International Journal of Multidisciplinary Research and Development 2014; 1(7): 301-304

International Journal of Multidisciplinary Research and Development

IJMRD 2014; 1(7): 301-304
www.allsubjectjournal.com
Received: 03-12-2014
Accepted: 22-12-2014
e-ISSN: 2349-4182
p-ISSN: 2349-5979

P. Durai Raj
Assistant Professor
Department of Mechanical Engineering, SRM University, Vadapalani Chennai, India.

S. Thamilarasu
Assistant Professor
Department of Mechanical Engineering, SRM University, Vadapalani Chennai, India.

K. Krishna das
UG research scholar
Department of Mechanical Engineering, SRM University, Vadapalani Chennai, India.

Correspondence:
P. Durai Raj
Assistant Professor
Department of Mechanical Engineering, SRM University, Vadapalani Chennai, India.

Water in vacuum as coolant in radiators: An unexplored concept

P. Durai Raj, S. Thamilarasu, K. Krishna das

Abstract
Today in the field of automation, technical experts are researching on concepts that can increase the efficiency of the present existing systems. One such system is the radiator system. Today we are going to see a new concept in the radiator systems. In this system we are making use of the concept that water boils at 7.22 ˚C in vacuum at 0.147 pounds per square inch, absolute pressure. Using this phenomenon of boiling of water in vacuum we circulate it in the radiator and cool the engine using this cold water which becomes liquid on coming in contact with the engine which is hot enough.

Keywords: Engine radiator, vacuum, boiling points, water.

1. Introduction
We have learnt in basic physics that as pressure reduces the boiling point of any substance or matter. Now what we are going to do here is exactly the same, we are reducing the pressure of the storage tank of the water that is used as the coolant in the designed radiators. A liquid in a vacuum has a lower boiling point than when that liquid is at atmospheric pressure. A liquid at high-pressure has a higher boiling point than when that liquid is at atmospheric pressure. In other words, the boiling point of a liquid varies depending upon the surrounding environmental pressure. For a given pressure, different liquids boil at different temperatures. [1] Now let us see the properties of vacuum and the Properties and their changes of water when placed in a vacuum environment.

2. Vacuum
Vacuum is space that is devoid of matter. The word stems from the Latin adjective vacuus for "vacant" or "void". An approximation to such vacuum is a region with a gaseous pressure much less than atmospheric pressure. Physicists often discuss ideal test results that would occur in a perfect vacuum, which they sometimes simply call "vacuum" or free space, and use the term partial vacuum to refer to an actual imperfect vacuum as one might have in a laboratory or in space. The Latin term in vacuo is used to describe an object as being in what would otherwise be a vacuum. [2] The *quality* of a partial vacuum refers to how closely it approaches a perfect vacuum. Other things equal, lower gas pressure means higher-quality vacuum. For example, a typical vacuum cleaner produces enough suction to reduce air pressure by around 20%. [3] Much higher-quality vacuums are possible. Ultra-high vacuum chambers, common in chemistry, physics, and engineering, operate below one trillionth (10^{-12}) of atmospheric pressure (100 nPa), and can reach around 100 particles/cm^3. [4]

3. Boiling Point of Water
As a liquid is heated, its temperature increases. As its temperature increases, the molecules of the liquid gain energy and their kinetic energy increase. As the kinetic energy increases, the molecular motion increases and the molecules of the liquid overcome the force of attraction between them. On continuous heating, a particular temperature is reached where the molecules of the liquid leave the surface in the form of vapour. This produces a pressure above the liquid equal to the atmospheric pressure and the liquid starts boiling. At this stage, the temperature of the liquid remains stationary even on further heating. This stationary temperature at which the vapour pressure of the liquid is equal to the atmospheric pressure is called the boiling point of that liquid. At this temperature, bubbles begin to form and rise in the liquid. Before reaching this temperature, the bubble is not forming because the atmospheric pressure is greater than the pressure in the bubbles and they collapse. [5]

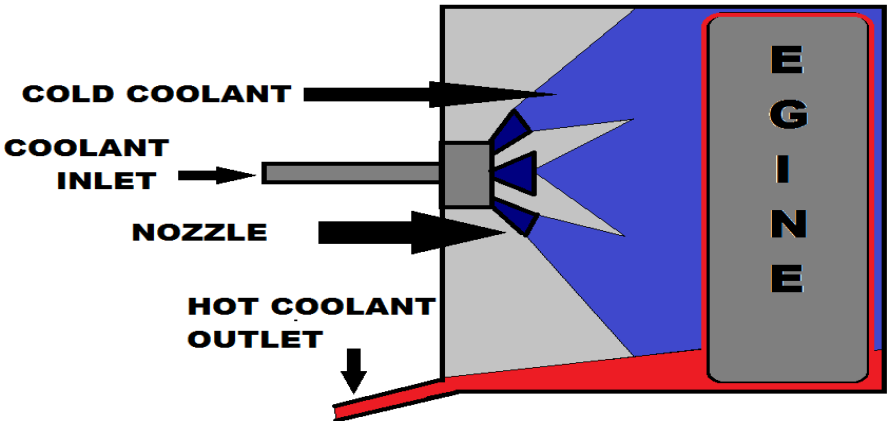
4. Pressure and boiling point

All liquids, at any temperature, exert a certain vapour pressure. The vapour pressure can be thought of as the degree to which the liquid molecules are escaping into the vapour phase. The vapour pressure increases with temperature, because at higher temperature the molecules are moving faster and more able to overcome the attractive intermolecular forces that tend to bind them together. Boiling occurs when the vapour pressure reaches or exceeds the surrounding pressure from the atmosphere or whatever else is in contact with the liquid. At standard atmospheric pressure (1 atmosphere = 0.101325 MPa), water boils at approximately 100 degrees Celsius. That is simply another way of saying that the vapour pressure of water at that temperature is 1 atmosphere. At higher pressures (such as the pressure generated in a pressure cooker), the temperature must be higher before the vapour pressure reaches the surrounding pressure, so water under pressure boils at a higher temperature. Similarly, when the surrounding pressure is lower (such as at high altitudes), the vapour pressure reaches that pressure at a lower temperature. For example, in the Denver, Colorado area of the U.S. where the elevation above sea level is approximately one mile (1600 meters), the atmospheric pressure is about 83% of a standard atmosphere, and water boils at approximately 95 degrees Celsius. The relationship between vapour pressure and temperature (or, looked at in the reverse direction, between boiling temperature and pressure) is called the vapour pressure curve. Water's vapour pressure curve is of great importance, since it determines the relationship between temperature and pressure in any process where water is going from a liquid to a vapour state or vice-versa. Such processes are important both in industry (for example in steam power generation where water is made into steam in boilers and eventually condensed after running through turbines) and in nature (for example, in rainfall and evapourations from bodies of water). [6]

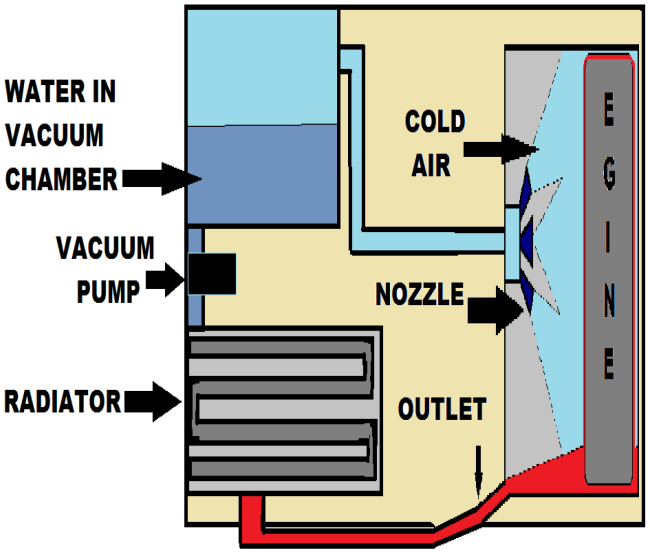
5. The concept

According to the property of water, it will start to boil and vapourise in vacuum when it has already reached a temperature of 7.22 ˚C in vacuum at 0.147 pounds per square inch, absolute pressure. So, this water in gaseous state (at low temperature) is forced out through three nozzles which becomes hot on spraying on the engine and this hot water is taken out through an outlet duct and is cooled using the radiator by passing on the heat from the engine body to the air passing outside the engine or the vehicle body. Now again the water that is liquid state is passed on to the storage tank after suction is done by bringing it to the required vacuum pressure. And so, the process continues thereby cooling the engine.

6. Diagrams



The Enlarged View of the Engine Side



The Whole Concept System

7. Definitions

7.1 Altitude

Altitude or height is defined based on the context in which it is used (aviation, geometry, geographical survey, sport, and more). As a general definition, altitude is a distance measurement, usually in the vertical or "up" direction, between a reference datum and a point or object. The reference datum also often varies according to the context. Although the term altitude is commonly used to mean the height above sea level of a location, in geography the term elevation is often preferred for this usage. [7]

7.2 Atmosphere

The atmosphere of Earth is a layer of gases surrounding the planet Earth that is retained by Earth's gravity. The atmosphere protects life on Earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night (the diurnal temperature variations). [8]

7.3 Boiling point

The boiling point of a substance is the temperature at which the vapour pressure of the liquid equals the pressure surrounding the liquid. and the liquid changes into a vapour.[9]

7.4 Kinetic energy

In physics, the kinetic energy of an object is the energy that it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its stated velocity. Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes. The same amount of work is done by the body in decelerating from its current speed to a state of rest. [10]

7.5 Molecules

It is the simplest unit of a chemical compound that can exist, consisting oftwo or more atoms held together by chemical bonds. [11]

7.6 Nozzle

A nozzle is often a pipe or tube of varying cross sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In nozzle velocity of fluid increases on the expense of its pressure energy. [12]

7.7 Pressure

Pressure is force per unit area applied in a direction perpendicular to the surface of an object. Gauge pressure (also spelled *gauge* pressure) is the pressure relative to the local atmospheric or ambient pressure. Pressure is measured in any unit of force divided by any unit of area.[13]

7.8 Radiator

Radiators are heat exchangers used for cooling internal combustion engines, mainly in automobiles but also in piston-engined aircraft, railway locomotives, motorcycles, stationary generating plant or any similar use of such an engine.[14]

7.9 Steam

The vapour into which water is converted when heated, forming a white mist of minute water droplets in the air. [15]

7.10 Suction

Suction is the flow of a fluid into a partial vacuum, or region of low pressure. The pressure gradient between this region and the ambient pressure will propel matter toward the low pressure area. Suction is popularly thought of as an attractive effect, which is incorrect since vacuums do not innately attract matter. Dust being "sucked" into a vacuum cleaner is actually being pushed in by the higher pressure air on the outside of the cleaner. The higher pressure of the surrounding fluid can push matter into a vacuum but a vacuum cannot attract matter. [16]

7.11 Temperature

A temperature is a numerical measure of hot and cold. Its measurement is by detection of heat radiation, particle velocity, kinetic energy, or most commonly, by the bulk behavior of a thermometric material. It may be calibrated in any of various temperature scales, Celsius, Fahrenheit, Kelvin, etc. [17]

7.12 Turbines

A turbine is a rotary mechanical device that extracts energy from a fluid flow and converts it into useful work. A turbine is a turbo machine with at least one moving part called a rotor assembly, which is a shaft or drum with blades attached. Moving fluid acts on the blades so that they move and impart rotational energy to the rotor. Early turbine examples are windmills and waterwheels. [18]

7.13 Vacuum

Vacuum is space that is devoid of matter. The word stems from the Latin adjective *vacuus* for "vacant" or "void". An approximation to such vacuum is a region with a gaseous pressure much less than atmospheric pressure. Physicists often discuss ideal test results that would occur in a *perfect* vacuum, which they sometimes simply call "vacuum" or free space, and use the term partial vacuum to refer to an actual imperfect vacuum as one might have in a laboratory or in space. The Latin term *in vacuo* is used to describe an object as being in what would otherwise be a vacuum. [19]

7.14 Vapour pressure

Vapour pressure or equilibrium vapour pressure is defined as the pressure exerted by a vapour in thermodynamic equilibrium with it's condensed phases (solid or liquid) at a given temperature in a closed system. The equilibrium vapour pressure is an indication of a liquid's evapouration rate. It relates to the tendency of particles to escape from the liquid (or a solid). A substance with a high vapour pressure at normal temperatures is often referred to as *volatile*. [20]

8. Conclusion

Thus, we have therefore seen a new and innovative model of a cooling system just by using water that is being utilized in vacuum pressure conditions to obtain more efficient cooling of the engine body as such. The scope and the application of this paper as a concept is very wide compared to the existing technologies and the simplicity of this paper with lesser complexity.

9. References

1. http://en.wikipedia.org/wiki/Boiling_point
2. Chambers. Austin *Modern Vacuum Physics*. Boca Raton: CRC Press, 2004. ISBN 0-8493-2438-6. OCLC 55000526
3. Campbell Jeff. *Speed cleaning*, 2005, 97. ISBN 1-59486-274-5. Note that 1 inch of water is ≈0.0025 atm.
4. Gabrielse G *et al.* "Thousandfold Improvement in Measured Antiproton Mass". Phys Rev Lett 1990; 65(11): 1317 - 1320. Bibcode:1990PhRvL..65.1317G.doi:10.1103/PhysRevLett.65.1317. PMID 10042233
5. http://amrita.olabs.co.in/?sub=73&brch=2&sim=29&cnt=1
6. http://www.iapws.org/faq1/boil.htm
7. http://en.wikipedia.org/wiki/Altitude
8. http://en.wikipedia.org/wiki/Atmosphere_of_Earth
9. http://en.wikipedia.org/wiki/Boiling_point
10. http://en.wikipedia.org/wiki/Kinetic_energy
11. http://dictionary.reference.com/browse/molecule
12. http://en.wikipedia.org/wiki/Nozzle
13. http://en.wikipedia.org/wiki/Pressure
14. http://en.wikipedia.org/wiki/Radiator_(engine_cooling)
15. http://www.thefreedictionary.com/steam
16. http://en.wikipedia.org/wiki/Suction
17. http://en.wikipedia.org/wiki/Temperature
18. http://en.wikipedia.org/wiki/Turbine
19. http://en.wikipedia.org/wiki/Vacuum
20. http://en.wikipedia.org/wiki/Vapour_pressure