Expressions for Cost of Electrical Ener essions for Cost of Electrical Energy

The overall annual cost of electrical energy generated by a power station can be expressed in two forms viz three part form and two part form.

(i) Three part form.

In this method, the overall annual cost of electrical energy generated is divided into three parts viz fixed cost, semi-fixed cost and running cost i.e. Total annual cost of energy = Fixed cost + Semi-fixed cost + Running cost = Constant + Proportional to max. demand + Proportional to kWh generated. = Rs (a + b kW + c kWh) where a = annual fixed cost independent of maximum demand and energy output. It is on account of the costs mentioned

b = constant which when multiplied by maximum kW demand on the station gives the annual semi-fixed cost. c = a constant which when multiplied by kWh output per annum gives the annual running cost.

(ii) Two part form.

It is sometimes convenient to give the annual cost of energy in two part form. In this case, the annual cost of energy is divided into two parts viz., a fixed sum per kW of maximum demand plus a running charge per unit of energy.

The expression for the annual cost of energy then becomes : Total annual cost of energy = Rs. (A kW + B kWh) where A = a constant which when multiplied by maximum kW demand on the station gives the annual cost of the first part. B = a constant which when multiplied by the annual kWh generated gives the annual running cost. It is interesting to see here that two-part form is a simplification of three-part form. A little reflection shows that constant "a" of the three part form has been merged in fixed sum per kW maximum demand (i.e. constant A) in the two-part form

Methods of Determining Depreciation

There is reduction in the value of the equipment and other property of the plant every year due to depreciation. Therefore, a suitable amount (known as depreciation charge) must be set aside annually so that by the time the life span of the plant is over, the collected amount equals the cost of replacement of the plant. The following are the commonly used methods for determining the annual depreciation charge :

(i) Straight line method ;

(ii) (ii) Diminishing value method ;

(iii) (iii) Sinking fund method.

(i) Straight line method.

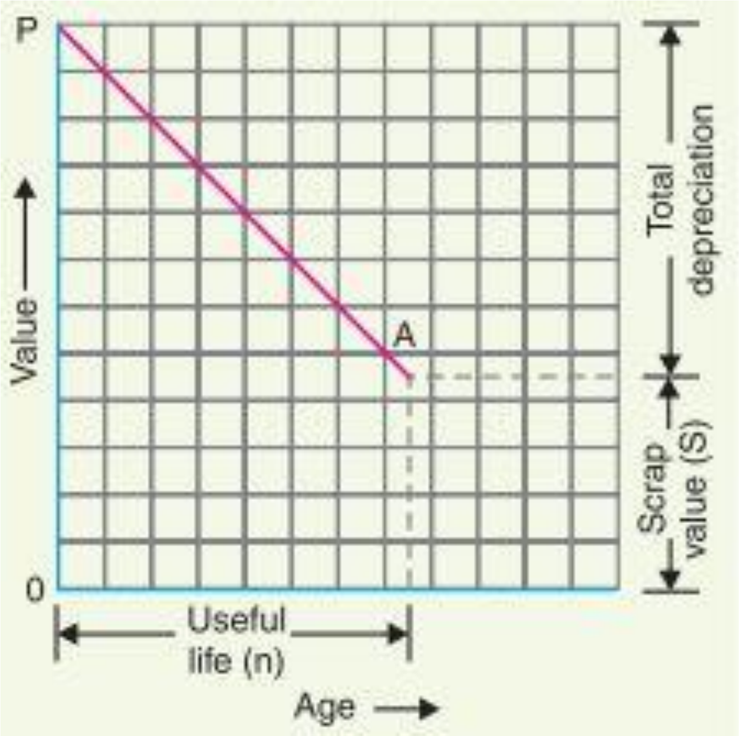
In this method, a constant depreciation charge is made every year on the basis of total depreciation and the useful life of the property. Obviously, annual depreciation charge will be equal to the total depreciation divided by the useful life of the property.

Thus, if the initial cost of equipment is Rs 1,00,000 and its scrap value is Rs 10,000 after a useful life of 20 years, then, Annual depreciation charge = Total depreciation Useful life = 100 000 10 000 − 20 ,, , = Rs 4,500

In general, the annual depreciation charge on the straight line method may be expressed as :

Annual depreciation charge = P S n − where P = Initial cost of equipment n = Useful life of equipment in years S = Scrap or salvage value after the useful life of the plant. The straight line method is extremely simple and is easy to apply as the annual depreciation charge can be readily calculated from the total depreciation and useful life of the equipment. Fig.shows the graphical representation of the method. It is clear that initial value P of the equipment reduces uniformly, through depreciation, to the scrap value S in the useful life of the equipment.

The depreciation curve (PA) follows a straight line path, indicating constant annual depreciation charge. However, this method suffers from two defects. Firstly, the assumption of constant depreciation charge every year is not correct. Secondly, it does not account for the interest which may be drawn during accumulation.



(ii) Diminishing value method.

In this method, depreciation charge is made every year at a fixed rate on the diminished value of the equipment. In other words, depreciation charge is first applied to the initial cost of equipment and then to its diminished value. As an example, suppose the initial cost of equipment is Rs 10,000 and its scrap value after the useful life is zero. If the annual rate of depreciation is 10%, then depreciation charge for the first year will be $0{\cdot}1 \times 10{,}000$ = Rs 1,000. The value of the equipment is diminished by Rs 1,000 and becomes Rs 9,000. For the second year, the depreciation charge will be made on the diminished value (i.e. Rs 9,000) and becomes $0{\cdot}1 \times 9{,}000$ = Rs 900.

The value of the equipment now becomes $9000 - 900$ = Rs 8100. For the third year, the depreciation charge will be $0{\cdot}1 \times 8100$ = Rs 810 and so on.

Mathematical treatment Let P = Capital cost of equipment n = Useful life of equipment in years S = Scrap value after useful life Suppose the annual unit* depreciation is x. It is desired to find the value of x in terms of P, n and S. Value of equipment after one year $= P - Px = P(1 - x)$ Value of equipment after 2 years = Diminished value − Annual depreciation $= [P - Px] - [(P - Px)x] = P - Px - Px + Px^2 = P(x^2 - 2x + 1) = P(1 - x)^2$ ∴ Value of equipment after n years $= P(1 - x)^n$

But the value of equipment after n years (i.e., useful life) is equal to the scrap value S. ∴ $S = P(1 - x) n$ or $(1 - x) n = S/P$ or $1 - x = (S/P) 1/n$ or $x = 1 - (S/P) 1/n$ ...(i) From exp. (i), the annual depreciation can be easily found. Thus depreciation to be made for the first year is given by : Depreciation for the first year = $xP = P[1 - (S/P) 1/n]$ Similarly, annual depreciation charge for the subsequent years can be calculated. This method is more rational than the straight line method. Fig shows the graphical representation of diminishing value method. The initial value P of the equipment reduces, through depreciation, to the scrap value S over the useful life of the equipment. The depreciation curve follows the path PA. It is clear from the curve that depreciation charges are heavy in the early years but decrease to a low value in the later years. This method has two drawbacks. Firstly, low depreciation charges are made in the late years when the maintenance and repair charges are quite heavy. Secondly, the depreciation charge is independent of the rate of interest which it may draw during accumulation. Such interest moneys, if earned, are to be treated as income