CEN 3311 HEAT TRANSFER

HEAT TRANSFER TO LIQUIDS WITH PHASE CHANGE

- **Two typical heat transfer processes with phase change are:**

1. **Steam is condensed in a condenser (condensing)**
2. **Water is converted into steam in a boiler (boiling)**

✓**A phase change involves the addition or substraction of considerable quantities of heat at constant temperature.**

✓**The values of h during condensation and evaporation are incredeably high.**

When does condensation occur on a surface?

- **Consider a surface at the**

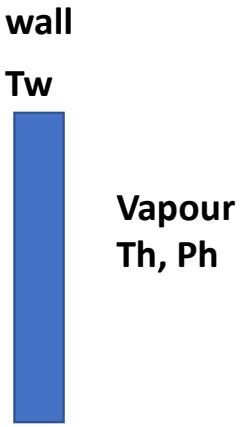
temperature of Tw

- **There is vapor at the saturation temperature**

Th (at Ph pressure)

If Th > Tw, vapor will condense on

the wall surface



Condensation occurs when a vapour with the saturation temperature Th (such as steam) comes in contact with the surface, which is maintained at Tw; Tw is less than Th.

CONDENSATION

Condensation of vapors:

- **water**
- **hydrocarbons**
- **other volatile substances**

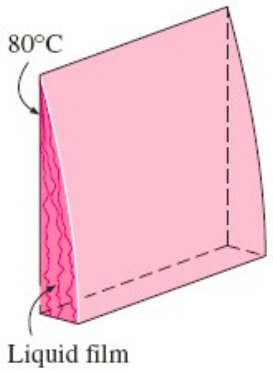
Types:

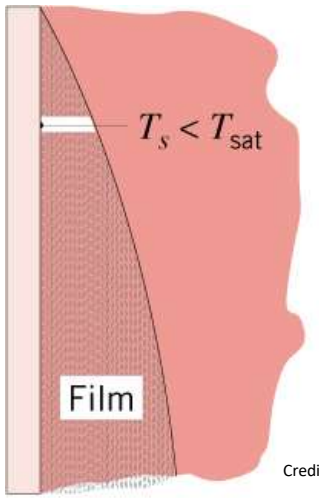
1. **Film condensation**
2. **Dropwise condensation**

In film condensation, a film of condensate is formed on the surface and flows over the surface by the action of gravity.

The liquid condensate wets the entire surface

The film forms the main resistance to heat transfer





Credit: Bergman, Lavine (2017) Fundamentals of Heat and Mass Transfer, 8th Ed.

In dropwise condensation, small drops are formed on the surface. These drops grow and coalesce, and then the liquid flows from the surface.

In dropwise condensation, the rate of heat transfer is much higher than the film condensation for the same temperature difference.

Credit: Bergman, Lavine (2017) Fundamentals of Heat and Mass Transfer, 8th Ed.