

DEPRECIATION & SALVAGE VALUE

*Engineering Economic Analysis Section
Perancangan Pabrik Kimia 2*

Schedule

- Time Value of Money (Interest Rate) & Cash Flow
- **Depreciation & Salvage Value**
- Profitability Analysis
- Selection of Alternatif Investment of Chemical Plant Equipment
- Sensitivity/Break Even Analysis
- Tax Principals (Dasar-Dasar Perpajakan)
- Selection of Plant Location
- Ujian Modul

Depreciation ??

- Depreciation: a decrease in value of a property over period of time due to any of the causes
- The causes of Depreciation:
 - physical deterioration
 - technological advances,
 - economic changes
 - other factors
- Total cost due to depreciation is the original or a new value of a property minus the value of the same property at the end of the depreciation period
- The engineer cannot wait until the end of the depreciation period to determine the depreciation cost ==> maka diprediksi di awal
- consequently, it is necessary to estimate the final value of the property as well as its useful life

Types of Depreciation

- **Physical Depreciation:**
 - wear and tear
 - corrosion
 - accidents
 - deterioration due to age
- **Functional Depreciation:**
 - obsolescence ==> due to technological advances
 - change in demand for the service
 - shift of population center
 - changes in requirements of public authority
 - inadequacy or insufficient capacity for the service required
 - termination of the need for the type of service rendered
 - abandonment of the enterprise

Obsolescences?

- **Product obsolescence:** is caused by the development and marketing of either cheaper or better substitutes
- **Equipment obsolescence:** equipment designs are radically improved
- **Process obsolescence:** process change for technological improvement
- **Capacity obsolescence:** batch process is replaced by continuous one for increased production, and for reducing overall operating expenses

Depletion

- Depletion: a measure of capacity loss due to material actually consumed
- Depletion Cost = (initial cost) (amount of material used/amount of material)

Percentage Depletion rate

TABLE 7.7 Percentage Depletion Rates

Material deposits	Percent
Sulfur, uranium; and if deposits in the United States, asbestos, lead ore, zinc ore, and mica	22
Gold, silver, copper, iron ore, and certain oil shale, if from deposits in the United States	15
Geothermal deposits	15
Borax, granite, limestone, marble, mollusk shells, potash, slate, soapstone, and carbon dioxide from a well	14
Coal, lignite, and sodium chloride	10
Clay and shale used or sold for use in making sewer pipe or bricks or used or sintered or burned for lightweight aggregate	7.5
Clay used or sold for use in making drainage or roofing tile, flower pots, kindred products, gravel, sand, and stone (other than stone used or sold for use by a mine owner or operator as dimension or ornamental stone)	5
Natural gas sold under a fixed contract	22
Small producers and royalty owners for any oil or gas well	15

Source: Ref. 10.

Service Life

- Service Life is the period during which the use/service of a property is economically feasible
- Both physical and functional depreciation are taken into consideration
- similar with **economic** or **useful life**
- Lihat Tabel 1 Peter (1991) pages 271-273 ==> Estimated Life of Equipment
- Lihat Table 2 Peter (1991) pages 274-275 ==> Class life asset depreciation range ==> umur pabrik
- Lihat Tables 7.2-7.3 Couper (2003) pages 179-180 ==> Class life asset depreciation range ==> umur pabrik

Depreciation Class Life

TABLE 7.2 Class Life ADR Table (Partial Listing)

Asset class	Description	Asset depreciation range, yr			Repair allowance, %
		Lower limit	Guideline period	Upper limit	
13.3	Petroleum refining	13	16	19	7.0
20.4	Food, other than sugar, grain	9.5	12	14.5	5.5
22.2	Manufacture of yarn	9	11	13	16.0
26.1	Manufacture of pulp from wood	13	16	19	4.5
26.2	Manufacture of paper	9.5	12	14.5	5.5
22.0	Manufacture of chemicals including petrochemicals	9	11	13	5.5
30.1	Manufacture of rubber products	11	14	17	5.0
30.2	Manufacture of finished plastics	9	11	13	5.5
32.1	Manufacture of glass products	11	14	17	12.0
32.2	Manufacture of cement	16	20	24	3.0
33.1	Primary ferrous metal	14.5	18	21.5	8.0
33.2	Primary nonferrous metal	11	14	17	4.5
49.12	Electric utilities, nuclear plant	16	20	24	3.0
49.5	Industrial steam and electric generation	22.5	28	33.5	2.5
60.11	Factory building	—	45	—	—
60.41	Office building	—	45	—	2.0
70.11	Office furniture	8	10	12	—

Source: Ref. 5.

TABLE 7.3 Depreciation Class Lives and MACRS Recovery Periods

Asset class	Description of asset	Class life, yr	MACRS recovery period, yr
00.12	Information systems	6	5
00.4	Industrial steam and electric generation and/or distribution systems	22	15
13.3	Petroleum refining	16	10
20.3	Manufacture of vegetable oils and vegetable oil products	18	10
20.5	Manufacture of food and beverages	4	3
22.4	Manufacture of textile yarns	8	5
22.5	Manufacture of nonwoven fabrics	10	7
26.1	Manufacture of pulp and paper	13	7
28.0	Manufacture of chemicals and allied products	9.5	5
30.1	Manufacture of rubber products	14	7
30.2	Manufacture of finished plastic products	11	7
32.1	Manufacture of glass products	14	7
32.2	Manufacture of cement	20	15
32.3	Manufacture of other stone and clay products	15	7
33.2	Manufacture of primary nonferrous metals	14	7
32.4	Manufacture of primary steel mill products	15	7
49.223	Substitute natural gas-coal gasification	18	10
49.25	Liquefied natural gas plant	22	15

Source: Ref. 1.

Book Value, Salvage Value, Scrap Value

- **Salvage Value** is the net amount of money obtainable from the sale of used property over and above any charges involved in removal and sale
- If a property cannot be disposed as a useful unit, it can be sold as junk to be used again ==> Scrap/Junk value
- **Scrap Value** ==> implies that the asset has no further useful life ==> barang rongsokan
- Salvage value, scrap value, and service life are usually estimated on the basis of conditions at the time the property is put in use
- **Book Value**: is the original asset investment minus the accumulated depreciation

Straight-Line Method Depreciation

- The Cost of an asset is distributed uniformly over its expected useful life
- Annual Depreciation (D):
$$D = \frac{I - S}{n}$$
- where: I: the cost of the asset; S: Salvage value; n: expected service life
- If Salvage Value is not taken (S=0) ==>
$$D = \frac{I}{n}$$
- The Book Value at the n of any given year is: $BV_r = I - (I/n)r$
- where r is a certain year in the life of an asset

TABLE 7.4 Straight-Line Method
Half-Year Convention 3, 5, 7, 10, 15, 20 Years

Year	Recovery period, yr					
	3	5	7	10	15	20
1	16.67%	10.00%	7.14%	5.0%	3.33%	2.5%
2	33.33	20.00	14.29	10.0	6.67	5.0
3	33.33	20.00	14.29	10.0	6.67	5.0
4	16.67	20.00	14.28	10.0	6.67	5.0
5		20.00	14.29	10.0	6.67	5.0
6		10.00	14.28	10.0	6.67	5.0
7			14.29	10.0	6.66	5.0
8			7.14	10.0	6.67	5.0
9				10.0	6.66	5.0
10				10.0	6.66	5.0
11				5.0	6.67	5.0
12					6.66	5.0
13					6.67	5.0
14					6.66	5.0
15					6.67	5.0
16					3.33	5.0
17						5.0
18						5.0
19						5.0
20						5.0
21						2.5

Source: Ref. 1.

Declining-Balance Method

- is also called as The Fixed-Percentage Method
- as the basis for the Modified Accelerated Cost Recovery System (MACRS)
- Declining-balance equation: $V_e = V_i (1-f)$
- where:
 - V_i : value of the asset at the beginning of a year
 - V_e : value of the asset at the end of the year
 - f : the declining-balance factor (constant from year to year)
- $f = \text{rate}/n$
- where the rate is either 150% or 200%
- if rate=200% ==> double-declining balance method and $f=2$
- The factor is applied to the previous year's remaining balance to determine the amount depreciated
- The Book Value at the end of a given year is:

$$BV_r = I \left(1 - \left(\frac{2}{n} \right) \right)^r$$

Sum-of-the-Years-Digits (SOYD) Method

- is the one of the two accelerated depreciation methods, the other being the MACRS
- Yearly depreciation: $SOYD_n = 1+2+\dots+(N-1)+N = N(N+1)/2$
- where n: number of years
- The depreciation for any year t is: $D_t = \left[\frac{N-(t-1)}{SOYD_n} \right] (P-S)$
- The Book Value at the end of year t is:

$$B_t = P - \left[\frac{P-S}{SOYD_n} \right] \left\{ SOYD_n - \left[\frac{(N-t)(N-t+1)}{2} \right] \right\}$$

Depreciation of Chemical Plant

- Biasanya Depresiasi ditentukan sebesar 8-10% dari Fixed Capital Investment (FCI)
- Umur pabrik ditentukan dari Asset Depreciation Range dari Tables 7.2-7.3 J. Couper (2003), atau dari Buku Peter & Timmerhaus (1991) ==> study analogy
- Salvage Value ditentukan dari persamaan depresiasi