PROCEEDING INTERNATIONAL CONFERENCE
Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0
Surabaya, July 11 - 14, 2018

ISBN: 978-602-449-160-4

APTEKINDO

PROCEEDING
INTERNATIONAL CONFERENCE

Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0

Surabaya, July 11 - 14, 2018

UNESA

Faculty of Engineering
Universitas Negeri Surabaya
2018

PROCEEDINGS

International Conference
Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia
(APTEKINDO) 2018

Theme:
"Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0"

Surabaya, 11-14 July 2018

Speakers:

Prof. Dr. Muhadjir Effendy, MAP.
Minister of Education and Culture, Republic of Indonesia

Michael Freiherr von Ungern – Sternberg
Extraordinary and Plenipotentiary Ambassador of the Federal Republic of Germany to Indonesia, ASEAN and Timor-Leste (Jerman)

Prof. Dr. Wenny Rahayu
Head of School of Engineering and Mathematical Sciences
La Trobe University Victoria (Australia)

Prof. Dr. Muchlas Samani, M.Pd.
Rector of Universitas Negeri Surabaya period 2010-2014 (Indonesia)

Faculty of Engineering
Universitas Negeri Surabaya
2018

PROCEEDINGS

International Conference
Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia (APTEKINDO) 2018

Theme:

"Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0"

FACULTY OF ENGINEERING
UNIVERSITAS NEGERI SURABAYA
ISBN 978-602-449-160-4

PREFACE

All praises be to Allah SWT, so that the 2018 International Conference of ***Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia*** **(APTEKINDO)** could be held in Surabaya during 11-14 July 2018. APTEKINDO International Conference isconducted biennially in which this year host is Faculty of Engineering, State University of Surabaya. Therewere sixteen colleges attending this year Conference, most of which were former Institutes of Teacher's Education (LPTK).

This year theme is *"Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0"* aimed to respond to the development and acceleration of the industrial revolution 4.0 that has become the most discussed issues inmany countries. Industrial revolution connects machines with internet systems. In regard to facing such phenomena, Indonesian government through the Ministry of Industry has launched "Making Indonesia 4.0", of whichthe program focuses on industries that are driving the development of the industrial revolution 4.0 such as food and beverages, electronics, automotive, textiles and chemicals. To achieve better results of the program actualization, vocational education helps to prepare compatible and competitive workers for the areas of the aforementioned industries. Henceforth, numbers of Conferences, conventions, and meetings amongIndonesian practitioners in FPTK / FT-JPTK need to be held to initiate ideas in strengthening the role of LPTK within industrial revolution 4.0 era.

The Conference's proceedings contain 121 research papers and ideas that are relevant to the following nine sub-themes: *Technical and Vocational Teacher Competencies, Technical and Vocational Education Curricula, Technical and Vocational Education Models, Technical and Vocational Education Evaluation, Technical and Vocational Education Policy, Public-private Partnership in Technical and Vocational Education, Technical and Vocational Education Management, Technopreneurship*, and *Competencies Certification.*

Finally, all the committees send their gratitude to the participating speakers and all parties who support the run of the Conference. They also apologize for any inconvenience and wish a better undertaking event next year.

WELCOMING SPEECH RECTOR UNESA

Conference and Convention

Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia (Aptekindo) 2018

Rich Palace Hotel Surabaya, 11-14 Juli 2018

Assalammu'alaikum Warahmatullahi Wabarakatuh.

Respectable Head of Universities, members of APTEKINDO
Distinguished Keynote speakers
Honorable authors, and fellow participants of APTEKINDO Conference and Convention 2018

Alhamdullilah, first of all, let us express our gratitude to Allah SWT because of his grace and blessings, we are able to attend this international Conference and convention of the Indonesia Association of Technology and Vocational Education or ***Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia*****(APTEKINDO)** held in Surabaya, 11-14 July 2018.

This international and national Conference is conducted biennially as a routine agenda held by Association of Technology and Vocational Educationor *Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia* (APTEKINDO), which consists of 16 different universities throughout Indonesia. We would like to thank for the opportunity given to Universitas Negeri Surabaya for hosting this year event.

In the raise of industrial revolution, Conferences, gatherings, and sharing of knowledge play an important meaning in supporting the acceleration of innovative science and technology. Therefore, this Conference's theme is ***"Revitalization ofTechnical and Vocational Education to Face Industrial Revolution 4.0".*** This is an interesting and challenging topic not only for academic researchers but also for stakeholders and industry owners.

Ladies and gentlemen,
Since 2011, the industrial sector has been integrated with the online system known as industrial revolution 4.0. The first industrial revolution was marked by the use of steam engines to replace human and animal power. The second stage of the revolution was marked by the utilization of electrical power and the concept of mass production. Furthermore, the application of automation technology brought the industrial revolution to its third stage. Tremendous revolution happened when information and communication technology was introduced and fully utilized in industrial area, of which the condition brought the world in the fourth stage of the industrial revolution. The utilization of this technology changed not only the production process, but also across the industrial chains that result in a new digital-based business model which can achieve higher efficiency and better quality in industrial products. The consequences of this revolution are the increase of production efficiency as well as changes in the employment prerequisite. There is an increasing demand for new manpower, whilst the machines are replacing the role of workers. This condition leads to the importance of a new and more advanced method of preparing human resources that are ready to compete in the industrial revolution.

TABLE OF CONTENT

Sub Theme 4: General Papers (GP)

The Effect of Neodymium-Iron-Boron Magnetism on Fuel Towards Four-Step Motorcycle Exhaust Emissions

Hasan Maksum
Universitas Negeri Padang
Indonesia
hasan_maksum@ yahoo.co.id

***Abstract*—Each substance has magnetic properties as well as hydrocarbons and each magnet has two different poles, north and south. Neodymium Iron Boron (NdFeB) Magnet is one of the strongest magnets used today. This was an experimental study and the results were seen from the percentage of the changes in the exhaust gas emission levels when using NdFeB configurations 1 and configuration 2 which are compared with the emission levels in the standard treatments. The results showed that there was a difference in exhaust emission levels generated using magnets and changing their direction. For RPM 3000, the rate of CO, HC, and CO2 emissions reductions in the use of first NdFeB configuration were 14, 5349%, 4.8544%, and 4.2969% of the standard treatment respectively whilst in the second configurations were 21.5116%, 35.9223%, and 23.0469%.**

Keywords— *neodymium iron boron; fuel combustion; exhaust gas emissions*

I. Introduction

Motor vehicles in Indonesia are significantly increasing year after year. This increase will certainly increase the air pollution surrounding it. The air pollution is, indeed, a serious issue of concern to the World Health Organisation (WHO) because of its negative adverse impact on human health as well as resulting in global warming.

Any substance present in nature has magnetic properties due to the spin motion/move that occurs in its constituent atoms. Each magnet has two different poles, namely, the north pole and the south pole. When the same pole is confronted, the magnets will then repel each other. When they are faced with a different pole, they will subsequently pull each other. The neodymium iron boron (NdFeB) magnet is one of the strongest magnets composed of rare earth material, neodymium material. This magnet is claimed stronger than the ferrite ones which are commonly used.

Similar to other substances, Hydrocarbon is a combination of atoms, namely, hydrogen atoms and carbon atoms. On this basis, the researcher is decidedly interested in researching the effect of neodymium-iron-boron magnetism on fuel to four-step exhaust gas emissions. This study aims at, firstly, determining the effect of neodymium-iron-boron magnetism on fuel to four-step exhaust gas emissions. Secondly, it determined the differences of the exhaust emission levels generated in the four-step motorcycles by changing the direction of neodymium-iron-boron magnets.

Theoritical Reviews

In essence, any substance or material on this planet has magnetic properties. All materials have magnetic properties "[1]. Another expert opinion affirmed that, "All materials experience magnetism, some more strongly than others. Permanent magnets, made from materials such as iron, experience the strongest effects, known as ferromagnetism "[2]. Basically, the atoms have magnetic properties due to the angular momentum possessed by their constituent base particles [3]. "The most important contribution to magnetism comes from the electron spin" [4] so that the magnetism found in the material comes from the spin motion/move and the angular momentum which exist in the constituent atoms of the material.

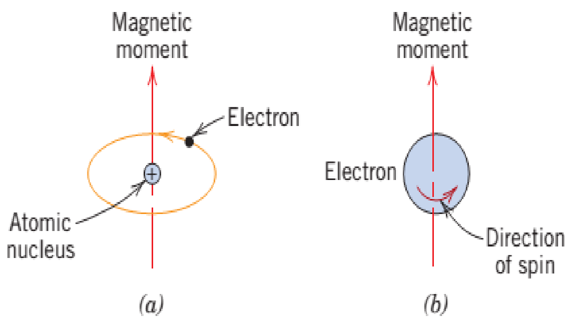


Fig 1. The direction of magnets generated by orbital and spin motion [5]

Based on Figure 1, it can be seen that the magnetic moment comes from the spin motion that occurs in the electron and the magnetic moment also has a direction based on where the direction of the electron spin occurs. *Neodymium iron boron is one of the strongest magnets that is claimed to be stronger magnet than the ferrite ones commonly used. "Ferrite magnets are also considered as strong magnets but not as strong as neodymium magnets" [6]*.

The use of NdFeB magnets is due to the high value of its remanence and coercivity. "One of the most important characteristics of the Nd-Fe-B rare-earth magnetic material is the high value of remanence and coercivity, which has a direct influence on the high values of maximum energy product" [7]. The followings are the nature of some types of magnetic material on Table 1. Based on Table 1, it can be seen that the value of Remanence Br (T), CoercivityHc (kA m-1), and energy production or (BH) max (kJ m-3) NdFeB magnet is higher than the stated magnet and ferrite magnet including one of them.

TABLE I. NATURE OF SEVERAL TYPES OF MAGNETIC

Material	Br (T)	Hc (kA m^{-1})	(BH) max (kJ m^{-3})
Alnico	1,30	52	44
Barrium ferrite	0,35	144	26
Vicalloy II	1,1	22	14
Neodymium iron boron	1,35	780	320
Samarium cobalt	0,92	690	200
Platinum cobalt	0,64	400	76

Perfect combustion will produce exhaust gas in the form of carbon dioxide (CO2), water vapour (H2O) and nitrogen. As stated by Hill (2010: 11) that during the combustion process, hydrocarbons react with atmospheric oxygen and produce carbon dioxide, water vapour and nitrogen but the burning of hydrocarbons in the combustion chamber is far from 100% efficiency thus it generates the other gases derived from the incomplete combustion. The following is the reaction of hydrocarbon combustion with perfect air.

$$C_\alpha H_\beta O_\gamma + \left(\alpha + \frac{\beta}{4} - \frac{\gamma}{2}\right)(O_2 + 3.76N_2) \rightarrow \alpha CO_2 + \frac{\beta}{2}H_2O + 3.76\left(\alpha + \frac{\beta}{4} - \frac{\gamma}{2}\right)N_2$$

The equation of the reaction. The reaction of hydrocarbon combustion with air [9]

"*In theory, this ratio for gasoline is an air-fuel mixture of 14.7 to 1. In reality, the exact ratio at which perfect mixture and combustion occurs depends on the molecular structure of gasoline, which can vary*"[10]. Thus, the molecular structure of the fuel used affects the exhaust emissions generated in the combustion process.

The hydrogen molecule in the hydrocarbon compound has the electrons and a rotating proton, this rotation can occur in the same direction with the other hydrogen atoms, or in the opposite directions. "*However, in the same hydrogen molecule we have two protons, whose spins may also be "parallel" (orthohydrogen) or anti-parallel (para-hydrogen)*"[11], the other expert stated that, "*Hydrogen occurs in two distinct isomeric forms Para and ortho. It is characterized by the different opposite nucleus spins*"[12]. Hydrogen in hydrocarbons in ortho state is more reactive than in Para. "*The coincident spins render o-H2 exceedingly unstable and more reactive than its p-H2 counterpart*"[13].

"*Research in the last ten years has highlighted the dramatic influence that magnetic fields can have on chemical reactions in gases, liquids and solids*"[14], the other sources affirm that "*Frequently, radicals with unpaired electrons appear during a chemical reaction. Magnetic fields can influence the kinetics or the yields of some chemical reactions due to the radicals*" [3]. Thus, it can be seen that the magnetic force can occur in the fluid and also in a chemical reaction.

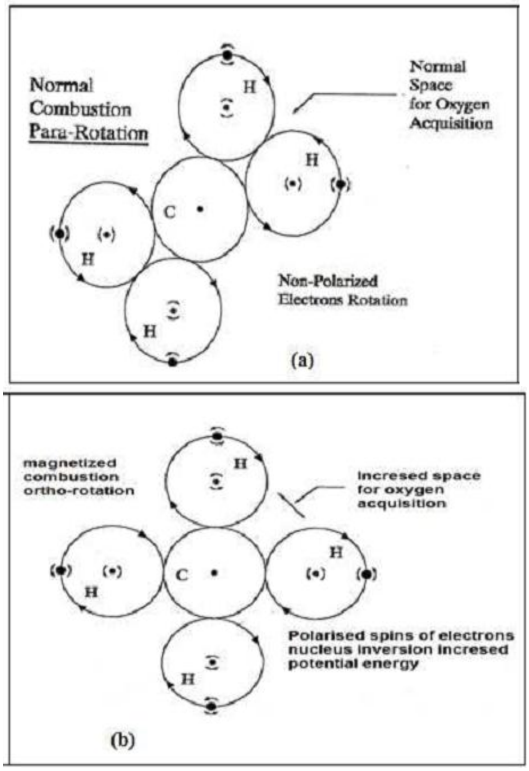


Fig 2. Illustration of parahydrogen changes to orthohydrogen. [12]

The external magnetic fields are capable of converting parahydrogen into ortho-hydrogen. Further, the other opinions claim, "*The magnetic field can change the spin state of hydrogen molecules in the fuel (converted from para–hydrogen to ortho–hydrogen) which greatly enhances the energy of the atom and increases fuel reactivity leading to higher engine output,...*"[15]. The conversion of parahydrogen to orthohydrogenis results in more space for oxygen to bind to hydrogen. This change can be seen in Figure 2.

The effect of the magnet on the combustion process can also be seen from the combustion enthalpy that occurs. The combustion occurs before using the magnet and after using the magnet can be seen in Figure 3.

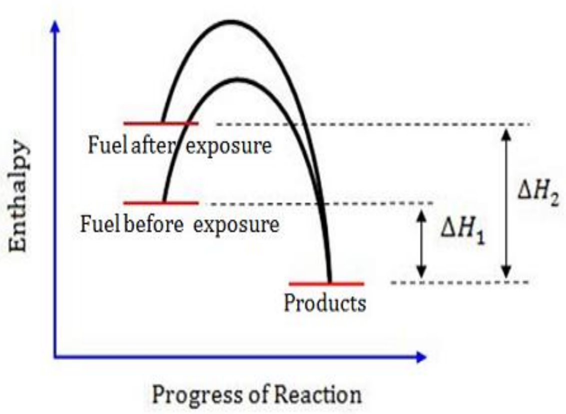


Fig 3. Combustion enthalpy before using magnet and after using magnet[16]

When an exothermic reaction produces a more negative enthalpy signifying at the time of reaction more reactants react so that the combustion becomes more perfect.

II. Method

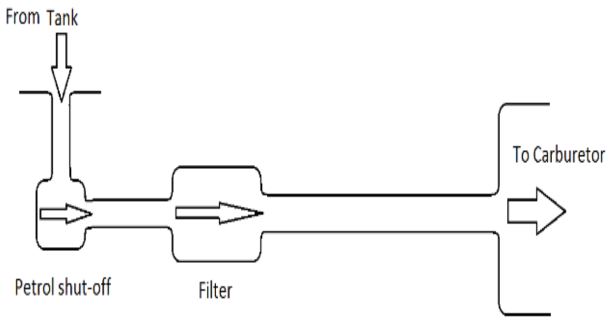
This research was the experimental research. The research was used to find the influence among the existing variables and to test the hypothesis. This experimental study used treatment or treatment of a particular group, and after the treatment was done and then evaluated to notice its effect. The study was intended to reveal the effect of neodymium-iron-boron magnetism on fuel to four-step exhaust gas emissions.

This study uses the percentage formula;

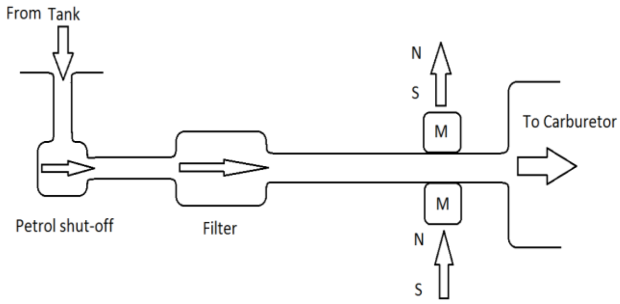
$$P = \frac{N}{n} \text{ x } 100\% \quad (1)$$

Detailed descriptions:
P = Percentage rate expected to obtain.
n = mean exhaust emissions at standard treatment.
N = Mean exhaust emissions at different treatments.

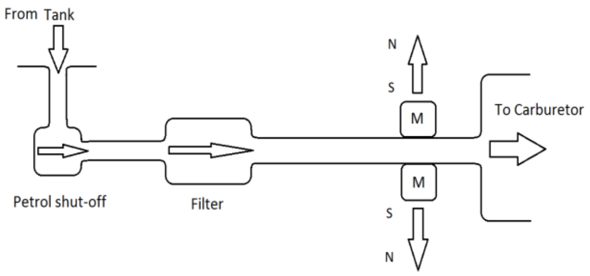
The NdFeB magnets are placed on the fuel line before the carburettor, with configuration 1 (pole direction) and configuration 2 (polar opposite direction), then notice what level of exhaust emission generated based on the emission level on the standard treatment. Exhaust emission levels observed were carbon monoxide (CO), hydrocarbon (HC), carbon dioxide (CO2). Then the data is processed and presented in graphical form. Then we can notice the difference of emission levels generated after using the magnet with one configuration and the two configuration, the x-axis with the zero coordinates shows the limit value of emission levels generated in the standard state. The following is a picture of his work in Figure 4.



(a)



(b)



(c)

Fig 4. (a) Standard treatment, (b) Configuration 1, (c) Configuration 2.

III. Results and Discussion

A. *Findings*

Based on the research that has been undertaken, the results are presented in table form as in Table 2. Then notice how the increase and decrease of the exhaust gas level in configuration 1 and configuration 2 than the standard treatment as in Table 3.

TABLE II. PERCENTAGE OF DATA ANALYSIS OF EXHAUST GAS EMISSION LEVEL.

Content of emissions	RPM	Standard (%)	Configura-tion 1 (%)	Configura tion 2 (%)
CO	1500	100	103,0769	75,6923
	2000	100	129,5238	107,6190
	2500	100	97,0874	96,1165
	3000	100	85,4651	78,4884
HC	1500	100	104,5455	85,1240
	2000	100	115,5963	87,1560
	2500	100	96,1538	94,2308
	3000	100	95,1456	64,0777
CO_2	1500	100	102,2388	94,7761
	2000	100	97,8378	78,9189
	2500	100	95,2381	83,8095
	3000	100	95,7031	76,9531

TABLE III .PERCENTAGE OF DECREASE AND INCREASE ON EVERY CONFIGURATION MAGNET AGAINST STANDARD CONDITION.

Content of Emission	RPM	Configura-tion 1 (%)	Configura-tion 2 (%)
CO	1500	3,0769	-24,3077
	2000	29,5238	7,6190
	2500	-2,9126	-3,8835
	3000	-14,5349	-21,5116
HC	1500	4,5455	-14,8760
	2000	15,5963	-12,8440
	2500	-3,8462	-5,7692
	3000	-4,8544	-35,9223
CO_2	1500	2,2388	-5,2239
	2000	-2,1622	-21,0811
	2500	-4,7619	-16,1905
	3000	-4,2969	-23,0469

Table III shows the reduction and increase in exhaust emissions generated using configuration 1 and configuration 2 seen from emission levels at standard treatment. A minus value (-) indicates a decrease in exhaust emission levels generated.

B. Discussion

The existing data are presented in graphical form as in Figure 5 as follows.

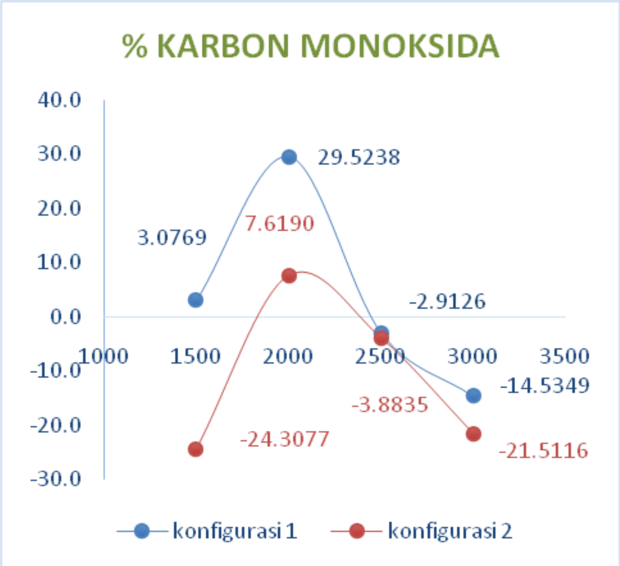


Fig 5. Graph of the Differences of the Percentage of CO.

The exhaust emissions in the standard condition are projected in a straight line on the x-axis of zero coordinates. Similarly, the level of exhaust emissions in the form of hydrocarbons can be seen in Figure 6.

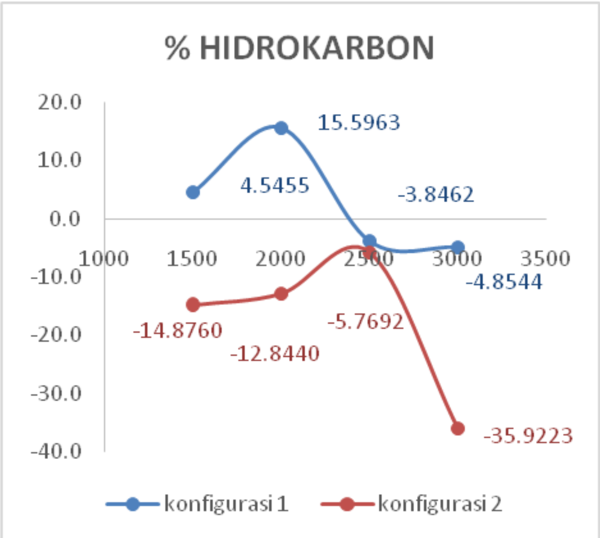


Fig 6. Graph of the Differences of the Percentage of HC

In the configuration 1, the value of the HC, at the initial RPM, increased by 4.5455% from the standard treatment, whereas the 2nd configuration instantly decreased by 14.8760%. At the RPM 3000 the emission levels of both configurations are lower than emissions on standard treatments.

Exhaust emission levels of carbon dioxide can be seen in Figure 7.

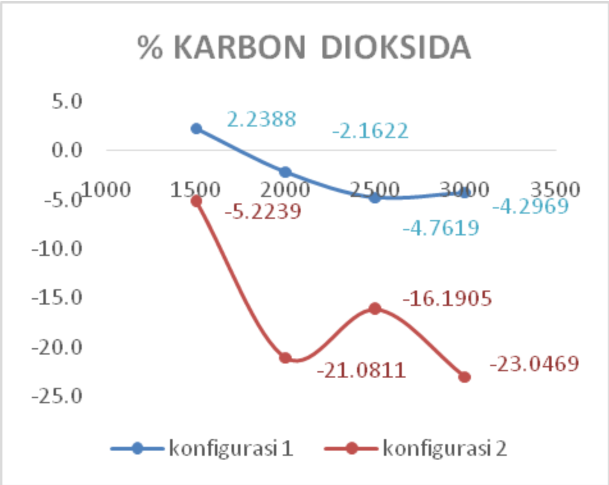


Fig 7. Graph of the Differences of the Percentage of CO_2

The NdFeB magnetism can increase and decrease the levels of the CO, HC and CO2 emissions, depending on which configuration is used. The obvious effect can be seen in Figure 7, that there is a decrease in CO2 emission levels after using NdFeB magnet compared to the levels of emission at standard treatment (without using the magnet). In Figure 5, the level of the CO emission in configuration 1 increased at the RPM 1500, but on test at RPM 3000, its CO emissions decrease. Likewise, the percentage difference rate of emissions of HC and CO_2 which is reviewed from the level of emissions on standard treatment can be seen in Figures 6 and 7. The emission level of each configuration is also different, for an example, the Figure 5 indicated that configuration 1, the CO emission level at the RPM 1500 increased by 3.0769% whereas configuration 2, it decreased by 24.3077%, whilst, at the RPM 3000, it decreased at the configuration 1 by 14, 5349%, whilst at the configuration, while in configuration 2, decreased by 21.5116% when viewed from the standard treatment.

IV. Conclusion

The results showed that at RPM 3000, the CO emission level decreased when the fuel used was affected by neodymium-iron-boron. Then, the HC emission decreased to 17.3529% in configuration 2 when viewed from standard treatment, the CO2 emissions up to 16, 3856% in configuration 2 when viewed from standard treatment.

There were differences in the exhaust emission levels generated on four-step motorcycles by changing the direction of the neodymium-iron-boron magnets, namely, at the configuration 1 and configuration 2. The levels of CO, HC and CO2 emissions which were produced by four-step motorcycles using NdFeB magnet configuration 2 was lower than NdFeB magnets in configuration 1. The level of CO emission using NdFeB in the configuration 1 at the RPM 1500 increased by 3,0769% while at the configuration 2, it declined by 24,3077%, then at the RPM 3000, the emission at the configuration 1 decreased by 14,5349% whereas at the configuration 2, it decreased by 21,5116% if viewed from standard treatment.

References

[1] Edvard .(2011). Materials with magnetic properties. Csanyi Group. diakses tanggal 26 Januari 2015. <http://electrical-engineering-portal.com/materials-with-magnetic-properties>.

[2] Lewis, Tanya. (2013). *What is Magnetism?*.Live Science. Diakses tanggal 10 Desember 2014. <http://www.livescience .com/38059-magnetism.html>

[3] Yamaguchi, Masuhiro & Tanimoto, Yoshifumi. (eds) (2006). *Magneto-Science: Magnetic Field Effects on Materials: Fundamentals and Applications*. Tokyo: Springer.

[4] Bécherrawy, Tamer .(2012). *Electromagnetism:Maxwell Equations, Wave Propagation, and Emission.* Hoboken: Wiley.

[5] Callister, W., D., Jr., & Rethwisch, D., G. (2010). *Materials Science and Engineering: An Introduction.* 8th. ed. Hoboken: John Wiley & Sons, Inc.

[6] Patel P. M., Rathod G., P & Patel T., M .(2014). "Effect of Magnetic Field on Performance and Emission of Single Cylinder Four Stroke Diesel Engine". *IOSR Journal of Engineering*. Vol 04. No 05. pp 28-34.

[7] Grujić, Aleksandar *et al* .(2011). *'Magnetic and Dynamic Mechanical Properties of Nd-Fe-B Composite Materials with Polymer Matrix'. in*J Cuppoletti (ed). *Metal, Ceramic and Polymeric Composites for Various Uses.* Rijeka: InTech. pp. 505-524.

[8] McCurrie. R. A. (1994). *Ferromagnetic Materials: Structure and Properties*. Great Britain: Academic Press

[9] McAllister, S., Chen J.Y & Pello, A.C.F. (2011).*Fundamentals of Combustion Processes.* New York: Springer

[10] Halderman J., D., & Linder, Jim. (2012). *Automotive Fuel And Emissions Control Systems*. 3rd. ed. Upper Saddle River: Prentice Hall.

[11] Piela, Lucjan. (2007). *Ideas of Quantum Chemistry*. Oxford: Elsevier.

[12] Ugare, V., Bhave, N & Lutade, S. (2013). "Performance of Spark Ignition Engine Under The Influence of Magnetic Field". *International Journal of Research in Aeronautical and Mechanical Engineering.* Vol. 1. No. 3. pp 36-43

[13] Govindasamy P & Dhandapani S. (2007). "Performance and Emission Achievements by Magnetic Energizer With A Single Cylinder Two Stroke Catalytic Coated Spark Ignition Engine". *Journal of Scientific & Industrial Research*. Vol. 66. pp. 457-463.

[14] Pankhurst, Q., A. & Parkin I., P. (2012) *'Chemical Reactions in Applied Magnetic Fields'. In* J S. Miller & M Drillon (eds). *Magnetism: Molecules to Materials IV: Nanosized Magnetic Materials.* Weinheim: Wiley-VCH. pp. 467-480.

[15] Khalil, Ra'ad A. (2011). "Reduction of Pollutant Emission in Ethanol-Gasoline Blends Engines with Magnetic Fuel Conditioning". *Al-Rafidain Engineering.* Vol. 20. No. 3. pp. 148-154.

[16] Jalali, Mahsa *et al.* (2013). "Enhancement of Benzine Combustion Behavior in Exposure to the Magnetic Field".

Journal of Clean Energy Technologies. Vol. 1. No. 3. pp. 224-227

RISTEKDIKTI

APTEKINDO

Asosiasi Pendidikan Teknologi dan Kejuruan Indonesia

ASSOCIATION OF INDONESIAN TECHNOLOGY AND VOCATIONAL EDUCATION

UNESA

CERTIFICATE

This is to certify that

HASAN MAKSUM

has participated as

PRESENTER

International Conference

"Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0"

at The 9th National Convention of Indonesian Association of Technological and Vocational Education (APTEKINDO)

Surabaya 11th - 14th July 2018

Organized by

Faculty of Engineering - Universitas Negeri Surabaya

Indonesian Association of
Technological and Vocational Education
Chairman,

ASOSIASI PENDIDIKAN TEKNOLOGI DAN KEJURUAN INDONESIA · APTEKINDO · PENGURUS PUSAT

Prof. Dr. Ekohariadi, M.Pd.

Surabaya, 14th July 2018

Head Of Committee,

Drs. Tri Wrahatnolo, M.T., M.Pd.