UDC 669.4+669.3

The Optimization of Copper Utilization during Decoppering of Technical Lead

Ahmet Haxhiaj[1], Islam Fejza[1], Murtsel Rama[1], Bajram Haxhiaj[2]

[1]Faculty of Mining and Metallurgy, Mitrovicë, University of Prishtina
[2]Faculty of Achitecture, Prishtinë, University of Prishtina.

In order to have increased utilization of copper during the decoppering process of technical lead in lead refinery in Trepça two samples have been analyzed with the same chemical composition. Furthermore, identical parameters have been used for both samples which are: the quantity of technical lead, the process temperature, the quantity of brimstone loaded, the mixing time and the time of removal of schlicker, and the dismantle of rings formed in the walls of caldron for refinery. After the removal of brimstone schlicker and chemical analyses one calculates the balance of melting phases and decoppering and the scale of copper utilization. The majority of copper is removed from technical lead with the oxide schlicker, one part with the liquation and remaining part by decoppering with brimstone. The paper reflects on increasing utilization of copper in the decoppering of technical lead which is achieved with effective engagement of human factor.

Keywords: SAMPLE, LOADING, DECOPPERING, SCHLICKER, LIQUATION

Introduction

The reduction of copper composition in the technical lead down to limits according to standards is conducted in the phase of deccopering process and includes these stages:

- The melting of technical lead and the removal of schlicker oxide,
- Cooling, liquation and the removal of wet schlicker,
- The removal of copper with sulfur.

The largest quantity of copper is removed from the technical lead mainly with schlicker oxide, one part during the process with liquation and another part during the decoppering of copper with sulfur. The level of copper utilization depends on human factor, whether the filtering is conducted well of schlicker oxide and whether the dismantle of rings formed in the walls of the caldron for refining during the first and second phase of fine decoppering of technical lead.

Results and Discussion

During this test we used two caldrons with capacity of 260t where are loaded 42 blocks of technical lead with an average of 5.9t and the overall weight of technical lead in caldrons reaches 247.8t each. The technical lead which is acquired in smelter of lead and which is tested in this experiment has the below chemical composition.

The loading is done after the heating of caldrons for refining. First, loading from 6-7 block of technical lead, when these melt add another 6-7 block, and after melting of them add the other larger quantity of technical lead block up to the loading of all the mass of technical lead.

Schlicker is formed during the melting where it pulls all the mechanical dirt from lead like: oxides, slag, etc, which do not dissolve in the given temperature of technical lead. During this time it comes to the point of copper removal with liquation process.

Copper dissolves better than lead in high temperatures and by lowering the temperature the dissolubility decreases, too. The lower dissolubility of copper reaches the temperature of 326oC (this is the temperature of solidification of euteckticum) and it contains 0.06% copper.

The largest quantity is removed by the liquation process. When the temperature reaches (460+10)°C and starts the breaking of crust of schlicker oxide. This is achieved by a 6 tone block which is locked on the crane that moves left and right and breaks crust of schlicker oxide. During this time the workers remove the steel flukes from the caldron.

After that the heating of caldron stops, the mixer is inserted and the mixing starts. During the mixing schlicker oxide is formed, and in the end of schlicker oxide formation the temperature in the caldron is 430°C. In order to facilitate the formation of schlicker oxide tinder is inserted to increase the temperature and the withdrawn lead mechanically is removed from schlicker oxide. After this, we proceed with the removal of schlicker oxide. Its removal is done with holey paddles and with the help of the crane. After the fine filtering of schlicker oxide from lead with mechanically loaded in. After finishing with this, we start with schlicker oxide.

The quantity of schlicker oxide during the poor filtering is G^{I}= 21 tone of sample I. The quantity of schlicker oxide during the fine filtering is G^{II} = 19.1 tone of sample II which is the experimental value of refining section in Trepça.

The quantity of technical lead in the caldron after decoppering is calculated with the expression

$$G_{Pb\ technical}^{decoppering} = G_{Pb\ technical} - G_{schlicker\ oxide}\ (t)$$

The chemical composition of the metal and schlicker oxide during the poor filtering and good filtering of schlicker oxide are analyzed at Lead-Zinc Institution in Trepça and are presented in **Table 2**.

Table 1. Presents the chemical composition of technical lead.

The composing elements of technical Pb	Quantity of technical Pb (t)	The composition of elements		
		%	g/t	T
Pb	247.8	96.11	-	238.16
Sb	247.8	0.87	-	2.156
As	247.8	0.75	-	1.86
Cu	247.8	0.8	-	1.982
Bi	247.8	0.16	-	0.396
Ag	247.8	0.0018	1800	0.00446
Au	247.8	0.0000031	3.1	0.0000076
Zn	247.8	0.0012	-	0.003
Fe	247.8	0.0007	-	0.0017
Other	247.8	1.3	-	3.22

Table 2. Chemical composition of Pb and Cu in technical lead and schlicker oxide.

Samples	% Pb	%Cu
Metal, technical Pb during the poor filtering	98.3	0.050
Metal, technical Pb during fine filtering	98.3	0.074
Schlicker oxide during the poor filtering	70.0	8.5
Schlicker oxide during fine filtering	69.8	9.45

The largest quantity of copper is removed in stages of schlicker oxide removal, but some quantity of copper remains in technical lead, therefore it should go through the fine deceppering. The given parameters before and after loading the sulfur in the melted technical lead after poor and fine filtering for samples 1 and 2 are:

- The quantity of technical Pb 226.7t during poor filtering, sample 1.
- The quantity of technical Pb 228.7t during fine filtering, sample 2.
- The quantity of Cu in technical after the removal of schlicker oxide for sample 1 is 0.1134t Cu or 0.05% Cu.
- The quantity of Cu in technical Pb after the schlicker oxide removal for sample 2 is 0.1692t Cu or 0.074% Cu.
- The temperature of technical Pb during the loading of the first sulfur quantity is 332 ^{o}C.
- The quantity of given sulphur is 70 kg.
- Mixing time is 45 mintues.

- The time of first part removal of sulphur schlicker is 40 minutes.
- The quantity of sulphur schlicker for the first phase for sample 1 is 2.5t experimental value.
- The quantity of sulphur schlicker for the first phase for sample 2 is 2.7t experimental value.

The quantity of technical Pb in the caldron after the removal of sulphur schlicker is calculated with the expression:

$$G_{Pb\ technical}^{fine\ decoppering} = G_{Pb\ technical}^{decoppering} - G_{schlicker\ sulphur}(t)$$

- The quantity of lead in the caldron after the removal of the first part of sulphur schlicker for sample 1 is 224.3t.
- The quantity of lead in the caldron after the removal of the first part of the sulphur schlicker for sample 2 is 226t.
- The chemical content of copper in technical lead decoppered with elementary sulphur after the removal of the first part of sulphur schlicker for sample 1 is 0.013% Cu.
- The chemical composition of copper in technical lead decoppered with elementary sulphur after the removal of the first part of sulphur schlicker for sample 2 is 0.015% Cu.

Because of low temperature of 332^{o}C during the insert of the quantity of sulphur as a reagent in the caldron for refining in the walls of the caldron is attached a quantity of copper in the form of rings as a consequence of low dissolubility of copper in technical lead in the existing temperature. There the worker should detach the formed rings.

The chemical composition of metal and sulphur schlicker when the poor and detachment of rings is done formed in the walls of caldron for refining of analyzed in the institution 'lead-zinc' in Trepça.

Table 3. Present the quantity of Pb and Cu in inter-products during the first decoppering stage of technical lead during poor filtering and fine filtering of schlicker oxide.

Quantity of Pb and Cu in inter-products of the first stage of decoppering.	Quantity (t)	Lead		Copper	
		%	T	%	t
The first stage of decoppering of technical lead during poor filtering.	226.8	98.3	222.94	0.050	0.113
The first stage of decoppering of technical lead during fine filtering.	228.7	98.3	224.812	0.074	0.16924
Schlicker oxide during poor filtering	21.0	70.0	14.7	8.5	1.785
Schlicker oxide during fine filtering	19.1	69.8	13.33	9.45	1.805
Total during poor filtering	-	-	237.64	-	1.898
Total during fine filtering	-	-	238.14	-	1.974
Difference during poor filtering	-	-	0.52	-	0.084
Difference during fine filtering	-	-	0.0162	-	0.0078
The degree of usage during poor filtering	-	99.78	237.64	95.76	1.898
The degree of usage during fine filtering	-	99.99	238.14	99.5	1.974

Table 4. Presents the chemical composition of Pb and Cu in technical lead and sulphur schlicker.

Samples	% Pb	% Cu
Metal, technical Pb during the poor detachment of rings formed of copper, sample I	98.5	0.013
Metal, technical Pb during the fine detachment of rings formed of copper, sample II	98.5	0.015
Sulphur schlicker after the first phase of poor detachment of rings formed of copper, sample I	79	3.10
Sulphur schlicker after the first stage of fine detachment of rings formed of copper, sample II	81	5

Table 5. Presents the quantity of the metal after the fine decoppering when fine and poor detachment of copper rings from the walls of the caldron for refining.

The quantity of Pb and Cu in inter-products after fine decoppering for samples I and II.	Quantity (t)	Lead		Copper	
		%	t	%	t
Pb and Cu after the first phase of fine decoppering, sample I.	224.3	98.5	220.935	0.013	0.0291
Pb and Cu after the first phase of fine decoppering, sample II.	226	98.5	222.61	0.015	0.0339
The first part of sulphur schlicker, sample I.	2.5	79	1.975	3.1	0.0775
The first part of sulphur schlicker, sample II.	2.7	81	2.187	5	0.135
Total of sample I	-	-	222.91	-	0.1066
Total of sample II	-	-	224.797	-	0.1689
The difference of sample I	-	-	0.034	-	0.0068
The difference of sample II	-	-	0.015	-	0.00034
The degree of usage, sample I	-	99.98	222.91	94.00	0.1066
The degree of usage, sample II	-	99.99	224.797	99.8	0.1689

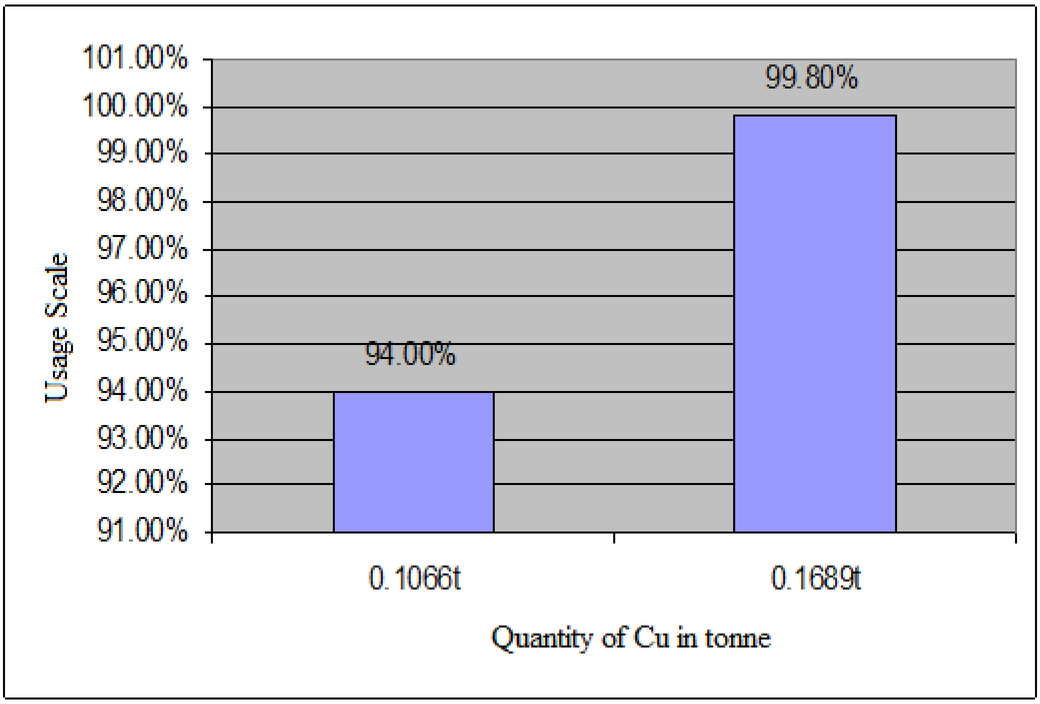

Figure 1. Presents the degree of usage of copper during the decoppering of the first phase of fine decoppering of technical lead for samples 1 and 2.

In order to increase the scale of decoppering of technical lead we continue with the process of decoppering with these parameters of the process.

- The temperature of technical lead during the loading of the second dosage of sulphur is 336 ^{o}C,
- The quantity of the sulphur dosage is 70 kg,
- The mixing time is 36 minutes,
- The time of removal of the second part of the sulphur schlicker is 20 minutes
- The quantity of sulphur schlicker is 1.2 t, sample I experimental value,

- The quantity of sulphur schlicker is 1.4 t, sample II experimental value.

The quantity of the technical lead melted in the caldron after the continuous decoppering process is calculated with the expression.

$$G^{fine\ decoppering}_{Pb\ technical} = G^{decoppering}_{Pb\ technical} - G_{schlicker\ sulphur}\ (t)$$

- The quantity of technical lead in the caldron after the removal of schlicker part is 223.1 t, sample I.
- The quantity of technical lead in the caldron after the removal of schlicker part is 224.6 t, sample II.
- The content of copper in lead after the removal of the second part of schlicker sulphur is 0.002% Cu.

Table 5 Presents the quantity of Cu and technical Pb during the process of decoppering.

Sample	Quantity of technical Pb (t)	Quantity of Cu (t)	% Cu
Technical Pb	247.8	1.982	0.8
Technical Pb decoppered, sample I	226.8	0.113	0.05
Technical Pb decoppered, sample II	228.7	0.169	0.074
Technical Pb of fine decoppering sample I	224.3	0.0291	0.013
Technical Pb of fine decoppering sample II	226.0	0.0339	0.015
Technical Pb of continuous decoppering sample I	223.1	0.00446	0.002
Technical Pb of continuous decoppering sample II	224.6	0.00449	0.002

Table 6. Presents the chemical composition of technical lead and sulphur schlicker of continuous decoppering when poor and fine detachment of the copper rings from the walls of the caldron for refining of sample I and II.

Samples I , II	**% Pb**	**%Cu**
Metal, technical Pb, sample I	98.6	0.002
Metal, technical Pb, sample II	98.6	0.002
Sulphur schlicker of the second phase, sample I	70	2.0
Sulphur schlicker of the second phase, sample II	82	2.1

Table 7. Presents the quantity of metal of continuous decoppering when poor and fine detachment of the copper rings from the walls of the caldron for refining of sample I and II.

The quantity of Pb and Cu in inter-products of continuous for samples I and II	**Quantity (t)**	**Lead**		**Copper**	
		%	**t**	**%**	**T**
Pb and Cu after the second phase of continuous, sample I	223.1	98.6	219.97	0.002	0.00446
Pb and Cu after the second phase of continuous, sample II	224.6	98.6	221.4556	0.002	0.004492
The second part of sulphur schlicker, sample I	1.2	70	0.84	2.00	0.024
The second part of sulphur schlicker, sample II	1.4	82	1.148	2.06	0.02884
Total of sample I	-	-	220.81	-	0.0284
Total of sample II	-	-	222.6	-	0.033332
Scale of usage, sample I	-	99.94	220.81	97.8	0.0284
Scale of usage, sample II	-	99.99	222.6	98.32	0.033332

During the decoppering process of technical lead the biggest part is removed with schlicker osixde, the remaining part of copper is removed with the decoppering process, fine and continuous of technical lead with sulphur in Trepça refinery. The technical lead produced from the Port-Piri furnaces contains 0.8 % Cu value which is removed with the continuous decoppering process of technical Pb and like that is treated in the paper to increase the scale of usage of Cu and sublimation of technical Pb.

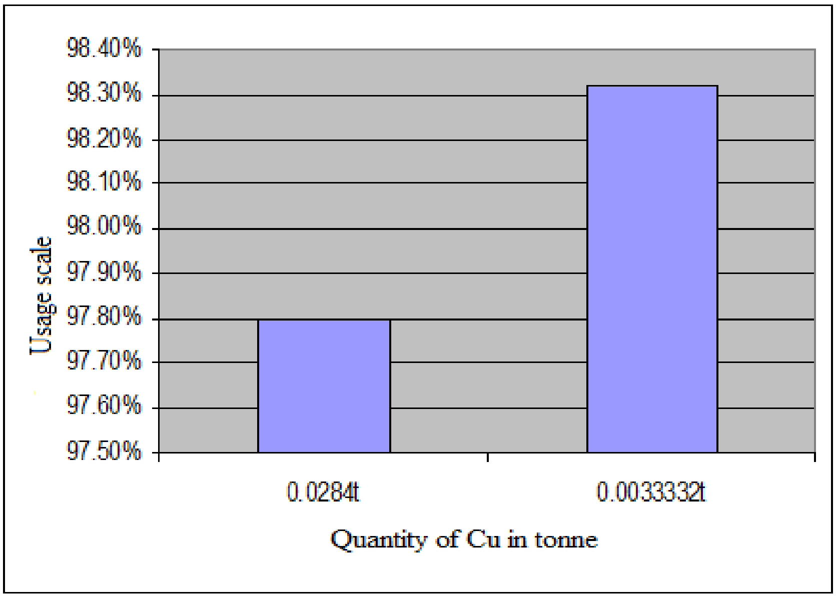

Figure 2. Present the scale of copper usage during the continuous decoppering of technical lead, for sample 1 and 2

Conclusion

Based on the production industry, calculation and experimental results of the paper for the decoppering of technical lead we can conclude that in order to produce high quality lead we should analyze in detail the chemical composition of technical lead and the decoppering process. The paper successfully analyzed the chemical composition of copper in technical lead in the continuous process of decoppering. By removing the oxide schlicker and sulphuric in effective melting of technical lead in the caldrons of the refinery in Trepça and we recommend as below:

The parameters of the process of copper removal from technical Pb are the same for the whole decoppered mass with some different specifics of sulphur dosage like a reagent and detachments of copper rings formed in the walls of caldron for sample I and II. The most part of copper is removed with oxide schlicker and the percentage of copper in technical lead decoppered is 0.05% Cu for sample I and for sample II is 0.074% Cu.

In order to increase the scale of copper usage and sublimation of technical we continue with the fine decoppering process in the caldron and like a reagent is used elementary sulphur which creates sulphur schlicker and like that is removed from the mass (technical Pb) and the percentage of Cu in technical Pb is left as below: Sample I contains 0.013% Cu., Sample II contains 0.015% Cu
In order to maximally increase the scale of copper usage and sublimation of technical we continue the decoppering process in the caldron and like a reagent we use another dosage of elementary sulphur which creates sulphur schlicker and like that is removed from the mass (technical Pb) and percentage of Cu in technical Pb is left as below: Sample I contains 0.002%Cu. Sample II contains 0.002%Cu

The paper argued the human factor in the continuous decoppering process of technical Pb to increase the usage scale of Cu and sublimation of technical Pb and positively reflected in quality and economic sustainability of the decoppering process of technical lead produced in Port-Piri furnaces.

References

1.Fatmir Agolli, “Metalurgjia e metaleve me ngjyrë”, Prishtinë, 1985.
2.Kumbara H., “Metalurgjia e metaleve me ngjyra”, Pjesa e parë Tiranë, 1979.
3.V. Gjokç, “Savremini procesi u metalurgiju bakra,olova i cinka”, Titova, Mitrovica, 1982.
4.Smirinov P.M., “Rafinirovanje sfinca i perera botka polu produktov”, ”Metalurgija”, Moskva, 1975.
5.Recykling of metallferous materials,birmingen,conferen-ce organized by institution of mining and metalurgy,april 1990.
6.Vraçar R,Nikoliç B., Ekstraktivna metalurgija olova nauçna kniga, Beograd, 1995.