The Effectiveness of the Absorption of CO, CH₄, CO₂, H₂S and Pb Gasses by a Mixture of Sansiviera and Coffee Powder

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Abstract. This study aims to analyze the effectiveness of the absorption of CO, CH₄, CO₂, H₂S and Pb Gasses by a mixture of Sansiviera and Coffee Powder. Gas measurements were carried out using a Multitec 250 gas detector, while Pb levels were analyzed using AAS. The results showed that the mixture of Sansevieria and coffee powder effectively absorbed CH₄, CO₂, H₂S and Pb gases with the highest effectiveness, respectively 87.5%, 71.06%, 55.5% and 59% with the composition of sansiviera: coffee in the sample respectively 50:50; 50: 0; 30:20; 40:10. Meanwhile, the mixture of sansiviera and coffee was slightly effective in absorbing CO gas with the highest effectiveness of 15.65% at the composition of 50: 0.

1. Introduction
Motorized vehicles are one of the main assets used by Indonesian people to carry out their daily activities, such as doing business, schooling, and so on today [1]-[3]. Therefore, the number of motorized vehicles in Indonesia is growing rapidly. Based on data from the Central Statistics Agency (BPS) in 2017 with an increase in the number of vehicles by 10-15% each year, the predicted number of vehicles in Indonesia in 2020 is 133,533,603.5; -139,603,312.75 million.

Motorized vehicles can not only ease human activity in moving places, but can also have negative impacts, such as congestion, pollution in the form of incomplete combustion in the form of vehicle fumes containing Pb gas, suspended particulate matter (SPM), nitrogen oxides (NOx), sulfur oxides (SO₂), hydrocarbons (HC), carbon monoxide (CO), and photochemical oxides (Ox) [4]-[7]. The presence of this pollution in the air will cause health problems, especially disturbances in the physiological functions of the body's organs, such as the lungs, blood vessels, eye and skin irritation. Generally, dust particles in the air will cause chronic respiratory disease, bronchial asthma, pulmonary emphysema and even lung cancer. High levels of Pb in the air will also interfere with the formation of red blood cells. Disruption of enzyme function is a symptom of premature poisoning which is shown in the formation of red blood cells which eventually causes other health problems, such as anemia and kidney damage. Meanwhile, the high CO gas in the air will cause carboxyhemoglobin (COHb) to form in the blood, if the affinity of CO is greater than oxygen to Hb it will interfere with the Hb function to carry oxygen throughout the body. This will cause the available oxygen to decrease, and if you do not immediately get fresh air, shortness of breath will occur, which can cause death. For NOx, SOx and H2S pollutants in the environment that exceed the allowable threshold, will cause irritation and inflammation of the respiratory
organs. In addition, all these pollutants can also damage the environment because they are one of the greenhouse gases that can cause global warming \cite{9-11}.

Many things have been done to reduce these negative impacts, including an increase in the number of quality mass vehicles for the community, an increase in the number of broadleaf trees in high-traffic areas. The use of masks will also greatly help people to maintain health in an environment with lots of air pollution. In this research, we want to develop materials that absorb some of these pollutants in order to maintain environmental quality so that public health can improve.

2. Method

2.1 Tools and Materials

The tools used in this study included a knife, oven, analytical balance, gas detector (Multitec 250 brand), beaker glass (Herma brand). While the samples in this study were Sansevieria and dried coffee.

2.1 Subjects and Objects

In this study, the subject was a mixture of the sansiviera and coffee, while the objects in the study were CH$_4$, CO$_2$, H$_2$S, CO, and Pb gases which were able to be absorbed by the mixture.

2.2 Preparation

The sansiviera is cut into small pieces using a knife, then oven at 105 °C for 21 hours, then blend until smooth using a blender. Meanwhile, 2 grams of coffee is put into 10mL of water, soaked for 5 minutes, then filtered, the dregs are taken, after which the dregs are set aside to dry at room temperature.

2.3 Data collection

Samples in the form of a mixture of sansiviera and coffee powder were placed on the test media with different variations to measure the gas levels of CH$_4$, CO$_2$, H$_2$S and CO. The variations in the mass of the sansiviera and coffee powder are presented in Table 1. The gas used is gas produced from motorized vehicles. The test media used for the previous measurement was filled sansiviera and coffee powder and then the gas was measured by taking the vehicle gas and then put it in the test medium and then tested using a gas detector with the brand Multitec 520. The gas was measured at the start, increments and every hour after the initial measurement. Meanwhile, the measurement of Pb levels is carried out using AAS which will be carried out at the Analytical Laboratory at Udayana University, Denpasar.

| Variation | Sansiviera (gr) | Coffee (gr) |
|-----------|----------------|-------------|
| I         | 0              | 50          |
| II        | 10             | 40          |
| III       | 20             | 30          |
| IV        | 30             | 20          |
| V         | 40             | 10          |
| VI        | 50             | 0           |
| VII       | 50             | 50          |
| VIII      | 0              | 50          |
2.4 Data Analysis

The data generated in the study were gas levels of CH₄, CO₂, H₂S, CO, and Pb before and after application. The data was then searched for the effectiveness of the mixture of coffee and sansiviera on the absorption of CH₄, CO₂, H₂S, CO, and Pb gas is sought with the formula as follows:

Absorption = t₀ - t₁

The effectiveness of absorption is sought by the following formula

\[ \text{Effectiveness} = \frac{t_0 - t_1}{t_0} \times 100\% \]

Note: t₀ is the absorption at the first contact time
      t₁ is the absorption at the end contact time.

3 Result and Discussion

The absorption levels of CO, CH₄, CO₂, H₂S and Pb by organic absorbent mixtures of the coffee and sansiviera are presented respectively in Table 2, Table 3, Table 4, Table 5 and Table 6.

Table 2. Absorption of CO Levels in Mixed Variations of Sansiviera and Coffee

| No | Variation Coffee (gr) : Sansiviera (gr) | CO Levels | Absorption CO Level (ppm) | %E | x/m (ppm/g) |
|----|----------------------------------------|-----------|---------------------------|----|------------|
|    |                                        | t₀ (ppm)  | t₁ (ppm)                  |    |            |
| 1. | 50 : 0                                 | 417       | 417                       | 0  | 0          |
| 2. | 40 : 10                                | 436       | 405                       | 31 | 7.11       | 0.62       |
| 3. | 30 : 20                                | 441       | 400                       | 41 | 9.29       | 0.82       |
| 4. | 20 : 30                                | 436       | 381                       | 55 | 12.61      | 1.1        |
| 5. | 10 : 40                                | 445       | 382                       | 63 | 14.15      | 1.26       |
| 6. | 0 : 50                                 | 447       | 377                       | 70 | 15.65      | 1.4        |
| 7. | 50 : 50                                | 447       | 379                       | 68 | 15.21      | 1.36       |

Table 3. Absorption of CH₄ Levels in Mixed Variations of Sansiviera and Coffee

| No | Variation Coffee (gr) : Sansiviera (gr) | CH₄ Levels | Absorption CH₄ Level (ppm) | %E | x/m (ppm/g) |
|----|----------------------------------------|-----------|---------------------------|----|------------|
|    |                                        | t₀ (ppm)  | t₁ (ppm)                  |    |            |
| 1. | 50 : 0                                 | 0.40      | 0.10                      | 0.3 | 75         | 0.006      |
| 2. | 40 : 10                                | 0.30      | 0.14                      | 0.16 | 53.33      | 0.0032     |
| 3. | 30 : 20                                | 0.25      | 0                         | 0.25 | 100        | 0.005      |
| 4. | 20 : 30                                | 0.30      | 0.14                      | 0.16 | 53.33      | 0.0032     |
| 5. | 10 : 40                                | 0.10      | 0.00                      | 0.1  | 100        | 0.002      |
| 6. | 0 : 50                                 | 0.35      | 0.13                      | 0.22 | 62.8       | 0.004      |
| 7. | 50 : 50                                | 0.40      | 0.05                      | 0.35 | 87.5       | 0.007      |
If the concentrations of CO, CH₄, and H₂S gases are compared in Tables 2, 3 and 5, it turns out that the gas from motorbike combustion contains much higher CO gas than other gases with an average level of 438.42ppm, then H₂S gas (20.28ppm) and CH₄ gas (0.3ppm).

Table 2 shows that the greater the amount of sansivera, the greater the effectiveness of absorption of CO levels. This means that sansivera is able to absorb CO gas with the highest effectiveness (15.65%), namely in the VI variation with the amount of coffee: sansivera = 0: 50. Table 2 also shows that coffee is unable to absorb CO gas, which can be seen in variation I, namely the composition of coffee: sansivera = 50: 0, the effectiveness is 0%.

Table 4. Absorption of CO₂ Levels in Mixed Variations of Sansiviera and Coffee

| No  | Variation Coffee (gr) : Sansiviera (gr) | CO₂ Levels t₀ (%) | t₁ (%) | Absorption CO₂ (%) | %E x/m (ppm/g) |
|-----|----------------------------------------|-------------------|--------|---------------------|----------------|
| 1.  | 50 : 0                                 | 2.25              | 1.80   | 1.07                | 47.55          | 0.0214         |
| 2.  | 40 : 10                                | 3.5               | 3.13   | 0.35                | 10             | 0.007          |
| 3.  | 30 : 20                                | 1.70              | 1.55   | 0.15                | 8.82           | 0.003          |
| 4.  | 20 : 30                                | 1.65              | 1.63   | 0.02                | 1.2            | 0.0004         |
| 5.  | 10 : 40                                | 1.60              | 1.54   | 0.06                | 3.75           | 0.0012         |
| 6.  | 0 : 50                                 | 1.65              | 1.55   | 0.1                 | 71.06          | 0.002          |
| 7.  | 50 : 50                                | 2.26              | 2.00   | 0.26                | 11.50          | 0.0052         |

Table 5. Absorption of H₂S Levels in Mixed Variations of Sansiviera and Coffee

| No  | Variation Coffee (gr) : Sansiviera (gr) | H₂S Levels t₀ (ppm) | t₁ (ppm) | Absorption H₂S (ppm) | %E x/m (ppm/g) |
|-----|----------------------------------------|---------------------|----------|---------------------|----------------|
| 1.  | 50 : 0                                 | 36                  | 20       | 16                  | 44.44          | 0.32           |
| 2.  | 40 : 10                                | 18                  | 8        | 10                  | 55.55          | 0.2            |
| 3.  | 30 : 20                                | 23                  | 15       | 8                   | 34.78          | 0.16           |
| 4.  | 20 : 30                                | 17                  | 14       | 3                   | 17.64          | 0.06           |
| 5.  | 10 : 40                                | 24                  | 19       | 5                   | 20.83          | 0.1            |
| 6.  | 0 : 50                                 | 24                  | 14       | 10                  | 41.66          | 0.2            |
| 7.  | 50 : 50                                | 24                  | 14       | 10                  | 41.66          | 0.2            |

Table 6. Absorption of Pb Levels in Mixed Variations

| Mixed Code | Variation Coffee (gr) : Sansiviera (gr) | Pb Levels C₀ (ppm) | Cₓ (ppm) | Adsorption Pb Levels % E | x/m |
|------------|----------------------------------------|--------------------|----------|--------------------------|-----|
| 1          | 50 : 0                                 | 12.5               | 39.74    | 27.24                    | 68% | 0.55          |
| 2          | 0 : 50                                 | 38.97              | 55.57    | 16.6                     | 29% | 0.33          |
| 3          | 40 : 10                                | 17.97              | 53.90    | 35.93                    | 66% | 0.72          |
| 4          | 30 : 20                                | 23.44              | 59.71    | 36.27                    | 60% | 0.73          |
| 5          | 20 : 30                                | 28.91              | 65.32    | 36.41                    | 55% | 0.74          |
| 6          | 10 : 40                                | 34.38              | 84.65    | 50.27                    | 59% | 1.05          |
In Table 3, it can be seen that coffee and sansevieria are able to absorb CH$_4$ gas. This can be seen in the effectiveness given to a mixture of variations 1 and 6 with the composition of coffee: sansevieria, respectively 50: 0 and 0:50, namely 75% and 62.8%. The highest effectiveness is in mixtures with variations 3 and 5 with the composition of coffee: sansevieria 30:20 and 10:40, respectively, that is 100%. Sansevieria absorbs CO$_2$ gas better than coffee, which can be seen in Table 4 in a mixture of variations 1 and 6. The effectiveness of the mixture with variation 6 also provides the highest effectiveness in absorbing CO$_2$ gas. The mixture of variation 6 which only contains sansevieria gives an effectiveness of absorbing 71.06 CO$_2$, while the mixture with variation 1 which only contains coffee only gives an effectiveness of 47.55%. In Table 5, it can be seen that the mixture with variation 3, namely the composition of coffee: sansevieria = 30:20, provides the highest effectiveness in absorbing H2S gas. While in Table 6 shows that coffee is very good at absorbing Pb gas, this can be seen in the mixture of variation 1 which only contains coffee which provides the highest effectiveness in absorbing Pb gas, which is 68%. The Table 7 shows the data that the composition of the coffee and sansevieria blends that provide the highest effectiveness.

**Table 7. Absorption of CO Levels in Mixed Variations**

| Gasses  | Variation | Gasses Levels | Absorption Levels | %E   | x/m    |
|---------|-----------|---------------|-------------------|------|--------|
|         | Coffe (gr) : Sansivieria (gr) | t$_0$ | t$_1$ |  |       |
| CO      | 0 : 50    | 447ppm        | 377ppm            | 70ppm | 15,65  | 1,4   |
|         |           |               |                   |       |        | ppm/g  |
| CH$_4$  | 30 : 20   | 0,2ppm        | 0,0ppm            | 0,25ppm | 100   | 0,005  |
|         |           |               |                   |       |        | ppm/g  |
| CH$_4$  | 10 : 40   | 0,1ppm        | 0,0ppm            | 0,1ppm | 100   | 0,002  |
|         |           |               |                   |       |        | ppm/g  |
| CO$_2$  | 50 : 50   | 2,26%         | 2,00%             | 0,26% | 11,50  | 0,0052 |
|         |           |               |                   |       |        | %/g    |
| H$_2$S  | 30 : 20   | 18 ppm        | 8 ppm             | 10 ppm | 55,55 | 0,2    |
|         |           |               |                   |       |        | ppm/g  |

Note:
- t$_0$: rate of first contact time
- t$_1$: rate of final contact time

Based on Table 7, it can be seen that the organic fragrances mixed from the coffee and sansevieria are not only able to absorb CO and CO$_2$ gases and neutralize air but also reduce CH$_4$, H$_2$S and Pb levels in motor vehicle fumes. The ability of the sansevieria to absorb pollutants is because in one strand it contains the active ingredient, pregnan glycoside, which is able to reduce pollutants into organic acids, sugars, and several amino acid compounds (Prasetyo, 2013). The use of coffee grounds as a mixture of the tongue-in-law for this organic fragrance is because coffee itself is able to neutralize air (Muspa, 2017). So that this organic fragrance will be very useful if used because it has many benefits.

**4. Conclusion**

Based on the description of the discussion above, it can be concluded that the mixture of Sansevieria and coffee powder effectively absorbed CH$_4$, CO$_2$, H$_2$S and Pb gases with the highest effectiveness, respectively 87.5%, 71.06%, 55.5% and 59% with the composition of sansevieria: coffee in the sample
respectively 50:50; 50: 0; 30:20; 40:10. Meanwhile, the mixture of sansiviera and coffee was slightly effective in absorbing CO gas with the highest effectiveness of 15.65% at the composition of 50: 0.

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