

5.10 Binary Vapor Power Cycle:

Thermal efficiency of Rankine cycle can be increased by:

- 1) *Increasing the average temperature of heat addition.*
- 2) *Decreasing the average temperature of heat rejection.*

Maximum temperature of the cycle is limited by practical considerations. For steam as a working fluid, the following difficulties arise at maximum temperature.

- 1) *Critical temperature of steam is equal to 374°C and critical pressure is 221.2 bar. It is not possible to work at this pressure.*
- 2) *Latent heat of vaporization decreases as the pressure increases.*
- 3) *If high pressure steam is expanded, high degree of moisture content will be present at the end of process.*

The minimum temperature of the cycle is usually limited to natural water temperature of 25°C . At this temperature, the saturation pressure of water will be 0.0318 bar. It means that the condenser has to work at vacuum. This is very difficult. So, ideal working fluid for Rankine cycle should fulfill the following requirements.

- 1) *Reasonable saturation pressure at maximum temperature.*
- 2) *Steep saturated vapor line to minimize moisture problem.*
- 3) *Saturation pressure higher than atmospheric at minimum temperature.*
- 4) *Low liquid specific heat so that most of the heat is added at maximum temperature.*
- 5) *Non-toxic and non-corrosive.*

All the above requirements are not met by any single working fluid. In binary cycle two working fluids are used in order to obtain good results. Mercury and steam are most commonly used working fluids. Saturation pressure and saturation temperature of mercury is 20.6 bar and 540°C at critical point.