GAS-LIQUID CONTACT

The gas-liquid contact can be achieved
Adiabatically or *Non-Adiabatically*

Adiabatic Operations

a) Cooling a Gas :
- no fouling heat exchanger;
- some of the liquid is lost;

b) Humidifying a Gas :
- way to control the moisture contenent;

c) Dehumidifying a Gas :
- air conditioning;
- solvent recovery;

d) Cooling a Liquid :
- water cooling.

Non-adiabatic Operations

a) Evaporating Cooling :
- liquid or gas flowing inside a pipe is cooled by an external film which is cooled by direct contact with a flowing air stream;

b) Dehumidifying a Gas :
- gas-vapor mixture brought into contact with refrigerated pipe.

GAS-LIQUID CONTACT (cont.)

Equipment

- **Packed Towers** :
  - conventional equipment;
- **Tray Towers** :
  - conventional equipment;
- **Water Cooling Towers** :
  - packing : wood grid (redwood), or plastic grid;
  - high void space $\Rightarrow$ handling of large volumetric flowrates with small $\Delta P/L$;
- **Spray Chambers** :
  - horizontal spray towers;
  - for adiabatic humidification with recirculating liquid;
- **Spray Ponds** :
  - they are fountains;
  - high liquid losses by windage.

PACKED TOWERS

- Used for *countercurrent* contact of liquid and gas in absorption, humidification, and to a limited extent in distillation;

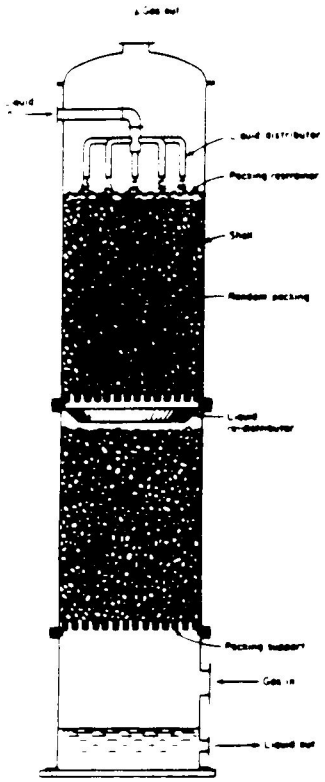
- Large specific surface area of contact; low $\Delta P/L$;

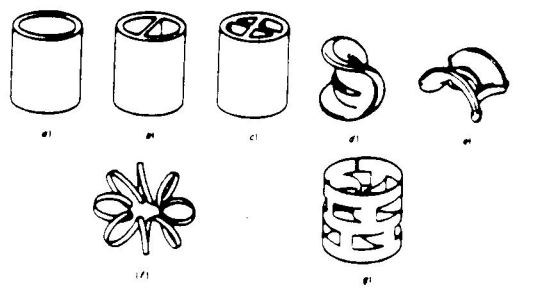
- Several packings are available. Two main types:

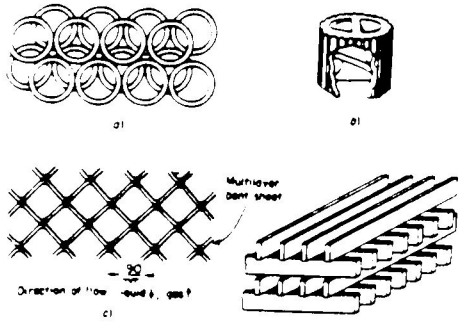
i) Random : randomly dumping the packing elements into the column; cheap, large specific surface area but large $\Delta P/L$ in smaller size;

ii) Regular : large sections of regularly arranged packing elements; more expensive; lower $\Delta P/L$

$\Rightarrow$ handling of larger volumetric flowrates

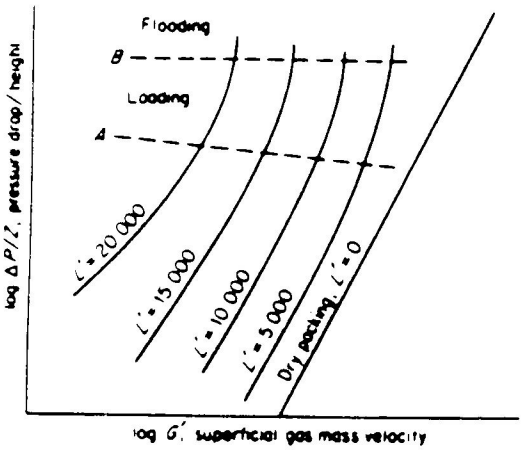






PACKED TOWERS (cont.)

- **Loading and Flooding**



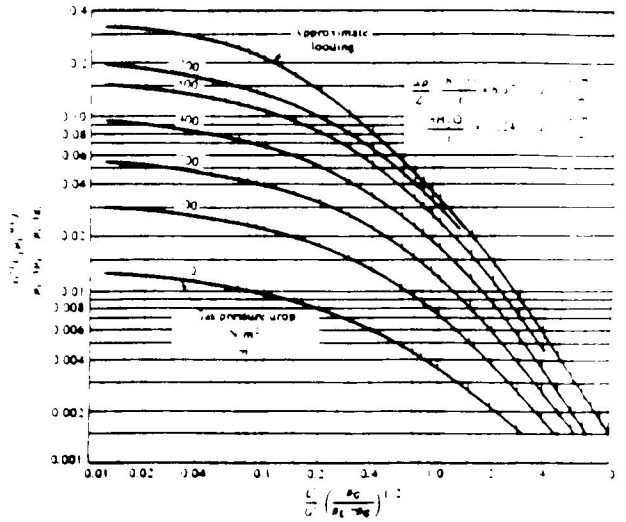


Figure 6.34 Flooding and pressure drop in random-packed towers. For SI units μ_L = 1 C, from Table 6.3, and αm J = 1. For G' = lb/ft² h, ρ = lb/ft³, μ_L = cP, g_c = 4.18 × 10⁸ C, from Table 6.3, and αm J = 1.500. (Courtesy of Eckert [38], Chemical Process Products Division, Koch Co.)

- **Sizing of the Tower Diameter, Φ_t**

  a) Most common design criterion

  Run the column at a G′ (the superficial gas mass velocity) such that the *pressure drop* per unit length, ΔP/L, is about 50% of the corresponding value at flooding.

  b) Other possible criteria

  i) $G' \approx 0.5\text{-}0.6\ G'_{flooding}$;

  ii) Pick Φ_t such that:

  $$\Delta P/L = 200\text{-}400\ N/m^2\ (= 0.25\text{-}0.50\ in\ H_2O/ft)$$