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SEARCH FOR LOW COST SHIELDING

V. J. Romano

Rough estimates of the shielding requirements for the external beam area indicate that 30,000 to 50,000 tons of material with a density of around 300 lbs per cubic ft would be needed.

With these large quantities, one cent per lb cost differential would mean $600,000 to $1,000,000 difference in total cost of shielding for this area. It is evident that very careful selection of material and very shrewd buying is necessary to effect a most economical shield design.

A preliminary investigation of the possible use of scrap metals, the cheapest cast iron, the cheapest cast ingots, etc. provides a number of leads for further development.

Bales of scrap metal, as commercially produced for sale to mills, vary in density from 25.0 lbs per cubic ft to 150 lbs per cubic ft. The press capacity and the type of scrap material are the most influential variables. Selected materials such as punching scrap, wire or can rejects could bring the density up to the maximum mentioned. This type of bale is referred to as No. 1 and is the most expensive. No. 2 bales consist mostly of scrap automobiles. (Costs mentioned in this note refer in general to No. 2 bales.) No. 3 bales include old water tanks, sinks or any other metal one might think of, along with the porcelain or glass linings they might have.

No. 3 bales are the least homogeneous and the most difficult to control dimensionally.

To meet the 300 lb per cubic ft density requirement, additional processing of the bales would be required.

Bale prices vary somewhat like the stock market (see following chart), but if we assume a price of one cent per lb we would have to reprocess the bales for something like three cents per lb including

the required extra handling and shipping in order to compete with some other possibilities mentioned in this note.

Inquiries regarding further densification of commercial bales met with mostly negative results. The scrap dealers appear to be doing the best they can with the presses they have.

One company, **"Ace Steel Baling Inc.," of Toledo, Ohio uses a** patented process (Pat. 3320051) for increased densification of bales but they are still only able to obtain 150 lbs per cubic ft density. Mr. Calvin Leberman of this company described the process as a grid type slicer which smashes junk into a grid pattern before feeding into a 700-ton press. The resultant bales are 24" x (18-20)" x (4-6)".

One can see from the dimensional tolerances that the average density of the bales is difficult to control. Furthermore, the density throughout each bale is practically impossible to control because gears, shafts, etc. are mixed with auto body sheet metal.

Increasing the density of existing bales would increase the uniformity of density.

The size of the press needed to reduce the size of the bales is not a straight line function of the density, i.e., if a 700-ton press is needed to produce 150 lb per ft^3 bales, then doubling the press capacity might not get you the 300 lb per ft^3 density (according to Mr. Leberman).

Even though Mr. Leberman sells scrap bales he strongly urged ("as a taxpayer trying to save money") the use of cast ingots. From his experience in the business he felt that if we were charged five cents per lb for raw cast ingots of the lowest grade the seller would be making too much money.

Mr. Robie, Vice President of Gilro Machine and Stamping Co., Oakland, also suggested cast ingots as the cheapest method. He thought the price of low-grade ingots should be four to five cents per lb. He

pays seven cents per lb for finished higher grade sheet.

Mr. Turnquist, of Oregon Steel Mills, Portland, thinks five cents per lb is about the price of their cast ingots, but they pay a higher price for scrap in the Portland area.

Mr. Ray Pell, of Jorgenson Steel, Seattle, said his company probably could not take the job of additional pressing of existing bales but the standard charge for the use of their press is $300 per hour. Assuming 1000-lb bales, he guessed 4 bales per hour, but with the quantity we are suggesting I thought this would be about 8 bales per hour. At this rate reprocessing would cost 3.75 cents per lb.

The information gathered so far indicates that raw cast low-grade ingots are the most economical way to shield in this area, especially when one notes that the density of these would be about 478 lbs/ft^3.

However, re-pressing existing bales cannot be ruled out if the problem is approached from a different point of view.

C. H. Berndt, of Baldwin Lima Hamilton Co., said a press of the 1000-ton size would cost in the order of $175,000. If this were installed at the accelerator site for $25,000, the total cost would be $200,000. With very simple accounting one could say:

$$\frac{\text{cost of press in cents}}{\text{shielding in pounds}} = \frac{2 \times 10^7}{6 \times 10^7} = 0.33 \text{ cents per lb}$$

to write off the cost of the press. Assume labor to run press at $30. per hour, eight 1000-lb bales per hour, then

$$\frac{3000 \text{ cents}}{8000 \text{ lbs}} = 0.375 \text{ cents per lb labor}$$

Assume about 0.295 cents per lb for power and maintenance expenses.

We now have:

Cost of scrap bales(on site)	1.500 cents per lb
Press depreciation	0.330 cents per lb
Operating labor	0.375 cents per lb
Maintenance and power	0.295 cents per lb
Total cost of 300 lb/ft^3 bales	2.500 cents per lb

The above figures may not be accurate, but if one doubled the cost of the press and doubled the cost of labor, the cost per lb of densified bales would be 3.2 cents per lb with the bonus of having a 1000-ton press on hand for the laboratory shops.

Another method of processing scrap bales is being investigated by the Bureau of Mines under the direction of Mr. Cloe Armantrout at the Albany, Oregon laboratory.

Mr. Armentrout is producing refined iron ingots from auto body bales (laboratory quantities) economically and metallurgically suitable for reuse in industry. He does this by heating the bales to 1100°C and pressing through a die to form a 10" diameter ingot weighing about 220 lbs. These ingots are then further refined but for shielding we would not be concerned with this.

The combustible materials in the junk bales provide enough BTUs (11 x 10^6, I think) to get the required temperature with very little fuel added after starting the process.

Mr. Armentrout said the whole process is "very cheap" but he has no record of costs since he is primarily interest in the chemistry.

Summary:

1. Raw cast ingots of almost any size up to about 50 tons should be available for . . . . . 4 - 5 cents per lb

2. No. 2 scrap bales (100 - 150 lbs/ft^3) should be available for . . . . . 1 cent per lb

3. Increasing density of No. 2 bales to 300 lbs/ft^3 with work done by outside contractos would cost . . . . 3 cents per lb

4. Increasing density of No. 2 bales to 300 lbs/ft^3 with work done on the site with NAL press . . . . . 1.5 cents per lb

References:

1. Jorgenson Steel, Seattle, Washington, Ray Pell (206) 762-1100
2. Baldwin Lima Hamilton, Los Angeles, C. H. Bernät (213) 482-8442
3. Bureau of Mines, Albany, Oregon, Cloe Armentrout (503) 926-5811
4. Gilro Mach. and Stamping Co., Oakland, Mr. Robie (415) 532-0062
5. Ace Steel Baling, Inc., Toledo, Ohio, C. Ioberman (419) 536-3747
6. Oregon Steel Mills, Portland, Oregon, G. Heindz (503) 228-7641
* 7. General Iron Industries, Chicago, Illinois, Irvine I. Hoffman 4600 W. Division Street
8. - 13. See next page.

* These people now have on hand 1000 bales which they are anxious to get rid of (cheap). 10-5-67.

REFERENCES

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COMPRESSED SCRAP METAL SHIELDING BLOCKS

* Revised 10-5-67
12-20-66 V.J. Romano

	SCHNITZER 444-9982	FINKELSTEIN (213) 566-2121	LEARNER 636-1566	JUDSON * 662-2530	LURIA (213) 589-6561 906-6887	BETHLEHEM STEEL CAST INGOTS
SIZE	24"x24"x70"	24"x24"x48"	24"x24"x60"	10"x10"x24-30"	24"x24"x48"	ANY SIZE UP TO LADLE CAPACITY 200 TON
WEIGHT	2000 LBS	1000 LBS	3000 LBS	500 LBS	1400 LBS	ALMOST ANY SIZE
DENSITY	86 LBS/FT^3	62.5 LBS/FT^3	150 LBS/FT^3	110 LBS/FT^3	25 LBS/FT^3	485 LBS/FT^3
COST TON	$30 /TON	$19.60/TON	$40 /TON	$ 2[illegible]/TON	$40 /TON	$140 /TON
COST LB	1.5¢/LB	0.982¢/LB	2.0¢/LB	1.32¢/LB	2.0¢/LB	7¢/LB
REMARKS		DENSITY ONLY INCREASES WITH TYPE OF MTL. CONTROL NOT POSSIBLE	SAYS 185/FT3 IS REALISTIC. SELECTED MTL COULD INCREASE			
		SELECTIVITY IS EXPENSIVE.	DENSITY ABOVE IS FOR DRILLING WING. 300# POSSIBLE.	JUDSON BUYS WILL NOT SELL	CANNOT CONTROL SIZE OR WEIGHT BECAUSE MTL VARIES. (BINS WATER TANKS etc) 6" TOLERANCE ON TWO DIMENSIONS 2 FEET ON LENGTH	PRICE INCLUDES VERY ROUGH MACHINING ON THE TAPERED SIDE FOR EASIER STACKING.