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The metallurgic treatment of lead ores as carried on in south-west Missouri

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THE
METALLURGIC TREATMENT

OF

LEAD ORES

AS CARRIED ON IN

SOUTH-WEST MISSOURI

7382
Frank A. Gith



Rolla

June



During the month of April
I visited Joplin for the purpose
of collecting information as to the
Metallurgic Practice in that locality.
I more particularly confined my attention
to the works of the Granby Mining ^{and}
Smelting Co. being personally acquainted
with the superintendent Mr. Peter E.
Blow to whom I acknowledge my
obligation for valuable information also
to Mr. J. Fisher Cashier of the Co. who
kindly furnished data as to costs &c.

A description of these works and
a delineation of the process will
serve to illustrate the practice in this
section.

The site of the works as well as
considerable of the adjacent land
owned "in mineral" are in the property
of the company.

The relative arrangement of the
Smelting House, Chambers, Stack & etc. will
be seen from Plate I. The Dressing Works
Engine ^{and} Boiler are in a separate building
not shown in drawing.

The principal apparatus consists of as follows:

Three American Scotch Hearths, for galena smelting.

One Flintless Revolver, used for fume reduction.

One No. 6 Sturtevant Blower, supplying blast to hearths.

The Dressing works have the following:

Six Hand Jigs.

One Blasty Crusher

One for Rolling

One Revolving Screen

together with elevator, fine screen, and etc.

Power is supplied by one 16 H.P. and one 30 H.P. Engine taking steam from a two flue boiler 42 inches in diameter by 24 ft long.

Water for Dressing water, boiler, and hearth back is furnished by two tanks holding respectively 1000 ^{and} 8000 gal. each.

The "Mineral" (local term for galena) treated is raised from pits ^{and shafts} in the vicinity and delivered to the works by teams. At present the price paid for mineral is 28¢ for 1000 pounds. The price however varies with the quotations of the lead market.

Fire Bricks -

... is received at the works is nearly all galena with small amounts of mechanical impurities such as Fine Blende - Clay - Carbonate of Lime. Occasionally some of the minor ores of lead constitute a portion of the impurities.

The primary cost of material at works is:

Wood for coal	\$ 2.25
Coal	\$ 2.25
Charcoal	.08
Lime	.20
Lime Bricks per thousand	\$ 40.00
Iron Castings per pound	.04

Dressing: -

The mineral is broken into a revolving screen having a slight inclination, the larger pieces passing through drop into the crusher and from that to the rolls which bring them to a convenient size for further treatment, which consists of washing and separating in the jig which are provided with screens of different sizes for treating the separate grades. The jigs are fed by means of elevator ^{and} revolving screen which automatically deliver each grade to the proper jig. After separation is complete the galena is taken out of the jig and thrown into bins ready for smelting.

There are four (4) grades of mineral supplied by the dressing works, as follows
I Black Mineral, large cubes from about 1/2 inch to 3/4 in.

II Gray Mineral, from "Smitten" up to "Black Mineral".

III Smitten, about 1/4 inch cubes

IV Sludge, the finer particles below Smitten
For use in smelting the "Black Mineral" is the most "desirable".

The following is an analysis of "Gray Mineral" taken from the jig and supposed to be a fair sample of that grade.

Analysis

SiO_2	_____	289
CaCO_3	_____	.049
MgCO_3	_____	.028
Al_2O_3	_____	.017
FeO_2	_____	.011
ZnO	_____	.086
Pb_2O_3	_____	.009
Ag_2O	_____	trace
CuO	_____	trace
PbO	by difference	<u>99.461</u>
		100.009

Metallurgic Treatments -

The selection of Lead from German
is an ancient industry well represented on
the Heath. This method, having been former-
ly more common, than that by the stibic-
acid, which is now nearly superseded, from
the recession of "Kain".

Heath - Treatment. This state of the
substance is an excellent process.
Lead (Litharge) was there being formed by
the larger mass, chiefly upon the
Gutten (Litharia of Lead). (See this page last)
article after I Rowling, II Reduction.

Place II ^{or} III represents the form of
American Water Heath - mass. The mass
has (see Place II ^{or} III, Place III) consists of
a slender vertical oval iron bar of
three inches, the iron ends having attached
a rectangular iron bar into which the
Lead is received and supported by
three layers of, above, one and in diam-
eter, the thin of oxidation of carbon
oxide, the thin of silica above the upper
part edge of the Heath Kain.

Through this mass on, "Litharge" in
course of mass is maintained, being
accounted as the left hand and other
changes as the same as in Lead ear-
ners.

The Heath - "Kain" or "Kain" (see Place II
^{or} III, Place III) upon which the mass -

back with a cast in one piece ^{and}
supported upon a pair of brick walls.
The basin holds about 2400 pounds
of lead.

Dimensions and arrangement of the
main part will be seen by Plates II ^{and} III

Coin backs are manufactured at the
Linton Iron Works, St. Louis and cost
\$350. ^{and} Mouth-castings ^{and} Plate are made
at the Joplin Foundry. They weigh about
3000 pounds ^{and} are used for 2 1/2 feet.

Hearth Manipulation: -

We will assume the hearth basin to be filled with lead as it is left after each shift. The galena, charcoal and lime are also delivered to the bin in front of the hearth.

The operation is as follows; upon the surface of the lead a fire of wood or charcoal is kindled and the blast turned on. After it is well ignited the residue of the last shift is added, this consists of small amounts of slag, galena, charcoal and etc. As soon as the lead in the basin is in a fluid state the charging commences which consists of throwing onto the hearth galena in amounts of from 20 to 30 pounds and covering with charcoal a little slaked lime is added as a flux.

The charge is now allowed to remain undisturbed for about five minutes at the expiration of which it is broken up with the pole ^{rod} stirred continually with the "spud" so that every part may come in contact with the blast and effect complete reduction. During this stage the slag which forms is removed in small clumps from time to time.

The above operation is repeated until the shift is over. As fast as the lead is produced it runs over the apron into the ~~spout~~ kept constantly warm by

a wood fire, from which it is ladled out into moulds.

After filling the mould a scraper is passed over the surface of the lead to remove the dross. The pig is taken from the mould by driving a spike into ^{one} end which is held in the left hand ^{and} by tapping the other end of the mould with a hammer the pig may be lifted out. This hammer is also provided with a sharp edge which is used to "close" the pig.

Smelting requires the attendance of two men known as the "Front Hand" ^{and} the "Back Hand". The front hand stands at the left of the hearth and charges both fuel ^{and} ore, breaks the charge with the poker and skims the lead. It is the duty of the back hand to work the charge with the spud, to mould the lead and remove the pigs from the mould ^{also to} throw the dross upon the hearth and clear it ^{smelting} after ready for the next shift.

Our ^{own} chemicals are delivered at the hearth by the yard men whose duty it also is to weigh both Galena and Lead.

During one shift of about eight hours 3000 pounds of Galena is smelted yielding at least 70% of lead. If more than this amount is produced the smelting value $\frac{1}{4}$ of a cent extra for every pound in excess of of this ~~amount~~.

From 15 to 20 bushels of charcoal
and about 70 pounds of Linn are
required to smelt 3000 pounds of galena
Then it produces about 300 pounds of
slag.

Cost of operating hearth for shift

1. Yard Man	1.50	
1. Engineer	2.00	
Tools ^{and} Repair50	
Fuel of Boiler	7.20	
Wood for Gate20	
Cost for shoe leather $\frac{8.50}{}$		
----- " " " one hearth		2.80
Fuel smelter		7.00
18 Bu. Charcoal @ 12 [¢]		2.16
Linn		<u>.15</u>

Cost of smelting 3000 pounds of galena \$9.14

It will be observed that in the
above estimate nothing has been charged
for wear and tear or for salaries of
officers.

From relations above described it
will be seen that economy attends the
uniting of several hearths together as the
blast will be supplied by one engine
blower. One yardman may also attend a
number of hearths.

The products of French-treatment are
as follows

- a. Lead
- b. Grey Slag
- c. Limes.

The lead produced is of a very
superior quality and is in great demand
for the manufacture of White Lead - It
is quoted in the market as "Missouri Soft
Lead".

The following is the analysis of a
sample furnished by Mr. Blow.

Copper	.01935
Cadmium	.00268
Iron	.00173
Antimony	.00096
Zinc	.02691
Nickel	.00122
Arsenic	Trace
Silver	.00031
Lead, by difference	<u>99.97697</u>
	100.00000

Slag: -

Slag produced in this operation is not homogeneous consequently there is a difficulty in arriving at its average composition.

A sample examined corresponds to the following analysis.

SiO_2	12.251
CaCO_3	11.260
MgCO_3	178
Al_2O_3	556
Fe_2O_3	534
ZnO	5,275
Pb	24,877
PbO	1,126
PbO by difference	5,515
PbSO_4	<u>38,706</u>

The presence of undecomposed galena in the slag is invariably the result of poor smelting.

Slag is sold to establishments smelting that body at from three to eight (3 to 8) dollars per ton

Zinc

The fumes which condense in the chamber ^{the} way leading to the stack are collected after each campaign and smelted in the Flintshire furnace.

I regret that I am unable to give any data as to the amount produced.

The Flintshire Method:-

Plate IV. represents a section of a reverberatory similar to the one at their works. The body of the furnace is of stone lined with fire brick and laterally braced by means of vertical iron bars through which pass rods to the opposite side.

This furnace was built in 1876 at the cost of about \$1000.

The mode of practice of smelting galena in the furnace resembles the operation as described in *Hull's Metallurgy*, Lead pg 39, Woods. ⁹⁴⁴ Coal or ~~together~~ used as a fuel and all charges consist of 3000 pounds.

Lead produced by this process differs very little from that produced in hearth smelting.

Tools ^{and} Appliances: —

Fig. 1 Plate 5 represents an ore car used in transporting the mineral from the Dressing works to the hearth. It has a capacity of 3000 pounds.

The car shown in Fig. 2 Plate 5 is used for moving pig lead.

Figs. 3, 4, 5 ^{and} 6 represent tools used about the Flintshire furnace for manipulating the charge ^{and} etc.

Fig. 1	The Spud
" 2	" Poker
" 6	" Ladle
" 9	Spade used in unloading lead from the mould.

The hammer used about the hearth is shown in Fig. 3.

Fig. 7 represents the form of shovel used about the hearth, the handle resembles that of an ordinary pitchfork.

Note I

Several of the latest works in this vicinity the Cicular Water Race (see Plate III Fig 3, 10) is in use.

This form is best adapted to the smelting of low grade ores, the being five instead of three layers as is the case in the square race.
