

Air Quality Analysis of Nitrogen Dioxide and Ozone (NO₂ and O₃) in the Chemistry Laboratory of Universitas Pakuan

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ABSTRACT

Universitas Pakuan is one of the universities in Bogor which has a chemistry education laboratory for practical purposes. In this study the room was tested is the instrument room and preparation room. Air testing of this work environment referring to the Minister of Manpower Regulation No. 05 of 2018. The test results for the instrument room and preparation room found that the levels of nitrogen dioxide (NO₂) and ozone (O₃) in the two rooms does not show any indication of NO₂ and O₃ pollution with result values below the detection limit testing (<0.0066 µg/m³ and <0.0491 µg/m³).

Keywords: Air quality, Environment, Nitrogen dioxide, Ozone

1. INTRODUCTION

Air is a mixture of various gases mechanically and not constitute chemical compounds. Air consists of various constant levels of gas at the earth's surface, such as nitrogen (78.09%), oxygen (20.95%), argon (0.93%), and carbon dioxide (0.04%). Air in nature is never found inside clean condition without any contaminants. Air pollution is the entry or inclusion of living things, substances, energy, and other components into the air by human activities or natural processes, so that air quality decreases to a certain level. Generally, air pollution found in gaseous form such as SO₂, CO, NO₂, and O₃. Air pollution is above the quality standard or threshold value boundaries and can cause interference health [1].

Nitrogen dioxide gas (NO₂) is a gas pollutant that generally comes from smoke petrol vehicles, waste burning and coal industry [2,3]. Gas NO₂ has a characteristic sharp odor, reddish brown and colored yellow below 21.2^oC. NO₂ gas has low solubility in water and dissolves in alkaline solutions. NO₂ gas can be dangerous for the body. This gas is deep High concentrations can react with Hb and has the same properties as CO, namely blocking the normal function of internal Hb blood, thereby potentially causing congestion breath, reduce lung function, and can causing death [4].

From the Government Regulation in Ref. [5] has set the Threshold Value NO₂ in the air is 400 µg/Nm³ (1 hour) and the threshold value O₃ gas is 235 µg/Nm³

(1 hour). Oxidants (O₃) are compounds in the air apart from oxygen which have properties as oxidizer. O₃ levels in the air are affected by temperature, humidity, solar radiation, changes in wind speed and wind direction. O₃ gas concentrations tend to increase in summer [6].

Air pollution measurement or analysis of ambient air is generally carried out in work environments such as in industry, shopping centers, and in the laboratory. Air the work environment is the area where a person works over a period certain. Usually someone works in industry or in the laboratory for 8 hours per day, so exposure to the substance is expected pollution to someone who works does not harm his health. Quality air both indoors and outdoors requires special attention because it can influence human health [1]. Inside air quality room depends on pollution outdoor air, motorized vehicles, presence of plants, active smoking, ventilation rooms with minimal or no ventilation, and a crowded room [7].

Sources of air pollution in laboratories can be sourced from the release of gas from materials used and contamination from outside. Based on this background, it was carried out air quality analysis working environment including NO₂ and O₃ gases in the instrument room and preparation room at the chemistry laboratory of Universitas Pakuan.

2. METHODS

This study was carried out over 3 months and includes the preparation phase, data collection, field surveys and sampling, data processing, as well data analysis. The research was carried out in the instrument room and preparation room of the chemistry laboratory at Universitas Pakuan, Bogor. Method carrying out air quality sampling carried out through active methods [8]. The parameters tested are humidity, temperature, nitrogen dioxide, and oxidants. The tool that was used in implementing this case study is *air sampler impinger*.

2.1. Preparation of Absorbent Solution

2.1.1. Absorbent Solution of NO₂

5 grams of anhydrous sulfanilic acid put into a 1000 mL beaker, 140 mL of glacial acetic acid was added, stirrer carefully and add distilled water up to 800 mL. The solution was transferred into a volumetric flask 1000 mL then added 20 mL of solution NEDA and 10 mL of acetone, then measured with distilled water up to 1000 mL.

2.1.2. Absorbent Solution of O₃

10 grams of KI dissolved in 200 mL distilled water. In another place dissolved in 35.82 g of disodium hydrogen phosphate dodecahydrate and 13.6 g potassium dihydrogen phosphate with 500 mL of distilled water. Add KI solution into the buffer solution while stirring until it is homogeneous. Dilute it the solution reaches 1000 mL in the measuring flask. Set the pH at 6.8 ± 0.2 with 1% NaOH or 1% phosphoric acid.

2.2. Sampling

Air sampling was carried out at 2 points at 10.00 – 11.00 WIB with only one sample being tested with absorbent solution. Taking samples using an impinger tool, following the reference [9] concerning O₃ testing and reference [10] concerning NO₂ testing. Absorbent containers are labeled for NO₂ and O₃ analysis, then fill with adsorbent solution according to the parameters tested then install it on the impinger. The impinger is moved at the test point. The impinger tool is turned on with a flow of 0.4 l/min for NO₂ and flow 0.5 l/min for O₃. Taking test samples for O₃ carried out for 30 minutes, while for NO₂ was carried out for 60 minutes. On point sampling the first is the instrument room, the condition of the room is there is sample testing going on, no windows are open, temperature 35.3 °C, and humidity 33%. Meanwhile, for sampling at the second point is the preparation room, the condition of the room

is busy with people preparation activities, open windows, temperature 33.1 °C, and humidity 40%.

2.3. Testing Parameter NO₂

Air sampling was carried out in accordance procedures in reference [10]. Next, sample analysis was carried out air using the Griess Saltzman method. The air sample is placed in a cuvette, then measured the intensity of the color formed at a wavelength of 550 nm using a UV-Vis Spectrophotometer. The sample concentration was calculated using a calibration curve. NO₂ concentration is done by calculating volume of air sample taken with the following formula:

$$V = \frac{F_1 + F_2}{2} \times t \times \frac{Pa}{Ta} \times \frac{298}{760}$$

so that the concentration of NO₂ (µg/Nm³) in ambient air with the formula following:

$$C = \frac{b}{V} \times \frac{10}{25} \times 1000$$

2.4. Testing Parameter O₃

Air sampling was carried out in accordance with procedures in reference [9]. Next, air sample analysis was carried out using the neutral buffer potassium iodide method (NBKI). Within a period of 30 – 60 minutes after air sampling, the air sample solution is placed in a cuvette, then measure the intensity of the color formed at a wavelength of 352 nm using a UV-Vis Spectrophotometer. O₃ concentration in the air is done by calculating the sample volume air is taken using the following formula:

$$V = \frac{F_1 + F_2}{2} \times t \times \frac{Pa}{Ta} \times \frac{298}{760}$$

So that the O₃ concentration is obtained (µg/Nm³) in the air with the following formula:

$$C = \frac{a}{V} \times 1000$$

3. RESULTS AND DISCUSSION

The results on the tool are in the form of absorbance which will later be calculated using calculations based on the available calibration curve. Then the results of the sample readings at these two points compared with existing regulations in reference [11].

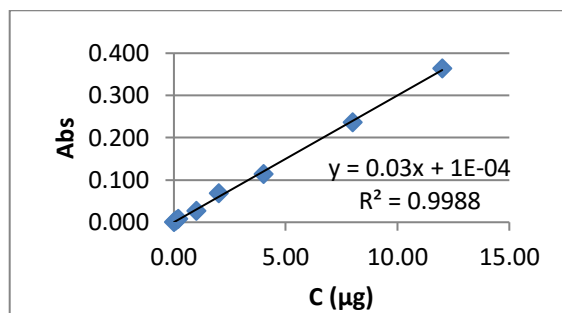


Figure 1. Calibration curve of NO₂

The calibration curve obtained shows the regression value $Y = 0.03x + 0.0001$ with a correlation value of 0.9988 (Figure 1), it means that the value obtained is acceptable. The NO₂ sample was read using a UV-Vis spectrophotometer with a wavelength of 550 nm and the absorbance results were obtained which can be seen in Table 1.

Table 1. Absorbance of NO₂ Samples

Sampling Point	Absorbance at 550 nm
Instrument room	0.003
Preparation room	0.001

Based on the Absorbance value obtained after calculating the NO₂ content value in the instrument room and preparation room is below the method limit, namely $<0.0066 \mu\text{g}/\text{m}^3$.

This shows that at the two sampling points there was no indication of NO₂ contamination in the air. The results are compared with the threshold value stated in the reference [11] which is $0.2000 \mu\text{g}/\text{m}^3$, so it can be said that the working environment air in the instrument room and preparation room in the chemistry laboratory at Universitas Pakuan not contaminated with NO₂.

Calibration curve for the O₃ series obtained shows the regression value $Y = 0.0478x + 0.0012$.

4. CONCLUSION

From the results of NO₂ pollution testing and O₃ that have been carried out, it can be concluded that the working environment air in the instrument room and preparation room of the chemistry laboratory of Universitas Pakuan has met the quality standards based on Minister of Manpower Regulation No. 5 of 2018 concerning Occupational Health and Safety in the Work Environment.

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