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RECLAMATION OF BATTERY PLATE SCRAP

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The development of the storage battery has given rise to a new form of industrial waste,—namely, old battery plates. Such battery plates are really a mixture of two different substances; the metallic grid, which is composed of antimonial lead, and the "paste", with which the grid is filled. Such paste is composed of a mixture of the oxides and sulphates of lead, and it is entirely free from antimony. Direct blast furnace smelting of this kind of a mixture can, of course, only result in the recovery of a low antimony alloy, for, as the ingredients described are present in about equal proportions, it follows that the resultant metal will only contain half of the antimony required to qualify as antimonial lead.

The customary reclamation practice of to-day is to charge the plates into a cupola, and to smelt them, with coke as fuel, into a low-grade, impure antimonial lead. This operation is attended by much loss, and virtually puts this high-grade material in the same class as an undesirable antimonial lead ore. In order to purify the resultant low-grade metal obtained from present day practices, it must be liquated at least once, if not twice, drossed, oxidized, and reduced. It must then be brought up to market standards by the addition of the requisite amount of metallic antimony,—all of which means considerable expense.

My improved process varies radically from these present day practices; to elucidate:

If we consider the difference in melting point between the metal portion and the "paste", we find that the metal fuses at below 350° C., that lead oxide fuses at about 900° C., and lead sulphate at over 1100° C. It is therefore evident that if the material be heated to a temperature intermediate between these extremes, then there will be effected a separation between the "paste" and the metallic portion. Furthermore, as the specific gravity of the metal is over 11, and the specific gravity of the "paste" somewhere between 9 (for lead oxide) and 6 (for lead sulphate), depending upon the relative quantities of these substances present, it will be evident, also, that the tendency of the lead will be to settle to the bottom, and for the "paste" to float on top of the melted lead.

To carry out this step I prefer the use of a revolving roaster, in which the solid oxidized lead compounds may readily be retained while the mobile fused lead is allowed to flow away, either continuously or intermittently. It will be evident that the charge is kept in a state of continuous agitation by the motion of the roaster, and thus every opportunity is given the globules of molten metal to sift downwards and join the pool of such molten metal which gradually forms at the talus of the sliding, unmelted particles, drawn up to the proper angle of slip by the motion of the roaster.

Having thus separated the fusible from the infusible portion of the charge, the temperature is raised to the point at which the sulphur compounds are broken down with the formation of lead oxide, and the operation continued as a roasting step until only crude litharge remains in the roaster.

Manifestly, it is impossible to separate the metallic portion from the non-metallic portion of battery plates with absolute precision by the procedure thus far described. A small amount of shots, or globules, of antimonial lead will be retained in the pulverulent residue remaining in the furnace, and this metal will in the roasting step, as previously described, be converted into oxide. The crude litharge will therefore contain a certain small percentage of antimony oxide. Should it be desirable to render this percentage as small as possible, then the pulverulent residue, remaining after the liquation of all the metal that may be drawn from the furnace, is discharged, cooled, and passed through a mill, such as a set of rolls, or a rod mill. As the "paste" is very brittle, the effect of the mill will be to reduce it to a powder. And as the shots of lead, in spite of their antimony content, are still somewhat malleable, they will flatten if not too harshly treated. The ground residue may therefore undergo a further purification by means of screening,—most of the mechanically admixed antimonial lead being retained upon the screen, while the undersize will be almost free from antimony. The further roasting of this undersize to crude litharge will be much facilitated by the fact that it is now in the form of a fine powder, and the roasting time will therefore be much shortened.

The breaking up of sulphates in this roasting is aided by the presence of carbon (such as is already present as charcoal from plate separators), but additional carbon may be added. The action of this carbon is to reduce the sulphate to sulphide, which in turn then exercises a reducing action on lead oxide. Such reduced lead will soon be re-oxidized to litharge, and the sulphur has thus been eliminated.

Of course, I may avoid the use of the cupola altogether if I now add sufficient carbon in some form (coke, coal charcoal, etc.), to the charge within the revolving roaster. This will reduce sulphate to sulphide which in turn will reduce the oxide with which the sulphide is in contact, and the oxide itself will likewise be reduced thereby. I may thus obtain most of the lead of the charge in the form of pure soft lead, eliminating at once the need for the cupola, the drossing furnace, and the softening kettle.

The type of work described in the last two paragraphs is a modern version of "Die Roest-re-aktions-Arbite", which, in English is better given by the term roast-reduction, employed in the claims. For full description, reference is made to any work on metallurgy which devotes space to old fashioned procedures,—such as Hoffman's Metallurgy of Lead, where, in the seventh impression, chp. 6, we are given a full exposition of reverberatory furnace practice in lead ores. It will be self-evident that the addition of carbon, above referred to, to a residual of lead sulphate and oxide will be entirely in accordance with the description. Whenever in the claims the expression "roast-reduction" is used it means that combination of oxidation and reduction as described in the above-mentioned chapter.

Having thus described my improvement, I claim:

1. A process for separating the fused metallic from the unfused non-metallic constituents of battery plate, which comprises first heating the material to be treated to a temperature sufficient to fuse the metallic alloy but insufficient to melt the other ingredients, performing said partial fusion within a revolving roaster, removing the fused metallic constituent, and then by the addition of carbonaceous material inducing a further flow of metallic lead reduced from the residual material left within the roaster.

2. A process for separating the fused metallic from the unfused non-metallic constituents of battery plate, which comprises the preliminary step of effecting a partial separation by liquation, said liquation being effected by heating the charge, contained within a revolving roaster, to a sufficiently high temperature to fuse the metallic ingredient while the non-metallic ingredients remain unfused, and submitting the furnace residue to the operation of grinding and screening for a more thorough separation, substantially as and in the manner indicated.

3. In the process of reclaiming battery plate scrap, the step of separating the fused metallic from the non-fused non-metallic ingredient within a revolving roaster, removing the fused metallic ingredient, and eliminating the sulphate-sulphur in the residue through the addition of carbonaceous material by roast-reduction treatment.

4. In the process of reclaiming battery plate scrap, the step of removing the major portion of antimony there in the form of antimonial lead by fusion, followed by a further removal of part of the remaining antimonial lead by grinding and screening, submitting the residue to roast-reduction treatment, and softening the lead thus produced to obtain the remaining antimony in the form of antimonial litharge.

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