeled motorized vehicles, in the last 5 years (2016-2020). This increase impacts traffic jams and air pollution due to transportation activities. The increase in transportation activities is in line with trading activities in the City of Gorontalo, which has become one of the problems in the City of Gorontalo. More and more street vendors are selling on the road, causing traffic jams and impacting the health of street vendors due to direct exposure to vehicle fumes.

The concentration of dust particles can be affected by air temperature conditions. High air temperature causes the air to become more tenuous so that the dust concentration is lower. On the

other hand, at low temperatures, the air becomes denser so that the concentration of dust in the atmosphere appears to be higher (18).

2. Noise

Noise is unwanted sound from a business or activity at a certain level and at a particular time, which can cause disturbances to human health and the comfort of the surrounding environment. After measurements were taken at McDonald's HB Jassin, Gorontalo City, on June 19, 2023, a minimum noise value of 62.1 dB (A) was obtained with a maximum noise of 80.8 dB (A) and LAeq of 77.1 dB (A) with a quality standard value of 70 dB. This shows that the noise around McDonald's HB Jassin, Gorontalo City, does not meet the standards.

Noise is a sound that consists of several frequencies with different sound levels. The most significant contributor to noise comes from transportation and industrial activities. The influence of noise can have side effects in the form of distractions that can affect comfort and health. Exposure to noise for a long time with high exposure concentrations will put the risk of hearing damage (19). Research conducted by Setiya et al, (2016). explained that noise affects the comfort of student learning (5). The noise value is increasing and has passed the established quality standards. According to Ikron (2005) and Hidayat (2012), noise values between 55-65 dB can affect the comfort of carrying out worship activities in the mosque, such as disturbing the solemnity and comfort of praying and praying and have a significant effect on other religious activities carried out in places of worship. Noise also affects psychological disorders such as stress, loss of concentration, and other disturbances.

Several factors, including the number of residents, motorized vehicles, and large industries in the research station, influence noise. The highest population number is at station one, while the highest population growth rate is at station two. Factors influencing population density include productive areas, government centers, and adequate infrastructure such as educational facilities, transportation, communication, entertainment, and information. The factors causing high population growth in stage two are strategic location, high birth rate, and better employment opportunities (20).

Researchers assume that the activities of residents are also one of the contributing factors to pollution in the ambient air. According to Mayasari, residents' activities that can increase the value of air pollution include burning garbage, cooking using firewood, opening new agricultural land by burning forests, and noise caused by entertainment and the sound of uncontrolled vehicles. Olenya Other efforts that can be made to minimize the value of pollution are conducting regular emission tests on motorized vehicles, conducting socialization related to the impact of air pollution, and managing green open spaces.

3. Generator Emissions

Generator emission measurements have been carried out, in this case, Carbon Monoxide (CO) located at McDonald's HB Jassin, Gorontalo City, showing the results obtained were 159.24 mg/Nm3 with a quality standard of 170. It can be seen that the results meet the criteria.

Air is an environmental component that is susceptible to quality degradation. This decrease significantly impacts life, considering the vital role of air. Air pollution is generally defined as a wide range of compounds, chemical mixtures, particulate materials, or biological materials in ambient air that can threaten and inconvenience human life and other living things (21).

Air pollution was linked to cancer, respiratory diseases, adverse pregnancy outcomes, infertility, cardiovascular diseases, stroke, cognitive decline, and other adverse medical conditions. Nearly 90% of air-pollution-related deaths occur in low- and middle-income countries, with almost 2 out of 3 occurring in South-East Asia and Western Pacific regions. The problem of outdoor pollution is not a new one. Still, the rapid urbanization, particularly in Asia, made the air pollution problem more visible and its health burden more tangible. Bibliometric analysis is the application of statistical methods on published literature to analyze publication trends with time and to shed light on influential researchers, countries, and institutions in the field (22).

Air is an environmental component that is susceptible to quality degradation. This decrease significantly impacts life, considering the vital role of air. Air pollution is generally defined as the

presence of a wide range of compounds, chemical mixtures, particulate materials, or biological materials in ambient air that can threaten and inconvenience human life and other living things.

Researchers assume that air quality modeling, its relation to the emission potential of each activity, emission distribution, and identification of potential emission reduction actions.

CONCLUSION

Overall the variables studied are still within the set threshold value, except for the noise variable that exceeds the set threshold.

ACKNOWLEDGE

Thank you to those who have helped in this research so the study can run smoothly.

REFERENCE

1. Diah Putri Lestiani dan Eram Tunggul Pawenang. Physical Environment that Affects the Presence of Aspergillus sp. in the Library Room. Higeia J Public Heal Res Dev. 2018;1(3):84–94.
2. Ma'rufi I. Analisis Risiko Kesehatan Lingkungan (SO2, H2S, NO2 dan TSP) Akibat Transportasi Kendaraan Bermotor di Kota Surabaya. MPI (Media Pharm Indones [Internet]. 2018 Jan 23;1(4):189–96. Available from: https://journal.ubaya.ac.id/index.php/MPI/article/view/770
3. Prasetya E, Jusuf H. Lead Content in Hair and Health Problems at Workers in SPBU (Gas Station) of Gorontalo City in 2017 . Public Health Departement , State University of Gorontalo , Gorontalo , Indonesia. Int J Sci Basic Appl Res. 2017;36(2):302–7.
4. Khamidah S. Analisis Risiko Kesehatan Lingkungan Dengan Risk Agent Total Suspended Particulate (TSP) Pada Pekerja Sentra Industri Pengasapan Ikan Bandarharjo Kota Semarang. 2019;32.
5. Rahayu TA. Analisis risiko kesehatan lingkungan paparan co pada operator pengisi bahan bakar di spbu kota palembang tahun 2019 skripsi. 2019;
6. Falahdina A. Analisis Risiko Kesehatan Lingkungan Pajanan PM 2,5 pada Pedagang Tetap di Terminal Kampung Rambutan. In: Skripsi [Internet]. 2017. p. 1–10. Available from: http://jk3l.fkm.unand.ac.id/index.php/jk3l/article/view/13
7. Kurniawati RTD, Rahmawati R,

Wilandari Y. Penglompokan Kualitas Udara Ambien Menurut Kota/Kabupaten Di Jawa Tengan Dengan Metode Klaster. J Gaussian [Internet]. 2015;4(2):393–402. Available from: https://doi.org/10.14710/j.gauss.v4i2.8588

8. Gunawan M, Asyahira R, M Sidjabat F. Evaluation of Ambient Air Quality Monitoring System in Jakarta: A Literatur Review. J Serambi Eng [Internet]. 2019 Dec 17;5(1). Available from: http://ojs.serambimekkah.ac.id/index.php/jse/article/view/842 – 851
9. Rose JJ, Wang L, Xu Q, McTiernan CF, Shiva S, Tejero J, et al. Carbon Monoxide Poisoning: Pathogenesis, Management, and Future Directions of Therapy. Am J Respir Crit Care Med [Internet]. 2017 Mar 1;195(5):596–606. Available from: https://www.atsjournals.org/doi/10.1164/rccm.201606-1275CI
10. Goldstein SR, Liu C, Safo MK, Nakagawa A, Zapol WM, Winkler JD. Design, Synthesis, and Biological Evaluation of Allosteric Effectors That Enhance CO Release from Carboxyhemoglobin. ACS Med Chem Lett [Internet]. 2018 Jul 12;9(7):714–8. Available from: https://pubs.acs.org/doi/10.1021/acsmedchemlett.8b00166
11. Fahmi MH. Analysis of Ambient Air Quality in the City Lhokseumawe. In: Skripsi. 2019.
12. Kan Z, Tang L, Kwan MP, Zhang X. Estimating Vehicle Fuel Consumption and Emissions Using GPS Big Data. Int J Environ Res Public Health [Internet]. 2018 Mar 21;15(4):566. Available from: http://www.mdpi.com/1660-4601/15/4/566
13. Thomas RJ. Particle Size and Pathogenicity in the Respiratory Tract. Virulence [Internet]. 2013 Nov 15;4(8):847–58. Available from: http://www.tandfonline.com/doi/abs/10.4161/viru.27172
14. Meo S, Al-Drees A, Al Masri A, Al Rouq F, Azeem M. Effect of Duration of Exposure to Cement Dust on Respiratory Function of Non-Smoking Cement Mill Workers. Int J Environ

Res Public Health [Internet]. 2013 Jan 16;10(1):390–8. Available from: http://www.mdpi.com/1660-4601/10/1/390

15. Dung NA, Son DH, Hanh NTD, Tri DQ. Effect of Meteorological Factors on PM10 Concentration in Hanoi, Vietnam. J Geosci Environ Prot [Internet]. 2019;07(11):138–50. Available from: https://www.scirp.org/journal/doi.aspx?doi=10.4236/gep.2019.711010
16. Rivai A, Ahmad H, Rasman, Inayah, Febriyanti. Levels of Particulate Matter 2.5 (PM2.5) on Potential Respiratory Disorders in Traders Around the Road of Sultan Alauddin Makassar City. Urban Health [Internet]. 2021;3(1):165–71. Available from: http://journal.poltekkes-mks.ac.id/ojs2/index.php/Prosiding/article/download/2497/1720
17. Briffa J, Sinagra E, Blundell R. Heavy Metal Pollution in the Environment and Their Toxicological Effects on Humans. Heliyon [Internet]. 2020 Sep;6(9):e04691. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2405844020315346
18. Rahmat A, Mutolib A. Comparison of Air Temperature Under Global Climate Change Issue in Gifu City and Ogaki City, Japan. Indones J Sci Technol. 2016;1(1):37–46.
19. Lu SY, Huang YH, Lin KY. Spectral Content (colour) of Noise Exposure Affects Work Efficiency. Noise Health [Internet]. 2020;22(104):19–27. Available from: http://www.ncbi.nlm.nih.gov/pubmed/33243964
20. Ningrum FIK, Marsant AS, Wibowo PA. The Relationship of Noise Intensity with Work Stress in Production Workers. Open J Syst. 2022;17(1978):253–62.
21. Manisalidis I, Stavropoulou E, Stavropoulos A, Bezirtzoglou E. Environmental and Health Impacts of Air Pollution: A Review. Front Public Heal [Internet]. 2020 Feb 20;8(14). Available from: https://www.frontiersin.org/article/10.3389/fpubh.2020.00014/full
22. Vardhan CMV, Bhomesh S, Ravindra V, Ramaganesh M. Outdoor air

pollution and respiratory health : A bibliometric analysis. Int J Health Sci (Qassim). 2022;6(June):11240–9.