p–ISSN: 2723 - 6609 e-ISSN: 2745-5254
Vol. 5, No. 7 July 2024 http://jist.publikasiindonesia.id/

Analysis of the Effect of Temporal Changes on the Coolant Viscosity of the Pendinggin System on Motorcycles

Zein Muhamad[1*], Indra Surya[2], Gilang Prayoga[3]
Universitas Bandar Lampung (UBL), Indonesia
E-mail: zein.muhamad@ubl.ac.id[1*], indra.surya@ubl.ac.id[2], gilang.20321017t@student.ubl.ac.id[3]
*Correspondence

Keywords: temperature change, viscosity, cooling system.

ABSTRACT

A combustion motor is a machine that converts chemical energy to motion energy, where the working system of a combustion motor produces power or engine rotation which is produced from the process of combustion in the combustion chamber (cylinder). In addition to producing power and rotation, it also produces heat (thermal) as a result of the combustion process. Excessive heat generated by the combustion process can also cause problems if not overcome properly, can cause overheating. Therefore, a good cooling system such as radiator coolant is needed, in the fluid cooling system there is viscosity (viscosity of the substance) which can affect the absorption of heat. The following are the test results at temperatures of 27.8oC (0.35dpa.s), 70oC (0.275dpa.s), 90oC (0.25dpa.s). If the viscosity value is low, then in the flow rate the faster the heat absorption and heat transfer will be more effective, while if the viscosity value is high, then in the flow rate the slower the heat absorption and heat transfer process becomes ineffective.

Introduction

A combustion motor is a machine that converts chemical energy to motion energy, wherein the working system of a combustion motor produces power or engine rotation which is produced from the process of combustion in the combustion chamber (cylinder) between fuel mixed with air and then compressed by the piston and then sparks by spark plugs (spark plugs) then an explosion or combustion occurs in the combustion chamber which produces power or rotation. (Muchlisinalahuddin, 2018). In addition to generating power or rotation, it also produces heat (thermal) as a result of the combustion process (Wantasen, Luntungan, & Tarore, 2020).

Excessive heat generated by the combustion process can also cause problems if not overcome properly, if not handled properly because it can cause overheating and can also cause damage to other engine components (DESKAM, 2023). A good cooling system such as a coolant radiator is useful to keep from overheating and maintain the temperature so that it is always optimal, this system works using a cooling fluid (coolant) that passes through the part to be cooled such as a water jacket (SARI, Hadiyanto, & Muhammad, 2019).

The viscosity of a coolant is determined by the amount of friction between the particles in the coolant. The higher the viscosity value, the more difficult it is for the fluid to flow and the more difficult it is for the fluid to move in the liquid. (Santiko & Heriyawan, 2024).

Newton's law of viscosity states that at a constant rate of angular deformation of a fluid, the shear stress is directly proportional to the viscosity [Victor L. Streeter, E. Benjamin Wylie Linguist Arko Prijiono 1958 (Darmawan, 2023). In addition to the time meeting, the type of fluid temperature also greatly determines the level of viscosity. (Wanti, 2015).

Viscosity is a disadvantage that is related to the obstacle to the manager. Some fluids can flow quickly but some are slow. Flowing fluids such as glycerin, honey, and oil, this is because they have a large viscose. Therefore, viscosity will affect the flow speed of a fluid. (LILIPALY & MAYA, 2018).

Heat Transfer By Conduction is the process of transferring heat from a high-temperature area to a low temperature in a solid medium or by medium-medium is different from direct interaction. In conduction flow, the transfer of energy occurs through direct molecular bonding without the movement of large molecules. (Permatahati, 2019). According to kinetic theory, the temperature of a material element is proportional to the average kinetic energy of the molecules that make up the element. The energy possessed by a material element caused by the velocity and relative position of its molecules is called inner energy. (Mufidah et al., 2023). Therefore, the faster the molecules move, the higher the temperature and energy of the elements of matter. Conduction is the only mechanism by which heat can flow in a solid substance that is impermeable to light.

The basis for heat transfer was proposed by a French scientist, J.B.J. Fourier, in 1882. he states that in units (Btu/h*), the rate of heat flow in deep conduction in the material is as follows; q_k

$$q_k = -k.A\frac{dT}{dX}$$

Where

k: Thermal Conductivity
(Fahrenheit/foot)
A: Flow surface area (ft2)
dT/dX: Gradient Temperature

Research Methods

Figure 1 Flow Chart

Where the author's method is used by using the Analysis method, in this test HONDA PRE-MX 800ml brand coolant media and testing tools using an iron vt - 04f viscometer. The implementation of the thesis has the needs and needs of the data in it. The following are the stages carried out by the author, including:

1. Literature Studies

By taking and collecting data from book literature, research results, and research journal references.

2. Observation

It is a direct observation activity (visual) this research aims to observe the work system and in the acquisition of data and information.

3. Defining a Testing Tool

Where in the implementation of this test using the Rion vt - 04F viscometer tool using a spindle no3

4. Coolant Selection

In this test, the coolant of the HONDA PRE – MIX brand was used with a capacity of 800ml.

5. Data Acquisition

Data collection during viscosity testing took place with temperatures of 27.8oC, 70oC, and 90oC on HONDA PRE – MIX Coolant media

Tools and Materials

1. Viskometer rion vt - 04f
2. Thermocouple
3. Measuring Cups
4. Thermo Scientific CIMAREC Stirring Hot Plates
5. Stopwatch

6. Coolant radiator HONDA PRE-MIX

Results and Discussion

Results of Viscosity Testing of Fluids and Heat Transfer by Conduction, Convection and Heat Transfer Combined with the temperatures used were 27.8oC, 70oC, and 90oC.

Table 1
Viscosity Test Results at 27.8oC

media	Spindle	Temperature	Result	time
coolant honda pre-mix	NO 3	27,8	0,35 dpa.s	60

Table 2
Viscosity at 70oC

Media	Spindle	Temperature	Result	Time
coolant honda pre-mix	NO 3	70oc	0,275	60

Table 3
At 90oC

Media	Spindle	Temperature	Result	Time
COOLANT HONDA PRE-MIX	NO 3	90	0,25	60

Seacra Heat Transfer (Conduction) at Temperatures of 27.8oC, 70oC, and 90oC. Calculation at Temperature 27.8oC.

$$q_k = -k.A\frac{dT}{dX}$$

Known;
k: 225,94 W/m²·K
A : 12594,54 mm2 → 0,01259454 m2
dT : 27,8 oC → 300,95 ^oK
dX: 8mm → 0,008m

Solution:

$q_x = 225{,}94.0.01259454\,\frac{300{,}95}{0{,}008}$ = -107048,881 watt (W)

Discussion at 70oC Temperature

$$q_k = -k.A\frac{dT}{dX}$$

Known k: 225,94 W/m²·K

A :12594,54 mm^2 → 0,01259454 m^2

dT : 70 ^{o}C → 343,15 ^{o}K

dX: 8mm → 0,008m

$q_k = -225{,}94.\,0.0125945\,\frac{343{,}15}{0.008}$

= -122058.899 watt (W)

Discussion at 90oC Temperature

$$q_k = -k.A\frac{dT}{dX}$$

Known k: Aluminum 225,94 W/m²·K

A : 12594,54 mm2 → 0,01259454 m^2

dT : 90^{o}C → 363,15^{o}K

dX: 8mm → 0,008m

qk = -225,95 x 0,01259454 363,15/0,008

= -129172,925 watt (W)

Seacra Heat Transfer (Convection) at Temperatures 27.8oC, 70oC, and 90oC.

Discussion at 27.8oC.

$$q_{permuk\ ke\ fluida}\text{=A. }\bar{h}_c(T_s - T_\infty)$$

Known

A : 628 mm^2 → 0,000628 m^2

$\bar{h}_c$: 225,94 W/m²·K

T_s : 27,8oC → 300,15 ^{o}K

T_∞ : 27,8oC → 300,95 ^{o}K

Settlement

$q_{permuk\ ke\ fluida} = 0{,}000628\ \times 225{,}94(300{,}15 - 300{,}95)$

= 0 watts (W)

Discussion at 70^{oC} Temperature

$$q_{permuk\ ke\ fluida}\text{=A.}\bar{h}_c\ (T_s\text{-}T_\infty)$$

Known:

A : 682 mm^2 → 0,000628 m^2

$\bar{h}_c$: 225,94 W/m²·K

T_s : 70^{o}C → 343,15 ^{o}K

T_∞ : 27,8°C → 300,95 °K

Solution

$q_{permuk\ ke\ fluida}$ = 0,000628 ×225,94 (343,15-300,95)

= 5,987 watts (W)

Discussion at 90oC Temperature

$$q_{permuk\ ke\ fluida}\text{=A.}\bar{h}_c T_c(T_s - T_\infty)$$

Known:

A : 628 mm^2 → 0,000628 m^2

$\bar{h}_c$: 225,94 W/m²·K

T_s : 90oC → 363,15 °K

$\bar{T}_\infty$: 27,8oC → 300,95 °K

Solutions:

$q_{permuk\ ke\ fluida} = 0{,}000628\ \times 225{,}94(363{,}15 - 300{,}95)$

= 8,825 watts (W)

Combined Conduction Heat Transfer

$$UA = \frac{1}{R_1 + R_2 + \cdots + R_n}$$

UA: Heat transfer coefficient

Overall Wattage *(W)*

1: Constant

R_n: Each of the results of

Conduction heat transfer

(watts)

Solution;

$$UA = \frac{1}{-107048{,}381 + -122058.899 + -129172{,}925}$$

$= -2{,}791\ watt\ (W)$

Convection Combined Heat Transfer

$$UA = \frac{1}{R_1 + R_2 + \cdots + R_n}$$

UA: Heat transfer coefficient

Overall Wattage *(W)*

1: Constants

R^n: Each of the results of

Conduction heat transfer *(watts)*

Solution;

$$UA = \frac{1}{-107048{,}305 + -122058.899 + -129172{,}925}$$

$= -2{,}791\ watt\ (W)$

Combined heat transfer of conduction and convection

$$UA = \frac{1}{R_1 + R_2 + \cdots + R_n}$$

UA: Heat transfer coefficient
Overall Wattage *(W)*
1: Constants

Rn: Each result of
Conduction heat transfer *(watts)*

Solution;

$$UA = \frac{1}{-2{,}791 + 0{,}067}$$
$$= -0{,}367\ watt\ (W)$$

Coolant Flow Discharge Measurement on Radiators
The flow rate can be measured with the formula.

$$Q = \frac{v}{t}$$

Known:
q : Debit aliran m^3/s
v : 101 (ml) (0,000101 m^3)
t : 15,82 (s)

$$Q = \frac{0{,}000101}{15{,}82}$$
$$= 6{,}384\ m^3/s$$

Conclusion

The viscosity of a fluid will affect the process of cooling, when a fluid has a low viscosity, the flow rate is faster which makes it easier to ferment the fluid with heat more effectively in heat transfer, while if the viscosity is high, the flow rate will be slower so that the heat absorption process is ineffective. If the viscosity is very high, a large amount of energy is needed to pump it to adjust the flow needed, so that the process of heat absorption and heat transfer is more effective.

Bibliography

Darmawan, Muh Arief. (2023). *Pengaruh Tegangan Dan Tekanan Fluida Terhadap Perubahan Koefisien Gesek Pada Pipa Dengan Metode Eksperimen= The Influence Of Voltage And Fluid Pressure On Changes In The Coefficient Of Friction In Pipe Using Experimental Methods*. Universitas Hasanuddin.

Deskam, Deskam. (2023). *Analisis Pengaruh Kerusakan Mesin Utama Pompa Pendingin Air Laut Mekanis Di Kapal Km Tonasa Lines Vi*. Politeknik Ilmu Pelayaran Makassar.

Lilipaly, Erlin, & Maya, Frederika. (2018). *Hubungan Dukungan Keluarga Dengan Activity Daily Living Pada Pasien Pasca Stroke Di Unit Fisioterapi Rumah Sakit. Stella Maris*. Stik Stella Maris.

Muchlisinalahuddin, Muchlisinalahuddin. (2018). Analisis Prestasi Mesin Motor Bakar Diesel Type Pauss Model 175 a Untuk Bahan Bakar Solar Dan Bio Solar. *Rang Teknik Journal*, *1*(2).

Mufidah, Intan Zahrani, Trisnowati, Eli, Salsabila, Keisya Meifiyanti, Muniroh, Choirul, Risqi, Fitri Dea Mawa, & Kurniawan, Rizki. (2023). Analisis Hukum Termodinamika pada Pembuatan Batu Bata di Magelang, Jawa Tengah. *JURNAL PENDIDIKAN MIPA*, *13*(3), 784–789.

Permatahati, Luthfiya Kurnia. (2019). *Penerapan Model Pembelajaran Two Stay Two Stray Melalui Metode Eksperimen Dan Diskusi Ditinjau Dari Kemampuan Berpikir Kritis Pada Materi Suhu, Kalor, Dan Perpindahan Kalor*.

Santiko, Tony, & Heriyawan, Mohammad Sapta. (2024). Analisis Kerusakan Exhaust Valve Main Engine Kapal OMS BROMO. *Proceedings*, *1*(1), 129–139.

SARI, Mardhika S., Hadiyanto, Hadiyanto, & Muhammad, Fuad. (2019). *Life Cycle Assessment Proses Hulu Produksi Minyak Bumi Area Geragai Dan Gas Bumi Area Betara Di Blok Jabung Kabupaten Tanjung Jabung Timur Dan Kabupaten Tanjung Jabung Barat Provinsi Jambi Oleh Petrochina International Jabung Ltd.* School of Postgraduate.

Wantasen, Sofia, Luntungan, Joudie N., & Tarore, Annie E. (2020). *Distribusi Spasial Temporal Klorin Di Daerah Aliran Sungai Tondano Provinsi Sulawesi Utara*.

Wanti, Putri Pradika. (2015). *Fluida Viskoelastik Yang Melewati Pelat Datar Dengan Memperhatikan Faktor Hidrodinamika Magnet*. Tesis Institut Teknologi Sepuluh Nopember. Surabaya.