1912

Depreciation

Reginald Henry Brinton Butler

D E P R E C I A T I O N

by

Reginald Henry Brinton Butler.

A

T H E S I S

submitted to the Faculty of the

SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI

in partial fulfillment of the work required for the

D E G R E E O F

METALLURGICAL ENGINEER

Rolla, Mo.

1912.

Approved by _____

B I B L I O G R A P H Y

"The Depreciation of Factpries and their Valuation"
----- Matheson.

"Works Management" ---------- W. D. Ennis.

"Steam and Power Plant Engineering" ---- Gebhardt.

"Principles of Industrial Engineering" ---- Diemer.

"Cost Keeping and Scientific Management" --- Evans.

C O N T E N T S

In estimating and stating working costs, we are often brought face to face with an important item of expense, for which no receipt is ever given and no invoice is ever rendered, viz; DEPRECIATION. For this reason perhaps the different ways of charging this liability are innumerable.

No two people often have their minds cast into similar moulds and in the charging of this item, the human and personal factor enters very largely into consideration. People differ widely as to just what part of the capital must be laid aside to meet "changing conditions in trade" and what ought to be charged as DEPRECIATION.

Some will recognize that DEPRECIATION is unavoidable and make some attempt to cover the loss their capital undergoes, but often it is not charged at all, and those who decline to charge it, can quote authorities to back their view, that DEPRECIATION is too vague and utterly impossible thing to charge.

To quote from Ennis, in his recent book on Cost Keeping;

"In many courts throughout the country it has been decided that depreciation is not an element of cost

and should not be charged against income. Hatfield quotes a decision in a California court, in which the judge decided that a charge of depreciation against income was "all wrong" and "not to be tolerated for a moment." Hatfield also states that some years ago the Supreme Court of the United States held, regarding depreciation: "We are clearly of the opinion that it is not a proper charge. Only such expenditures as are actually made can with any propriety be claimed as a deduction from earnings." On the other hand, the Statutes of Germany, France, Belgium, Switzerland and Austria require that depreciation must be charged before profits can be paid. The courts of England have also almost always held that depreciation must be considered, and this has been the ruling in many states in this country. The most important recent ruling is that of the Interstate Commerce Commission that an allowance be made for the depreciation of the equipment of railroads."

Mining and Metallurgical text books, schemes of mine accounting, technical articles on working costs are often found to give the costs of such articles as candles, or power, in fractions of a cent, worked out to five decimal places, and to exclude all reference to a DEPRECIATION charge (and often Interest on Investment also.)

It would be quite possible, in a plant where there is no DEPRECIATION CHARGE, for a firm to put down a $1,000,000 plant, paying $60,000 per annum "profit" until at the end of ten years, when the plant was dispossed of, it fetched $250,000 when the firm would awaken to the fact, that instead of making a profit they had in reality been paying from resources account and had incurred a loss of $150,000. Profit and loss is not merely a question of difference between receipts and expenditures.

Others charge it as a known liability and promptly dismiss it by charging 10% or 20% and let it go at that, whilst some, wishing to be "conservative", charge a heavy amount to this fund. Heated discussions arise between accountants as to whether percentage of value of the equipment, charged to this fund, is on the original investment or whether it be on the investment is reduced by its annual deduction to the depreciation fund.

DEPRECIATION is the allowance made for the loss the capital has really undergone through wear and tear of the asset, from the influence of the elements, and changes in trade. It may be said that deprecia-

tion is an effect produced "not by anything being parted with, but by its being kept." It represents capital that must be periodically renewed. It is not a fixed unvarying quantity that can be taken care of by simply charging some annual sum, arrived at by guess or without careful investigation as to the probable causes and limits of its variation. To overcharge it is to be as far from the truth and is as deceptive in its results, as to omit it, or under estimate it.

The three main causes of depreciation are;

1 - Time and the elements.

2 - Wear and tear through use and abuse.

3 - Modern progress, tending to render the plant obsolete, and changes in trade.

Of these, the last is the most elusive and difficult to estimate. For instance, a factory may be put up during the days when the bicycle is the craze of the moment only to fall into evil times by reason of the advent of the motor car.

OF THE DIFFERENT METHODS OF CHARGING DEPRECIATION, the following may be considered as the three most general methods:-

1 - Fixed percentage on original value, i.e. a broad fixed rate over all.

2 - Fixed annual charge to cover repairs, maintenance and depreciation.

3 - Fixed percentage on diminished value.

In many plants, some of the machinery is constantly in use, while others are only used occasionally. This will show the inaccuracy which must result when some broad average rate of depreciation is charged to the whole plant without bearing in mind the uses to which it is put.

Another method for charging DEPRECIATION is to pay for all repairs, etc., out of profit and distribute to the costs over a number of months. This entails high cost and expenditure when the machinery gets older and necessitates borrowing from one month's profits and distributing costs or renewals over a number of months.

Some firms make their expenditures out of the yearly profits to cover all depreciation and repairs, before the profits are divided. This involves much care and accuracy as would be the case for a reasonable and properly applied annual charge.

Sometimes in the case of big companies, a

large depreciation reserve is set aside and deductions are made from this according to the years profit. A bad year would not add much to this reserve fund - a good one would pay heavily to the fund. The aim here is to keep dividends constant and the same principle as when the mine manager keeps back a gold reserve to augment a bad month's work. There is no other word for this than "deception." It obscures the truth from those who ought to know it, merely to help someone keep his job.

It is not often practicable to periodically revalue properties and to discover in this way the actual loss by depreciation. Also the apparent depreciation that has taken place would be an insufficient charge, because though showing no deterioration or lessening value, the factor of lessened time enters into consideration and must be reckoned with, bearing in mind that time is one of the chief causes of depreciation, and that modern progress tends to render all machinery more or less out of date.

Depreciation should be charged annually to our costs and recovered from our sales and laid aside as a "DEPRECIATION RESERVE," which, when invested at coumpound interest should accumulate in such amounts

as to replace the wear and tear of the gradually lessening value of the plant.

There are five factors, generally used for gauging depreciation;

1 - First costs of the plant, building or asset, or its estimated value.

2 - Its probable duration of life.

3 - Its value at the end of that period as scrap or other uses.

4 - The amount of repairs and renovation it may have absorbed at different times.

5 - Its present earning power compared with similar plants.

To consider the factors that have been mentioned above. The first cost and the probable duration of life are the two that demand most attention.

With regard to the first cost of plant such items as freight and delivery costs, duty and similar charges can be quite fairly charged to first cost and depreciated accordingly. Although the foundations of the machinery are a costly part of the first cost, it would not be reasonable to include this under the cost of plant and depreciated at the same rate. In most cases the cost of foundations,

etc. would be written off entirely. They would probably outlive the plant in any case, and in comparison tothe plant do not depreciate at all.

The probable duration of life is fixed by the nature of the asset in question and the uses to which it has been put; In estimating the probable life of buildings, we should be influenced by the kind of materials and workmanship that have been expended, the climate to which the building has been exposed and the uses to which it has been put. The same may be said of machinery.

Certain classes of machinery have been estimated to have a probable value as follows;

TABLE #1

Dynamos	30	years	to 8%	residual	value.
Motors	25	"	" 9%	"	"
Water Tube Boiler.	12	"	" 5%	"	"
Steam Engines	25	"	" 6%	"	"

Gebhardt in his "Steam and Power Plant Engineering" gives the following table;

TABLE #2

APPROXIMATE USEFUL LIFE OF VARIOUS PORTIONS OF STEAM POWER PLANT EQUIPMENTS.

	YEARS
Buildings, brick or concrete	50

Buildings, wooden or sheet iron	15
Chimneys, brick	50
Chimneys, self-sustaining steel	25
Chimneys, Guyed sheet-iron	10
Boilers, water-tube	25
Boilers, fire-tube	15
Engines, slow-speed	25
Engines, high-speed	15
Turbines	25
Generators, direct-current	25
Generators, alternating-current	30
Motors	20
Pumps	25
Condensers, jet	35
Condensers, surface	20
Heaters, open	30
Heaters, closed	20
Economizers	20
Wiring	20
Belts	7
Coal conveyor, bucket	15
Coal conveyor, belt	10
Transformers, stationary	30
Rotary converters	25
Storage batteries	15
Piping, ordinary	12
Piping, first class	20

NOTE:- So much depends upon the design and the conditions that no fixed values can be definitely assigned and the above figures should be used with caution. Practice shows that most power-plant appliances become obsolete long before the limit of their useful life is reached.

TABLE #3

DEPRECIATION PERCENTAGES DETERMINED BY THE

TRACTION VALUATION COMMISSION,

POWER-PLANT DEPRECIATION.

Chicago, Ill., Sept. 9, 1906.

	Per Cent
Engines, Corliss, slow-speed	3 to 5
Engines, automatic, high-speed	5 to 10
Cable-winding machinery	3
Generators, direct connected, modern	5
Generators, belted (depending on date)	5 to 10
Traveling cranes	2
Switchboard and all wiring	2
Piping	35
Pumps	5
Heaters, closed	6 to 10
Heaters, open, if cast iron only	3
Breeching and connections, brick	5
Breeching and connections, steel	10
Boilers and settings, horizontal tubular	10
Boilers and settings, water-tube	35
Grates	10
Stokers	See Below
Coal-handling machinery	6
Ash-handling machinery	8
Combined coal and ash-handling machinery	7
Storage bins, steel	3 to 5
Miscellaneous items	5

The above annual rates of depreciation have been used as a basis in depreciating the power-plant equipments. Apparatus has been depreciated at these rates down to 20 per cent of the wearing value, the wearing value being determined by subtracting the scrap value from the cost new. All power-plant equipment has

been considered as worth 20 per cent of its wearing value as long as it is in operating condition. Depreciation applied to wearing value, as apparatus is always worth scrap value.

STOKERS: The fixed parts depreciate very little and the moving parts and grates very rapidly, as the moving parts are renewed and maintained in good condition. All stokers in operation have been depreciated 25 per cent.

The above percentages applied to a particular plant of 3900 kilowatts capacity give an approximate depreciation for the whole plant for 4 per cent.

The above table gives the depreciation percentages determined by the Traction Valuation Commission Chicago, Ill., as reported by the commission, Sept. 18, 1906.

Having determined the probable life or loss in value of the property, the next step is to ascertain the amount to be yearly set aside in order that it may be atoned for in loss of value by Depreciation.

Ennis gives the following formula;

$$S = A\frac{r^n - 1}{r - 1}$$

"Where A is the annual appropriation in dollars, N is the number of years of life (compounding assumed to be annual) and is 1 plus the fraction indicated by the probable rate of interest, viz; if the interest is 4%, R = 1.04+ S = loss in value in dollars to be offset by the annual appropriation A, " but adds that no small degree of judgement is needed to fix the rate of interest that will be conservative and equitable over a period of years to come.

Of the various methods of charging depreciation, a method to be recommended is what is known as the sliding scale method. This takes into consideration the fact that a new plant has but few charges for repairs and maintenance, during the first few years. A new plant is also presumably competing against older plants elsewhere, and therefore is probably more up to date in its equipment. Later on, as time passes, repairs and maintenance costs increase, and the plant itself is then competing with new rivals. The charges for depreciation and repairs are thus nearly equalized, and at the same time, the plant is taxed most heavily at a time when it is more able to stand it, and during its declining years is not loaded down with the accumu-

lations of wear and tear of earlier years. Again the drop in the value of the plant, were it to be offered for sale, is much greater between the first and third year, than between the eight and ninth year, an additional reason for a higher charge during the first few years.

I believe that the best method in the case of machinery and equipment is to determine the residual value as scrap at the end of a fixed number of years. This period must take into consideration the use to which the plant is to be put, other than the different factors already set forth, and the possible uses and value at the end of its useful life. It would be absurd, for instance, to give a value as scrap iron to a stamp mill in Central America where it would not have any residual value.

The following table shows clearly the annual decreasing depreciation charge for a plant costing $4403;

Cost of Plant	$4403
Value in 10 Years	203
Shrinkage by Depreciation ..	$4200

10 Years of life = 10+ 9+8+7+ 6 +5+4+3+2+1 = 55

1 Year has about 280 working days.

TABLE #4

YEAR		DEPRECN. FRACTION	DEPRECN. $	PLANT VALUE $	% OF $4200
	0	----------	--------	4403.	
1912	1	10/55 of $4200	763.636	3639.364	18.2%
	2	9/55 "	687.272	2952.092	16.3
	3	"	610.909	2341.183	14.7
	4	7/55 "	534.545	1806.638	12.7
	5	"	458.181	1348.457	11.4
	6	5/55 "	381.818	966.639	9.1
	7	"	305.454	661.185	7.3
	8	3/55 "	229.090	432.095	5.5
	9	"	152.727	279.368	3.6
	10	1/55 "	76.363	203.005	1.8

ACCOUNTING: It is not within the scope of the present paper to go into details of depreciation account, other than to state briefly that the reserve is set aside, crediting depreciation reserve and debiting profit and loss account. The sum vanishes as an asset and becomes a liability. All charges for replacing machinery are debited to

depreciation reserve and the cash account credited therefore.

BETTERMENTS: When machinery is replaced, it is generally found that it is desired to replace it with something "more up to date" and often such machinery will be found to be very costly and will more than use up the depreciation reserve. Betterments are <u>not</u> Depreciation and should not be paid for from this fund, which is solely set aside to insure the maintenance of the plant at its <u>original</u> value. The actual betterment itself, should be the basis for new capitalization; whilst the actual replacement of the machinery should be paid for from the depreciation fund. This may be regarded as a nice point, and perhaps as hair splitting, and without doubt it does undoubtedly leave an opening for argument as to just what would be called, "conservative."

In conclusion, we can only say that the facts and limitations that govern the methods and means of approximating DEPRECIATION are most variable and elusive that it is almost impossible to expect any uniformity in methods.

Between the man who wishes to be conserva-

tive and the man who looks upon charges in trade as plain "business risks" there will always be great differences of opinion, and with much to be said for both sides.

It is hoped that the present paper may show that DEPRECIATION is a liability that must be reckoned with, and that the fixing of broad rates, although a step in the right direction, is liable to give misleading figures when these broad charges are apportioned to the different machines and their respective departments.

R. H. B. Butler