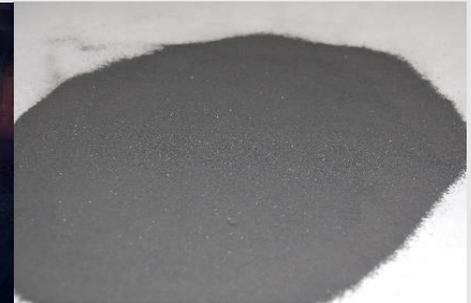


Removal of arsenic from arsenic-bearing copper concentrates by alkaline sulfide leaching

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Copper Expert Committee- September, 30th 2021

- 1) Introduction
- 2) Experimental setup and analyses
- 3) Results
- 4) Conclusions and Summary

1.) Introduction



Increasing demand / prices for Cu:
24 Mio. t Cu / a (2019)
refined copper



Challenges of producing concentrates



As as impurity in Cu-minerals



Best practice-partial roasting
0.3 wt.-% As in calcine



Test: Alkaline sulfide leaching

2. Experimental setup and analyses

Methods

Alkaline
sulfide
leaching

Materials

Sulfidic
concentrates
A and B

Sample preparation

A and B
sieving and
crushing

Chemical analyses

AAS after
aqua regia
digestion
C/S for S
XRF

Mineral analysis and particle size properties

PXRD
and laser
light
diffraction

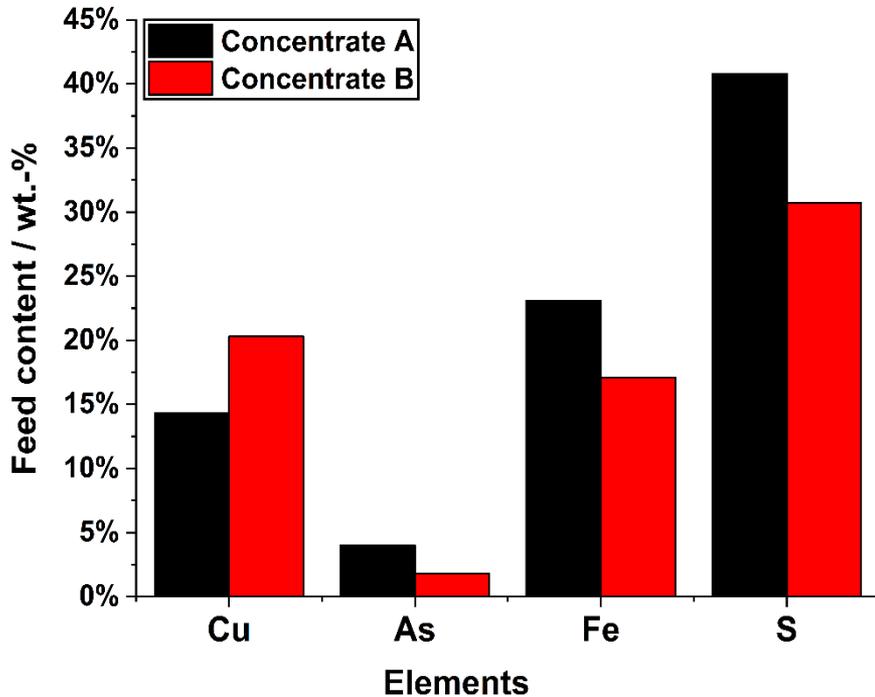
2. Experimental setup and analyses



- Four parameters under investigation:
 - S/L-ratio: 1:2 / 1:5 / 1:10
 - Time t: 4 h and 3 samples: 1 h / 2 h / 4 h
 - Temperature T: 60 °C / 70 °C / 80 °C
 - NaHS concentration: 0 M (pure 2.5 M NaOH) / 1 M / 2 M

Experimental setup

3. Results



Minerals containing following elements:

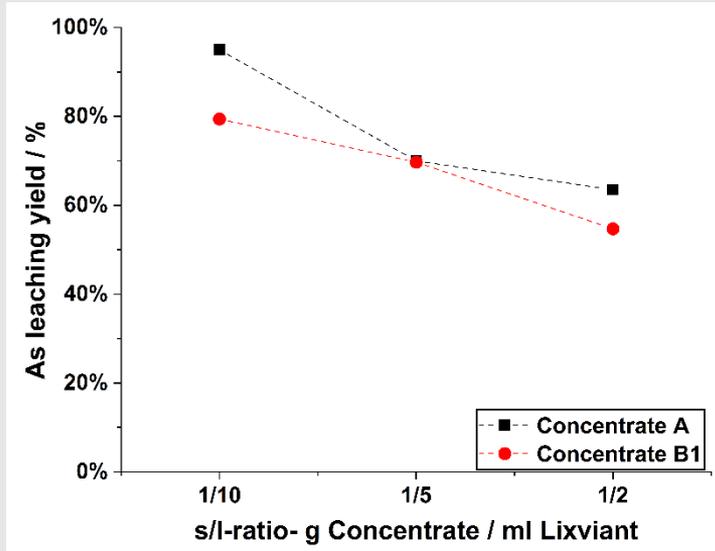
Cu: Enargite, Tennantite, Chalcopyrite

As: Enargite, Tennantite

Fe: Pyrite, Chalcopyrite

	Concentrates	
	A	B
$d_{80} / \mu\text{m}$ (dry)	91.9	92.9
Cu / wt.-%	14.3	20.3
As / wt.-%	4.0	1.8

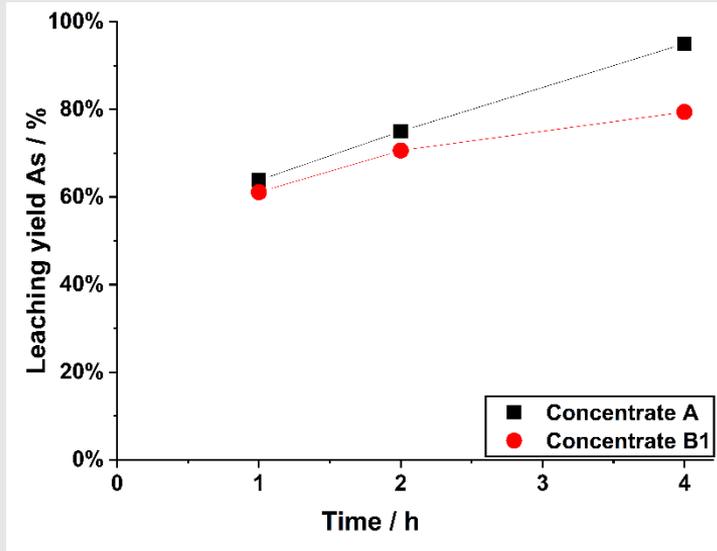
Effect of s/l-ratio



- Yield decrease by s/l-ratio
- Best result with s/l-ratio 1/10
95 % for A
80 % for B1

As Leaching yield vs. s/l-ratio at 80 °C
and 2.5 M NaOH / 2.0 M NaHS

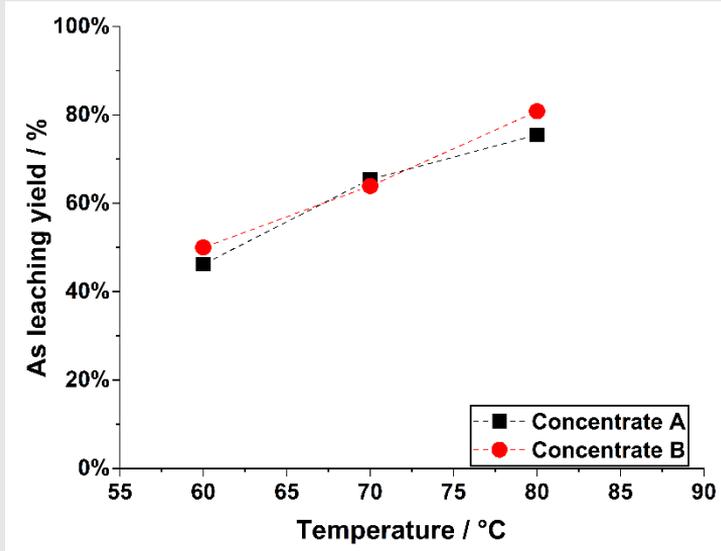
Effect of time



- Positive effect of time on As leaching yield
- Probably better crystalline leachability of Enargite than Tennantite

As Leaching yield vs. time at 80 °C,
s/l-ratio 1:10 and 2.5 M NaOH / 2.0 M NaHS

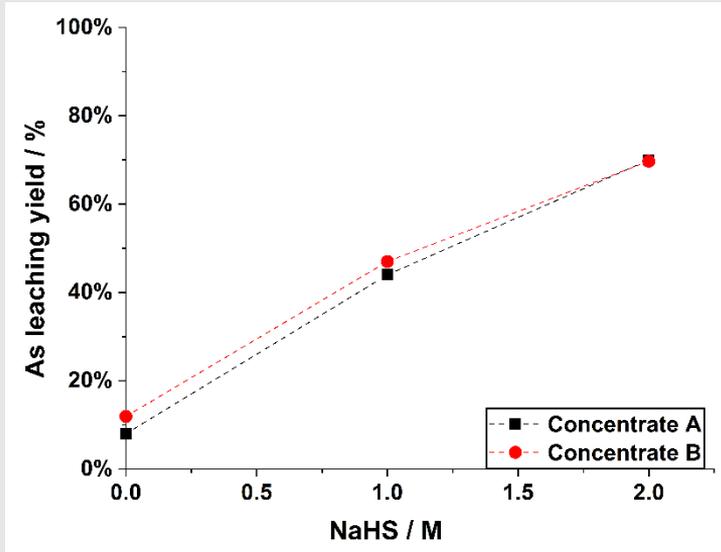
Effect of temperature



- Strong positive effect of temperature on concentrates
- 80 °C effective for As leaching

As leaching yield vs. temperature at 2.5 M NaOH / 2.0 M NaHS and S/L-ratio 1:5

Effect of NaHS



- Positive effect of NaHS on As leaching yield
- Probably due to enhanced formation of As-S-complex
→ Thioarsenate

As leaching yield vs. NaHS concentration at 80 °C
2.5 M NaOH and S/L-ratio 1:5

4. Conclusions and Summary

- Main minerals of concentrates A and B:
- Pyrite, Enargite, Tennantite, Chalcopyrite

Best As leaching yields (based on leaching solution):

Time: 4 h

S/L-ratio: 1:10

Temperature: 80 °C

[NaHS]: 2 M → **95 % for A / 80 % for B**

Alkaline sulfide leaching suitable for concentrates

- (low and medium S-content, independent Ca-content)

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- INTERNATIONAL COPPER STUDY GROUP (2020): The World Copper Factbook: 59
- SCHLESINGER, M.E., M.J., SOLE, K. C. AND DAVENPORT, W. G. (2011): Extractive Metallurgy of Copper, 5th Edition - Elsevier N
- WILKOMIRKSY, I., PARRA, R., PARADA, F., BALLADARES, E. (2013). Physico-Chemistry and Kinetics of Partial Roasting of High-arsenic Copper Concentrates - Proceedings of the 8th International Copper Conference (Copper 2013), Santiago, Chile
- TONGAMP, W., TAKASAKI, Y., SHIBAYAMA, A. (2009): Arsenic Removal from Copper Ores and Concentrates through Alkaline Leaching in NaHS Media - Hydrometallurgy, 98: 213-218N
- AWE, S, A., SANDSTRÖM, A. (2010): Selective Leaching of Arsenic and Antimony from a Tetrahedrite Rich Complex Sulphide Concentrate using alkaline sulphide solution, Minerals Engineering, 23: 1227-1236
- GUENTNER, J., WROBEL, M., CHARITOS ,A. HAMMERSCHMIDT, J. (2016): Treatment of As-containing Flue Dust from Copper Flash Smelter - Proceedings of the 9th International Copper Conference (Copper 2016) 605-615, Kobe, Japan
- DUCKWORTH, D. (2016): HIGH-ARSENIC COPPER CONCENTRATES - INTERNATIONAL MINING, [HTTPS://IM-MINING.COM/2016/02/23/HIGH-ARSENIC-COPPER-CONCENTRATES/](https://im-mining.com/2016/02/23/high-arsenic-copper-concentrates/), LAST ACCESS: 27 DECEMBER 2021
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