CH0401 Process Engineering Economics

Lecture 3d

Balasubramanian S

Department of Chemical Engineering
SRM University

Process Engineering Economics

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

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 – *Comparison*

Comparison of different interest rate percentages in annual cost method and present worth method

Problem 3. Using the same data from problem 1 with money worth 4%, Find out the relative annual costs and present worth's of two alternatives for 10 years service and how do these results compared with those obtained when money worth 10%?

Items	**Plan A** (Plate and frame filter press)	**Plan B** (Continuous filter)
Cost of filter	$10,000	$30,000
Labor cost	$18,600	$11,000
Annual direct cost	8% of investment	10% of investment
Money worth	**4%**	**4%**
Service life	10 years	10 years
Salvage Value	$600	$1,000

Process Engineering Economics – *Comparison*

Annual Cost Method

Plan A	Plan B
We know,	We know,
$P = R\left(\frac{(1+i)^n - 1}{i(1+i)^n}\right)$ (1)	$P = R\left(\frac{(1+i)^n - 1}{i(1+i)^n}\right)$ (1)
$R = P\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right)$ (2)	$R = P\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right)$ (2)
$R = (P - L)\times\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) + L \times i$ (3)	$R = (P - L)\times\left(\frac{i(1+i)^n}{(1+i)^n - 1}\right) + L \times i$ (3)
now taking i =0.04, n = 10 years, L = \$600,	now taking i =0.04, n = 10 years, L = \$1,000,
P=\$10,000 from the problem statement	P=\$30,000 from the problem statement
we have,	we have,
$R = (10{,}000 - 600)\times\left(\frac{0.04(1+0.04)^{10}}{(1+0.04)^{10} - 1}\right) + 600 \times 0.04$	$R = (30{,}000 - 1{,}000)\times\left(\frac{0.04(1+0.04)^{10}}{(1+0.04)^{10} - 1}\right) + 1000 \times 0.04$
$R = (9{,}400)\times\frac{0.0592}{0.4802} + 24 = 1159.02 + 24$	$R = (29{,}000)\times(0.1233) + 1000 \times 0.04 = 3615.7$
R = \$1183	R = \$3616

Process Engineering Economics – *Comparison*

Annual Cost Method

Therefore, the total annual cost for the service are

Items	**Plan A** (Plate and frame filter press)	**Plan B** (Continuous filter)
A. Capital investment	$10,000	$30,000
B. Capital recovery, *R*	$ 1,183	$ 3,616
C. Labor cost	$18,600	$11,000
D. Other direct costs	$ 800	$ 3,000
Total annual costs (B+C+D)	**$20,583**	**$17,616**

Comparison:

I. If we use 10% interest rate potential saving in annual cost = $2,170 i.e. (20,990 – 18,820) from annual cost method problem no 1.

II. If we use 4% interest rate potential saving in annual cost = $2,967 i.e (20,583 – 17,616)

Therefore, both the interest rates are in favor of Plan B. But it is seen that lower interest rate raises the difference in annual cost to (20,583 – 17,616) = $2,967 in favor of plan B.

Present Worth Method

Plan A

We know,

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

Therefore, the present worth of annual cost, P is calculated as follows

$$P = 19{,}400 \times \left(\frac{(1+0.04)^{10} - 1}{0.04(1+0.04)^{10}}\right)$$

$$P = 19{,}400 \times 8.1115 = 1{,}57{,}363.1$$

$$P = \$1{,}57{,}363$$

Present worth of salvage is given by

$$F = P(1+i)^n$$

$$P = \frac{F}{(1+i)^n}$$

$$P = \frac{600}{(1+0.04)^{10}} = \frac{600}{1.4802} = 405.35$$

$$P = \$405$$

Process Engineering Economics – *Comparison*

Present Worth Method

Plan B

We know,

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

Therefore, the present worth of annual cost, P is calculated as follows

$$P = 14{,}000 \times \left(\frac{(1+0.04)^{10} - 1}{0.04(1+0.04)^{10}}\right)$$

$$P = 14{,}000 \times (8.1115) = 1{,}13{,}560.81$$

$$P = \$1{,}13{,}561$$

Present worth of salvage is given by

$$F = P(1+i)^n$$

$$P = \frac{F}{(1+i)^n}$$

$$P = \frac{1000}{(1+0.04)^{10}} = \frac{1000}{1.4802} = 675.58$$

$$P = \$676$$

Process Engineering Economics – *Comparison*

Present Worth Method

Particulars	**Plan A** (Plate and frame filter press)	**Plan B** (Continuous filter)
(i) Present worth of annual cost	$157,363	$113,561
(ii) Present worth of salvage	$ 405	$ 676
(iii) Present worth of initial cost	$ 10,000	$ 30,000
Total present worth = (i – ii) + (iii)	**$166,958**	**$142,885**

Comparison:

Interest rate	**Plan A**	**Plan B**
I. Equivalent present worth by 10 % (from problem 2)	$119,213	$86,030.0
II. Equivalent present worth by 4%	$157,363	$113,561

Form the above table it is seen that the difference in equivalent present worth is greater in favor of **Plan B** than for **Plan A** when money worth 4%. Hence **Plan B** is recommended

Process Engineering Economics – ***References***

- Herbert E. Schweyer. (1955) ***Process Engineering Economics***, Mc Graw Hill
- Max S. Peters, Kaus D. Timmerhaus, Ronald E. West. (2004) ***Plant Design and Economics for Chemical Engineers***, 5th Ed., Mc Graw Hill
- Max Kurtz. (1920) ***Engineering Economics for Professional Engineers' Examinations***, 3rd Ed., Mc Graw Hill
- Frederic C. Jelen, James H. Black. (1985) ***Cost and Optimization Engineering***, International Student edition, Mc Graw Hill
- Grant L. E, Grant Ireson. W, Leavenworth S. R. (1982) ***Principles of Engineering Economy***, 7th Ed., John Wiley and Sons.