



Mass transfer

Lecture 14: *Gas absorption*

Jamin Koo

2019. 11. 18

Learning objectives

- **Be familiar with major applications of gas absorption in the modern society.**
- **Derive material balance equations for a given absorption process.**
- **Understand why one needs to optimize operating conditions of the packed towers.**

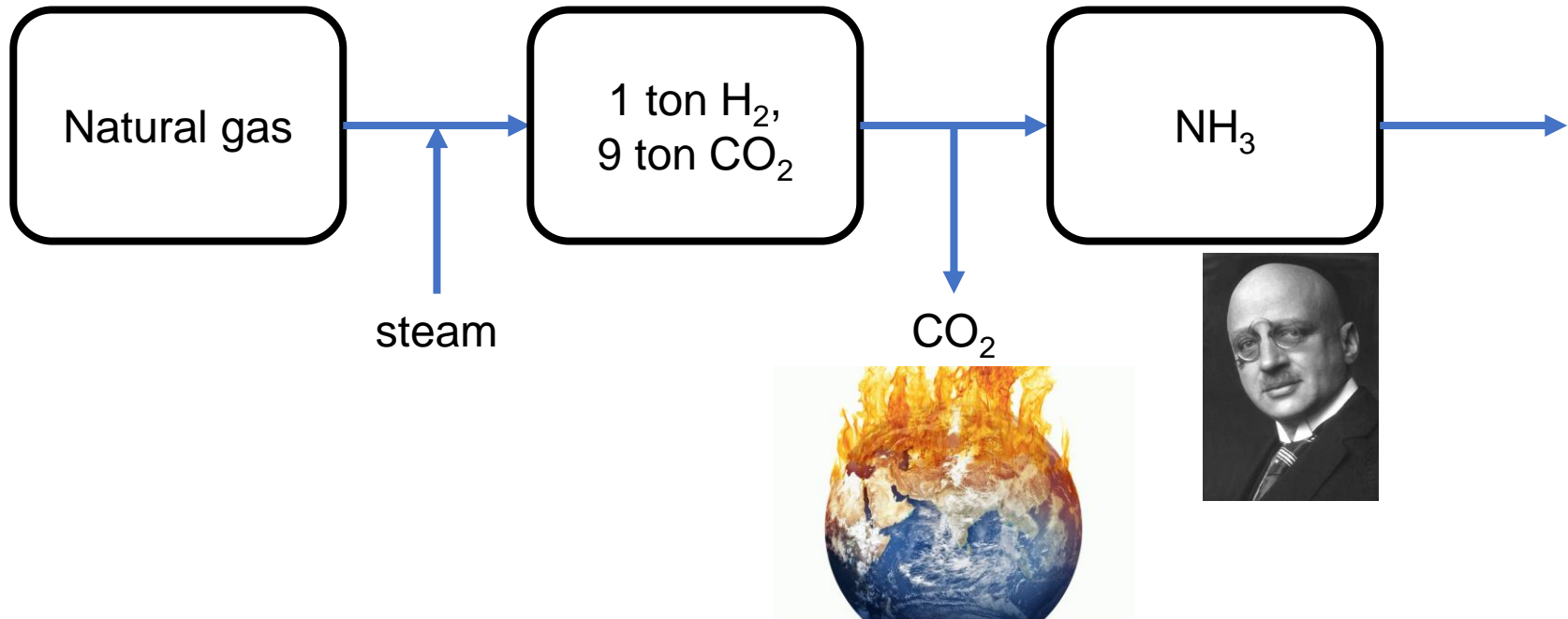
Today's outline

- **Gas absorption**

- ✓ Introduction
- ✓ Packed towers, packings
- ✓ Pressure drop and limiting flow rates
- ✓ Choice of operating velocity
- ✓ Material balances
- ✓ Graphical representation
- ✓ Limiting G-L ratio

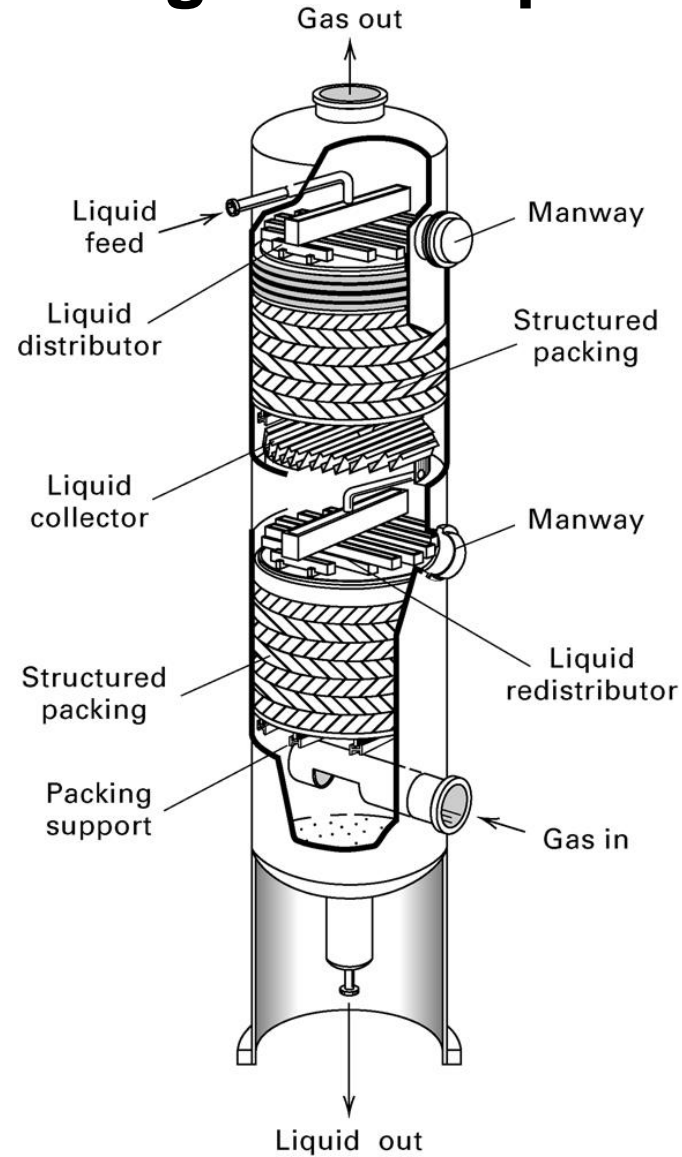
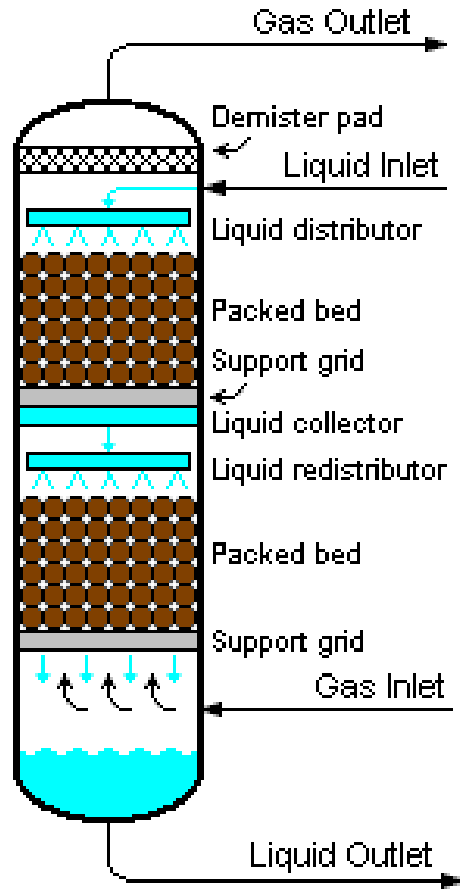
18.1 Introduction

- **Gases can be absorbed by a liquid in which they are soluble.**
 - ✓ eg., removal of CO_2 and H_2S from natural gas by solutions of amines or alkaline salts



18.2 Packed towers

- It is the common choice for gas absorption.



18.2 Packings

- **Packing determines the effectiveness of gas-liquid contact and mass transfer efficiency.**

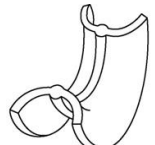
- ✓ Packings can be random, stacked, or structured.



Ceramic Raschig rings



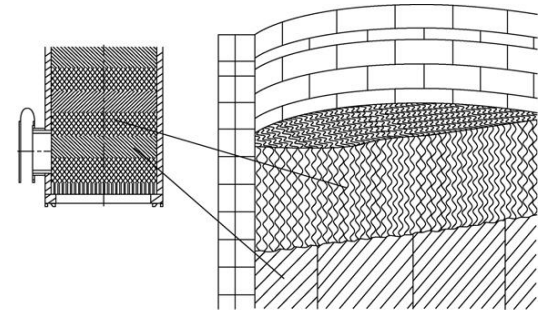
Ceramic Berl saddle



Ceramic Intalox® saddle



Plastic super Intalox® saddle



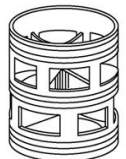
Flexiceramic Flexeramic®



Metal Intalox® IMTP



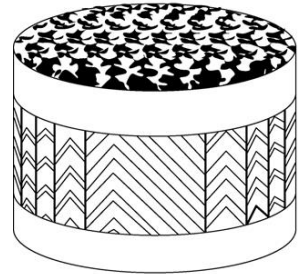
Metal Pall® ring



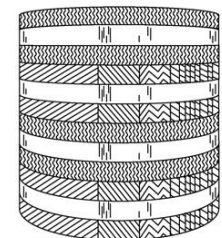
Plastic Flexiring®



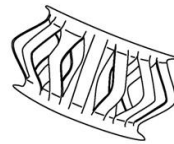
Metal Bialecki® ring



Mellapak™



Flexipac®



Metal Fleximax®



Metal Cascade Mini-ring® (CMR)



Metal Top-Pak®



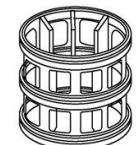
Metal Raschig Super-ring



Plastic Tellerette®



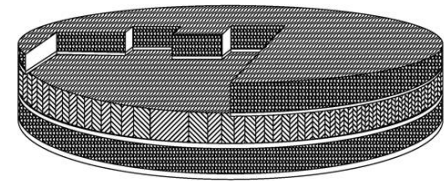
Plastic Hackett®



Plastic Hiflow® ring



Metal VSP® ring

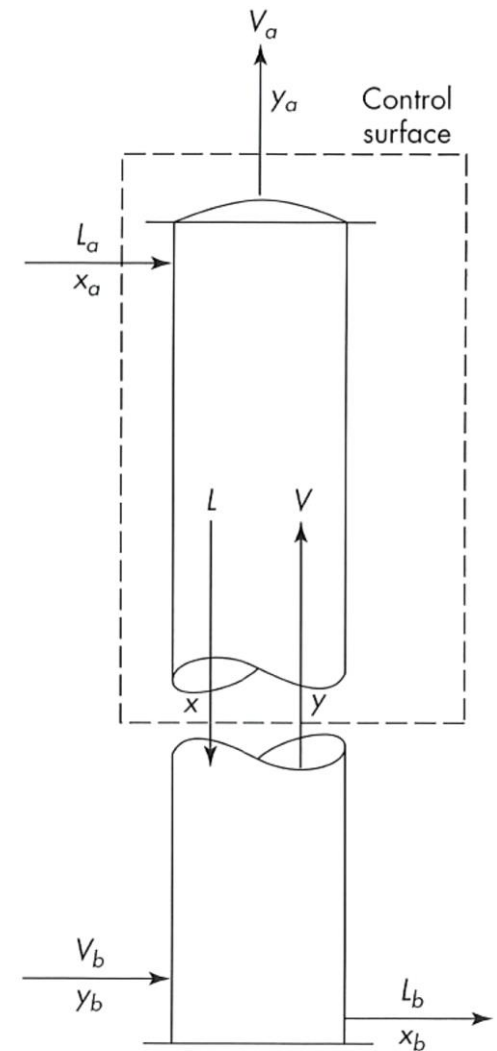


Montz™

18.3 Material balances

- **For the control surface,**
 - ✓ total material balance
 - ✓ balance for component A:

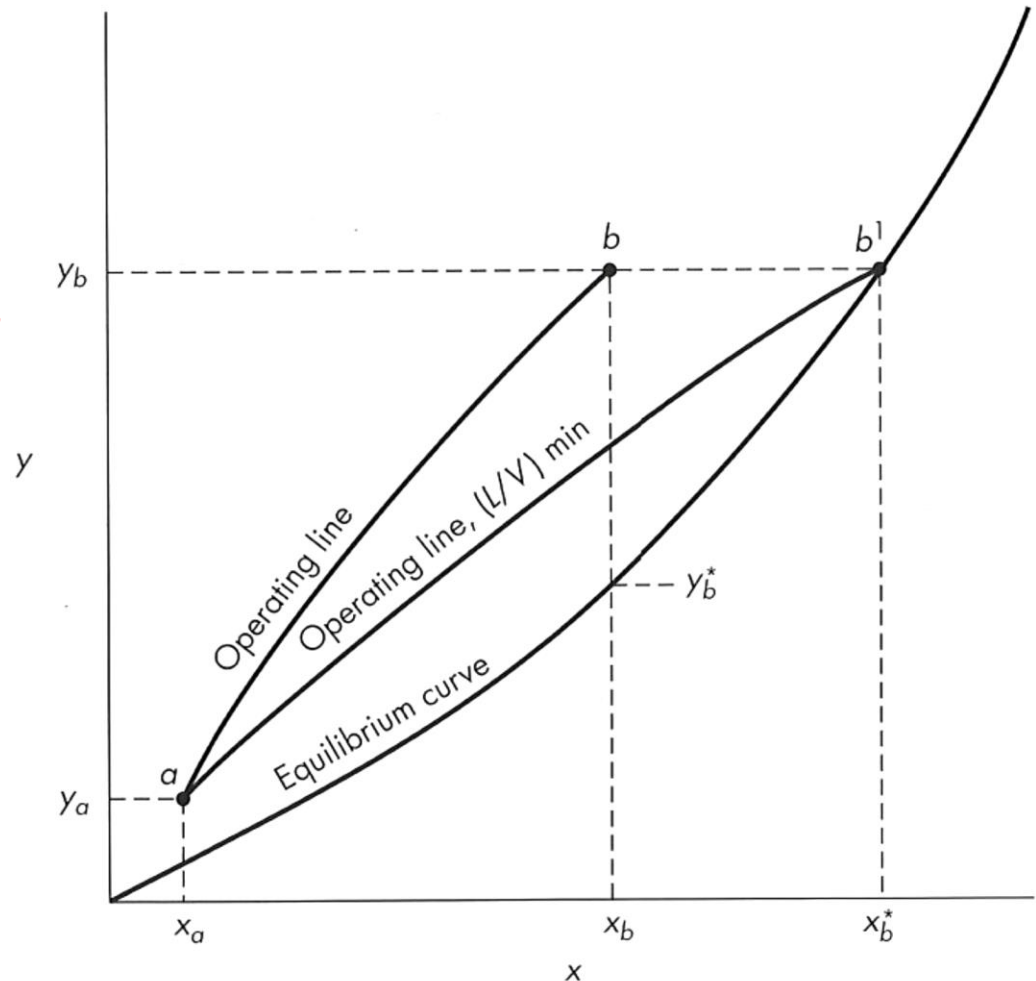
- **For the entire column,**
 - ✓ total material balance
 - ✓ balance for component A:
 - ✓ operating line equation:
$$y = \frac{L}{V}x + \frac{V_a y_a - L_a x_a}{V}$$



18.3 Graphical representation

- The graphical representation are as follows:

- ✓ Why is the operating line curved in this way?
- ✓ When will it be okay to approximate the operating line as linear?



18.3 Limiting G-L ratio

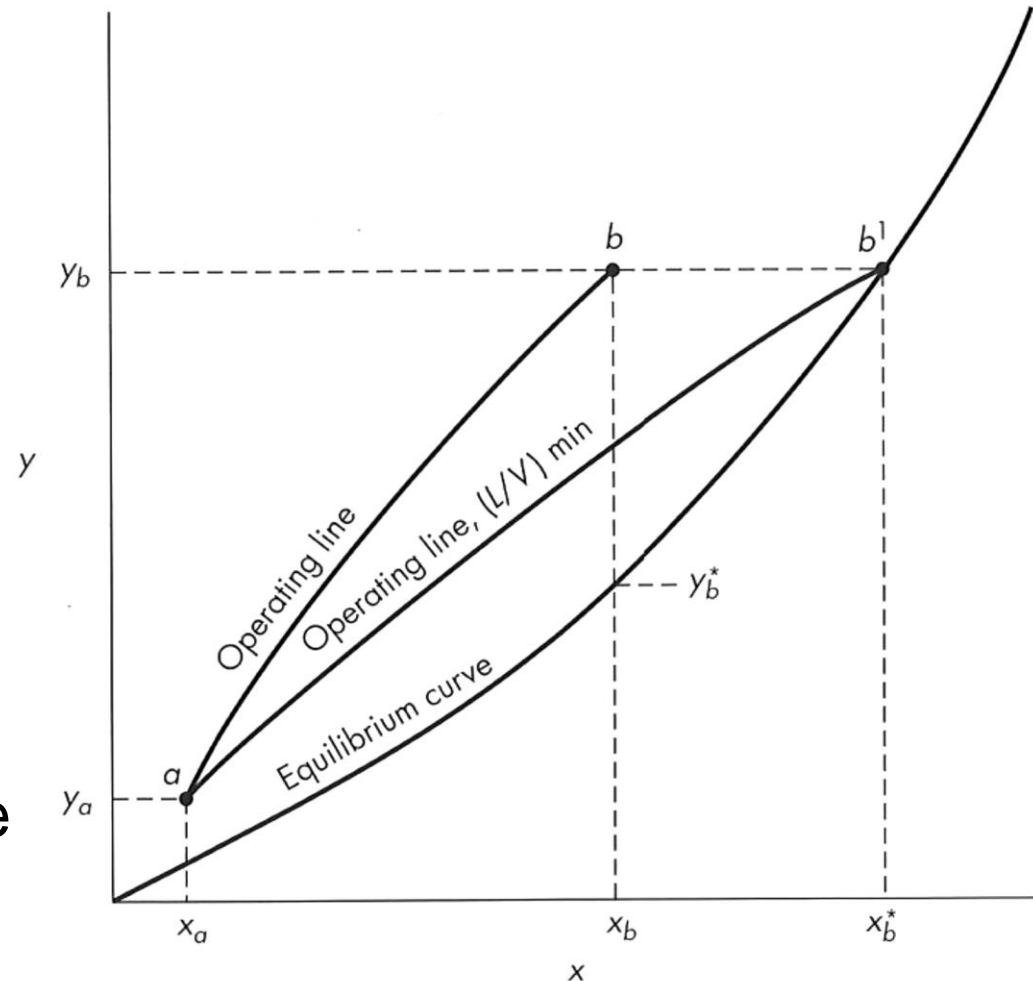
- The line ab_1 is the minimum slope of the op. line for a given point a and V .

✓ Why?

✓ Is it always better to have a steeper op. line?

✓ What is the driving force for the absorption at a or b ?

✓ It is harder to recover the absorbed gas from liquid if the liquid is more dilute.



18.3 Interface concentrations

- You can estimate interface concentrations using the diffusion model and rate equations.
 - ✓ Which model?
 - ✓ Derive the slope shown in the graph.

