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The Creation Of Data Pattern Of Kerosene-mixed Gasoline By Utilizing Gas Sensor And Fast Fourier Transform Method To Detect The Purity Of Gasoline

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Abstract:

The research regarding the creation of data pattern of kerosene-mixed gasoline by using gas sensor has been conducted through the utilization of fast fourier transform (FFT) method. This research is aimed to create data pattern of both pure and kerosene-mixed gasoline. The composition of kerosene in gasoline is varied by 10%, 20%, 30%, 40%, and 50%. The FFT method test is conducted to create pattern from the detected gas. The sensor of TGS 2620 Gas has low sensitivity towards the change of steam/vapor of kerosene-mixed gasoline. The data sample of pure gasoline and kerosene-mixed gasoline have dominant frequency values that frequently occur in 17-31 frequency range, while the entire random samples that used are identified to have been mixed with kerosene.

Keywords — **Gasoline, Kerosene, TGS 2620 Gas Sensor, Data Pattern**

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I. INTRODUCTION

Gasoline is the main fuel for all almost vehicles. The pure gasoline is important to keep vehicle operating. Unfortunately there is a bad behavior in our society that mixes gasoline with another material. Of course it will contaminate gasoline and destroy the machine [1][2] and air pollution [3]

Gasoline in Indonesia can be obtained in Gas Station or Gas Retailer Kiosks. In general, the gasoline obtained from the Gas Station has a high purity level, however, the gasoline acquired from retailers or kiosks are frequently mixed with the other fuels or what commonly mentioned as mixed-gasoline. Mixed-gasoline usually contains the other fuel materials, including kerosene.

The detection of gasoline purity level becomes an important matter in order to prevent the deteriorating impact from the use of mixed-gasoline. However, it would not be easy to detect the purity of gasoline at present. Visually, there is no contrast difference between Pertamina Indonesia-standard gasolines with the gas that has been mixed with kerosene [4].

In order to differentiate the standard gasoline distributed by Pertamina with the gasoline that has been mixed with other materials such as kerosene, proper method or tools are required to facilitate the detection process. By detecting the gas resulted from the gasoline, it is possible to discover the purity of that gasoline. In this research, the gas sensor tool to detect the purity of gasoline because the gas sensor is super sensitive towards the gasses produced by oil, including gasoline or kerosene. The result of gas sensor detection requires processing to obtain clear pattern in order to differentiate a pure and a mixed gasoline. By using the Fast Fourier Transform (FFT) method, it is possible to create a pattern from the detected gas. According to this background, this research is aimed to create the Data Pattern of Kerosene-Mixed Gasoline Based on Gas Sensor by Using Fast Fourier Transform (FFT) Method.

II. THEORETICAL BASE

2.1 Gasoline

A gasoline is one of the fractions from the distillation result of petroleum, including the compound of paraffinic hydrocarbons with 5-12 carbon atoms in the forms of straight-chain, branched, cyclic, saturated, unsaturated, or aromatic. Gasoline has 50^{o}-225^{o} of boiling point and 88 octane's number. Gasoline is a fraction from the distillation result of petroleum with common formulation of CnH2n + 2, and a branched carbon chain. Gasoline has unsaturated, cyclic, and aromatic bonds [2].

2.2 Kerosene

Kerosene name is derived from *"keros"*; a Greece language. Kerosene is a fraction of petroleum that heavier than gasoline and has 150-300^{o}C boiling point, including the paraffinic hydrocarbons compound with 12-16 carbon atoms.
Kerosene is acquired through fractional distillation of petroleum with a common formulation of CnH2n + 2. Kerosene is a flammable and colorless hydrocarbon liquid [6]

2.3 Semi-Conductor Type of Gas Sensor

The gas detector material of this sensor is metal oxide, especially the SnO2 compound. When metal oxide (SnO2) is warmed to a certain temperature, the oxygen will be absorbed on the surface of the crystal and the oxygen will have a negative charge.
The TGS2620 sensor is categorized as a semi-conductor sensor. This sensor has sensitivity to organic solutions and flammable gases such as carbon monoxide. This sensor is able to detect several gases, including methane gas, CO, Iso-butane, Hydrogen and ethanol. TGS 2620 only requires 42mA of heater current and the device is placed in a TO-5 standard [4]

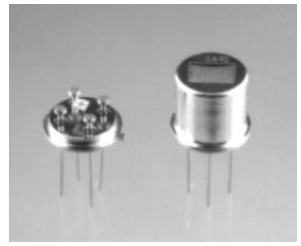

Figure 1. TGS 2620 Gas Sensor

2.4 Fast Fourier Transform (FFT)

Fourier transformation is performed to transform signals from time domain to frequency domain. Fast Fourier Algorithm or FFT is an efficient DFT calculation procedure that will speed up the DFT calculation process. If this method is applied to a time zone then this algorithm is also mentioned as FFT decimation-in-time (DIT). Decimation then leads to a significant reduction in the number of calculations that performed on the time zone data.[8]

2.5 Data Pattern

Data pattern is divided into four types, namely [8]:

a. Horizontal Data Pattern

This form of data pattern occurs when the value of data fluctuates around its mean value.

b. Seasonal Data Pattern

This form of data pattern occurs when the data is influenced by seasonal factors.

c. Cyclic Data Pattern

This form of data pattern occurs when this data is influenced by long economic fluctuation, including what associated with business cyclical and others

d. Trend pattern

This form of this data pattern occurs when the decrease or increase of data occurs in prolonged period.

III. METHOD

The main program of FFT algorithm consists of bit reversing process, butterfly algorithm and magnitude calculation. The flow diagram of the main program of the FFT algorithm is shown in a Figure below.

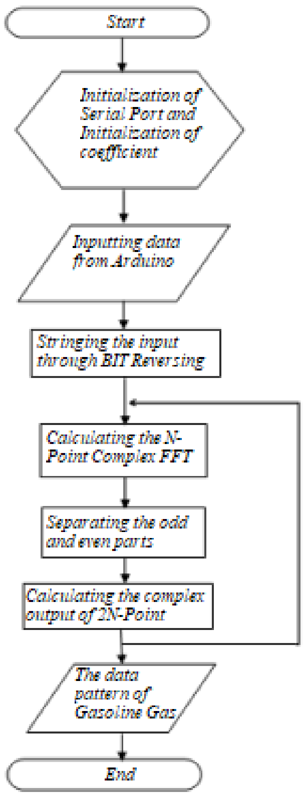

Figure 2. The flow diagram of the main program of the FFT algorithm

The system designing consists of the designing process of program hardware and software. The hardware includes power supply circuit, TGS 2620 gas sensor, Microcontroller ATMega328 based *Arduino Uno* that connected to Personal Computer (PC). The programs include a program to read the voltage values resulted from ATMega328 Microcontroller and a program for processing data on the computer to acquire the data pattern of gas vapor of gasoline hydrocarbon.

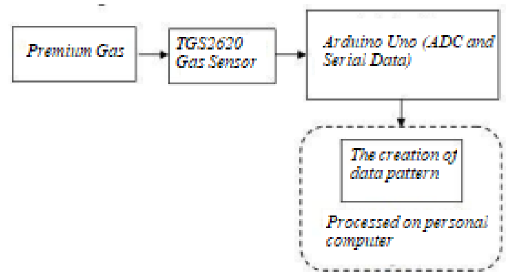

Figure 3. Block Design of System Diagram

IV. RESULT AND DISCUSSION

This system consists of TGS 2620 gas sensor, arduino uno, and PC. This detection of gasoline purity is conducted by using TGS 2620 gas sensor, the output data of gas sensor will be processed with ADC in arduino uno microcontroller. The processing will convert analog data into digital data. The output of the gas sensor is in the form of resistance.

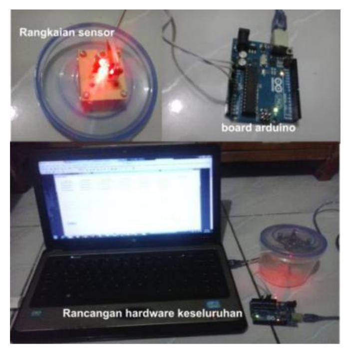

Figure 4. Mechanic System

Objects used in this study are pure gasoline; the gasoline mixed with 10% to 50% of kerosene. In the graphic of FFT result, the X axis expresses the frequency value (Hz) and the Y axis represents the magnitude value.

In the process of pattern creation, 5 experiments are conducted for each data sampling. The length of FFT used is 64 with a delay of 500 ms (0.005 seconds). During the data collection process, the input frequency data shown in the graph can be seen. The data retrieval/collection process will stop automatically on the 64th counter. After this process is performed, the

FFT spectrum output is shown in the graph with a spectrum that has a certain magnitude value. The FFT spectrum formed from the sample can be seen in figure 5.

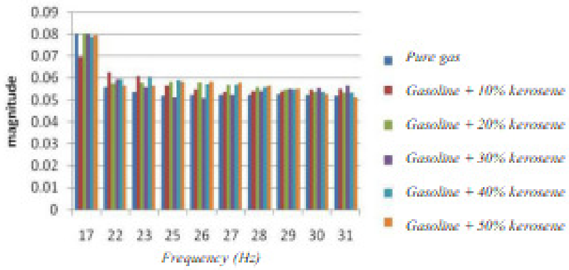

Figure 5. FFT Spectrum of Gasoline Sample

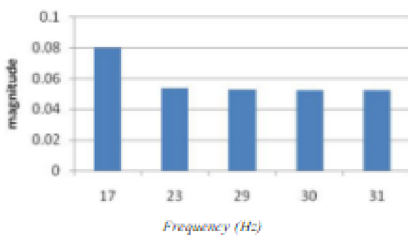

Figure 6. Data Pattern of Pure Gasoline

a) Figure 6 is a data pattern of pure gasoline. After 5 experiments were conducted, the smallest difference between experimental magnitude and average magnitude was calculated, thus, the dominant magnitude value appeared at 17th, 23rd, 29th, 30th and 31st frequencies with the highest value occurs at the 17th frequency.

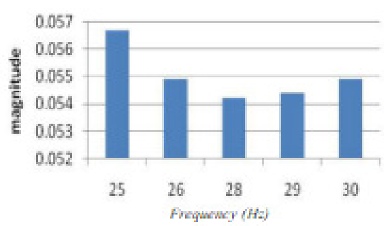

Figure 7. Data Pattern of the Gasoline that mixed with 10% Kerosene

b) Figure 7 is the data pattern of gasoline that mixed with 10% kerosene. After 5 experiments were performed to calculate the smallest difference between the magnitude of the experimental results and the average magnitude value, it is found that the dominant magnitude values appear at the 25th, 26th, 28th, 29th and 30th frequencies with the highest value occurs at the 25th frequency.

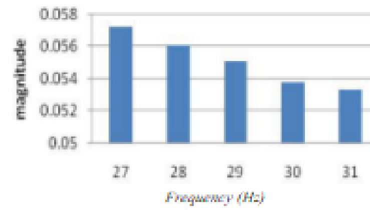

Figure 8. Data Pattern of the Gasoline that mixed with 20%% Kerosene

c) Figure 8 is the data pattern of the gasoline that mixed with 20% Kerosene. After 5 experiments were performed to calculate the smallest difference between the magnitude of the experimental results and the average magnitude value, it is found that the dominant magnitude values appear at the 27th, 28th, 29th, 30th and 31st frequencies with the highest value occurs at the 27th frequency.

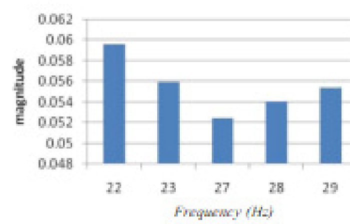

Figure 9. Data Pattern of the Gasoline that mixed with 30% Kerosene

d) Figure 9 is the data pattern of the gasoline that mixed with 30% Kerosene. After 5 experiments were performed to calculate the smallest difference between the magnitude of the experimental results and the average magnitude value, it is found that the dominant magnitude values appear at the 22nd, 23rd, 27th, 28th and 29th frequencies with the highest value occurs at the 22nd frequency.

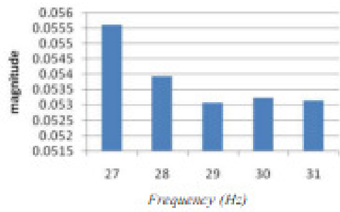

Figure 10. Data Pattern of the Gasoline that mixed with 40% Kerosene

e) Figure 10 is the data pattern of the gasoline that mixed with 40% Kerosene. After 5 experiments were performed to calculate the smallest difference between the magnitude of the experimental results and the average magnitude value, it is found that the dominant magnitude values appear at the 27th, 28rd, 29th, 30th and 31st frequencies with the highest value occurs at the 27th frequency.

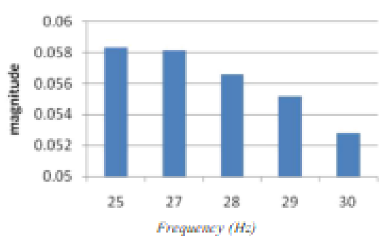

Figure 11. Data Pattern of the Gasoline that mixed with 50% Kerosene

f) Figure 11 is the data pattern of the gasoline that mixed with 50% Kerosene. After 5 experiments were performed to calculate the smallest difference between the magnitude of the experimental results and the average magnitude value, it is found that the dominant magnitude values appear at the 25th, 27rd, 28th, 29th and 30st frequencies with the highest value occurs at the 25th frequency

After data testing were conducted in 5 experiments on a random gasoline sample, it is acquired that the system has detected the five samples were mixed with kerosene. As for the random samples 1 and 2 in the 1st experiment of a random sample 1 and the 5th experiment on a random sample 2; the system detected that the samples were pure gasoline. The detection of this random sample as pure gasoline has a small percentage (10%).

V. CONCLUSIONS

5.1Conclusion

After doing the testing and analysis on this tool circuit/series, the conclusion can be summarized as follows:

1) TGS 2620 gas sensor has a low sensitivity towards the changes of the vapor of kerosene-mixed gasoline. The lower the purity level of gasoline or the higher the kerosene level in the mixed gasoline, the pressure of saturation vapor will be lower.
2) In the data sample of pure gasoline and kerosene-mixed gasoline, the dominant frequency values that often occur are in the 17-31 frequency range. Each data sample has a pattern that resembles each other but retains the uniqueness and characteristic indicated by the maximum magnitude of different emerging frequency values.
3) Based on the test results of 5 random samples, the system detected that all samples were identified as kerosene-mixed gasoline.

5.2 Recommendation

The recommendations required in the improvement process for this tool are as follows:

1) In order to acquire more accurate data retrieval, it should be ensured in prior that the sensor room is sealed tightly and unaffected by the sensor-sensitive gas elements.

2) In order for the identification process to run properly, then, it is expected that in the development of this identification process, variations of sensor are combined by using the other gas sensors which more specific.

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