INVESTIGATION OF CONEVETIVE HEAT TRANSFER WITH DIFFERENT FLUIDS

SUBMITTED BY

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ABSTRACT

The objective of the present study is to examine how the coupling between mass and heat transfer characteristics during coolant in IC engines when different fluids like water, 2T engine oil, palm oil, and coolant oil are used. The onset of convection in a thermal layer generated by transient heat conduction in deep fluid is examined. Transient heat conduction time function is a crucial function for heat transfer in the process for heavy oil production, the important role of the heat transfer coefficient on transient heat conduction with different fluids is revealed after the comparison of the practical values with theoretical values. A system, built for measurement of convective heat transfer coefficient (h) was adapted and used to measure the h value and the fluid velocity simultaneously. Viscosity can also find by using Ostwald viscometer. Importance of oils than water can also be explained in this report. By the end of the report we can get knowledge of what is transient heat conduction and how transfer coefficient varies with different fluids and its applications.

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INTRODUCTION

HEAT TRANSFER

Heat is one of many forms of energy that can be transformed into each other in accordance with the First Law of Thermodynamics. However, it is important to note that the energy contained within any substance cannot be regarded as heat. In fact, heat only exists when it is transferred between two media and then only due to a temperature difference between those media. There are many misuses of the word “heat”.

MODES OF HEAT TRANSFER

CONDUCTION:

conduction takes place in the rod that is held at one end by a human hand while the other end is situated in a stream of very hot gaseous products of combustion.

COVECTION: The latter end absorbs energy from the hot gases by a process called convection. Once the energy has been absorbed by the rod, it passes from the hot end to the cooler end of the rod by a process of collisions among molecules, atoms, and even free electrons

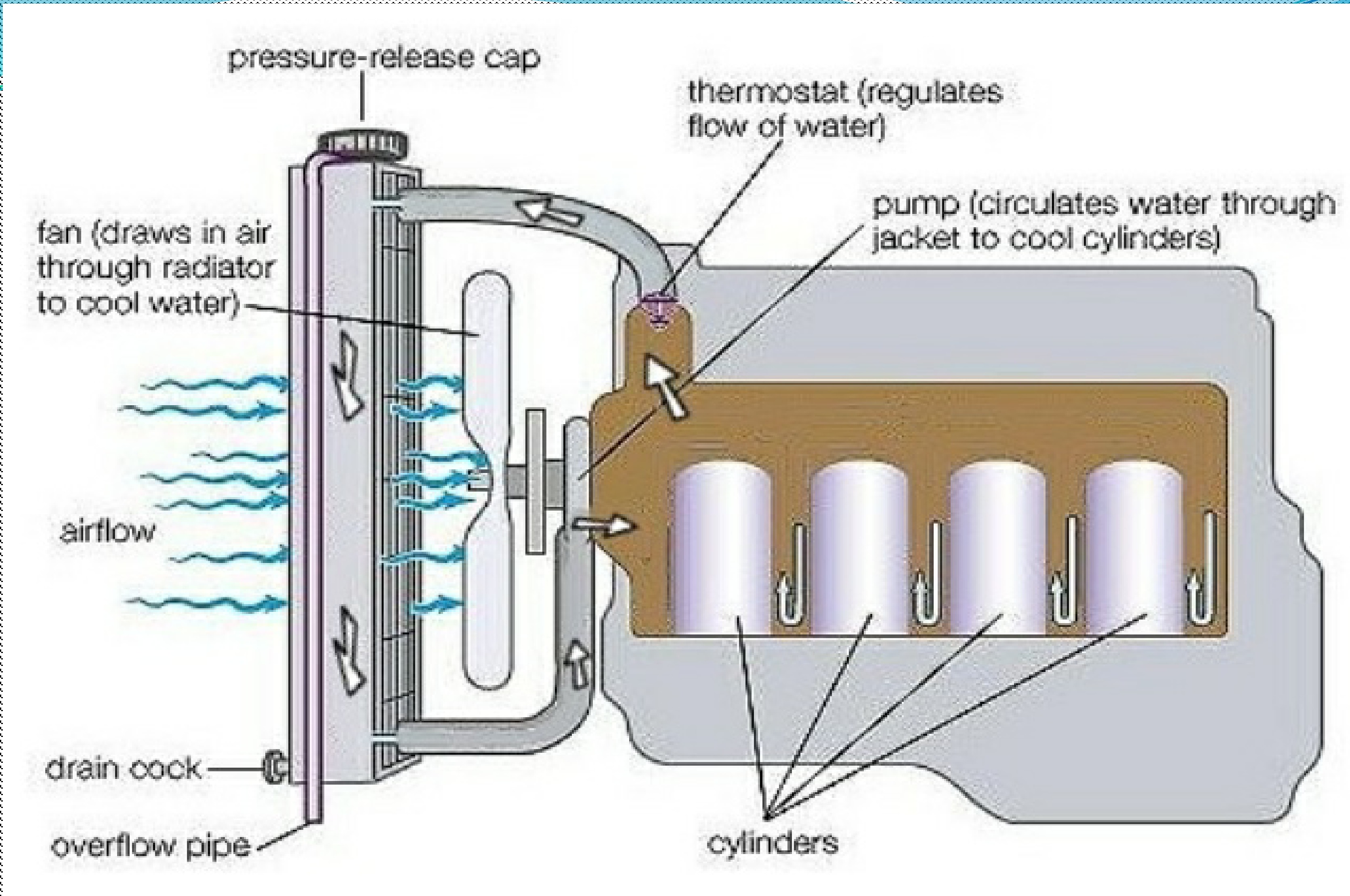
RADIATION: The latter end absorbs energy from the hot gases by a process called convection. Once the energy has been absorbed by the rod, it passes from the hot end to the cooler end of the rod by a process of collisions among molecules, atoms, and even free electrons

TRANSIENT HEAT CONDUCTION

In general, during any period in which temperatures change *in time* at any place within an object, the mode of thermal energy flow is termed transient conduction. Another term is "non steady-state" conduction, referring to time-dependence of temperature fields in an object. Non-steady-state situations appear after an imposed change in temperature at a boundary of an object. They may also occur with temperature changes inside an object, as a result of a new source or sink of heat suddenly introduced within an object, causing temperatures near the source or sink to change in time. When a new perturbation of temperature of this type happens, temperatures within the system change in time toward a new equilibrium with the new conditions, provided that these do not change.

COOLING OF IC ENGINE

- Most internal combustion engines are fluid cooled using either air (a gaseous fluid) or a liquid coolant run through a heat exchangercooled by air. Marine engines and some stationary engines have ready access to a large volume of water at a suitable temperature.Most liquid-cooled engines use a mixture of water and chemicals such as antifreeze and rust inhibitors. The industry term for the antifreeze mixture is engine coolant. Some antifreezes use no water at all, instead using a liquid with different properties, such as propylene glycol or a combination of propylene glycol and ethylene glycol. Most "air-cooled" engines use some liquid oil cooling



pressure-release cap
thermostat (regulates flow of water)
pump (circulates water through jacket to cool cylinders)
fan (draws in air through radiator to cool water)
airflow
drain cock
overflow pipe
cylinders

PURPOSE

- The purpose of the project is to analyze how the cooling ability of quenching fluids is varying when the temperature, agitation, condition and different types of fluids is changed. The overall method of the project is to find the heat transfer coefficient of different fluids like water, palm oil, 2T engine oil, coolant oil.

OILS

- *Oils are u*sed in coolant to control the heat transfer from the metal piece that is going to be hardened, this reduces the thermal gradients that can lead to distortion and cracking in the metal piece.It is usually desirable to minimize the number of heat transfer stages in order to maximize the temperature difference at each stage. However, Detroit Diesel 2-stroke cycle engines commonly use oil cooled by water, with the water in turn cooled by air. Oils can be based on either mineral oils or vegetable oils. The most common ones are based on mineral oils and consist of petroleum and additives to improve its properties such as cooling. They are equivalent to other petroleum oils such as engine oils and industrial lubricants. Vegetable oils are used as well since mineral oil has become more regulated in how they should be used. Improper disposal of mineral oils may cause environmental damage

ADAVANTAGES OF USING OIL INSTEAD OF WATER

- Oils have a higher boiling point.
- Heat transfer fluid is composite liquid phase organic heat carrier with special high thermal stability is the most widely used heat transfer fluid.
- The cooling rate during the convection phase depends on the viscosity of the fluid.
- Oil has the higher viscosity than the water
- High reliability is your first choice if the applicable temperature is above 310degree.
- When the water is used as coolant the boiling phase is still occurring. The cooling in this stage is still so high that the thermal stresses is locked in the material causing distortion and cracks. In order to minimize distortions and cracks in the work piece oil is preferred as coolant.

important properties of coolants

- Good cooling and lubrication,
- prevention of corrosion,
- physical, chemical and technological stability during use,
- no harmful effects on human health,
- no excessive foaming.

EXPREMENTATION METHODOLOGY

DESCRIPTION OF APPARATUS

The apparatus consists of a specially designed stainless steel tank with heater arrangement. An Aluminium sphere is provided to study the experiment with stand to place in heater tank. Heater regulator with thermo set to supply the regulated power input to heater and to set the temperature.

Thermocouple at suitable position to measure the temperature digital temperature indicator with channel selector to measure the temperature. Made of whole arrangement is mounted on an aesthetically designed study frame MS tubes and nova pan board with all provisions for holding the tank and accessories.


TRANSIENT HEAT CONDUCTION

PROCEDURE

- Take the fluid (water or oil) in tank.
- Heat the fluid to required temperature say 70degreeC in case of water and more than 100degreeC in case of oil.
- Note down the initial temperature of sphere and hot fluid.
- Immerse the sphere in hot fluid both for heating.
- Note down the core and outer surface temperature of sphere at every 10sec till it attain fluid temperature.
- Take out the sphere from hot fluid and cool it in atmosphere air.
- Note down the temperature at every 10sec till it reaches atmospheric condition.
- Repeat the experiment for different temperature of fluid.

FORMULA

- Heat transfer coefficient (h):
  The amount of heat which passes through a unit area of a medium or sy stem in a unit time.
  when the temperature difference between theboundaries of the system i s 1 degree
- $h = Nu \times k / D$
- Nusselt number : A dimensionless parameter used in calculations of heat transfer between a moving fluid and a solid body.
- $Nu = 2 + 0.43(GrPr)^{0.25}$ for $1 < GrPr < 10^5$
- $Nu = 2 + 0.50(GrPr)^{0.25}$ for $3 \times 10^5 < GrPr < 8 \times 10^5$
- Grashoffs number (Gr):
- The Grashoffs number (Gr) is a dimensionless numbering fluid dynamics and heat transfer which approximates the ratio of the buoyancy to viscous force acting on a fluid.
- $Gr = D^3 \times \partial^2 \times \beta \times g \times dt / \mu^2$

COOLANT OIL

- Initial temperature of air = $T = T = 21.7^{\circ}C$

- Initial temperature of sphere = $T_0 = T_3 = 19.9^{\circ}C$
- Temperature of core in case of water = $T_2 = 70.4^{\circ}C$

SNO.	Temperature° C		TIME(sec)	Cooling Sphere
	$T_c=T_2$	$T_0=T_3$		
1.	72.7	32.6	10	67
2.	72.4	38	20	66.8
3.	71.6	44.4	30	66.5
4.	71.6	47.7	40	66.2
5.	71.5	52.4	50	66
6.	71.4	55.9	60	65.8
7.	71.3	58.3	70	65.5
8.	71.2	60.2	80	65.3
9.	70.9	67.7	90	65.1
10.	70.7	68	100	64

- h):
- h= Nu ×K/ D w/m k
-
- AT T = 27.1° C
- Gr = D×∂×β×g×dt / µ
-
- D= 0.075m, ∂= 927kg/m, β=3.52×10k, g=9.81, dt=10.9° C, µ=1.26×10 Ns/m
- Gr = (0.075) ×927×3.52×10×9.81×10.9 / (1.26×10)
- Pr = 11.61
- Nu = 2+ 0.50 (GrPr) = 90
- h= 460 w/m k
- AT T = 29.9° C
- Gr = D×∂×β×g×dt / µ
-

. RESULT AND EVALUATION

- We have tried to analyse the transient heat conduction behaviour for different fluids based on the previous analysis used for finding the heat transfer coefficient. And in table 5.1 we can find how the heat transfer coefficient varying with different fluids and also we can see the comparison of practical heat transfer coefficient value to the practical heat transfer coefficient values.

FLUIDS	HEATTRANSFER COEFFICIENT(h) w/m^2k PRACTICAL	HEATTRANSFER COEFFICIENT(h) w/m^2k THEORITICAL
WATER	895	500-10,000
2T ENGINE OIL	85	10-700
PALM OIL	421	10-700
COOLANT OIL	616	10-700

CONCULSION

- The different fluids show significant differences in cooling ability. When increasing the temperature the coolant power and heat removal capacity increases. After the oil has been used in production the cooling ability is changed. Both increase and decrease in cooling ability is seen for the different fluids. All but one of the resulting on the differences in cooling ability for water and oil could be seen. The cooling abilities of the oils were enough for reaching the maximum hardens than the water. And also the heat transfer coefficient for different fluids has different values according to their cooling abilities.

FUTURE SCOPE:

- By using the same transient heat conduction, heat transfer coefficient for various nano fluids can be studied.
- The performance of the heat transfer coefficient can also be studied under different parameters.

THANK YOU