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Analysis Characteristics Hybrid Coolant Nanoparticles As a Cooling Media for Genset Generator

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ABSTRACT

Industry nanotechnology- based is a very significant new modern era, where throughout field develop and use it. In the world of technology as primary needs at the moment This for society, has Lots use results its products. Cooling system as balancers in the industrial world including generators require gensets research and development For cool diesel generator engine . Hybrid coolant has composition 30% material natural and 70% distilled water. The addition nanoparticles to in hybrid coolant of 1% (TiO_2-SiO_2-Al_2O_3). The test was carried out is temperature point education, pH value, density. Analysis results The characteristics of hybrid coolant are point boiling 99°C, pH value between 5.79-6.06, as well mark density of 1,012-1,024.

Keywords: Hybrid coolant, Nanoparticles, Genset Generator.

Introduction

Development nano technology is already very significant modern, as shown from development industry nano technology based like: paint industry, industry fertilizer and seed, industry packaging, manufacturing industry, and industry automotive. Very rapid development and benefits felt by several user give motivation to industry and consumers For use nanotechnology in life everyday [1].

Palm oil is plants that can produce oil vegetable and many used as oil eat [2]. Fresh fruit bunches (FFB) of coconut palm oil that has harvested will the crude palm oil (CPO) refining process is carried out, where the process is boiling (sterilizer), threshes, pressing (press), purification [3]. CPO that has been obtained will reprocessing is done become a number of product derivatives, such as cooking oil, ingredients cosmetics, ingredients paint mixing, materials product food (margarine, creamer, mayonnaise, etc.), ingredients standard in the field health & medicine, as well as other products used For health and automotive [4]. Currently derivative from results processing oil coconut palm oil in

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the form of ethelyne glycol, propelyne glycol, and glycol derivatives can produced from material standard coconut palm oil [5]. Ingredients This is materials used For need paint industry, resin, coating, automotive as mixing coolant in engines industry.

Nanoparticles is particles created with very small size with nanotechnology. Utilization nano particles aim For repair and refinement performance from a system, such as heating (heating system), system cooling system, and other systems that have been Lots used, such as the paint coating process, where can cover pores material parent so that covered with perfect [6]. Some other technologies that are used in system cooler is nanoparticles made from metal originating from from plant used to speed up the process expenditure the heat inside system [7]. Nanoparticles made from metal own ability For deliver good heat (conduction), so that can bring hot from the source to place (environment) outside [8]. Nanoparticles made from metal with very small size as well as capable mixed perfect with liquid media, so that capable give benefit as a cooling medium (coolant) in the engine used [9, 21-24].

Frequently used cooling media called with coolant, in general only using water as a medium material cooler. Where water is the easiest ingredients as well as cheap For get it. However Thus, there is less water Good own shortcomings, such as causes rust (corrosive), contains substance carrier impurity (sludge), containing element metal that can settles on the system [10, 25]. Currently researcher from the coolant system has analyze and try look for simulation and exact formula For get a replacement coolant for water. The coolant that is currently. This Already start develop in system radiator cooler for motorbikes, cars, vehicles heavy, and generators for anticipate from damage engine, overheating in system, as well as corrosive that occurs inside system, so that cause blockage [11]. Coolant For diesel engine as mover from electric generator generator moment. This Still little and have enough opportunities significant For conducting research process more continue [12].

Methods

Preparation

Researcher do preparation tools and materials used in the process of researching coolants based on derivative coconut palm oil. The tools used namely: glass beaker, measuring glass, magnetic stirrer, ultrasonicator, flask separator. Materials used is 70% distilled water, glycerol 5 %, ethelyne glycol 10 %, Proprlyne glycol 20 %, and Refine Bleaching Deodorizing Palm Olein CPO (RBDPO) 10%, nanoparticles as much as 1% (TiO_2, SiO_2, Al_2O_3).

Preparation the tool that will used, then material coolant (aquadest, glycerol, ethelyne glycol, propelyne glycol, and RBDP) and nanoparticles entered to in glass beaker. Next fluid the done mixing for 10 minutes use magnetic stirrer. Next shaking is done using ultrasonicator during one hour with temperature 55°C, after finished, then step final is separation between coolant with fluid light that is in the part on from coolant.

Testing

Testing density

The density of the material is a the value that is owned each material and states characteristics from a material in unity mass form volume [13]. The more big mark the density it has, then will the more congested as well as ionic bonds that occur the more big and tight, but the more small mark the density it has a material, then the more light and ionic bonds that occur between them the more far (distant). To know mark density in liquids, in simple can use pumpkin measure (pycnometer), where The pycnometer has a volume of 25 ml. The image is show mark density can seen in **Figure 1**.

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Figure 1. Weighing Pycnometer

Testing point boil

Point boil is ability fluid liquid evaporate at the moment given temperature high, so that fluid changed form from liquid going to gas [14]. The heat provided will seen clear on the fluid that will be reach temperature boil with pair mercury thermometer. At the time fluid Already to look for point boil, then noted as well as analysis the result. The heating used is use stove electricity with 300 W. Provision temperature warmup in a way constant will give heating that can known in a way easy and fast in process point boiling. As for the testing process point boil can seen in **Figure 2**.

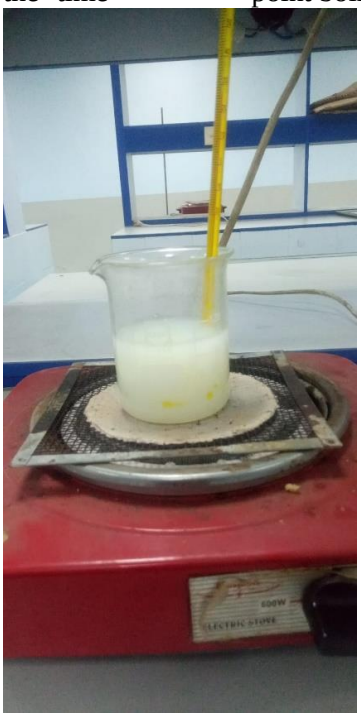

Figure 2. Testing Point Boiling Coolant

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pH testing

pH (power of hydrogen) is characteristics from fluid measured liquid For know level acidity and also the bases it has [15]. The more tall its value, then will called language, whereas the more low pH value owned will it is said acid . For normal pH value is of 7-9 [16]. Measurement data For knowing the pH of the fluid can known with using a pH meter. The relationship the use of pH meter is know acids and bases, where the more acids and bases owned fluid liquid, then will result in the more fast process rate corrosive to materials the metal that it is exposed to [17]. So that required neutral/normal fluid, so that No happen rate rapid corrosiveness to materials metals that are in contact [18]. Tools for measuring the pH of fluids can using the pH meter shown in **Figure 3**.

Figure 3. pH Meter

Results and Discussion

Hybrid coolant based on natural additives (coconut) palm oil at the moment This is development and utilization results from CPO which will applied for fluid generator genset cooler. Generator genset is a generator power electricity that uses diesel engines burn diesel fuel to mover mainly. Coolant that has been Ready For applied to generator engine used as diesel engine coolant. The cooling media that is usually only using fresh water from source spring, when This researcher use ingredients from derivative oil palm oil as coolant mixture besides aquadest. The result of making a cooling medium (coolant) with material derivative coconut palm oil can seen in **Figure 4**.

Figure 4. Coolant Based Palm Oil Derivatives

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Coolant that has been made with several stages of the process, starting from mixing magnetic stirrer, unification fluid coolant with sonication process (using frequency vibration) with give warmup in 1 hour time, and stage final will the separation process is carried out with use pumpkin separator. The results that have been finished processed, will done a number of testing characteristics from coolant. Test results This aiming For know abilities & traits coolant characteristics that have been produced. Coolant is done testing density with objective For know ionic bonds occur , so that obtained characteristics that are not Far different with coolant base (water) as material common cooler used [20]. The results testing density coolant can seen in **Table 1**.

Table 1. Test Data Density Coolant

No	Picno Empty (gr)	Volume (ml)	Pycno+Fluid (gr)	Density (gr/ml)
1	23.39	25	48.67	1.0112
2	23.38	25	48.68	1,012
3	23.39	25	48.68	1,0116
4	23.39	25	48.7	1.0124
5	23.39	25	48.69	1,012

In **Table 1**, it can be seen that mark density formed from coolant results mixing derivative coconut palm oil can to match from water which is basically used, where water has density 1 gr/ ml [19]. This can also be displayed in **Figure 5**, where mark density coolant no own very significant value . This is also influenced by the material derivative palm oil which is polar and can mixed in a way perfect in distilled water as substance dissolved. Condition This allow can used as generator coolant for change the water.

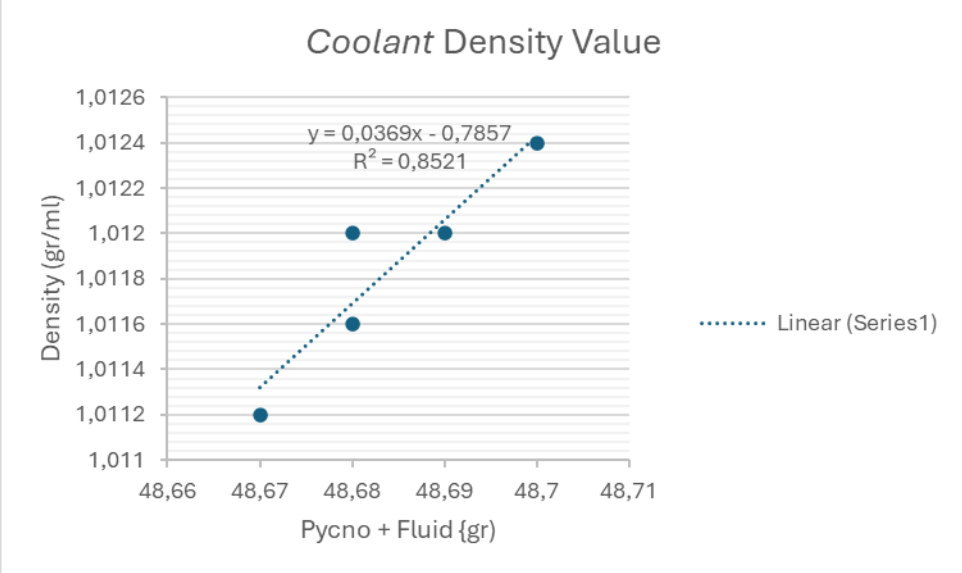

Figure 5. Density Value Graph Coolant

In **Table 2**, it states that coolant from material derivative coconut palm oil own mark acid seen from results testing . Based on base mark neutral from the power of hydrogen (pH) namely between 7-9. Test score This give mark sour, but Still approaching the safe limit in the process of speed corrosive formed . The value testing can seen in **Table 2**. Testing furthermore is ability for see point boiling fluid coolant that has been processed. Test results can seen in the following this bellow in **Figure 6**.

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Table 2. Coolant pH Value

No	pH value	Temperature (°C)
1	6.06	24.8
2	5.79	24.6
3	5.84	24.6
4	5.88	24.7
5	5.79	24.5

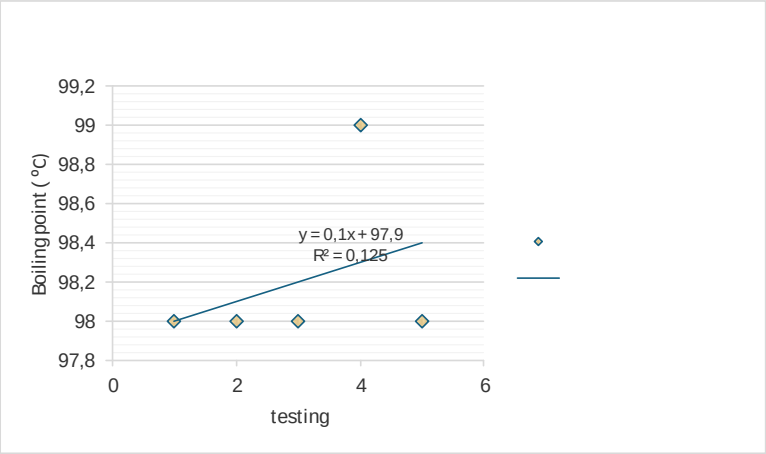

Figure 6. Graph Point Boiling Coolant

In **Figure 6** above, it can be seen that from the 5th test that has been done For know point boiling, most is at 98°C, and there is 1 experiment that can reaching 99°C. With make chart from the test data that has been carried out, namely : Y = 0.1x + 97.9 and R^2 = 0.125. With thus regression formed from test data can to obtain results Enough Good in process point boil and can used as a coolant. Coolant that has been finished processed, will done visual testing with using a test tube, where testing This aiming For knowing the coolant that has been mixed in a way perfect will analyzed with time. With the walk time as the retention time of the coolant, then will cause sedimentation (deposits) of materials heavy and light from the coolant mixture. With add nanoparticles as material plus For speed up the cooling process in the generator radiator. As for visual testing on the reaction tube can seen in **Figure 7**.

Figure 7. Nanoparticle Coolant in Reaction Tube

Conclusions

A number of results testing conducted by researchers in to make/to form hybrid nanoparticle coolant namely: hybrid coolant has composition 30% material natural and 70% distilled water. The addition nanoparticles to in hybrid coolant of 1% (TiO_2 -SiO_2 -Al_2O_3). The tests carried out is temperature point education, pH value, density. Analysis results characteristics hybrid coolant is point boiling 99°C, pH value between 5.79-6.06, as well mark density of 1,012-1,024. visual testing process is carried out get results No happen separation between fluid, where material derivative palm oil is made from polar base and can united in a way perfect with water, so that the hybrid coolant has produced can replace water media as generator cooler, friendly environment, and sustainable.

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Author Contributions

ABR, HS, IBR, AIR: Conceptualization, method, writing, analyses, supervision, review, ALS: editing review, IBR, AIR: methodology, ALS, ABR, ES: methodology, analyses, ABR, IBR, ES: drafting, ABR, ALS, HS: experiment, data experiment.

Conflicts of Interest

The authors declare no conflict of interest in this paper.

References

[1] Ariningsih, Ening. "Prospek penerapan teknologi nano dalam pertanian dan pengolahan pangan di Indonesia." *Forum Penelitian Agro Ekonomi*. Vol. 34. No. 1. 2016.

[2] Siregar, Ameilia Zuliyanti. "Kelapa Sawit: Minyak nabati berprospek tinggi." (2006).

[3] Ageta, Asteria Noventi, and Ratna Purwaningsih. "Pemetaan Supply Chain Pengolahan Tandan Buah Segar (Tbs) Menjadi Crude Palm Oil (Cpo) Dan Inti Kernel Di PKS Sawit Seberang." *Industrial Engineering Online Journal* 12.4 (2023).

[4] Irawan, Bambang, and Nining Indroyono Soesilo. "Dampak kebijakan hilirisasi industri kelapa sawit terhadap permintaan CPO pada industri hilir." *Jurnal Ekonomi & Kebijakan Publik* 12.1 (2021): 29-43.

[5] Sholihah, Sovia Masfuri Walidatus. *Sintesis dan Karakterisasi Bioaditif Bahan Bakar Solar sebagai Peningkat Lubrisitas dari Minyak Sawit*. Diss. Institut Teknologi Sepuluh Nopember, 2022.

[6] Saptaji, Kushendarsyah, et al. "Studi Pengembangan Nanofluida Hijau Berasal Dari Bahan Lokal Alam Untuk Aplikasi Di Bidang Teknik." *Jurnal Teknologi* 15.2 (2023): 345-358.

[7] Rahardja, Istianto Budhi, et al. "Inovasi dan Kemajuan Teknologi Bidang Kelapa Sawit Sebagai Kearifan Natural Materials Indonesia." *Prosiding Seminar Nasional Penelitian LPPM UMJ*. Vol. 1. No. 1. 2023.

[8] Ramadhan, Anwar Ilmar, et al. "Aplikasi Nanofluida Hijau untuk di Aplikasikan pada Sistem Pendingin Motor." *Prosiding Seminar Nasional Penelitian LPPM UMJ*. Vol. 1. No. 1. 2023.

[9] Ma, Kun-Quan, and Jing Liu. "Nano liquid-metal fluid as ultimate coolant." *Physics Letters A* 361.3 (2007): 252-256.

[10] Pattireuw, Kevin Jones, Fentje Abdul Rauf, and Romels Cresano Apelles Lumintang. "Analisis laju korosi pada baja karbon dengan Menggunakan air laut dan H2SO4." *Jurnal Poros Teknik Mesin UNSRAT* 2.1 (2013).

[11] Fatmawati, Anni, et al. "Analisa Penggunaan Coolant Terhadap Sistem Pendingin Pada Kendaraan Roda Empat Di Politeknik Negeri

ISSN : 2085 – 1669
e-ISSN : 2460 – 0288

Samarinda." *MEKANIK* 16.2 (2023): 8-14.

[12] Yadav, R. J., and R. S. Verma. "Effective utilization of waste heat from diesel genset to run air conditioning plant." *proceedings of national conference on advances in energy research (AER-2006), IIT Bombay*. 2006.

[13] Sukanto, Heru. "Pengaruh Suhu Sintering Terhadap Densitas dan Kekuatan Komposit Plastik-Karet." *Jurnal Ilmiah Teknik Mesin* 3.1 (2009): 57-61.

[14] Bhirawa, Gama Kusuma. *Pengaruh Temperatur Dan Waktu Proses Perengkahan Katalitik Crude Palm Oil Terhadap Nilai Oktan Dan Titik Didih Biogasoline Menggunakan Katalis γ-Al2O3*. Diss. Institut Teknologi Sepuluh Nopember, 2023.

[15] Harianti, Hasrianti, and Nurasia Nurasia. "Analisis warna, suhu, pH dan salinitas air sumur bor di Kota Palopo." *Prosiding* 2.1 (2016).

[16] Zulius, Antoni. "Rancang Bangun Monitoring pH air menggunakan soil moisture sensor di SMK N 1 Tebing Tinggi Kabupaten Empat Lawang." *Jusikom: Jurnal Sistem Komputer Musirawas* 2.1 (2017): 37-43.

[17] Buchori, Muhammad Lukman. *Identifikasi tingkat, jenis, dan faktor-faktor penyebab kesulitan siswa MA Negeri Wlingi dalam memahami materi indikator dan pH larutan asam-basa*. Diss. Universitas Negeri Malang, 2013.

[18] Haidir, Andi, Anditania Sari Dwi Putri Tania Dwi, and Ely Nurlaily Ely Nurlaily. "Analisis Laju Korosi Paduan Aluminium Feronikel Pada pH Basa Dengan Potensiostat." *PIN Pengelolaan Instalasi Nuklir* 10.18 (2017).

[19] Kasli, Elisa, and Aminullah Aminullah. "Pengaruh massa jenis benda terhadap tekanan hidrostatis." *Jurnal Pendidikan Geosfer* 1.1 (2016).

[20] Ramadhan, A.I., Umar, E., Azmi, W.H. and Sari, A.M., 2024. Heat transfer performance of Al2O3-TiO2-SiO2 ternary nanofluids in plain tube with wire coil inserts. Mechanical Engineering for Society and Industry, 4(1), pp.50-67.

[21] Ramadhan, A.I., Sari, A.M., Saptaji, K., Rahardja, I.B., Umar, E., Perdana, S.Y. and Azmi, W.H., 2023. Characterization and Stability of ZrO2-SiO2 Nanofluids from Local Minerals Indonesia as Green Nanofluids to Application Radiator Cooling System. Journal of Advanced Research in Fluid Mechanics and Thermal Sciences, 111(2), pp.126-140.

[22] Ramadhan, A.I., Diniardi, E., Basri, H., Almanda, D. and Azmi, W.H., 2023, May. Experimental investigation of thermal conductivity of Al2O3-TiO2-SiO2 nanofluids in EG/water mixture for automotive radiator cooling system. In AIP Conference Proceedings (Vol. 2706, No. 1). AIP Publishing.

[23] Ramadhan, A.I., Azmi, W.H., Sharma, K.V. and Umar, E., 2022. Experimental Investigation of Thermal Properties of Ternary Nanofluids in Water-Ethylene Glycol (60: 40) Mixture. Journal of Applied Sciences and Advanced Technology, 5(1), pp.13-26.

[24] Diniardi, E., Basri, H., Ramadhan, A.I., Almanda, D. and Sari, A.M., 2022. Studi Eksperimental Perpindahan Panas Dan Penurunan Tekanan Dari Hibrida Nanofluida Di Pendingin Radiator Mobil. *Jurnal Teknologi*, *14*(2), pp.221-232.

[25] Hamisa, A.H., Azmi, W.H., Yusof, T.M., Ismail, M.F. and Ramadhan, A.I., 2022. Rheological Properties of TiO2/POE Nanolubricant for Automotive Air-Conditioning System. *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, *90*(1), pp.10-22.