PRACTICAL NO: 01

Marcet Boiler and Introduction to Steam Power Cycle

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Experiment

Marcet’s Boiler

Objectives

To find the relation between the pressure and the temperature of saturated steam.

Apparatus

Marcet Boiler consists of pressure gauge, thermometer pocket containing mercury to ensure good contact with interior of the boiler, safety valve, tripod stand and steam cock etc.

Theory

Saturation temperature means a given pressure the temperature at which a pure substance changes its phase. Saturation pressure means a given temperature, the pressure at which a pure substance changes its phase. In this practical we are going to show the relationship between the saturation temperature and its corresponding pressure for water. While increment of the energy in the water, increase in the number of molecules escape from water surface until equilibrium state is reached (because increase the activities in the molecules). Equilibrium state depend of the pressure between water surface and steam. It’s very easy to leave the surface that less required in relevant state of equilibrium. In this practical we are going to compared experimental slope(dT/dP) and theoretical value(dT/dp) that find by calculation from the steam table.

Procedure

First of all, Boiler's container filled half with water and bunkers pressurized the pressure to the vapors up to 1, allowing air to move air out of the air and assuming that there was no atmospheric air. Boiler. Then allow the boiler to cool and allow the atmospheric pressure. This reads the entire device at the same temperature before it can be read as quickly as possible. Now place the boiler in heat and bars up to 7 bars (temperature and pressure values of up to 0.5). This machine was removed.

Results

Absolute Pressure (bar)	Temperature from Steam Tables (ºC)	Temperature from Steam Graph (ºC)	Error
0.100	45.83	92	-46.17
0.500	81.35	97.5	-16.15
1.000	99.63	103	-3.37
1.500	111.37	109	2.37
2.000	120.23	114	6.23
2.500	127.44	119	8.44
3.000	133.54	125	8.54
3.500	138.87	130	8.87
4.000	143.63	135.5	8.13
4.500	147.92	141	6.92
5.000	151.85	146.5	5.35
5.500	155.47	151.5	3.97
6.000	158.84	157	1.84
6.500	161.99	162.5	-0.51
7.000	164.96	168	-3.04
7.500	167.76	173.5	-5.74
8.000	170.42	178.5	-8.08
8.500	172.94	184	-11.06
9.000	175.36	190	-14.64

Discussion

1. What is the saturation temperature of a vapor or the boiling temperature of a liquid?

   The given pressures that vapor pressure of a liquid equals the external pressure surrounding the liquid, the temperature at vapor or boiling water. The boiling point of a liquid varies depending upon the surrounding environmental pressure. This temperature of a liquid depends on the pressure of the atmospheric pressure.

2. Using the theory of partial pressures, show how the presence of air inside the boiler affects the readings.

   In here air include in the Marcet boiler. Total pressure equals to sum of all partial pressures. Because of the air that contain in the boiler total gauge pressure is measured by the sum of air pressure and vapor pressure. Because of that reading that from the practical higher than the actual vapor pressure. So, we have to remove the air that contain in boiler.

3. Give other possible reasons for the discrepancies observed between the experimental values and the steam table values.

   In the experiment, there will be occur reading errors
   Room temperature and pressure accuracy
   The calculation error of the data obtained
   The stability of the water

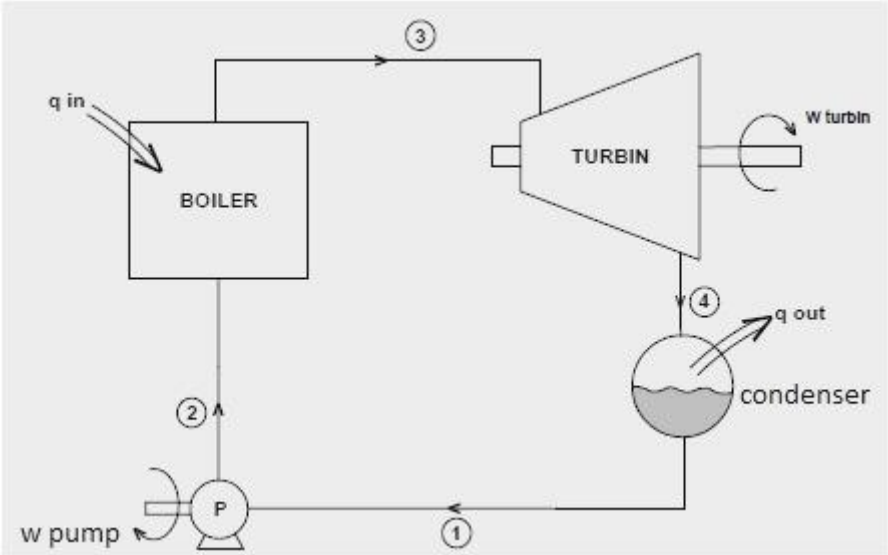
Conclusion

Vapor pressure exaggerates as exemplified by the exemplified saturation temperature of the saturated vapor temperature, which is exemplified by the perfect gas law in physics. When the boiler is heated, the liquid molecules are rushing to collapse.

Steam Power Cycle

Introduction

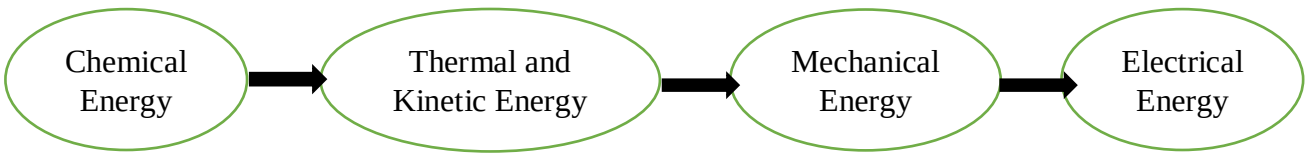
We need energy for every activity. In our life we use various type of energy form such as light energy, thermal energy, electric energy. Because of that it is important to produce such needed energy source way or the other. Energy cannot be created or destroy, only can converted into other form of energy. Steam power plant converts fossil fuel such as petroleum gas, coal into electricity. Fuel use for heating the water to produce steam. Boilers, turbines, condensers, and the pumps are contained in steam power plants. This heat flows at a high velocity and pressure into turbine. So, the turbine is rotated. Then the central axis, the high pressure steam is removed from the energy. After steam flows, then condensation in the condenser. After water is pumped by pump back to the boiler.



Discussion

1).The energy conversion process in Steam Power Cycle

There are three energy conversion in generate electricity by using steam turbines. Using the boiler, extract thermal energy from the fuel and to increase the vapor, the vapor will convert the thermal energy to kinetic energy and the generate electrical energy from conversion of the mechanical energy of the turbine.



2).Working mechanism of the steam Power Cycle and important of the each component

There are two types of cycles that use by the steam power plants;

Steam Boiler

A steam boiler is a device used to create steam by applying heat energy to water. Convert water to vapor that done by heating the water in the pipes with heat from burning fuel.

Steam Turbine

A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. Steam that contain high pressure and temperature were directed to push turbine blades mounted on the shaft and that shaft rotates. Due to perform work on the turbine, the pressure and temperature of steam coming into the turbine down to saturated vapor.

Condenser

condenser is a device or unit used to condense a substance from its gaseous to its liquid state (water), by cooling it.

Pumps

pump is a device that moves fluids (liquids or gases) that have low pressure and low energy , by mechanical action.

3). Explain the differences between steam turbine and water turbine thermodynamically

Steam turbine pressurized steam is used as the working fluid, water turbine water is used as the working fluid. Water turbine doesn't have intermediate energy conversion. Water turbine are much more efficient than steam turbine.

4). Discuss about the different types of boilers, turbines and condensers.

Boilers

Mainly boiler can be divided as Industrial steam generators and power generation boilers. Also, boilers can be divided as fire tube and water tube boilers.

- Water tube boilers-natural circulation boilers, forced circulation boilers, zero circulation boilers
- Fire tube boilers- locomotive boilers, industrial boilers, domestic use boilers

Boilers can be classified based on the type of fuel used as,

- Industrial waste fired boilers
- Oil fired boilers
- Gas fired boilers
- Biomass fired boilers
- Multi-fuel fired
- Coal fired boilers

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Turbines

There are two types of turbines,

- Reaction turbine-use for steam power plants
- Impulse turbine-use for hydro power plants

Impulse Turbines

An impulse turbine is a turbine that is driven by high velocity jets of water or steam from a nozzle directed on to vanes or buckets attached to a wheel. The resulting impulse (as described by Newton's second law of motion) spins the turbine and removes kinetic energy from the fluid flow. Before reaching the turbine, the fluid's pressure head is changed to velocity head by accelerating the fluid through a nozzle. This preparation of the fluid jet means that no pressure casement is needed around an impulse turbine.

Reaction Turbines

Reaction turbines generate electrical energy by using the mutual action of pressure and moving water. When the rotor is completely filled in the water and is enclosed in a pressure casing, the operation of reaction turbines is attained. A draft tube is a diffuser that exists in all reaction turbines below the runner. The water discharges through the draft tube. Accordingly, the static pressure below the runner is reduced and the effective head increases. Application of reaction turbines is in sites with lower heads and higher flow rates.

Gravity turbine

Gravity turbine is driven simply by the weight of water entering the top of the turbine and falling to the bottom, where it is released – for example, an overshot waterwheel. These are inherently slow-running machines.

Condensers

The steam condensers are broadly classified into two types:

Condensers are categorized into 3 types:

- Water-cooled condenser
- Air-cooled condenser
- Evaporative-cooled condenser

According to the cooling action

- Low level jet condensers
- High level jet condensers
- Jet condensers
- Ejector jet condensers

According to the flow input there are 3 types of condensers.

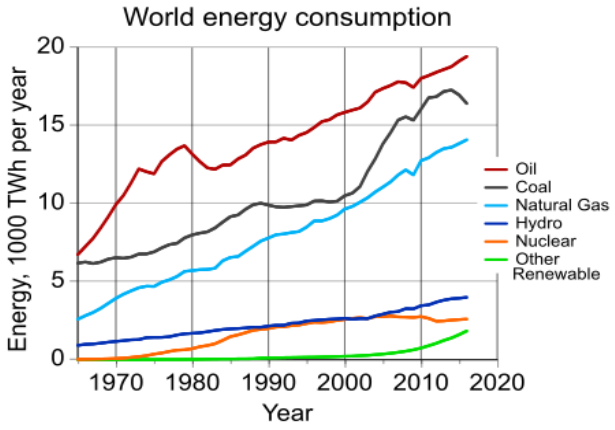
- Cross flow
- Parallel flow
- Counter flow

The surface condenser is designed to condense and deaerate the exhaust steam from the main turbine and provide a heat sink for the turbine bypass system. In general, there are two types of surface condensers:

- Water-cooled surface condenser
- Air-cooled surface condenser

5). Discuss about world energy consumption by sources

Now a days most people use consumptive energy source such as fossil for our day today activities. Energy is an important ingredient in all phases of society. We live in a very interdependent world, and access to adequate and reliable energy resources is crucial for economic growth and for maintaining the quality of our lives. But current levels of energy consumption and production are not sustainable. About 40% of the world's energy comes from oil, and much of that goes to transportation uses. Oil prices are dependent as much upon new (or foreseen) discoveries as they are upon political events and situations around the world.



6). Briefly discuss about the world energy trend in the future.

A present day we use huge energy for every day. Most of this enormous requirement is addressed by burning fossil fuels. So far, fossil fuels have catered to our energy needs very efficiently, but they are also non-renewable and rapidly depleting. These fuel sources have also contributed greatly to greenhouse gas emissions and pollution. The time has come to find suitable and better replacements for fossil fuels. Scientists are constantly researching newer and greener sources of energy that have limited impact on the environment and reduce their contribution to global warming, which is believed to be caused by the release of carbon dioxide while burning fossil fuels.

Atomic energy, solar energy, and energy from wind and bio fuels are just a few of the promising alternatives for a cleaner and greener future. Other relatively new sources of energy such as fuel cells, geothermal energy, and ocean energy are also being explored. In the following sections, we'll take a look at current sources of energy as well as discuss possible future energy sources.