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LEAD AND ZINC REMOVAL FROM ALLOY Zn-Ag-Pb UNDER REDUCED PRESSURE

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Preliminary Note – Prethodno priopćenje

The presented work shows the results of vacuum melting of industrial Zn-Ag-Pb alloy arising from the processing of silver-bearing foam. The tests were carried out in an induction vacuum aggregate in the temperature range 773 - 873 K and pressure 10 - 1 000 Pa. Based on the results obtained, the values of the density of the evaporating stream of zinc and lead were estimated, which were at the level from $3,95\times10^{-4}$ to $9,53\times10^{-4}$ $g_{Zn}cm^{-2}s^{-1}$ and from $5,39\times10^{-5}$ to $30,9\times10^{-5}$ $g_{Pb}cm^{-2}s^{-1}$. In addition, silver losses were estimated in the analysed process. The maximum degree of dezincification of the alloy achieved for the assumed temperature and pressure was 99 %.

Key words: Zn-Ag-Pb alloy, fire refining of lead, silver-bearing foam, vacuum refining, evaporation of metals

INTRODUCTION

Silver is one of the most valuable admixtures found in zinc-lead primary raw materials. During their pyrometallurgical processing, this metal almost entirely goes to raw lead, from which it is separated in the process of fire refining. The silver removal technology is based on the formation of intermetallic compounds of the Ag-Zn system by adding zinc to liquid lead. These compounds, due to their low density, accumulate in the form of so-called silver-bearing foam on the surface of the bath, from where they are gradually removed. As a result of melting the foam, a Zn-Ag-Pb alloy is obtained that contains up to 30 % of silver mass and approx. 25 % of lead. This alloy is most often subjected to a smelting process under reduced pressure in order to remove from it, by means of evaporation, both zinc and lead. The amount of metals repelled in this process depends on many factors. The most important of them are temperature, pressure [1-4], type of aggregate in which the process is carried out [5-9] and the composition of the alloys [10] and atmosphere in the furnace [11-14]. The presented work shows the results of research on industrial melting of a Zn-Ag-Pb alloy resulting from the processing of silver-bearing foam for the removal of both zinc and lead from it. The tests were carried out in an induction vacuum aggregate[15].

RESEARCH METHODOLOGY

The research was carried out on an industrial alloy of Zn-Ag-Pb containing 82,06 % mass of Zn; 7,23 %mass of Ag and 5,49 % mass of Pb. All experiments were carried out in an induction vacuum aggregate equipped with a rotary pump - diffusion pump system. At the beginning of each experiment, the alloy sample was placed in a graphite crucible with an internal diameter of 20 mm, which was introduced into the head with an induction coil. After its closure, the sample was heated to the assumed temperature (this process was carried out in helium atmosphere) and then the pressure in the system was lowered. The tests were carried out in graphite crucibles in the temperature range of 723 - 873 K and at working pressure from 10 to 1 000 Pa.

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RESEARCH RESULTS AND THEIR ANALYSIS

Figure 1 and 2 show as an example changes in the content of zinc, lead and silver in the Zn-Ag-Pb alloy obtained for remelts carried out at a temperature of 873 K and a pressure of 10 Pa and 1 000 Pa. Based on these changes, the average values of zinc and lead flux density were estimated, which are collected in Table 1 there are presented gained for all experiments estimated mass losses of both lead and zinc from the analyzed alloy.

Table 1 **Zinc and lead weight loss**

U_{Pb} / %				
T/K \ *p*/Pa	723	773	823	873
1 000	8,55	8,85	14,31	17,03
100	10,27	14,04	18,01	29,85
50	12,62	18,72	20,02	33,80
20	14,34	20,03	29,29	38,60
10	15,38	22,72	41,41	48,82
U_{Zn} / %				
1 000	41,30	55,79	65,43	76,26
100	48,34	65,85	75,16	80,94
50	52,35	72,43	76,95	81,54
20	62,61	80,12	82,93	86,46
10	85,80	96,34	98,64	99,53

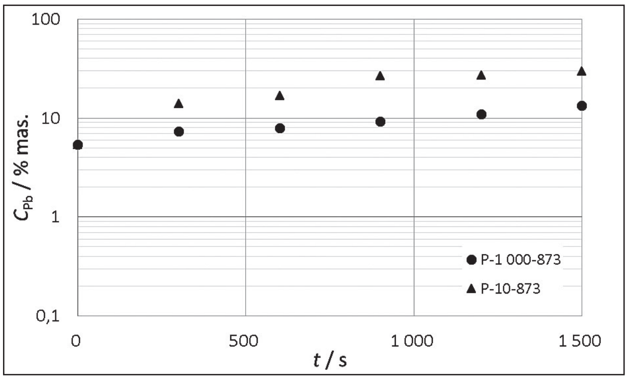

Figure 1 Change of lead content in Zn-Ag-Pb alloy during remelting carried out at the temperature of 873 K

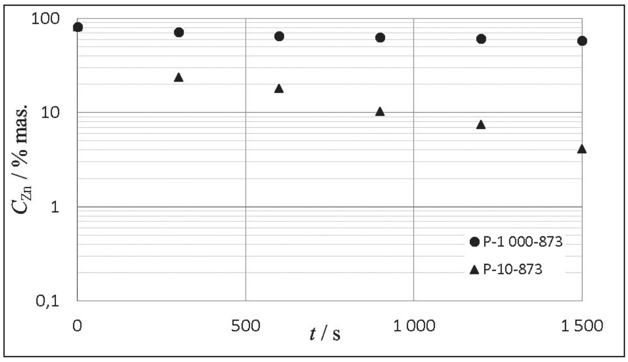

Figure 2 Change of zinc content in the Zn-Ag-Pb alloy during remelting carried out in the temperature of 873 K

In Table 2, the average density values of the zinc and lead evaporating from the liquid alloy are collected. Graphic interpretations of the changes in value of these fluxes in the temperature range of 723 – 873 K are presented in Figures 3 and 4.

The data presented above shows that the increase in temperature from 723 K to 873 K with a simultaneous decrease in working pressure in the melting system is accompanied by an increase in the degree of zinc removal from the alloy from 41 to 99 % and lead from 8,5 to 49 %. At the same time, for the same range of basic process parameters (p, T), an increase in the average value of the flux density of the evaporating metals was observed respectively from $3{,}95\times10^{-4}$ to $9{,}53\times10^{-4}$ gcm^{-2}s^{-1} for zinc and from $5{,}39\times10^{-5}$ to $30{,}9\times10^{-5}$ gcm^{-2}s^{-1} for lead. With the increase in temperature and pressure in the melting aggregate, there was also a decrease in the N_{Zn}/N_{Pb} ratio, which is illustrated, as an example in the Figure 5.

Table 2 **Zinc and lead flux densities**

$N_{Zn}\times10^4$ /g cm^{-2}s^{-1}				
T/K \ p/Pa	723	773	823	873
1 000	3,95	5,34	6,26	7,31
100	4,63	6,30	7,20	7,75
50	5,01	6,94	7,37	7,81
20	6,00	7,68	7,94	8,28
10	8,22	9,23	9,45	9,53
$N_{Pb}\times10^5$ / g cm^{-2}s^{-1}				
T/K \ p/Pa	723	773	823	873
1 000	5,39	5,58	9,02	10,70
100	6,49	8,85	11,40	18,40
50	7,96	11,80	12,60	21,00
20	9,04	12,60	18,50	24,30
10	9,70	14,30	26,20	30,90

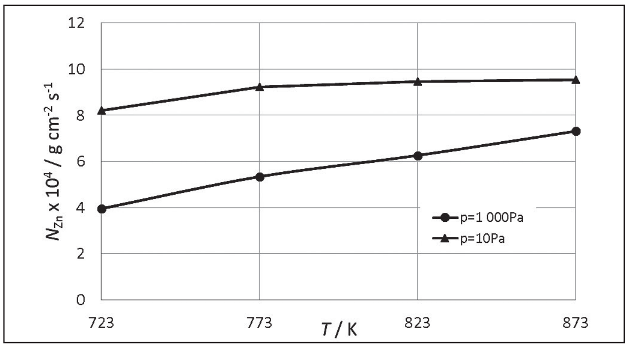

Figure 3 Zinc evaporation flux density

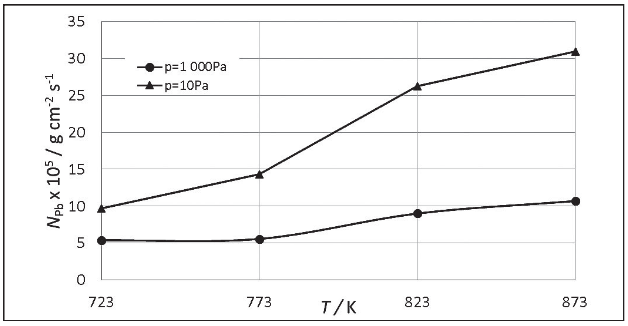

Figure 4 Lead evaporation flux density

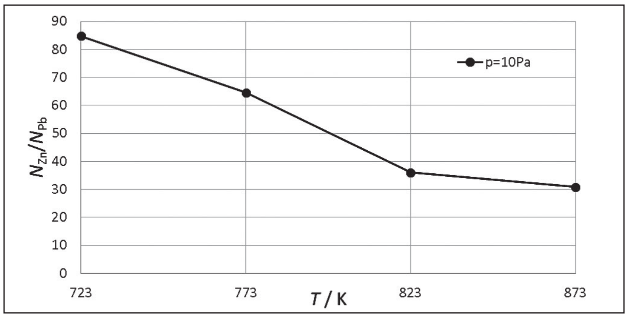

Figure 5 Change in the N_{Zn}/N_{Pb} ratio for tests carried out at a pressure of 10 Pa

CONCLUSIONS

Based on the results of the conducted tests of vacuum melting of the Zn-Ag-Pb alloy it was stated that:

- It is possible to remove zinc from the analysed alloy up to 98 and lead up to 49 %
- As the temperature increases as well as the working pressure decreases in the measuring system, the silver loss in the alloy increases to 18 %. This phenomenon is unfavourable from the point of view of the idea of the technological process itself.
- The obtained values of evaporating zinc and lead streams for the adopted process parameters were within the range from $3{,}95\times10^{-4}$ to $9{,}53\times10^{-4}$ gcm^{-2}s^{-1} for zinc and from $5{,}39\times10^{-5}$ to $30{,}9\times10^{-5}$ gcm^{-2}s^{-1} for lead.

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Note: The responsible translator for English language is Ling House. Poland.