GEN - GENERAL INFORMATION (10) A

EXCERT FROM :

POWDERED COAL IN
AMERICAN INDUSTRY

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POWDERED COAL IN THE FERROUS METALLURGICAL FIELD

There are today in the United States approximately 200 pulverized fuel plants installed in connection with the iron and steel industries, serving approximately 2,500 furnaces which use approximately 3,000,000 tons of bituminous coal annually. There has been a very great increase shown in the interest in this fuel during the past year and all indications now point to a rapid increase in its use. In the early installations there was much guess work as to proper needs and some grief was experienced which has taken study to correct.

In the past few years it has come to be realized that there is a vast difference between the burning of pulverized coal in boiler furnaces or cement kilns and its combustion in metallurgical furnaces. Successful operation in metallurgical work requires that the material being heated or melted shall not become contaminated. This requirement which is not present in boiler firing practice, makes it necessary to have a clean flame and much more accurate control of the fuel. To insure these it has been found necessary to pulverize the coal more uniformly fine. To prevent the packing together of the particles it has been found advisable to reduce the surface moisture content. Improvement of equipment has been rapid and today pulverized coal plants are installed that are clean in operation and require a minimum of attention.

Thus, advancement on the heating side of metallurgical work has heretofore been made in the preparation of the fuel and the method of burning it, rather than in the design of the furnace. More recently the latter has been given increasing attention. Changes of roof design and combustion chamber, for example on a continuous heating furnace from the old standard practice of necked roof have practically doubled the output in one plant. Similarly other changes in furnace design, and as time goes on, developments along this line will no doubt show increases in economy as great as have hitherto been effected by changes in fuel and improvements in preparation equipment.

The standard fuel is bituminous coal. Its use in pulverized form has many advantages, not the least of these being the ability to secure any type of flame required from highly oxidizing to intensely reducing.

Pulverized coal installations have become so standard that they are not considered any more liable to shut-down than any other part of the plant. Pulverized coal, when properly dried, can be safely stored in bins at the furnaces for many months, without danger of fire or deterioration.

Changing from oil firing to pulverized coal at one plant reduced the fuel cost per ton of steel heated 50 per cent. In malleable iron melting fuel ratios of better than 3.8 to 1 are now being secured and with furnace changes planned it is hoped to bring this up to 4 to 1 at least.

Open hearth plants using pulverized coal report successful operations. One plant using all cold metal charge reports 540 pounds of 12,000 B.T.U. coal per gross ton of ingots produced. It has been found that efficient operation of open hearth furnaces required an illiminating flame with considerable weight and pulverized coal seems to fit this condition best.

The output of these furnaces on pulverized coal is equally as good as with furnaces fired with other fuels, and the life of furnaces above floor line is over 200 heats, while the simplification of installation below the floor line has increased the life over 100 per cent.

Time of heats with pulverized coal has also been reduced so that the average time per heat is 9 to 11 hours. Elimination of expensive checker renewals is one of the advantages of pulverized coal in this plant. These furnaces were originally built for oil fuel. Experience gained indicates the proper lines for furnace to use pulverized coal. Fuel consumptions, as low as 450 pounds or better will no doubt shortly be secured.

In the heating of the steel ingots, slabs, billets and rails, important developments have been achieved. Ingot heating furnaces as shown in Figure 15 of the regenerative reversing end type, fired with producer gas, have been changed to pulverized coal firing, with only minor furnace changes, continuing to operate as reversing end and securing the advantages of preheated combustion air, greatly increasing fuel efficiency, and due to softness of flame secured, reducing the time necessary to heat the ingots.

Wrought iron pile reheating furnaces of the sand hearth type, when changed to pulverized coal firing, in one plant show a saving of over 200 pounds of coal per ton heated and an actual saving in metal loss, due to better heating, amounting to 3000 pounds per 10 hour turn, per furnace.

Slab and billet heating continuous type furnaces, with roof of the flat arch suspended type have shown marke improvement in efficiencies and increased output, the flat arch roof insuring a more even distribution of the heat across the furnace, and the furnace lines being calculated to properly ignite and burn the coal in the combustion chan sending the non-dust-carrying flame along the steel under t sloping roof of tunnel at such an angle as to properly pres the travelling gases down on the steel as they progress. In this type of furnace a gas velocity of 20 ft. per second is maintained, although this is varied to meet specific conditions. One installation heating billets from 3½ to 4 ½ inches square, in lengths up to 11 ft. shows an average fuel consumption of 220 pounds pulverized coal per ton heated for a months record, operating only single turn, including all standby losses.

Malleable melting furnaces have not shown much change, although the fuel preparation has been greatly improved and fuel ratios of 3.8 to 1 are being secured. This is 7,430,700 b.t.u. per net ton of iron melted. The principal advance in this branch of the industry is the determination of method for eliminating deleterious carbon and sulphur additions to the bath. Proper drying and fine pulverizing have made this possible.

Steel reheating requires a semi-luminous or mellow flame and this can be secured best with coal in pulverized form. Improvement of feed control equipment has made it possible to secure this at will.

The cost of preparing, storing, feeding and burning pulverized coal ranges between 45 to 70 cents per net ton of coal. Comparing pulverized coal with oil and natural gas on the basis of slack bituminous coal per net ton delivered, $3.00 and addition $1.00 for all preparation charges, overhead and contingencies, we have the following:

1.	Coal in pulverized form (12,000 b.t.u.per lb.) raw coal per net ton delivered	$3.00
2.	Oil per gallon, including atombzation	.02
3.	Natural gas per 1,000 cu.ft. (based on 1,000 b.t.u., per cu.ft.)	.14 5/10
4.	Tar having 130,000 b.t.u's per gallon, price delivered per gal. (including all costs of heating, feeding & burning)	.02 2/3

Actual costs of oil and natural gas in Pittsburgh district are equivalent to the expenditure for coal in pulverized form as follows:

> Natural gas at 30¢ per 1,000 cu.ft. is equivalent to coal for pulverizing at $7.40 per net ton delivered. Oil at 5¢ per gallon is equivalent to coal for pulverizing at $9.30 per net ton delivered.

Although the improvements in preparation equipment and in furnace design have made it possible to use slack and screenings as well as lower grade coals, yet the most economical coal to use in pulverized form is the coal that gives the greatest number of b.t.u's for one cent with the lowest ash content.

Furnace efficiencies have been greatly improved by changing to pulverized coal and in heating furnace work actual over-all b.t.u. efficiencies of 35 per cent are being secured.

Due to the more effective heating with pulverized coal increased furnace outputs are being secured, as can readily be seen by the following comparison:

1. Rail reheating furnace; from hand-fired to pulverized coal 60%
2. Billet reheating furnace; from by-product gas to pulverized coal 40%
3. Slab-reheating furnace; from oil to pulverized coal 30%
4. Open-hearth furnace; from oil to pulverized coal 14%
5. Pile reheating furnace from natural gas to pulverized coal 18%
6. Puddling furnace; from natural gas to pulverized coal; reduction in time for 5 heats - 1 hour.

A quotation from a plant owner's published account of the results obtained and benefits derived should be a fitting end to this paper:

"The substantial reduction in costs, due to powdered coal, can not be measured by a comparison of the direct costs only, such as fuel and labor, as the collateral benefits of this important installation are many. Lower costs when the mills are operated intermittently, lower furnace maintenance,

elimination of ash handling, lower operating labor costs around the furnaces, stimulation of production due to increased heating capacity, better heating and improvement in quality, all can be attributed to the use of pulverized coal.

"Powdered coal enabled the organization to solve a difficult problem, as, in addition to the urge of economic necessity and with civic pride aside, the company was confronted with a recently enacted city smoke ordinance. While receiving the co-operation of the Bureau's inspectors, the terms and conditions of the ordinance were unmistakable.

"The plant is located in a thickly populated section. The disappearance of the black smoke, due to the use of powdered coal, and the noticeably cleaner atmosphere are welcome to the citizens, as well as meeting the requirements of the smoke ordinance."