



ELSEVIER

Contents lists available at ScienceDirect

Ultrasonics - Sonochemistry

journal homepage: www.elsevier.com/locate/ultson

Efficient cleaning extraction of silver from spent symbiosis lead-zinc mine assisted by ultrasound in sodium thiosulfate system

Haoyu Li^{a,b,c,d}, Shiwei Li^{a,b,c,d,*}, C. Srinivasakannan^e, Libo Zhang^{a,b,c,d}, Shaohua Yin^{a,b,c,d},
Kun Yang^{a,b,c,d}, Huimin Xie^{a,b,c,d}

^a State Key Laboratory of Complex Nonferrous Metal Resources Clean Utilization, Kunming University of Science and Technology, Kunming, Yunnan 650093, China

^b Faculty of Metallurgical and Energy Engineering, Kunming University of Science and Technology, Kunming, Yunnan 650093, China

^c Key Laboratory of Unconventional Metallurgy, Ministry of Education, Kunming, Yunnan 650093, China

^d National Local Joint Laboratory of Engineering Application of Microwave Energy and Equipment Technology, Kunming, Yunnan 650093, China

^e Chemical Engineering Department, Khalifa University of Science and Technology, The Petroleum Institute, Abu Dhabi, United Arab Emirates

ARTICLE INFO

Keywords:

Silver
Ultrasound-assisted
Leaching
Dynamic model

ABSTRACT

The process to fast recovery of silver from the spent symbiosis lead-zinc mine enhanced by ultrasound has been developed. A system composed of thiosulfate and the spent symbiosis lead-zinc mine under ultrasound radiation is researched and compared with regular methods to prove the superiority of ultrasound enhanced leaching. Oxygen is not provided by the usual way but by the cavitation of ultrasound, and the effect of ultrasonic enhanced leaching is more obvious than oxygen enhanced leaching effect. We are more authoritative by combining some valuable literature after conducting systematic experiments. The process mechanism was analyzed by fire assaying, XRD, XRF, SEM and EDS. The optimal conditions were found out through single factor experiments: stirring rate of 300 rpm, thiosulfate concentration of 75 g/L, leaching temperature of 303 K, PH of 5, leaching time of 2 h and the ultrasound power of 100 W. And the leaching rate is 77.34% under the best conditions. When the ultrasonic experiment has the same parameters as the normal, the leaching rate at five minutes under ultrasonic conditions was 73.88%, while the leaching rate was only 72.51% at two hours under normal conditions. The apparent activation energy under conventional and ultrasonic conditions is 12.47 kJ/mol and 12.35 kJ/mol, respectively, and it is proved that both are controlled by diffusion.

1. Introduction

Metallic silver, as one of the widely used metals, has a pivotal position in industrial production. The significant properties of silver such as high melting point, strong acid resistance, good electrical conductivity and good ductility resistance have made it widely useful in aerospace, electrical, electronic and various other industries [1]. With increasing demand in limited resources, various ways of silver recycling and the choice of raw materials have received considerable attention.

Silver can be found in several resources, the most common ones are minerals, soot, spent catalysts, printed circuit boards and fibers [2–4]. Soot, especially the lead-zinc minerals after roasting, is largely extracted to enrich the precious metals in the minerals. So we choose soot as the raw material of the experiment to highlight the role of ultrasound. Although there are many processes reported to leach silver efficiently, the most efficient way was reported to be cyanide leaching.

However, due to the stringent environmental regulations use of cyanide is being slowly phased out of practice [5,6]. In the recent years, the use of thiosulfate has been proposed as potential alternative to cyanide for the leaching of the precious metals [7–9]. The thiosulfate medium has been extensively considered as an efficient and economic system which has the ability to produce strong complexes with silver.

The interest of scientific community in thiosulfate as leaching agent of precious metals has increased due to sodium thiosulfate not having any pollution to the environment. Previous studies showed various sulfide mines can be dissolved to vary degrees in thiosulfate-ammonia media, especially. And the structure of the ore wrapped silver is wreck, the complexation of silver and thiosulfate is carried out sufficiently [10,11]. Senanayake et al., [12] reported that silver leaching is faster than gold under the same non-cyanide lixiviant system, such that the silver in the ore of thiosulfate-ammonia-Cu system is completely leachable. In the ammonia system, silver will be easily separated and

* Corresponding author at: State Key Laboratory of Complex Nonferrous Metal Resources Clean Utilization, Kunming University of Science and Technology, Kunming, Yunnan 650093, China.

E-mail addresses: lswei11@163.com, lishiweikmust@163.com (S. Li).

<https://doi.org/10.1016/j.ultsonch.2018.07.034>

Received 25 March 2018; Received in revised form 14 July 2018; Accepted 25 July 2018

1350-4177/© 2018 Elsevier B.V. All rights reserved.

Table 1
Elemental composition of raw material (mass fraction, %).

Ag (g/t)	Zn	S	Pb	Fe	Ca
185	31	8	7	6	0.8

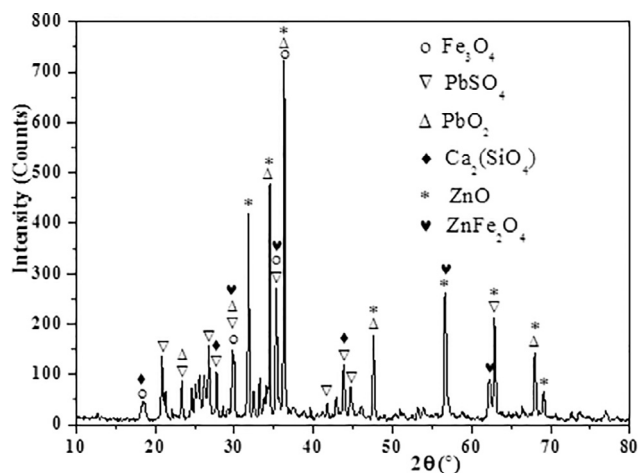
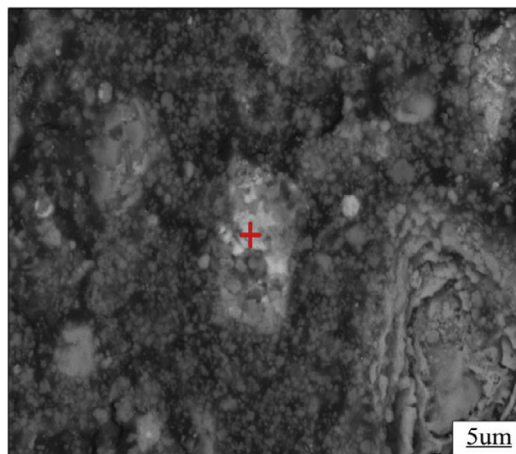


Fig. 1. XRD pattern of roasted soot.

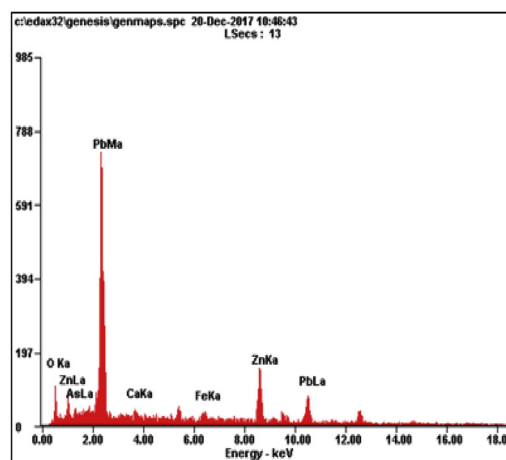
ammonia will be generated, simultaneously. As the ammonia effect on human health is well known, alternative process know-how to replace ammonia is imperative [13]. Pollet et al., Rivera et al., [14,15] have reported a new method to leach silver in the O_2 -thiosulfate system, as a possible way to leach silver in the absence of ammonia. Although it is an alternative method, its effectiveness in comparison with the ammonia system is not ensured.

Ultrasound can produce mechanical and chemical effects on the reaction medium by sound cavitation, and accelerating or initiating chemical reactions [16,17]. Therefore, ultrasonic enhanced leaching has gradually become a matured technique. Recently, ultrasonic enhanced leaching of various metals in the field of ultrasound is increasingly getting popular. Li et al., [18] have reported enhanced leaching of nickel sulfate directly with oxidants of sulfuric acid and hydrogen peroxide augmented by ultrasound. Zhang et al., [19] have introduced the ultrasonic assisted methods to leach germanium from roasted slag to improve the leaching rate. Fu et al., [20] have developed the synergistic extraction method for gold enhanced by ultrasound. Salim et al., [21] have reported leaching silver from solid waste augmenting with ultrasound in thiourea system. After the literature was completely screened, it has to be remarked that reports on the ultrasound augmented leaching of silver from the abandoned soot has not been reported in open literature.

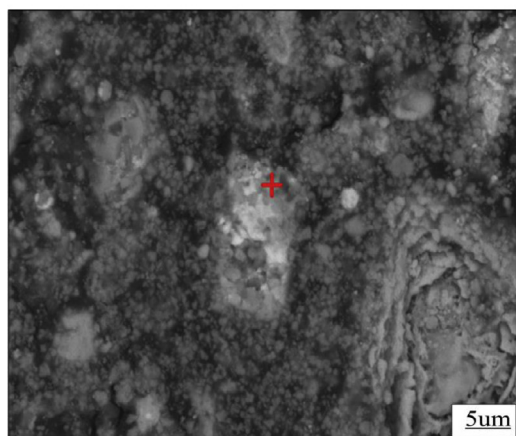
In this research the ultrasound reaction mechanism was first investigated to leaching of silver with the process parameters such as sodium thiosulfate concentration, leaching temperature, pH and



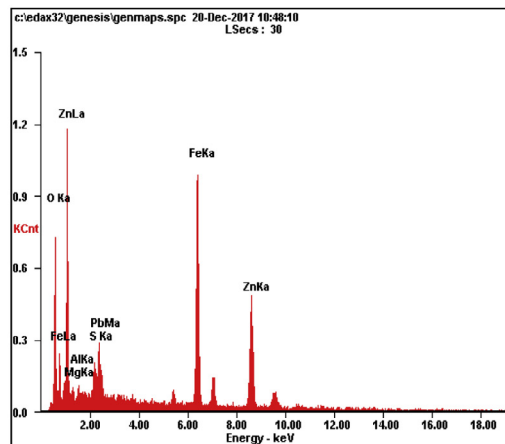
(a)



(b)



(c)



(d)

Fig. 2. SEM-EDS images of roasted soot.

Download English Version:

<https://daneshyari.com/en/article/8961225>

Download Persian Version:

<https://daneshyari.com/article/8961225>

[Daneshyari.com](https://daneshyari.com)