Prototype Design of Carbon Monoxide Box Separator as a Form of Ar-Rum Verse 41 and To Support Sustainable Development Goal’s Number 13 (Climate Action)

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Article Info

| Article History | Abstract |
|-----------------|----------|
| Received May 19, 2021 | The maritime sector is one of the paths to Golden Indonesia 2045. This is because 70% of Indonesia's territory is a sea with an area of 3.25 million km2 and is supported by the large potential that can be utilized for the welfare of Indonesia, one of which is as a contributor to foreign exchange with foreign exchange potential from maritime sector amounting to US $ 28 million to US $ 56 million. The problem lingers on how to possibly solve the problem regarding air pollution without shutting down industrial operations. Many multinational power plants have launched different campaigns in order to minimize the problem like planting trees and the like. But these small growing industries like grilling restaurants have given way to arising problem of air pollution issues. On the other hand, the ocean is a contributor to half of the world's oxygen. But in a period of 50 years, areas with minimal oxygen levels in the oceans have increased. The main cause is global warming, one of which comes from increasing levels of carbon monoxide in the air. One of these gases comes from incomplete combustion in motorized vehicles. This is also exacerbated by the growth of motorized vehicles which has increased by 11.5% per year. If left like this, marine life will be destroyed and Indonesia will not reach its peak of glory in 2045. So to overcome this problem, a prototype design of Carbon Monoxide Box Separator was created. This prototype is a combination of detector sensors consisting of MQ7 to detect carbon monoxide, MQ135 to measure air quality, and DHT11 to measure humidity and air temperature, as well as a high voltage system on the L-Box (Lightning Box) which can produce O2 because of the copper plate. on the L-Box will bind the element carbon to carbon monoxide using a voltage of 400 kV. With this prototype design, it is hoped that Indonesia can achieve its glory and also as a form of QS practice. Ar-Rum verse 41 regarding Allah's command to preserve nature and the environment and in this paper aims to produce a tool that can break dirty air into clean air. |
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I. INTRODUCTION

Indonesia is a tropical country with a sea area larger than the land area where 70% of Indonesia's territory is a sea with an area of 3.25 million km2 and has a coastline of 99,093 kilometers which is the second longest coastline in the world. Besides that, it is also supported by the large potential that can be utilized for the welfare of the Indonesian people. The known potential wealth of Indonesia reaches more than IDR 1,700 trillion, equivalent to 93 percent of the total Indonesian State Budget for 2018. This wealth comes from fish, mangroves, marine tourism and so on. In addition, the sea is also a contributor to the country's foreign exchange, with foreign exchange potential from the maritime sector of US $ 28 million to US $ 56 million.
On the other hand, the sea is a contributor to half the amount of oxygen in the world. However, in a period of 50 years, areas with minimal oxygen levels in the oceans have increased [1][2]. According to a study entitled Declining Oxygen in the Global Ocean and Coastal Water published in the Science Journal on January 15 2018, states that the main cause of the decline in oxygen levels on earth is global warming [3]. This is because when the air temperature at the sea surface increases, high levels of oxygen will be absorbed by the hot temperature at the sea surface. After that, oxygen with low concentrations will be attracted to the seabed which in turn will cause the sea temperature to become cooler [4]. One of the causes of global warming is the increase in carbon monoxide (CO) levels in the air. The increase in carbon monoxide levels is also closely related to the increase in population in Indonesia, which is the second most populous country in the world. According to the Ministry of National Development Planning (Bappenas) 2018, Indonesia's population has reached 265 million, where the latest data states that between 2025 and 2045 the total population of Indonesia is estimated to reach 296.4 million with a population growth rate of 1.49%. One of the sources of this gas formation is from incomplete combustion by motorized vehicles. This is also exacerbated by the growth of motorized vehicles which has increased by 11.5% per year. This gas is one of the dangerous gases, because in addition to causing global warming, this gas is dangerous because it can react with hemoglobin (CO-Hb) so that in large quantities it will cause symptoms of mild toxicity or poisoning such as nausea and headaches [5].

The problem lingers on how to possible solve the problem regarding air pollution without shutting down industrial operations. Many multinational power plants have launched different campaigns in order to minimize the problem like planting trees and the like. But these small growing industries like grilling restaurants have given way to arising problem of air pollution issues. This may be small restaurants but because they are in chains, they increase the risk of unnoticeable problems in the environment. The researchers believed that it is necessary to monitor these chains of grilling restaurants to evaluate their smoke level emissions.

The study is conducted primarily to provide smoke detectors that are affordable and readily available as well as monitor the carbon monoxide emissions of chicken grilling restaurants. Specifically, the study is conducted to develop a prototype that will detect and measure the concentration levels of carbon monoxide

If left like this, marine life will be destroyed and Indonesia will not reach its peak of glory in 2045 [6]. Allah has stated in Surah Ar-Rum 41 that in fact the damage in the sea and on land is the result of human intervention himself, so that Allah will show a reward for what humans have done [7]. This is also explained by Ath Thohari in his book Jami’ Al Bayan Fi Ta’wil Al Quran where Allah reminds people that damage has appeared in the plains of the earth and sea and it is all the result of human actions even though Allah has forbidden it. As an Indonesian citizen, especially a Muslim student as an agent of change, it is proper to have an obligation to protect this country. So, to solve this problem, a prototype design of Carbon Monoxide Box Separator was created. This prototype is a combination of detector sensors consisting of MQ7 to detect carbon monoxide, MQ135 to measure air quality, and DHT11 to measure humidity and air temperature, as well as a high voltage system on the L-Box (Lightning Box) which can produce O2 because of the copper plate on the L-Box will bind the element carbon to carbon monoxide using a voltage of 400 kV. With this prototype design, it is hoped that Indonesia can achieve its glory and also as a form of QS practice. Ar-Rum verse 41 regarding Allah's command to preserve nature and the environment and in this paper aims to produce a tool that can break dirty air into clean air.

II. MATERIALS AND METHODS

A. Materials and Equipments

The tools and materials used in making prototypes include:

![Fig. 1. Arduino [1]](image)

The sensor is programmed to achieve the required conditions that it will detect the carbon monoxide gas (Fig. 1). Figaro TGS 203 is operated in two temperature level which is 300 oC (60 s) and 88 oC (90 s). In order to achieve these conditions, Vhh and Vlow must be applied to the circuit alternately. For the first 60 seconds Q1 and Vhh is set to high and the Vlow to low. After that, Vhh is set to low and Vlow to high for the next 90 seconds. All the connections then is cut off which is setting the Q1, Vhh and Vlow to low for another half a second for sensor reading.

B. Making System Design Concepts

Below (Fig. 2) is the design concept of the CO Box Separator prototype where the planning process of the CO Box Separator design is carried out using the AUTOCAD 2007 software. Where this prototype is equipped with fans on the right and left sides of the box, so it can help speed up air circulation in the box so that the process of separating carbon in carbon monoxide will
be more efficient. The power source used is two types of 18650 batteries with a voltage of 3.7V on each battery [8]. Where one battery is used to supply power to a series of detector sensor systems and another battery is used to supply the Lightning Box (L-Box) system which will be used to break down carbon from carbon monoxide [9].

![Prototype CO Box Separator Design](image1)

In addition to planning the design of the CO Box Separator prototype, the planning of the work scheme of the CO Box Separator prototype itself is also carried out. The working scheme of the CO Box Separator prototype can be seen in Fig 2.

![Block Schematic Work Schematic of CO Box Separator](image2)

The picture Fig. 3 shows the working scheme of the CO Box Separator prototype which is divided into three parts, namely "input" where the CO gas content in the input and output is measured using MQ7, NH3 as air quality parameters tested using MQ135, and air temperature and humidity are measured using DHT11, which is a series of detector sensors, has been calibrated first through calculations from the sensor datasheet itself. Furthermore, in the "process" section, the analog data that has been obtained will be processed by the Arduino Uno R3 microcontroller which is then in the "output" section, the results of data processing will be displayed using the LCD. For the electrical circuit can be seen in the Fig. 4.

C. Data analysis

After the required data has been collected, data processing is carried out in a systematic and logical manner. After the required data has been collected, data processing is carried out in a systematic and logical manner. The data analysis technique chosen was to use regression techniques and the mean to determine the average levels of carbon monoxide, NH3 in the air and the temperature and humidity of the air. After that, it will be assessed whether the air quality in the area meets the standards or not. This study was carried out by analyzing data in a descriptive qualitative manner based on the national ambient air quality standards in Government Regulation number 41 of 1999 concerning Air Pollution Control which has been converted into units of ppm (TABLE I, AND TABLE II). This is intended to make observations easier because the output from the sensor has units of ppm.

Formula: 
\[
C = \left( \frac{\text{ppm} \times \text{BM}}{24.45} \right) \times 103
\]

C: concentration of CO levels (μg / Nm3)
ppm: calculated pressure (ppm)
BM: molecular weight

| No. | Parameter | Quality Standard (μg / Nm3) | Quality Standard (ppm) |
|-----|-----------|-----------------------------|------------------------|
| 1.  | SO2       | 900                         | 22.15                  |
| 2.  | CO        | 30,000                      | 738.56                 |
| 3.  | NO2       | 400                         | 9.84                   |
TABLE II. AIR COMPOSITION TABLE

| Composition     | Formula | Percent Volume | Ppm  |
|-----------------|---------|----------------|------|
| Nitrogen Oxygen | N₂O₂    | 78,0820        | 780820|
| Argon           | Ar      | 0,934          | 9340 |
| Carbon dioxide  | CO₂     | 0,0314         | 314  |
| Neon            | Ne      | 0,00182        | 18   |
| Helium          | He      | 0,000524       | 5    |
| Methane         | CH₄     | 0,000114       | 1    |
| Krypton         | Kr      | 0,0025         | 25   |
| Ammonia         | NH₃     | 0,0025         | 25   |

D. Arduino Uno R3

Arduino is a microcontroller development board based on the ATmega328P. By using this development board, it is possible to assemble an electronic circuit [10]-[12]. Programming Arduino is also very easy, this is because Arduino uses a high-level programming language, namely C++ which is easy to learn and is supported by the library from Arduino itself which is quite complete Fig. 5.

E. Sensor MQ7

MQ 7 is a gas sensor (Fig. 6) used to detect Carbon Monoxide (CO) gas. This sensor has a high level of sensitivity to CO and the result of its calibration is stable and durable. MQ 7 is composed of Al2O3 micro ceramic tube, tin dioxide (SnO2) sensitive layer, measuring and heating electrodes as a skin layer made of plastic and stainless steel harung surface. A heater provides the necessary working conditions for sensitive components to work [13].

F. Sensor MQ135

MQ-135 is a gas sensor (Fig. 7) that can be used in air quality control equipment for buildings / offices to detect ammonia gas (NH3), Nitrogen Oxide (NOx), alcohol, benzene, smoke, carbon dioxide (CO2), and others. The sensitive material of the MQ-135 gas sensor is SnO2 [14]. This sensor has high sensitivity to harmful gases (Ammonia, Sulfide, Benzene). This sensor requires a power supply of 5V. This sensor is capable of detecting NH3 gas with a detection range from 10 to 300 ppm, detecting benzene gas with a detection range from 10 to 1000 ppm, and 10 to 300 ppm for alcohol.

G. Sensor DHT11

The DHT11 sensor (Fig. 8) has a digital signal output that is calibrated with its temperature and temperature sensor capabilities. This sensor can be integrated with an 8-bit microcontroller with high performance. The technology used in the DHT11 sensor is reliable and it has a very good level of stability over a long period of time. This sensor has a resistive element and a sensor that can be used in negative temperature measurements. This sensor has excellent quality, fast response, “anti-interference” capability and high performance [15].

Each DHT11 sensor features a highly accurate humidity detection feature. Calibration coefficients are stored in the OTP program memory, the internal sensor detects signals in progress. Small size, low power, transmission signal distance of up to 20 meters, which allows the needs of various applications.

H. Lightning Box (L-Box)

L-box is a device used to separate carbon and oxygen (Fig. 9). Carbon Monoxide is produced by biological oxidation, motor vehicle emissions, etc. This uses the high voltage generated by the step up power where the voltage used is 400kV with an input voltage of 3.7V.
III. RESULTS

A. Measurement of CO levels at the Input and Output of the Lightning Box (L-Box)

The test was carried out at the Keputih intersection, Sukolilo, Surabaya on November 16, 2019. This test aims to determine the carbon monoxide content in the CO Box Separator input and output. Test result data can be seen in TABLE III.

TABLE III. CO MEASUREMENT AT THE INPUT AND OUTPUT OF THE CO SEPARATOR BOX

| TIME (SECONDS) | CO input (ppm) | CO output (ppm) |
|----------------|----------------|-----------------|
| 0              | 302            | 25              |
| 10             | 309            | 24              |
| 20             | 339            | 25              |
| 30             | 340            | 24              |
| 40             | 340            | 24              |
| 50             | 329            | 23              |
| 60             | 331            | 23              |
| Average        | 336,807        | 27.22           |

Below is a graph obtained from testing CO levels.

![CO test chart](image1)

After testing the carbon monoxide levels at the Keputih intersection, Sukolilo, Surabaya, it is known that the carbon dioxide content from the CO Box Separator input is 336,807 ppm. In addition, it is also known that the carbon monoxide content on the output side of the CO Box Separator prototype is 27.22 ppm. With this test, it can be seen that this prototype can reduce carbon monoxide levels in the air by up to 91%. So that the air that has been processed through this prototype can be classified in the clean air group. This is because according to the table of ambient air quality standards in PP number 41 of 1999 concerning Air Pollution Control, the maximum content of carbon monoxide is 738.56 ppm. Based on carbon monoxide levels, the ratio of air quality after and before being passed in the CO Box Separator prototype is 1: 12.44 (Fig. 10).

B. Air Quality based on NH3 Levels

This test was conducted to determine the air quality at the Keputih intersection, Sukolilo, Surabaya. This test was carried out at 0700, 16.00 and 20.00 WIB on November 16, 2019 using the MQ135 sensor and the observed variable was the level of NH3 di at the Keputih intersection, Sukolilo, Surabaya (TABLE IV). This is because NH3 can be used as a parameter for whether the air is clean or not (Fig. 11).

TABLE IV. TESTING NH3 CONDITIONS

| Time (seconds) | Concentration of NH-3 (ppm) |
|----------------|----------------------------|
| 07.00          | 0 5.92  16.00  20.00        |
| 10             | 4.55  5.64  4.04            |
| 20             | 6.05  7.14  5.54            |
| 30             | 7.86  8.96  7.35            |
| 40             | 8.33  9.41  7.86            |
| 50             | 13.9  14.99 13.6            |
| 60             | 7.56  8.65  7.55            |
| Average        | 9.365                                     |

The following is a graph obtained from testing the NH3 concentration.

![NH3 test chart](image2)

After testing the NH3 level at the intersection of Jalan Keputih, Sukolilo, Surabaya is 9,365 ppm. So the air quality at the intersection of Jalan Keputih, Sukolilo, Surabaya is in the clean category because the range of NH3 levels in the air is still below 25 ppm.
and humidity

This test was carried out by observing the temperature and humidity at the intersection of Jalan Keputih, Sukolilo, Surabaya (Fig. 12). This test is conducted to determine the temperature and average humidity of the air at the intersection of Jalan Keputih, Sukolilo, Surabaya. This test was carried out at 0700, 16.00 and 20.00 WIB by observing each session for one hour and recording data every 10 minutes. The Fig.12 is a graph obtained from testing air temperature and humidity.

After conducting this test, it is known that the average temperature and humidity at the intersection of Jalan Keputih, Sukolilo, Surabaya is 30.28 C and 66.47% (TABLE V).

TABLE V. MEASUREMENT OF TEMPERATURE AND AIR HUMIDITY

| TIME (MINUTES) | TEMPERATURE (°C) | HUMIDITY (%) |
|----------------|------------------|--------------|
| 0              | 30               | 78           |
| 10             | 30               | 78           |
| 20             | 30               | 77           |
| 30             | 30               | 76           |
| 40             | 31               | 75           |
| 50             | 31               | 73           |
| 60             | 31               | 70           |
| Average        | 30.28            | 66.47        |

IV. DISCUSSION

From the research that has been done, it can be seen that based on the carbon monoxide content, the air quality ratio after and before being passed in the CO Box Separator prototype is 1: 12.44. In addition, the reading of the MQ135 sensor for NH3 levels was 9,365 ppm and based on this test it was found that air quality was still in the clean category because NH3 levels were still below 25 ppm. Meanwhile, based on the DHT11 sensor readings, the temperature and humidity readings were 30.28 °C and 66.47%. The use of the MQ125, MQ 7 and DHT11 sensors is because in previous research measurements were carried out using the MQ 8 and MQ 9 sensors which resulted in the detection sensor having the lowest detection range which was too high at 120 ppm so that the detector sensor that was owned still had a high error percentage of 17%.

In order to achieve reliability of results, the researchers used a device to secure that the prototype developed were reading and obtaining the measuring the correct concentration level, the researcher used a parallel tool in data gathering. The equipment is an Electronic Gas Analyser, a technology of Bacharach. It specializes in measuring the concentration levels of the sensor in PPM (parts per million). The equipment serves as a parallel data of the sensor. The researcher does not necessarily measure and reflect the data obtained by the Bacharach, but the researchers did recording simultaneously of the sensor since the developed prototype has its display circuit.

The application of this prototype will have a positive impact on the environment. Because the design of this prototype can separate carbon compounds in carbon monoxide so that it can produce an output in the form of oxygen gas. Therefore, with this prototype design, marine life can be preserved which previously was threatened with extinction due to human behavior itself. By preserving marine life, humans can also use it to improve their welfare. In addition, with the preservation of marine life, Indonesia can take advantage of its wealth where the known potential of Indonesia’s marine wealth reaches more than Rp.1,700 trillion, which comes from fish, mangrove ecosystems, tourism, etc. as a source of foreign exchange income because the sea is also a contributor to foreign exchange. countries with foreign exchange potential from the maritime sector amounting to US $ 28 million to US $ 56 million.

V. CONCLUSION

The design results of this prototype can be said to be potable and flexible. This is because this prototype can be brought to any place easily and can be placed in various polluting places. Based on carbon monoxide levels, the ratio of air quality after and before being passed in the CO Box Separator prototype is 1: 12.44.

Based on the tests that have been done, the reading of the MQ135 sensor on NH3 levels is 9,365 ppm and based on this test it is found that air quality is still in the clean category because NH3 levels are still below 25 ppm. Meanwhile, based on the DHT11 sensor readings, the temperature and humidity readings were 30.28 C and 66.47%.

The developed prototype has detected, measured and log the concentration levels of carbon monoxide. Furthermore, among the establishments where test – run of the prototype conducted, it must be noted that one of the chicken grilling restaurants has emitted beyond the safe standards of carbon monoxide concentrations.

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