CH0401 Process Engineering Economics

Lecture 3e

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1. **Economics of Selecting Alternatives**
2. Annual cost method
3. Present worth method
4. Replacement – Rate-of-return method
5. Payout time method

Process Engineering Economics

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Rate of Return Method

Problem 4. Employing the data of problem 1 where the cost of service with a plate and frame filter press costing $10,000 and having annual operating charges of $19,400 (labor cost to the direct costs) is to be compared with the cost of service for a continuous filter costing $30,000 with annual operating charges of $14,000, Calculate the rate – of – return on the extra investment in the continuous filter if the lives both are 10 years with salvage value of $600 for the plate and frame and $1,000 for the continuous filter. Assume $i = 24\%$

Rate of Return Method

Items	**Plan A** (Plate and frame filter press)	**Plan B** (Continuous filter)
Cost of filter	$10,000	$30,000
Annual operating cost	$19,400	$14,000
Money worth	24%	24%
Service life	10 years	10 years
Salvage Value	$600	$1,000

Plan A

We know,

$$P = R\left(\frac{(1+i)^n - 1}{i(1+i)^n}\right) \qquad (1)$$

$$R = P\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) \qquad (2)$$

$$R = (P-L)\times\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) + L\times i \qquad (3)$$

$$R = (P-L)\times\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) + L\times i + \text{AOP} \qquad (4)$$

where AOP = Annual Operating Cost

now taking i =0.24, n = 10 years, L = \$600, P=\$10,000 and AOP = 19,400 from the problem statement we have,

$$R = (10{,}000 - 600)\times\left(\frac{0.24(1+0.24)^{10}}{(1+0.24)^{10} - 1}\right) + 600\times 0.24 + 19{,}400$$

$$R = (9{,}400)\times(0.2716) + 144 + 19{,}400 = 22097.04$$

$$R = \$22097$$

Plan B

We know,

$$P = R\left(\frac{(1+i)^n - 1}{i(1+i)^n}\right) \qquad (1)$$

$$R = P\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) \qquad (2)$$

$$R = (P - L)\times\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) + L\times i \qquad (3)$$

$$R = (P - L)\times\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) + L\times i + \text{AOP} \qquad (4)$$

where AOP = Annual Operating Cost

now taking i =0.24, n = 10 years, L = \$1000, P=\$30,000 and AOP = 14,000 from the problem statement we have,

$$R = (30{,}000 - 1000)\times\left(\frac{0.24(1+0.24)^{10}}{(1+0.24)^{10} - 1}\right) + 1000\times 0.24 + 14{,}000$$

$$R = (29{,}000)\times(0.2716) + 240 + 14{,}000 = 22{,}116.4$$

$$R = \$22{,}116$$

Particulars	**Plan A**	**Plan B**
Rate of return for money worth 24%	$22,097	$22,116

Once again it is seen from the above table that the rate – of – return for **Plan B** is greater when compared with **Plan A**, therefore the Plan B is strongly recommended

But in the same problem if we use 23.88% roughly we get the same rate – of – return i.e. $22086 for both the plans.

Payout time

Problem 6. A small-scale company plans an expansion involving \$3,00,000 with installation of new equipment's. The government allowable depreciable life is 10 years, and it is expected that that the net return, R or net profit will be \$75,000. Determine the economic payout time when i = 8% and 4% in the basic (annuity) equation.

Solution

$$P = R\left(\frac{(1+i)^n - 1}{i(1+i)^n}\right) \qquad (1)$$

Rearranging the above equation we have,

$$n = \frac{-\log\left(1 - \frac{iP}{R}\right)}{\log(1+i)}\text{, years}$$

We know that, P = \$300,000 ; R = \$75,000 i = 8% and 4% from the problem statement

Therefore, for i = 8%

$$n = \frac{-\log\left(1 - \frac{0.08 \times 300{,}000}{75000}\right)}{\log(1+0.08)} = 5.01$$

$$n = 5 \text{ years}$$

for $i = 4\%$

$$n = \frac{-\log\left(1 - \frac{0.04 \times 300{,}000}{75{,}000}\right)}{\log(1 + 0.04)} = 4.5$$

$n = 4.5$ years

Process Engineering Economics – ***References***

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