SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF MECHANICAL ENGINEERING

ENGINEERING THERMODYNAMICS

UNIT 4 – STEAM POWER CYCLES

TOPIC – ACTUAL RANKINE CYCLES

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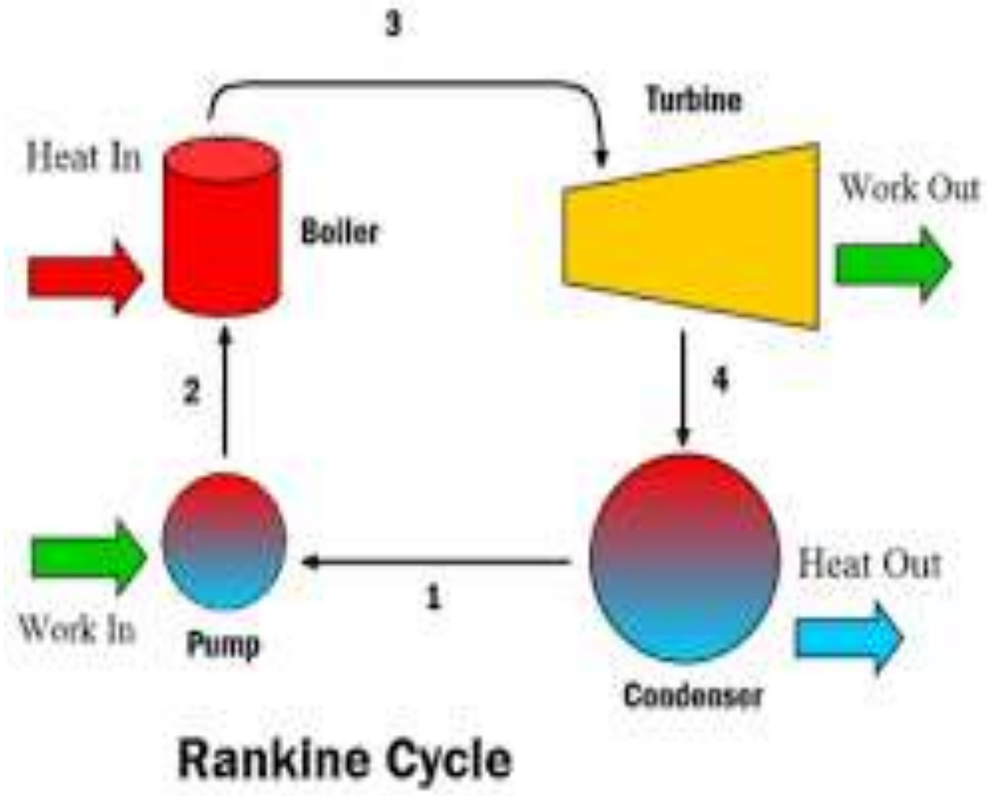
Rankine cycle



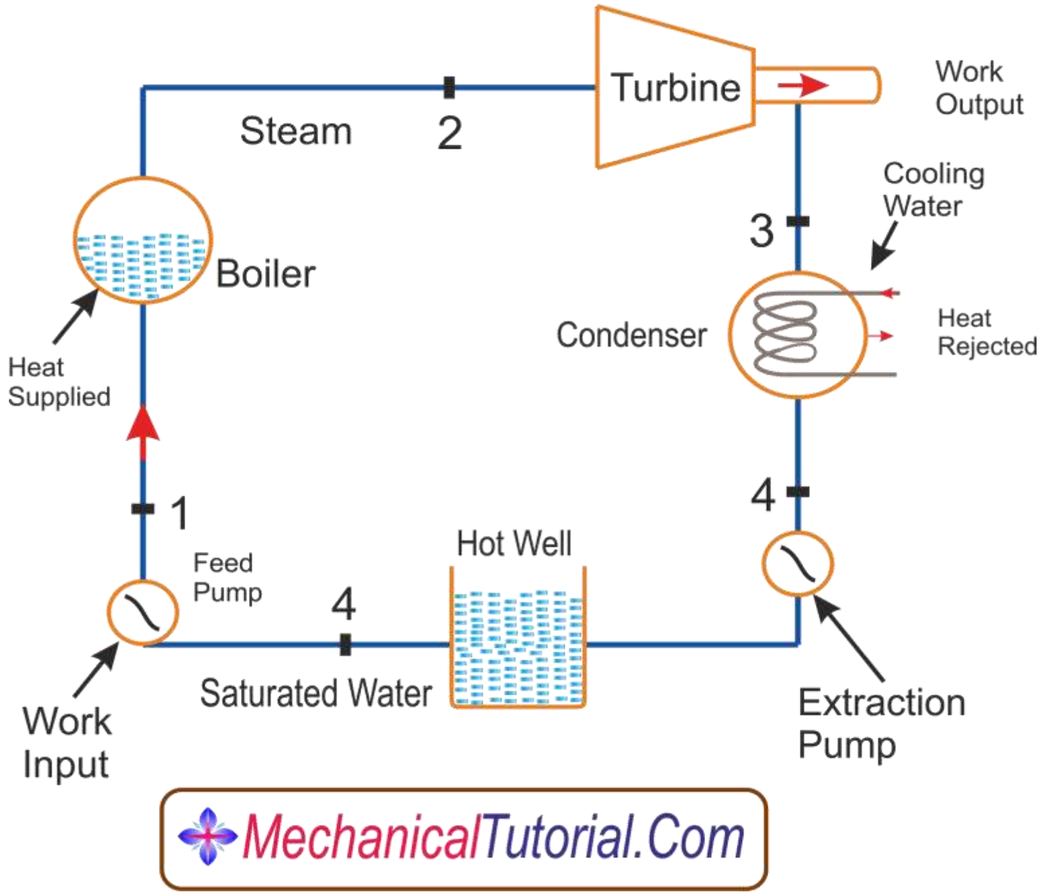
The heat given as input(boiler) and Work (turbine) as output by using water as working fluid

Source : https://energyeducation.ca/

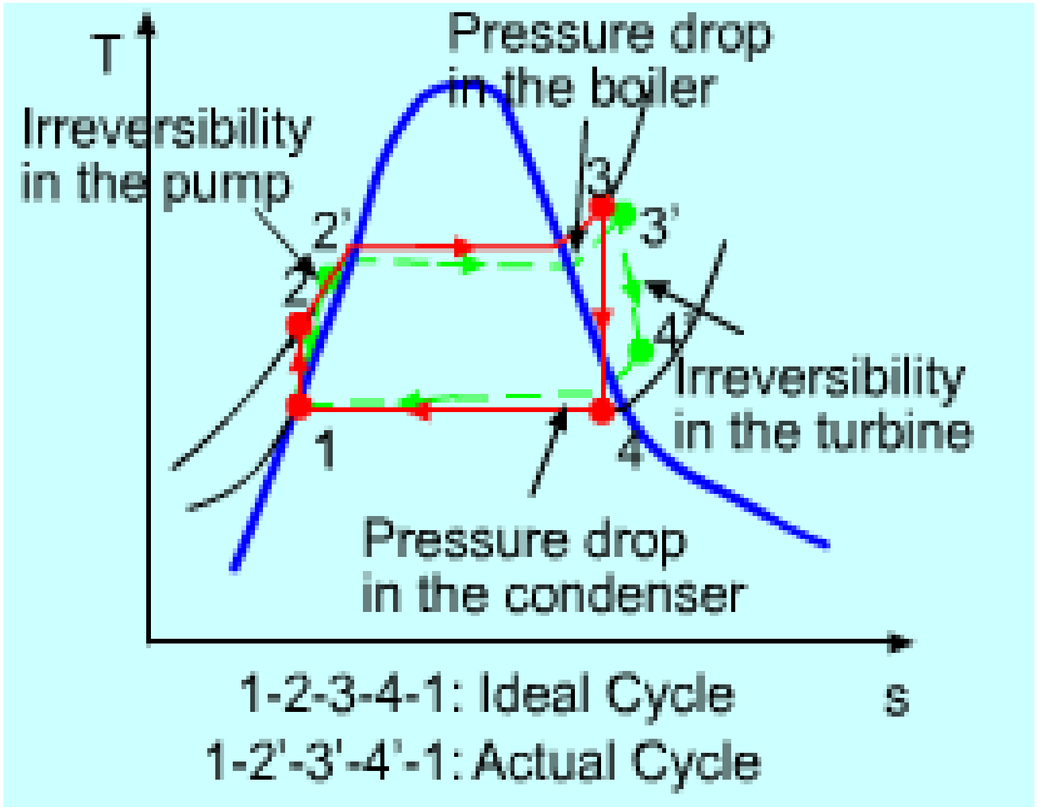
Difference between Ideal and Actual Rankine cycle

Ideal Cycle	• All processes are ideal • No heat leakage(Adiabatic) • No frictional effects
Actual cycle	• Heat leakage and friction effects are encountered • Due to Irreversibility

Schematic diagram Actual Rankine cycle



Source : mechanicaltutorial.com



Source : http://www.ecourses.ou.edu/

Schematic diagram Actual Rankine cycle

- The steam(turbine) is flowing through the condenser and gets condensed
- The condensate is fed back to the boiler using (pump)
- The condensate (water) undergoes the polytropic process due to irreversibility (friction and heat)
- Consequently the overall thermal efficiency of the plant decreases

Assessment -1

1. In steam power plant, maximum heat rejection occurs at

a) Turbine
b) Condenser
c) Boiler
d) Pump

2. The heat is supplied in Rankine cycle in the following process

a)Constant Temperature
b)Constant Pressure
c) Constant Volume
d) Constant Entropy

Assessment -1(Contd..)

3.In Rankine cycle ,the work output by the turbine is given by

a) Change in internal energy
b) Change in enthalpy
c) Change in entropy
d) Change in temperature

4. When compared to Ideal cycle, the efficiency of Actual cycle gives _____ efficiency

a) More
b) Less
c) Same
d) 100%

Processes Involved in Actual Rankine cycle

- Process 1-2 Polytropic compression (due to Irreversibility friction and heat in Pump)
- Process 2-3 Constant pressure heat addition (Boiler)
- Process 3-4 Polytropic expansion (due to Irreversibility friction and heat in Turbine)
- Process 4-1 Constant Pressure heat rejection (Condenser)

- Consequently the overall thermal efficiency of the plant decreases due to irreversibility effects

Estimation of Actual Rankine cycle

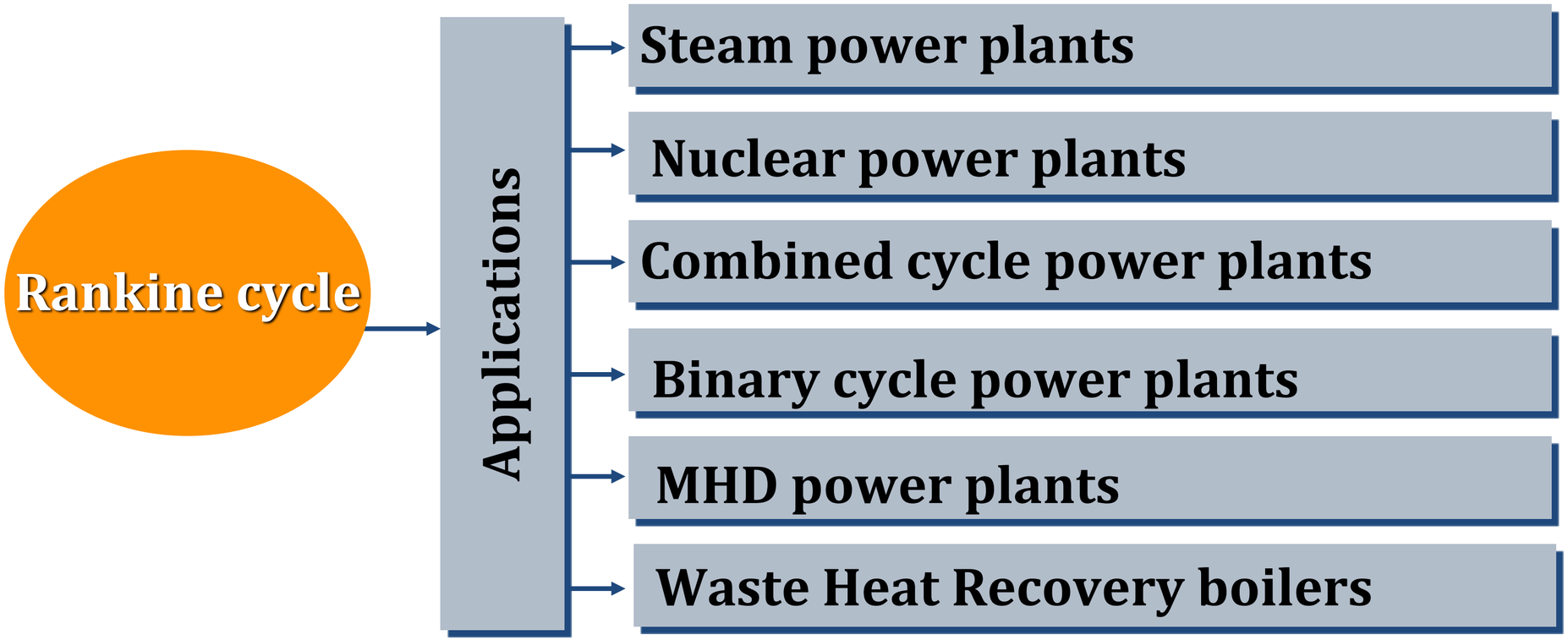
Turbine work can be calculated as $W_T = (h_3 - h_4')$

Compressor work can be calculated as $W_p = (h_2' - h_1)$

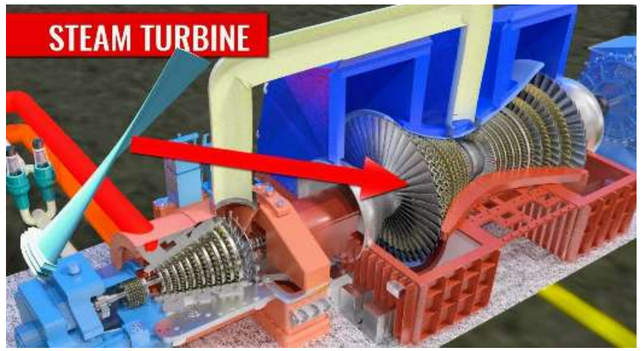
Heat input can be estimated as $Q_{in} = (h_3 - h_2')$

Efficiency of Actual Rankine cycle $\eta = (W_T - W_p) / Q_{in}$

Applications



Disadvantages



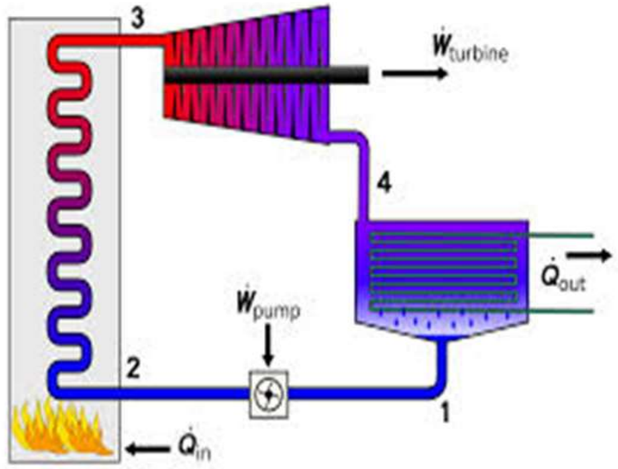
_Source : https://tinyurl.com/y9sqlssk

- Decreases the turbine work because of heat loss

- Increases the pumping power

_Source : https://www.pumpsandsystems.com/

Disadvantages



Source : en.Wikipedia.org

- Decreases overall thermal efficiency

Assessment -2(Problem)

1. In an Actual Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 20 bar super heated at 300°C. The exhaust pressure is 0.07 bar and isentropic efficiency of turbine and pump are 85% each. Determine

a) Turbine work

b) Compressor work

c) Actual Efficiency

Assessment -2

2. In steam power plant, maximum Work obtained at

a) Turbine

b) Condenser

c) Boiler

d) Pump

3. Name the process in which the heat is rejected in Rankine cycle

a)Isothermal

b)Isobaric

c) Isochoric

d) Isentropic

References

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