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WAR-TIME DEPRECIATION IN OPEN HEARTH STEEL PLANTS AND ROLLING MILLS

It may seem strange to be writing now about conditions affecting depreciation in 1917 and 1918, but when it is considered that there are many corporations whose liability for income and excess profits taxes for those years have not yet been audited by the Treasury Department, it will be conceded that such a discussion is timely. It may be safely asserted that there are many accountants of large steel companies who are still engaged with problems affecting the 1917 and 1918 income tax returns of their companies, and depreciation is by no means the least important of these problems. The subject, therefore, may prove of interest to them as well as to accountants in other industries which operated under similarly trying conditions during the War Period.

The term "War Period" as used herein includes the years 1917, 1918, 1919 and 1920. Although the War ended in the latter part of 1918, the years 1919 and 1920 were anything but normal. In fact, of these four years, 1920 may be said to have been the worst, culminating in the peak of the period of inflation. The last two years were "blessed" with all the evils that usually accompany such a period.

In many steel plants, 1920 witnessed the production of higher tonnages of steel products of all kinds than had any previous year.

The question of abnormal depreciation during the War Period has been considered at various times, and engineering and accounting authorities have thoroughly demonstrated the necessity for making provision therefor. The engineers of the Ordnance Department, for example, made allowance for extraordinary depreciation in valuing machinery. In the charts made by them for appraisal purposes, they have provided for substantial increases in the normal rate of depreciation in all cases where overtime work was a factor during War production. In their book entitled "Cost Accounting," Major J. Lee Nicholson and John F. D. Rohrbach have placed themselves on record as accepting the theory of extraordinary depreciation where conditions are abnormal. The strongest authority, in the eyes of the taxpayer, however, is the official attitude of the Income Tax Unit. This is reflected in the following excerpt from Bulletin E, one of its publications: "It is recognized also that property, for example, manufacturing machinery, may be subject to extraordinary depreciation due to being operated overtime, at an overload, or being used for some purpose for which it is not adapted. Under such conditions a taxpayer may deduct, in addition to the amount measuring the depreciation under normal conditions, a further sum to provide for the extraordinary depreciation."

The burden of proof, however, will be upon the taxpayer to convince the Government as to the extent of abnormal depreciation which was suffered, and in passing upon this question weight will be given by the Unit to such factors as high production, overtime work, inefficiency of labor, inability to make repairs properly, and any other peculiar conditions which may have interfered with the smooth operation of machinery and equipment. These will be discussed in more detail below.

In this article, normal and ordinary causes of depreciation as mere efflux of time, exposure to the elements, excessive heat generated by furnaces, soaking pits, etc., corroding action of chemical vapors, etc., will not be considered. The unusual wear and tear sustained during the War Period was brought about principally by the various abnormal causes mentioned above and these will furnish the basis for this discussion.

Effect of High Production on Equipment and Depreciation

Production is one of the most important causes of depreciation. Machinery is purchased for the specific purpose of turning out production or aiding indirectly in doing so. In a great many cases engineers can roughly estimate the approximate number of units of production which a machine will manufacture before it is ready for the scrap heap. It is logical to assume, therefore, that hastening the processes of production will accelerate the rate of depreciation. One of the best illustrations of this principle is the case of certain, powerful cannon with respect to which it is definitely known in advance how many shots they can fire. While this is an extreme case, the same principle underlies the operation of ordinary machinery except that it does not work out as easily as in the example given.

Normally, as far as production is concerned, depreciation is caused by actual contact of the product with the machinery, and, with respect to auxiliary equipment, by the number of motions or movements necessary to keep in operation the equipment engaged directly in production. In cases of high production we have more production units coming in contact with what we might call Primary Equipment and a noticeable increase in the number of movements of auxiliary equipment to keep pace with increased production. It is true, therefore, that the demands of high production will affect not only the equipment with which the steel in the various manufacturing processes comes in direct contact, but also auxiliary departments or equipment such as steam or electric generating departments, gas producers, coal pulverizing equipment, etc. This is patent. If high tonnage of steel is handled in the furnaces, there will be extraordinary usage of cranes, charging cars, gas producers, steam generating equipment, etc., to keep pace with the increased demands of the production department.

An excellent illustration of direct depreciation is found in the blooming mill where every ton of steel made in the open hearth furnaces in the form of ingots is reduced, by a rolling process, to "blooms." Glancing into a blooming mill one is struck by the maze of machinery. Every ton of steel that passes through the rolls jars the entire rolling mechanism, and contributes its quota of vibration which in time undermines even the foundations. It logically follows that an increase in the tonnage of steel passing through the blooming mill, will correspondingly increase the rate of depreciation in this department.

A simple illustration of the same principle is contained in the experience of a steel company which built a plant in 1907. During the first three years of operation, production was considered of primary importance in order that previous production records in other plants of the same company might be broken. Furnaces were forced to produce more than rated capacity and in the process, important operating details were neglected to an extent which did not augur well for the condition of equipment. In consequence, after only three years of operation, it was apparent that the plant was in worse physical condition than another plant owned by the same company which had been operated under normal conditions for nine years. All other factors having been the same, it may be safely assumed that the hastening of depreciation was caused by abnormal production.

With regard to many steel companies the average production of steel in the War Period was over 100% greater than the average of pre-war years. It is granted that in part, this may have been due to the installation of additional open hearth furnaces or, in other words, to an increase in the capacity of the plant. A large part, however, was the result of "driving the furnaces," squeezing the last ounce of possible production out of them. From a study made in one plant it was found that in 1918 production had been increased 70 per cent over 1914. 50 per cent of this increase was accounted for by a similar increase in rated capacity. 20 per cent of the increase was a result of "driving" for high production.

The discussion of the effects of such practice on equipment may be more readily understood if considered in connection with the following description of an open hearth furnace. Each furnace, although a complete unit in itself, is usually one of a series of from six to eight or more, built in a row. On the outside of the steel building in which they are located can be seen many towering stacks, corresponding in number to the number of furnaces in the plant. The furnaces are rectangular in form, being about 25 to 30 feet long, 20 to 25 feet wide, and from 10 to 15 feet high.

There are two checker chambers at either side to permit the introduction of gas and air into the furnaces, in the proper state. The checker system extends below the floor-level and consists of a network of brick so arranged as to allow a draft of air to pass up, around, and into the furnace. The walls and arched roof are made of brick which are bound up and kept together by a heavy steel framework, consisting of buckstays, beams, etc. There are heavy iron doors on the front side of the furnace through which the "charge" of raw material is introduced into the hearth. These doors are manipulated by electric or hydraulic power.

At the floor level there is a steel pan, consisting of heavy plates of steel, riveted together, upon which is spread a thick layer of magnesite and dolomite or some other refractory material. The inside of the furnace above this pan is usually referred to as the hearth. There is a tap hole at the back of the furnace through which the molten steel is made to flow into the large ladle at the signal of the melter, as soon as his practiced eye, with the aid of chemical analysis, shows that it is time to do so. Another item of equipment is the heavy steel butterfly valve which is about seven or eight feet high. This is part of the checker system and is the point at which the air enters and leaves the furnaces.

The construction of each furnace may be divided into two sections or parts, viz., a temporary section, consisting of the brickwork and other minor items used in connection therewith; and a permanent one, which is made up of foundation, steel pan, checker chambers proper, steel framework, valve, stack, etc. This distinction is made because the brickwork is torn down every four to six months for purposes of reconstruction; while the basic structure of the furnace, referred to as permanent construction, should under normal conditions of operation, last about 20 years. In considering the question of depreciation, it is important that we bear in mind this distinction.

One of the methods used to secure greater production during the War Period was to increase the temperature in the hearth. This tended to "sweat" out the bottom silica brick lining, thus damaging the steel pan. It also burned and bent the buckstays and framework, getting them considerably out of line, and affecting the entire basic structure of the furnaces.

Under ordinary conditions it is necessary to renew the brick lining about every five or six months. Under such conditions, when production is normal and well regulated, the condition of the brick can be carefully observed so that the furnace may be shut down for repairs in time. In the War Period we find things entirely changed. The management was pushing for production and in many cases took a long chance in running a furnace several additional heats, when the condition of the brick clearly indicated that a shut down was in order. The result was in many cases the flame burned clear through the brick and caused severe damage to the iron work, buckling and bending it out of shape. This rarely if ever occurs in normal times.

Depreciation was caused in another manner by the desire to meet the unparalleled demand for steel. In 1918, in order to secure greater production in the blooming mill, the management of a certain company attempted to use a larger sized ingot than the rolls and other equipment in that mill were designed to handle. This particular mill had been constructed to take care of ingots of a maximum weight of 6,600 pounds, but, in order to increase production, ingots weighing 10,000 pounds were forced through it. The table rollers were not strong enough to stand the strain, and several serious breakdowns occurred. Experimentation went on for more than a year in an effort to strengthen the equipment, but all efforts failed and the attempt was finally abandoned. When it is considered that every pound of steel produced in the open hearths must have been rolled in that blooming mill, it stands to reason that the life of equipment in that department was shortened considerably.

Power companies broke down repeatedly during the War on account of the tremendous increase in the demand for electric current brought about by high production in practically all industries. In one case there were three breakdowns during a single year which proved to be very disastrous to a certain steel company. In the case cited, forty minutes after power was cut off, the water storage supply in the stand pipes became exhausted on account of the pumps being down. At a result, the water cooling equipment around the open hearth furnaces burned up and the doors burned out of the furnaces. Power was cut off with a ladle full of molten steel suspended in mid-air. The steel froze, seriously damaging the ladle. Charging machine equipment was damaged by power being cut off with charging box inside the furnace. Numerous other instances can be mentioned. The power company in this case furnished low voltage during practically all of 1917 and 1918, which damaged the electrical equipment all over the plant and seriously interfered with operations. This is a notable example of the confusion and chaos which prevailed during the war.

It is interesting to note that in many cases the War Industries Board allocated orders to companies which the latter were not equipped to handle, but which they nevertheless accepted out of a spirit of patriotism and a desire to do their share in winning the war. One company was practically forced to take orders for French shell steel, the large sized bloom on which work damaged the shears.

Production Method for Recording Depreciation

While on the subject of production and its effect on the question of depreciation, it may not be out of place to say a few words on the "Production Method" of determining and charging off depreciation. Under this method a pre-determined amount is charged to operations for each ton of ingots and sheet steel produced. In other words, actual production figures are used as a basis for computing depreciation. This is not an accurate method, and few steel companies use this basis for arriving at a depreciation charge-off, as there are other factors which must be considered besides production. For example, it is obvious that depreciation is going on where a plant is idle. In fact, it is generally known that in some cases greater depreciation is sustained where a machine is idle than when it is operated under normal conditions, so that while there is a close relationship between production and depreciation, an increase in the former does not necessarily produce a proportionate increase in the latter. In the opinion of the writer, the "Production Method" should rarely be used to measure actual, physical depreciation. This method, however, might serve effectively in connection with industries depending for their existence on a supply of wasting assets, such as timber, for example. An ideal illustration is that of a sawmill located near its source of supply, away from an industrial center. Inasmuch as it will have to discontinue operations as soon as its supply of timber is exhausted, and in that event the plant will be worth salvage value, it would be good accounting practice to set up a reserve based on the unit of production so that the entire cost of the mill may be amortized by the time the last tree is leveled.

Straight Line Method

The straight-line method appears to be the most popular one and is generally used by steel company accountants. In ascertaining the periodic charge for depreciation under this method, a great many accountants use a single, composite rate which is applied to certain classes of equipment such as buildings, machinery, furniture and fixtures, etc. The writer has seen one instance where plant account was sub-divided into more than fifty classifications and depreciation was computed on the amount of each classification by applying percentages which had been worked out to four decimal places. An extensive discussion of all of these methods does not come within the scope of this paper. However, irrespective of the method employed, an additional provision for depreciation should have been made for the years 1917, 1918, 1919 and 1920. What that additional amount or rate should have been must be decided on the facts in each case and on the extent of ill treatment to which equipment may have been subjected.

Effect of Overtime Work on Depreciation

Another cause of high depreciation is overtime work. This was recognized by the Bureau of Aircraft Production which advocated an increase of 50 per cent over the normal depreciation rate of factory equipment where, during the war, a plant was operated three shifts a day instead of one.

During a large part of the War Period many steel plants were operated at full blast seven days a week. Large premiums were being paid for deliveries of steel and this served as an incentive to work a plant to its utmost. In normal times, because of the nature of the processes necessary to convert iron into steel, a plant is usually operated 24 hours a day. But ordinarily the plant is closed down on Sundays. During the War Period many plants ran 24 hours a day and 7 days a week for long stretches of time. Furthermore, it should not be overlooked that in ordinary times there are periodic shut-downs caused by lack of orders. There are "slack times" when men will get off two and three days every week. Such shut-downs and the regular day of rest furnish sufficient time in which to thoroughly inspect all items of equipment, make repairs and keep things generally in shipshape condition. It has been scientifically proved that metal is subject to fatigue. It follows, therefore, that a period of rest at regular intervals will lengthen the life of equipment. The constant vibration of machinery must have a detrimental effect upon the buildings in which it is located, and such rest periods will unquestionably prolong the life of such structures.

INEFFIENCY OF LABOR

A discussion of this subject would be incomplete without some reference to labor conditions during the War Period. During that time labor on the average was very unsatisfactory. It is the consensus of opinion of mill superintendents and foremen that this was one of the most serious and perplexing problems that it was necessary to contend with during the war. Owing to the extraordinary demand for men, the employee unquestionably had the upper hand. The situation was further aggravated by an unprecedented rise in wages which contributed towards a spirit of independence. There was a noticeable lack of coöperation and team-work.

It is significant to note that the above-described conditions were found to exist even in the smaller steel towns where men had worked in the same mills for years, some of them all their lives. These unfortunate conditions may be attributed to the influx of an undesirable type of foreign and other unskilled labor to take the places of the men who had enlisted or were drafted. This dilution of skilled forces with unskilled men must have had an important bearing on the state of equipment. When these two factors are considered: the first, that every machine, every unit of equipment, had to be operated or manned by men; and the second, that unskilled and inefficient labor had to be used, the question may very well be asked whether machinery was given the attention and care it required or whether it was manhandled.

The president of a steel company some years ago in an article prepared for a business course said: "Of the three factors in carrying on a business, neither machinery nor materials can compare in importance with the human element, the workmen who operate the machines and handle the materials. The machines and materials are at the mercy of a poor workman. If he is inefficient or careless and indifferent, or disloyal and resentful, he can easily reduce them to the junk pile and the scrap heap." This statement was intended to be applied under normal operating conditions. Its importance may therefore be appreciated when it is interpreted in the light of the unfavorable conditions which existed during the War Period.

The human element is more important in the steel industry today than when the industry was in its infancy about 25 years ago. In those days machinery played a much smaller part than it does today. The greater part of the work was done by hand, common labor being employed for the most part. For example, charging of iron into the furnace was done by hand. This was true also of stripping moulds and crushing scrap. Today these operations are performed respectively by charging machines, mechanical strippers, and skull crackers. Great strides have been made in the construction and operation of cranes and there has been a remarkable improvement in machinery in general all over the plant which has created a demand for a more intelligent class of labor. It must be admitted, considering the general inefficiency of labor during the war and the difficulty of securing experienced men to take the place of those that went to fight, that machinery depreciated at a greater rate than normal.

To cite one example: The craneman should be expert in manipulating his machine and the load which it may be carrying. This requires great skill. Inefficient, careless, or green cranemen have been known to swing loads against expensive machinery and to damage the buckstays of furnaces. An efficient craneman can easily put his machine out of commission. The life of a crane will be shortened by running the trolley to the end of the tracks without putting the brakes on or by continuing to wind up the hook after it has reached the top, thus bending the shaft. During the War many cranes were practically racked to pieces by their misuse.

Steel men are in agreement on the fact that the efficiency of labor during the period under discussion was only 60 to 70 per cent of what may be considered normal. The situation became very acute in the latter part of 1919 when the big steel strike occurred, which lasted from September to November. Inexperienced men of the most undesirable type were brought in as strike breakers, because it was necessary to keep the plants running at any cost on account of the unheard-of demand for steel products. It will be generally admitted that machinery and equipment suffered by reason of this costly experience.

Some companies suffered more than others as far as labor troubles were concerned. This was especially true with regard to plants located away from the large labor centers. There is one company in particular which experienced great difficulty in securing the necessary skilled operatives. Its plant is located in Kentucky and skilled men were not to be obtained at all in that section. Agents visited all the large industrial cities in an attempt to round up an experienced working force, but what few men were obtained in this manner were entirely unsatisfactory, being of the lowest type of labor on the market. The company was confronted with the task of breaking in the natives of that section of Kentucky. This was a difficult task as these men had had no previous industrial experience, most of them having been engaged in farming.

In the process of being broken in, these green country boys caused heavy depreciation on equipment. For example, charging machine operators would let the charging box get stuck in the furnace. Sometimes a leaky stopper would develop underneath a ladle with 50 tons of molten steel suspended in mid-air. The ladle crane operator, seeing red-hot metal flowing out accompanied by a shower of sparks, would become panic-stricken and run out of the plant, allowing the metal to damage cars, moulds and other equipment. Cranemen, charging machine operators, and others who operated complex machinery in this plant, were instrumental in causing heavy depreciation without doing so intentionally.

Considering all of these facts, there can be no question that the low efficiency of labor during the War was responsible for a large part of the abnormal depreciation which was sustained during that period.

Inability to Make Repairs Properly

The most effective way to counteract depreciation is to make repairs promptly and efficiently. Some accountants consider this matter of paramount importance and where large amounts have been spent in making repairs they have correspondingly reduced the depreciation rates. This would seem to be a sound method where the increased expenditures for repairs have been carefully analyzed and it is found that they have succeeded in actually arresting depreciation.

If the above is true, the reverse is equally so; that is, if there was skimping in the making of repairs there must have been a corresponding increase in the depreciation sustained. This is exactly what occurred in most steel plants during the War. Production was a sort of "Golden Calf" which was worshipped to the neglect of other essentials. Everything else was subordinated to it and every ounce of energy that it was possible to commandeer was diverted to increase production. There is no doubt that even so important an item as repairs was sadly neglected.

A case in point is the matter of painting the steel buildings. The open hearth building, which is constructed of steel sheeting, is between one and two city blocks in length depending on the number of furnaces it covers. Here is a mass of steel surface which, if not painted on an average of once each year to maintain it in a proper state of preservation, will rust away very quickly. While some companies let this job by contract to outside painters, a great many employ men who do nothing but paint. During the War these men were to a great extent diverted to the stenciling of boxes containing steel for shipment, and painting was neglected. The same was true of steel stacks and in one plant, as a result of such neglect, several stacks rusted away and fell over.

The soaking pits are an important example of the same thing. In the process of steel-making, the molten steel is first poured from the furnace into moulds. After the steel has solidified, but while it is yet red-hot, the ingot is stripped from the mould and deposited in a soaking pit where the heat in the ingot is distributed evenly.

It is then ready for the blooming mill. In order to push production, soaking pits were repeatedly continued in operation where they should have been shut down for repairs and relining. It is possible to operate soaking pits in an inefficient sort of way where repairs are overdue, but the pit is greatly damaged in doing so as slag runs down into the checkers and clogs them. When the pit is finally rebuilt it entails three times as much expense. Many soaking pits were practically destroyed by the end of 1920 and had to be entirely rebuilt.

An unusually interesting example of the neglect of repairs in the case of a battery of two blast furnaces, recently came to the attention of the writer. Blast furnaces produce the principal raw material of the open hearths, which is pig iron. In the course of operations they should be shut down periodically for repairs and relining, and in this respect they are somewhat similar to open hearth furnaces. On account of the great demand for pig iron during the War, to feed open hearth furnaces all over the country, blast furnaces were operated straight through for inconceivably long periods of time. In the case cited, repairs were neglected to such a serious extent that when things quieted down the furnaces were in a practically wrecked condition. They had to be dismantled and completely rebuilt from the ground up.

Production seriously interfered with the condition of such equipment as cranes and charging machines. A little attention once a week will do wonders in keeping such machinery in good condition. During the War they were neglected for six months at a time. Normally, charging machine tracks, and all other tracks in the plant and yards, are inspected regularly and maintained in good condition. Here again, during the War, men who were engaged in this work were to a great extent if not entirely diverted to some job in the production end of the business.

The spreading of tracks, allowed to go unnoticed, caused the derailing of many a charging machine with damage all around. Spread rails in the case of charging buggies, caused them to jump the tracks and precipitate a load of pig iron against furnaces, bending and damaging the buckstays. The spreading of crane tracks had a tendency to derail one end of the crane and twist it out of shape. In several cases cranes fell to the ground and became candidates for the scrap heap. In the case of locomotive cranes, poor condition of the brakes permitted the load to come down with a bang, damaging whatever happened to be in the way. And so it went all over the plant. A loose bolt here, a leaking tube there, going unmended, might develop into serious functional trouble.

Not only were necessary repairs belated, but even when made they were made under pressure. The management would have moved heaven and earth, if that were possible to get things going as soon as possible after a shut-down. As the time in which a repair is made decreases, the cost increases and repairs made in this hurried manner are in many cases not thorough. In the sheet mills there is an iron bed-plate standing on a concrete foundation on which the mill rests. Normally, to replace such a foundation requires from eight to ten days' time to permit the concrete to "set" properly. During the war, the loss in production that would result from such an enforced shut-down was so great, considering the high prices that were being received for steel products, that foundations were made with lead, which cost from five to ten times as much as concrete but which did not last as long.

A situation which was of the utmost importance in connection with the ability to make necessary repairs, was the condition of the market for supplies. It was extremely difficult and at times impossible to secure needed materials. Ties for railroad trackage could not be obtained and fence posts had to be used instead. The brick for the furnaces were of a very inferior quality, cracked and crooked, although they cost over three times as much as the better brick which was normally secured. On this account, in many instances the roof and walls of the furnaces caved in while a "heat" was in progress. It was extremely difficult to procure dolomite and magnesite as these products are imported from Austria. These refractory materials are spread on the steel pan in the hearth, but, on account of the shortage, were used very sparingly. The result was that holes were burned in the steel pan which permitted the red hot metal to flow over the open hearth floors, cars, rails, etc. Upon cooling, gobs of steel were frozen to the equipment which it was necessary to cut off by the use of a torch. This is another sample of what it was necessary to contend with during the War.

For a certain time, before the situation had been properly presented to them, some Government accountants contended that extraordinary depreciation was counteracted by the large amounts expended for repairs and replacements. The figures were very misleading, the repair account in some cases showing an increase over pre-war years of over 500 per cent. However, upon learning the extent to which repairs were neglected, they agreed to a substantial additional depreciation allowance.

A table showing merely the amount spent for repairs and maintenance each year will be found to be practically worthless for comparative purposes, as far as the question of depreciation is concerned, for the reason that it deals with dollars rather than with the actual amount of repairs made per unit of property. A statement of repairs would serve its purpose much better if it contained the number of hours spent on a given unit of equipment or in a certain department, or in so far as practicable, the amount of material used in repair work by units or departments. In most cases it will be found that it is next to impossible or that it would consume too much time to set up such a statement, on account of the many different kinds of material used in making repairs, the numerous items of equipment in the plant, etc. In such cases tests should be made, if possible.

If a table could be prepared, using the pre-war period as a standard and showing the percentage of increase or decrease in the amount of repairs, disregarding all money values, it would in most cases show a decrease for the War Period, in spite of the fact that actual expenditures may have been 500 per cent in excess of the pre-war figures.

Not a small part of the increase in the repair account represents repairs made on property which was not in existence in the pre-war years. There are few steel companies that did not expand there manufacturing facilities between 1912 and 1918. Taking actual figures, one company whose repair account showed a 400 per cent increase in 1918 over 1912 had a book value for plant representing a cost of twice as much in the latter as in the former year. With more units in the plant in 1918 than in 1912, it follows that there would be a corresponding increase in the amount of repairs made.

The reduction in the purchasing value of the dollar is another important factor accounting for part of the increase. The cost of labor and practically all materials which are used in making repairs was on an average over 150 per cent higher in 1918 than in 1912.

The following is a comparison of the cost of rebuilding open hearth furnaces in 1914 and 1918 in one steel plant:

	1914	1918
Labor	$11,215	$49,192
Brick	22,598	133,871

Bear in mind, however, that there was an increase in wages for this kind of work averaging 150 per cent; the cost of brick increased about 300 per cent; there was about 50 per cent increase in rated furnace capacity, representing the installation of new open hearth furnaces; there was a 30 per cent increase in the number of shut-downs for repairs.

The increase in the cost of labor and brick may be roughly accounted for as follows:

LABOR

Cost in 1914	$11,215
150 per cent increase in cost of labor	16,822
	$28,037
30 per cent increase in number of repairs	8,411
	$36,448
50 per cent of $28,037 for increase in furnace capacity	14,019
	$50,467

BRICK

Cost in 1914	$22,598
30 per cent increase in number of rebuildings	6,779
	$29,377
50 per cent increase in furnace capacity	14,688
	$44,065
200 per cent increase in cost of brick..	88,130
	$132,195

It should be noted that the additional number of shut-downs did not counteract depreciation on the basic structure of the furnaces. In fact, it is possible that an increase in the number of rebuildings might tend to weaken the basic structure. Yet, the additional costs entailed in rebuilding are included in the repair account and are partly responsible for the increase over the normal amount of repairs, as far as money values are concerned.

It is practically impossible to make similar comparisons with respect to such machinery as cranes, charging machines, etc., because of the poor condition of the records of most steel companies for 1914 and other limitations. In 1917 owing to the excess profits tax steel companies began to realize the importance of good records, and there has been a remarkable improvement since.

The preponderance of evidence showing the extreme neglect of repairs, is so great that such a comparison is not necessary. There is not an item in the repair account which did not cost at least 150 per cent more in 1918 than in any of the pre-war years, but there are a great many items, the percentage of whose increase is much greater than that. For example, it has already been described how repair of bed-plates, due to the use of lead instead of cement, increased the cost from five to ten times; and how the cost of soaking pit repairs increased 300 per cent on account of delay. There are countless other examples which might be given. They all lead to one conclusion, which is, that fewer or less extensive repairs were made in the War Period than in the years prior thereto.

CONCLUSION

The experiences of the various steel plants which were visited by the writer were found to be surprisingly uniform during the War Period and most superintendents had practically the same comment to make in regard to production problems, dealings with labor, troubles in making repairs, etc.

There may have been exceptional situations where abnormal depreciation was not sustained during that period, but such cases must have been rare. In the opinion of the superintendent of a well-known steel company, the average life of an open hearth furnace operated under normal conditions should be about twenty years, but on account of the abusive treatment which the furnaces in his plant received during the War Period, their life was unquestionably shortened by about four or five years. In the same manner the life of other equipment throughout the plant was shortened. To determine the extent of such extra depreciation it will be necessary to make a careful study of the situation in each individual case.

In closing, the writer trusts that nothing in these pages will be interpreted as a criticism of the attitude of steel company management during the War towards the various questions of operation discussed herein. It no doubt was better business to increase production at the expense of depreciation. To have attempted to maintain equipment at the expense of production would have been "Penny wise and pound foolish."

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