CH402 Chemical Engineering Process Design

Class Notes L16

Plant Cost Scaling and Breakeven

L15 lookback: Estimating capital cost for an industrial facility

Method 1 – scaling against a known price

- Method 1a – scaling equipment
- Method 1b – scaling entire facilities (problems 6-9 and 6-10)

Method 2 – percentage method

- Method 2a – percentage of FCI – Example 6-1
- Method 2b – percentage of PEC – Colorful worksheet
- Need to differentiate between capital investment and purchased equipment cost.
- Need to understand the different components of capital investment.
- *Key - Each of these components has a well-known percentage of the total FCI.*
- To illustrate, we examined example 6-1 and problem 6-8.
- We also discussed Method 2c – Lang Factors - in Lesson 15.

FE Ref. Manual pages 257

Objectives for Lesson 16:

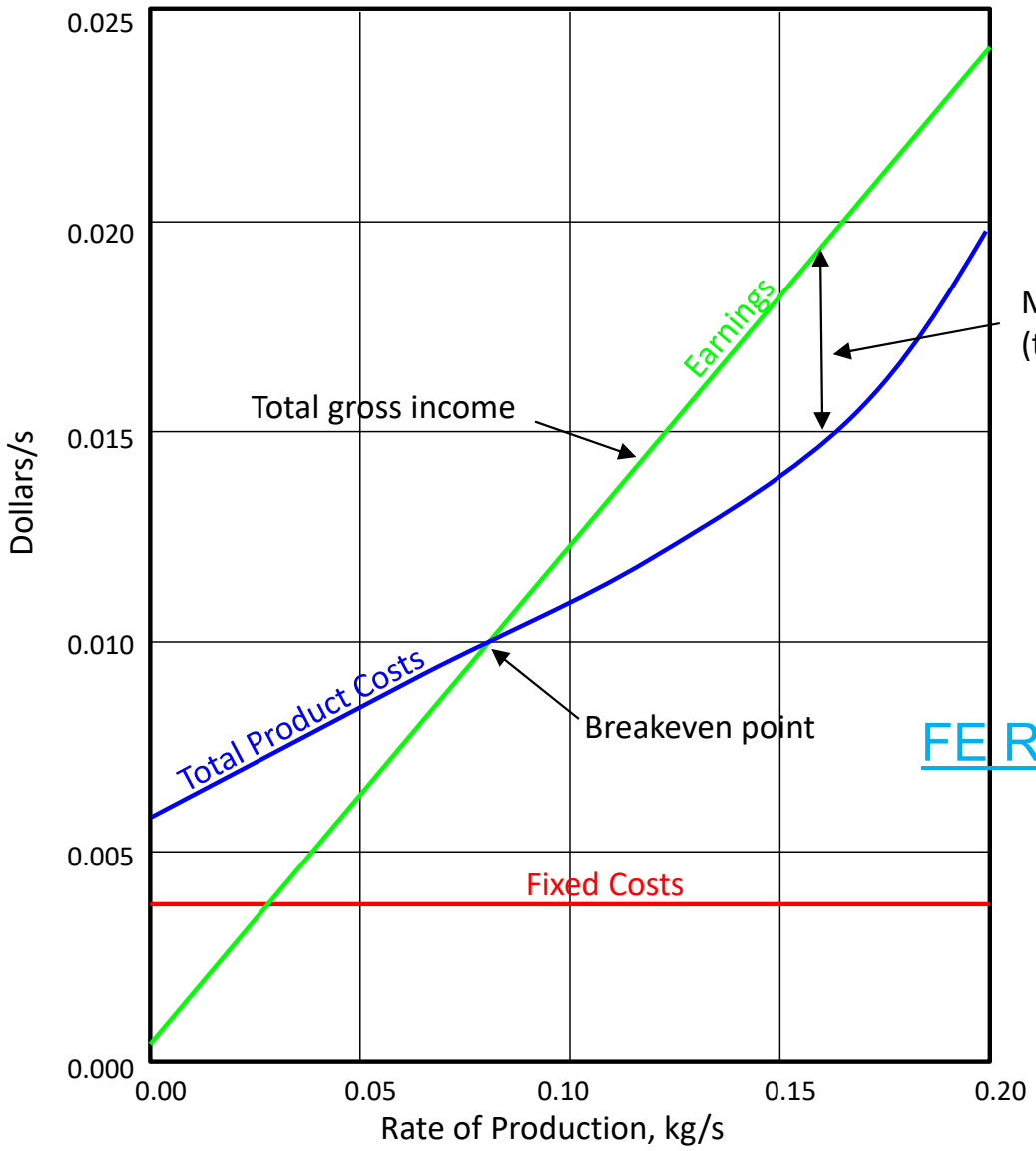
1. Estimate capital costs using scaling factors.
2. Estimate capital costs based on turnover ratio.
3. Determine breakeven point given production data.

FEE Manual v10.4 page 231

Break-Even Analysis – ICP

Figure 6-3; FEE p. 231; equation: gross earnings – variable costs – fixed costs

apply this equation



FE Ref. Manual pages 231

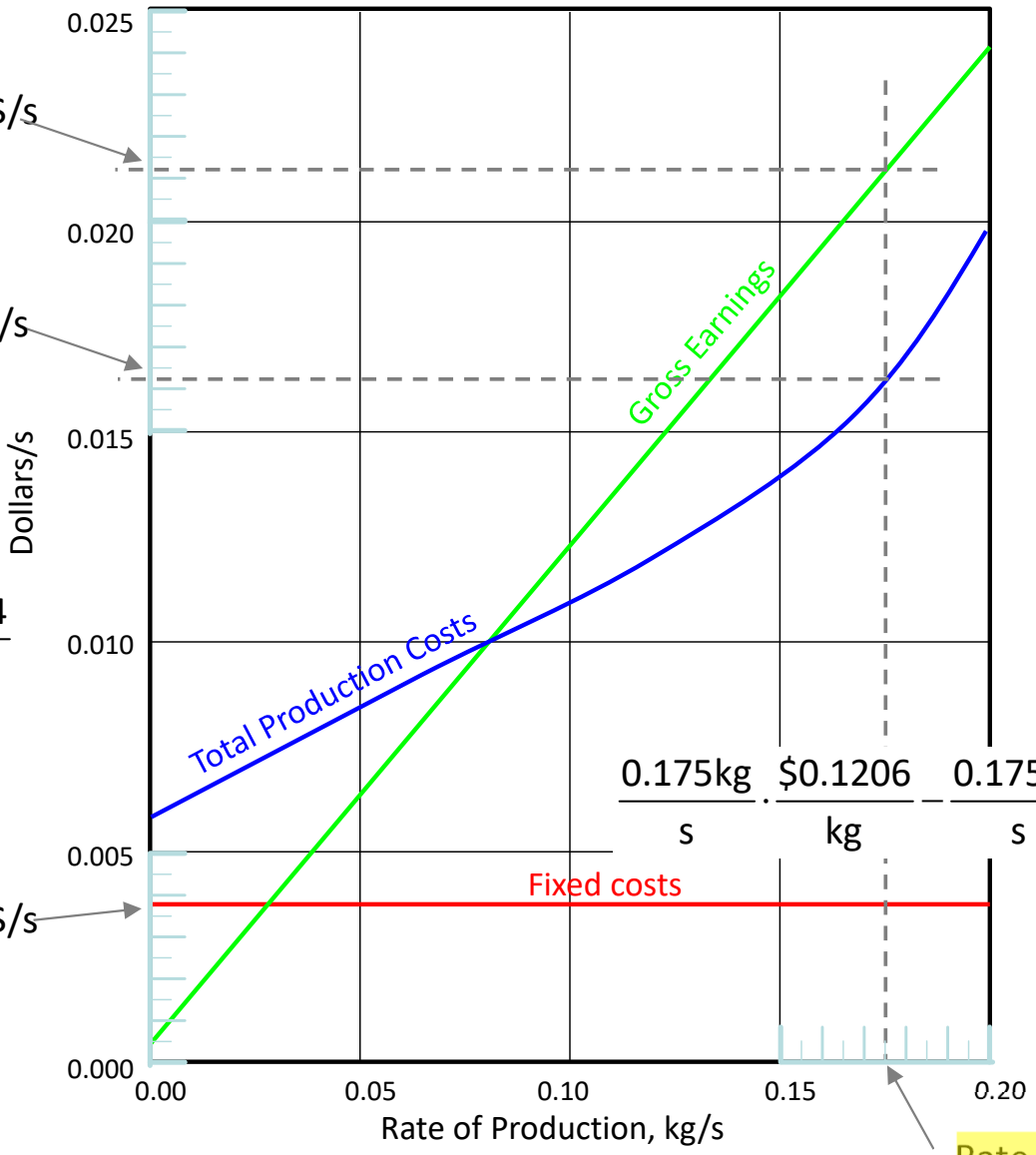
The authors do not state that fixed costs are included in total product costs. Normally they are not (as in ICP).

Breakeven point is at the indicated point if total product costs include fixed costs.

Break-Even Analysis – Ex1

Figure 6-3; FEE p. 231; equation: gross earnings – variable costs – fixed costs

apply this equation



Gross Earnings = 0.0211 $/s

Total Prod. Cost = 0.0162 $/s

Variable Costs:

$$0.0162 - 0.0038 = \frac{\$0.0124}{s}$$

Fixed Costs = 0.0038 $/s

market price, $/kg:

$$\frac{0.175\text{kg}}{s} \cdot x = \frac{\$0.0211}{s}$$

$$x = \frac{\$0.1206}{\text{kg}}$$

variable production cost, $/kg:

$$\frac{0.175\text{kg}}{s} \cdot y = \frac{\$0.0124}{s}$$

$$y = \frac{\$0.0709}{\text{kg}}$$

$$\frac{0.175\text{kg}}{s} \cdot \frac{\$0.1206}{\text{kg}} - \frac{0.175\text{kg}}{s} \cdot \frac{\$0.0709}{\text{kg}} - \frac{\$0.0038}{s} = \frac{\$0.0049}{s}$$

Operating at a profit

Rate of production = 0.175 kg/s

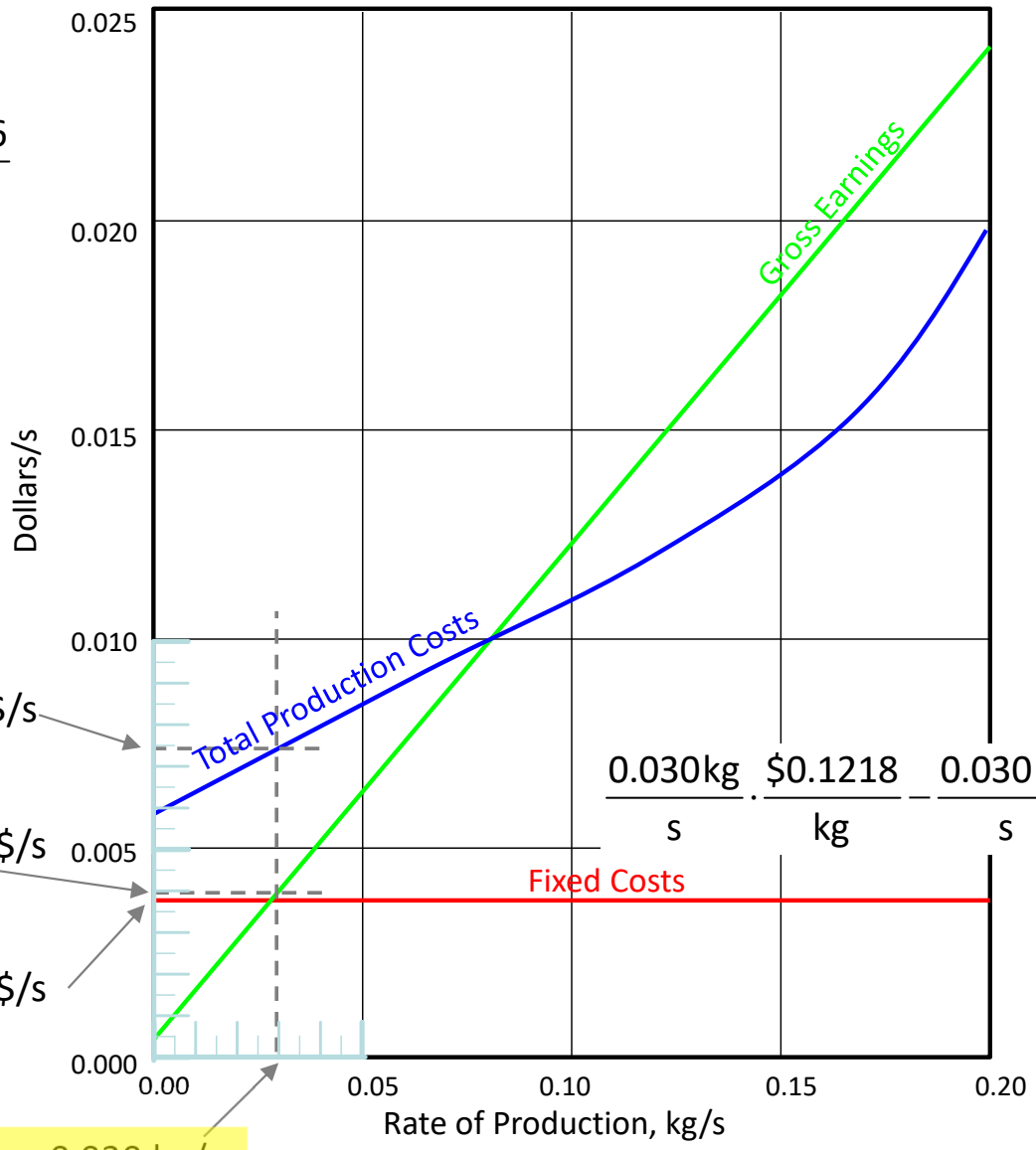
Break-Even Analysis – Ex2

Figure 6-3; FEE p. 231; equation: gross earnings – variable costs – fixed costs

apply this equation

Variable Costs, $/s:

$$0.0064 - 0.0038 = \frac{\$0.0026}{s}$$



Total Prod. Cost = 0.0064 $/s

Gross Earnings = 0.0039 $/s

Fixed Costs = 0.0038 $/s

Rate of production = 0.030 kg/s

market price, $/kg:

$$\frac{0.030\text{kg}}{s} \cdot x = \frac{\$0.0039}{s}$$

$$x = \frac{\$0.1300}{\text{kg}}$$

variable production cost, $/kg:

$$\frac{0.030\text{kg}}{s} \cdot y = \frac{\$0.0026}{s}$$

$$y = \frac{\$0.0867}{\text{kg}}$$

$$\frac{0.030\text{kg}}{s} \cdot \frac{\$0.1218}{\text{kg}} - \frac{0.030\text{kg}}{s} \cdot \frac{\$0.0867}{\text{kg}} - \frac{\$0.0038}{s} = -\frac{\$0.0025}{s}$$

Operating at loss

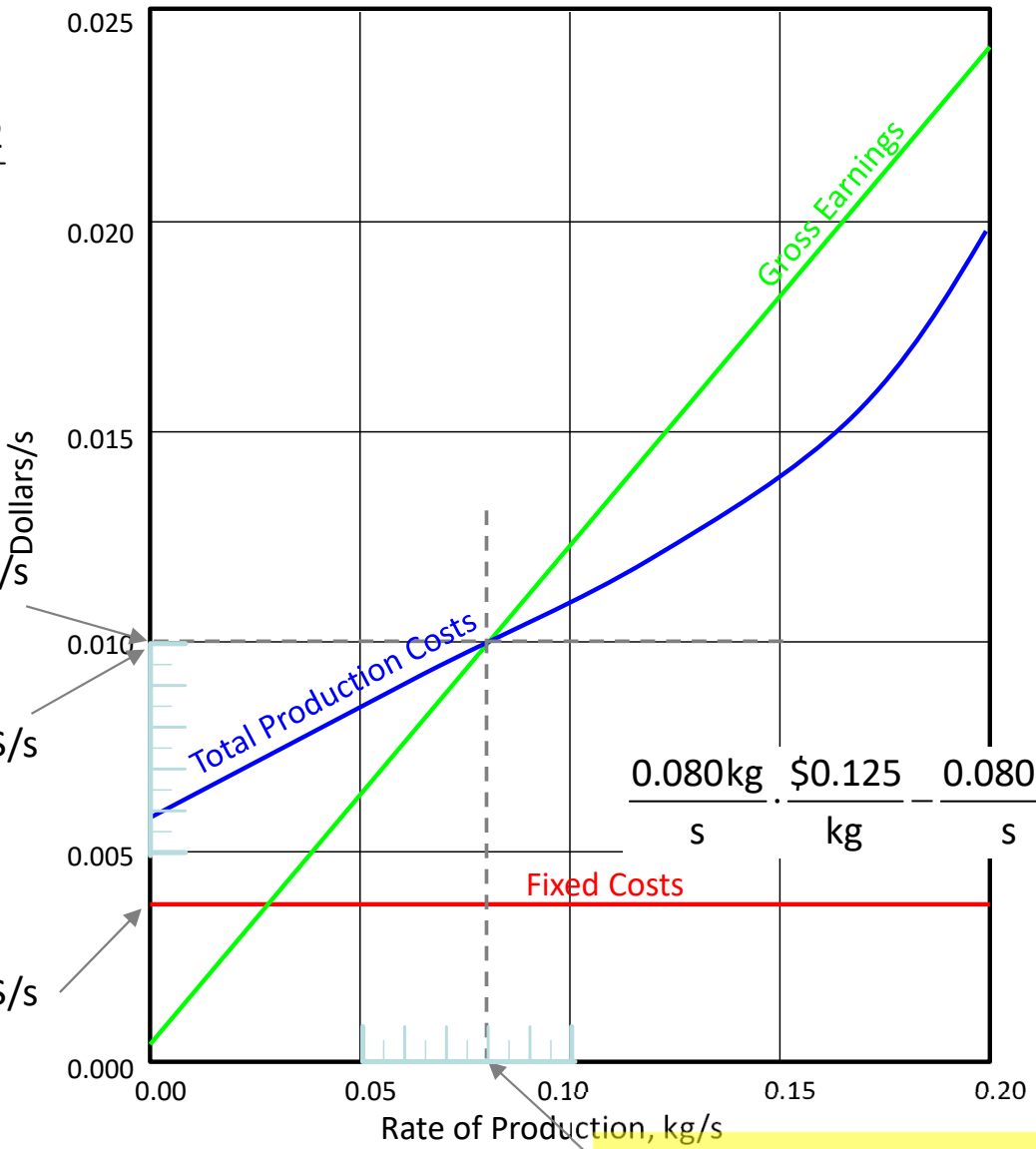
Break-Even Analysis – Ex3

Figure 6-3; FEE p. 231; equation: gross earnings – variable costs – fixed costs

apply this equation

Variable Costs, $/s:

$$0.0100 - 0.0038 = \frac{\$0.0062}{s}$$



Total Prod. Cost = 0.0100 $/s

Gross Earnings = 0.0100 $/s

Fixed Costs = 0.0038 $/s

market price, $/kg:

$$\frac{0.080\text{kg}}{s} \cdot x = \frac{\$0.0100}{s}$$

$$x = \frac{\$0.1250}{\text{kg}}$$

variable production cost, $/kg:

$$\frac{0.080\text{kg}}{s} \cdot y = \frac{\$0.0062}{s}$$

$$y = \frac{\$0.0775}{\text{kg}}$$

$$\frac{0.080\text{kg}}{s} \cdot \frac{\$0.125}{\text{kg}} - \frac{0.080\text{kg}}{s} \cdot \frac{\$0.0062}{\text{kg}} - \frac{\$0.0038}{s} = \frac{\$0.0000}{s}$$

“Breakeven”

Questions?