Putting Waste Metals to Work

Methods and Machines That Make It Profitable for Every Plant to Handle Its Own Junk

By Robert G. Skerrett

THE salvaging of our metallurgical derelicts has become a business of imposing proportions, and the more we persist in this form of conservation the better able shall we be to hold our own in the near future in that keen industrial competition which is bound to tax productive cunning to the utmost.

The old bit of lead pipe, the odds and ends of cast-off iron, the battered door knob, the leaky faucet, the tinsmith's waste, the copper kettle that has served its day, and thousands of other articles of allied sorts have long been classed in the popular mind as junk. To the man in the street they have fulfilled their primary purpose and are fit only for the scrap pile. It is well, however, that there are others among us who do not look so indifferently upon these waste materials. In the language of our Government experts such scrap is today dignified as "secondary metals"; and their value in the course of a single year reaches a total of tens of millions of dollars.

The war we waged upon waste during the recent period of strife brought home to us how spendthrift we were ordinarily; and practices were then instituted which can be of incalculable good if we persist in them nationally henceforth. From now on the aim of our factories and mills must be to realize quantity output with a stricter regard to the costs involved. The problem is not going to be one of promptness of delivery so much as profit at an attractive price. We have got to count the pennies and put to service metals, for instance, that formerly were thrown aside with little heed to their possible re-employment. Indeed, in some fields, we may be called upon to reuse a given quantity of metal several times in the course of a comparatively brief interval. And what have we already done in this direction?

In 1915 the value of the secondary recoveries from six metals amounted to more than \$114,000,000, and the U. S. Geological Survey reports that secondary copper, brass, lead, zinc, tin, antimony, aluminum, and nickel reclaimed two years ago represented \$181,841,500. And what about iron and steel scrap and the various ferro-alloys that were remelted during 1919? It is estimated that this particular group of secondary metals bulked substantially 8,000,000 tons and that they ranged in value from seven dollars to several hundred dollars a ton. This happened in a year when our railways were yielding only about 60 per cent of their normal supply of old iron and steel.

Ordinarily, the average yearly discard of iron and steel by our land lines totals about 8,000,000 tons, and at a conservative figure this material should bring not

less than \$100,000,000. This seeming wastage is not hard to understand when we recall how extensively iron and steel figures in the equipment of the rolling stock and the roadbeds of these great and far-reaching common carriers. So much for the baser metals; and now for some of those of the rarer sort that are made fit again for service.

The secondary platinum, iridium, and palladium recovered from domestic sources in 1919 was worth \$8,053,265, and was more than the value of the platinum and allied metals which we imported for consumption during the same twelvemonth. It may never have occurred to you that when you parted with a filled tooth you were perhaps contributing to a veritable bonanza, but it seems that dental waste and jewelry

furnish the largest share of secondary gold, while silverware and photographic waste yield us most of our secondary silver. According to the Government authorities, the gold or silver contained in old jewelry, dental waste, silver tableware, ornaments, and other articles remelted two years back was in excess of \$27,592,060. Mints and refineries reported the recovery of 6,463,002 fine ounces of silver and \$19,354,398 in gold from refuse or discarded material.

In the course of a twelvemonth one small refinery reclaimed 30,000 ounces of silver from the waste of some moving picture laboratories. Those familiar with the business are aware that a considerable part of well-nigh every new film is spoiled or cut out before the reel is displayed, and, besides, old films are scrapped. All films contain silver in their coatings, and so do the solutions in which films are originally developed. It pays to adopt measures to salvage this precious metal.

As many of us know, the lead-in wires of electric light bulbs are commonly made of platinum because the coefficient of expansion of that metal is so low that it will stand wide variations of temperature without tending to crack the enveloping glass. In the past little was done to recover the imbedded filaments in cast-off globes; but an example was set in the direction of conservation during the war at the house of correction of a large Western city. A testing plant was created for the examination of discarded light bulbs found in the municipal waste. Not only was a sufficient number of good lights thus discovered to meet the needs of the entire institution, but platinum that sold for more than \$9,000 was reclaimed from the "dead" lamps.

Not long ago the repair-shop foundry of one of our big trunk lines devoted half of its time to the manufacture of new bearings for its rolling stock, but by improved practices this work was reduced nearly 40 per cent. The bearings proper are of bronze and lined with an anti-frictional composition. The remedy adopted was to melt out what was left of this soft metal lining whenever the bronze bodies came into the shop and to recast the lining material into ingots. From these ingots, when remelted, bearings, otherwise sound, were refilled. The system developed for recovering the old lining metal became so complete that only 25 per cent of new anti-frictional metal had to be bought to take care of this particular department of the road's requirements. A quantitative idea of the savings thus made possible can be gathered from the fact that in 1917 a single large railway purchased and worked up

A pulley type of magnetic separator treating foundry waste

Left: Briquets of flue-dust being carried by a belt conveyor from a briquetting machine to the blast furnace. Above: Partly consumed flue-dust briquets, showing how these hold together while undergoing melting in the furnace. Right: Machine for the briquetting of borings, turnings and millings from machine-shop waste. The finished blocks are discharged from the elliptical opening at the lower left of the view

How scrap is compressed into large cakes where it could not profitably be handled loose

21,000,000 pounds of bearing metals to carry the loads superposed upon the journals of the line's myriad car and locomotive wheels.

In machinery of all sorts brass and bronze figure extensively, and these metals, when scrapped, are not infrequently associated or mixed with iron and steel. This is especially true in machine shops where the turnings from lathes, etc., dealing with various materials, are swept up together and dumped in common piles. Miscellaneous scrap of this character is of little or no value as it stands, because there should be no iron or steel in brass castings and no brass in ferrous ingots or castings. It is therefore highly desirable that the ferrous and the non-ferrous metals be segregated so that they may be made ready for remelting. This could not be done cheaply and rapidly on a commercial scale but for the evolution of magnetic separators, which are obtaining steadily increasing recognition in our industrial life.

It has been said that a handful of iron will ruin a hundred pounds of babbitt metal; and iron in brass and copper alloys is likely to occasion grave trouble in working up the castings. This is owing to the manner in which iron forms into small nodules which absorb all of the carbon in the surrounding non-ferrous mass and become harder even than the hardest of tool steel. If, for example, the cutting tool strike any of these while machining a brass casting the instrument is apt to break, and, apart from the money loss in the damaged tool, the latter may injure the casting before the operator is aware of it. Plainly, much is to be gained by separating the antagonistic metals.

Where borings and turnings are very oily it is needless to remove this coating before separation begins, inasmuch as the oil causes fine iron particles to stick to the other metals and thus to draw the latter along with the iron. This objectionable oil can be got rid of by various means. In general, in handling mixed metals, it is advisable to screen the chips through a half-inch mesh before feeding them to the separator. For the treatment of a combination of iron, steel, brass, copper, aluminum, or nickel scrap of this character, what is known as the disk-type of separator answers admirably.

In a machine of this sort the magnets consist of a large, stationary, primary magnet body and a series of small, secondary induced magnets which are mounted upon a rotating disk. The primary magnet has heavy double coils and cores with pole pieces projecting downward and conforming to the circle of the disk. The secondary magnets, made of Swedish iron, are inductively energized by the primary magnet, but become demagnetized as they sweep beyond the neighborhood of the primary poles and when so weakened they drop any iron or magnetic material that they may have attracted, in this way the discharge falls into a conveyor and is transported to a near-by box or bin, while the non-magnetic substances are carried to another point of deposit.

For handling bulkier materials there has been devised a pulley-type of magnetic separator. In apparatus of this kind the magnetism is strong enough to exert itself at a given point through the conveyor belt that turns about it. In operation, as the mixture comes within the magnetic zone of the pulley, the magnetic bodies are attracted and carried around and beneath the magnet where they are released and free to fall into a receptacle, (Continued on page 415)

Two magnetic-pulley separators, on either side of a disk separator, also of magnetic type

Our New Sixteen-Inch Barbette Coast-Defense Gun

IN our issue of January 29th of this year we described and illustrated the new 16-inch, 170-ton, disappearing coast-defense gun, a type which is to be mounted in some of our most important fortifications. We now present a photograph of the same gun on the new barbette mount, which has been designed by Army Ordnance and built at the Watertown Arsenal. The mounting shown in this photograph is the first of its type to be built.

The disappearing mount, it will be remembered, was designed to permit the loading and sighting of the gun to be done below the shelter of a massive sand-and-concrete parapet, with a view to giving protection to the gun and its mounting and the crew. After the gun is loaded, it is raised by its counterweight until the barrel is clear of the parapet, and on firing, the energy of recoil carries the gun back and down once more into the loading position. The barbette mount is simpler, inasmuch as the barrel of the gun is permanently exposed above the parapet. The mounting consists essentially of a carriage and a sleeve, the carriage rotating horizontally on a turntable and the sleeve rotating vertically on journals which form part of the carriage. The gun recoils within the sleeve, which carries the recoil cylinders for gradually absorbing the momentum and returning the gun again to the firing position.

The Army coast defense gun is a huge piece, 69 feet in length and weighing 170 tons. Its heaviest armor-piercing projectile weighs 2,400 pounds and has a range of over 22 miles. The powder charge weighs 850 pounds, and the projectile has sufficient energy to penetrate any armor that can be carried by a modern battleship; and it

Our new 16-inch barbette, coast-defense gun, weighing 170 tons, which fires a 2400-pound shell to an extreme range of 22 miles

can effect this penetration at any range.

The recent firing tests against the old battleship "Massachusetts," carried out by our Coast Defense Artillery, demonstrated the great effectiveness of high-angle fire; and this mount has been designed so that the gun can be fired at an elevation of 65 degrees. A 2,400-pound shell fired at such an elevation, and falling, as it would, almost vertically from a height of several miles, upon the deck of a ship would unquestionably penetrate to the vitals, even were she a 43,000-ton vessel with the great protective armor of our new "Indiana" class. It is a pretty safe guess that the effect of such a shot would be to cause the ship to fall out of line.

Tin Cans as Fuel

IT might be left to the expert metallurgist to say whether or not there is any

material quantity of heat evolved in the burning of tin cans and if so just what their "fuel value" is. As an efficient and sanitary means for disposing of them there can be no question regarding their cremation.

That almost any quantity of tin cans can be conveniently disposed of by burning in an ordinary hot air or steam house-heating furnace cannot be generally known to householders at large or there would be less back yards, vacant lots and dumps cluttered up with this most unsightly and insanitary kind of refuse. As usually thrown out without the formality of rinsing, they are "smelly" and where they not infrequently lodge, they collect rain water and become most luxuriant breeding places for flies and mosquitoes. All this could be readily avoided by simply "firing" the cans into the furnace along with the other fuel. The burning of a tin can, as any other combustible, is a process of *oxidation*. Oxidation takes place slowly in the space above the fuel bed, because then if the fire is intelligently handled and there is a minimum of "air dilution" there will be no great amount of free oxygen. As the cans are allowed to sink deeper and deeper into the fuel bed, and, finally, into the underlying bed of ashes, they encounter more and more free oxygen which, at a comparatively high temperature, soon results in their almost complete disappearance.

In order that they may be got rid of as quickly as possible it is best to put them into the furnace before firing on fresh coal. They should not be "poked" (neither should burning coal for that matter, except in very rare incidents), but left alone to sink gradually down to, and finally through, the grates, in which there will be nothing left of them but a few scattered fragments of brittle oxide. It may be remarked that practically all other refuse from the house can be disposed of in the same way.

To the city dweller this information may be of minor interest although it does not require a very vivid imagination or otherwise active mind to show what an improvement there would be in the outskirts of every city infested with "dumps" if all combustible matter were disposed of in this way. The refuse from the usual dwelling house would be one product, and one product only—a mixture of fine ashes and clinkers, the former of which in the case of the rural and suburban owner can be readily separated out by dumping on an inclined screen for use in lightening the soil of the garden, and the latter, constituting about 50 per cent by volume, can be disposed of in the usual way or used in making concrete.

Putting Waste Metals to Work

(Continued from page 405)

while the non-magnetic substances are swept by momentum off of the belt when it begins its downward course. Disk separators are built capable of treating from 300 to 1,200 pounds of material in the course of an hour, and the magnetic-pulley pattern of separator, according to size, is able to take care, in the same interval, of from 550 pounds up to nearly 40 tons of waste. Apart from doing what is quite impracticable by manual labor, these separators recover values that otherwise would probably be lost. Magnetic pulley separators are extensively employed now in withdrawing iron and steel from blast-furnace slag, when crushed, and from the sand of foundries. Indeed, magnetic separators are reclaiming ferrous metals from ashes, grindings and sweepings, and helping to add largely to our stores of these secondary metals. So far, so good, but separation, in itself, does not suffice to insure the fullest reuse of the salvaged scrap.

Light, loose turnings, borings, etc., when remelted in that form, entail serious losses by excessive oxidation in the furnace. These can be minimized by compacting or briquetting the material in advance. Machines are built which effect this by subjecting the bulky scrap to enormous pressure, and the result is a dense mass which will undergo melting with nearly as little loss as a like weight of solid metal. This may be done either at the source of the scrap or at the nearest plant that specializes in the briquetting of such material. From there it is returned in the form of so-called ingots or briquets. These can be forked, dumped, and handled without appreciable loss by abrasion; they facilitate economy in the use of crucibles because their shape and density permit a maximum weight of charge; and they promote greater output of re-cast metal in less time and at a lower cost for fuel. One establishment has a briquetting equipment which turns out from 16 to 20 briquets of steel turnings per minute and these run from 12 to 20 pounds each. The light steel for these briquets is bought at the market price for such scrap and, after compacting, is sold at a premium above the market price for so-called heavy-melting steel.

That the Government set an example in economy is evidenced by what was done at the U. S. Naval Gun Factory where, during three years' work, it was found that manganese bronze, previously supposed to be an exacting composition, could be made without resorting to high-grade virgin metals. The alloy was produced in a reverberatory furnace from materials of low grade, such as yellow brass, machine-shop turnings, zinc dross from galvanizing pots, aluminum turnings, old zinc scrap, foundry-floor scrap and skimmings, and scrap copper. Similarly, the Navy Yard proved that open-hearth steel could be made from cheap unsalable scrap, and that a considerable saving could thus be achieved over the ordinary practice of utilizing practically all heavy and high-priced melting stock.

The use of lead batteries has expanded greatly through the development of the automotive industry and a large part of our secondary lead is obtained from old batteries. In 1919 the secondary lead recovered from various sources amounted to 122,100 tons. Considerable impure and low-grade lead scrap is now manufactured into toys here which previously came from abroad. Two years back the secondary tin salvaged was equal to about 42 per cent of the tin imported; it totaled 24,033 tons, and was valued at \$29,868,200. Some of this was got from clean tin-plate scrap and about 400 tons was recovered from scrap tin, clippings, old tin pipe, tin foil, and collapsible tubes. Nearly all clean tin scrap is detained by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpeter. By the

(Continued on page 417)

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The effect of pressure on the life of the saw and how it affects cutting costs is very clearly shown in the succeeding tables and curves. From all of these, it will be at once evident that too light

a pressure will allow the saw to slide and wear without doing effective cutting. This may show long life in hours, but also requires long periods per cut, and results in an ultimate low efficiency. On the other hand, excessive pressure is unnecessarily destructive. The saw may cut much faster while it lasts, but it doesn't last long enough to justify the practice. Between these extremes lies the happy mean which represents the acme of Hack Saw economy.—From Hack Saws and Their Use, published by The L. S. Starrett Co., Athol, Mass., for free distribution.

Putting Waste Metals to Work

(Continued from page 415)

first method the tin is reclaimed in the form of a spongy granulated precipitate, which can be remelted into pig tin; by the second, tetrachloride of tin is recovered for use in the weighting and the dyeing of silk; and by the third procedure the tin is secured as an oxide, which is employed as a coloring agent in the enamel industry or melted into pig tin by means of a reverberatory furnace.

Aluminum chips from castings produced in the making of automobiles have become a large source of secondary aluminum. By the old treatment the loss in remelting such chips was sometimes as high as 40 per cent, but government experiments revealed awhile back that it was quite practicable to lower this loss to as little as 10 per cent. The secondary aluminum, in the shape of pig aluminum or in alloys, totaled a matter of 18,691 short tons in 1919, and was valued at \$12,014,600. Various products are made by smelters and refiners from scrap aluminum. During the same year we obtained 2,447 short tons of secondary nickel worth \$1,829,400. Of the resultant refined nickel, about 60 per cent is used in nickel steel, 30 per cent in white-metal alloys, 5 per cent in anodes for plating, and 5 per cent for miscellaneous purposes, including the manufacture of salts and other chemical compounds. As has been well said, "By depriving the market of any useful scrap metal the price of virgin metal is driven up proportionately."

Finally, in sketching the potential savings through the recovery of secondary metals, let it be said that blast-furnace flue dust, which is so often neglected, has an iron content of more than 40 per cent. By briquetting this dust it can be fed back to the furnace and much of the valuable iron in it can be melted and cast into marketable pigs. The recent perfecting of machinery for briquetting this material opens up channels to tremendous economies. Our large industrial enterprises are profiting by the lessons learned during the late conflict, but the thing needful is to impress upon their smaller brethren that they, too, ought to adopt the same practices so that the nation as a whole may be the better fitted to cope with the foreign producer.

The Truth About the Dye Industry

(Continued from page 408)

for the production of essential pharmaceuticals. Some of the most necessary drugs for the maintenance of public health are produced from coal-tar products. I will mention only such things as salvarsan, aspirin, novocain and phenacetin.

Prior to 1914 we were entirely dependent upon Germany for these products; to-day, physicians and dentists will tell you that they are difficult to obtain, and are very expensive. They have not yet been produced adequately by the American dyestuff manufacturer, but given a fair field this is the next step of development which, already in preparation, is bound to come. Is it not advisable that an industry which can yield such substances for the relief and benefit of the human race should be maintained?

Again, we are reaching a point where in many sections of our country, the soil has become exhausted and requires replenishment with those necessary chemical ingredients which enable it to yield its full percentage of crops. These chemicals again come from the collateral chemical lines intimately connected with the coal-tar chemical industry, such as the products of nitrogen from the air, which make possible the necessary nitrates and the manufacture of ammonia, as well as other chemical factors which are indispensable to the proper preservation of land values.

Finally, the preservation of the coal-tar chemical industry is indissolubly as-

sociated with the national welfare, in that it is from this industry that the high explosives and poison gases are obtained which have made modern warfare what we realized it to be in 1917-1918.

The country which has a well-established coal-tar chemical industry, is the country which is ready to meet an aggressive attack almost at a moment's notice. The same plants which produce coal-tar colors can be changed and diverted into the manufacture of poison gases and high explosives with the least possible margin of delay—to use a slight literary exaggeration, almost over-night.

For instance, there is a black dye, sulfur black, very extensively used for dyeing our black cotton stockings. In its finished state, it is simply a harmless, grayish-black powder. If the process of its manufacture however had been stopped before the last step was completed, and had been switched off in another direction, we should have produced picric acid, one of the most powerful explosives known.

Again, a certain brilliant yellow dye, made from coal tar, and in universal use for obtaining delicate golden tints, if also stopped before the completion of the final step, produces one of the most deadly forms of poison gas, a gas which renders modern rifle fire and the machine gun ineffective and useless to the same degree as the high-powered bullet threw into the discard the shoulder-to-shoulder formations and solid squares of the days of Waterloo.

There is a story, which may be apocryphal, that prior to 1914 one of the largest German dyestuff manufacturers was making, under instructions from Berlin, large quantities of di-nitrotoluol. There was no particular market for this product, and they simply continued its manufacture, piling up huge quantities without any apparent outlet for it. When the war broke suddenly upon the world in 1914, instruction came from Berlin to add one part of nitric acid to this di-nitrotoluol and it was immediately converted into tri-nitrotoluol—TNT.

With this TNT Germany battered down the walls of Liege and Antwerp and blasted her way through Belgium and northern France, while the Allies were still under the delusion that they could hold back her gray hordes by peppering them with shrapnel.

Some weeks ago a squadron of airplanes flew over the lower part of New York. They were a beautiful sight, and the surging crowds filling the streets at the noon hour watched them with admiration and interest. In their passage over the business district, they dropped smoke bombs and marked the places where they struck. The layman cannot easily imagine what would have happened if these had been bombs filled with TNT and poison gas; but the expert knows. Theoretically, these planes destroyed the whole lower part of New York and its dense day-time population in fifteen minutes. And this destruction would have been caused by products obtained from the coal-tar chemical industry.

Do we want to see this country placed in a position where such a thing as this might easily happen; where from the decks of a line of mother ships anchored twenty miles off shore, such a squadron might have been sent to cause this destruction without any possibility of defense? The world is sick of war, but is there anyone who is so optimistic as to believe that war has been finally abolished? As long as human ambition leads individuals to seek the glory that comes from triumphant war, as long as the surging yellow and brown hordes of overpopulated countries are seeking outlets for their millions who are starving to death on their own resources; as long as the industry and commerce of a nation develop beyond the point where its products can be absorbed by the home mar-

(Continued on page 419)

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