US011584974B2

(12) **United States Patent**
Morgan et al.

(10) **Patent No.: US 11,584,974 B2**
(45) **Date of Patent: *Feb. 21, 2023**

(54) **SYSTEM AND METHOD INCLUDING MULTI-CIRCUIT SOLUTION EXTRACTION FOR RECOVERY OF METAL VALUES FROM METAL-BEARING MATERIALS**

(71) Applicant: **FREEPORT MINERALS CORPORATION**, Phoenix, AZ (US)

(72) Inventors: **Jason M Morgan**, Morenci, AZ (US); **Barbara J Savage**, Silver City, NM (US); **David G Meadows**, Phoenix, AZ (US); **Wayne W Hazen**, Lakewood, CO (US)

(73) Assignee: **FREEPORT MINERALS CORPORATION**, Phoenix, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 52 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/366,653**

(22) Filed: **Jul. 2, 2021**

(65) **Prior Publication Data**

US 2021/0332458 A1 Oct. 28, 2021

Related U.S. Application Data

(60) Continuation of application No. 16/671,323, filed on Nov. 1, 2019, now Pat. No. 11,053,566, which is a (Continued)

(51) **Int. Cl.**
C22B 3/02 (2006.01)
B01D 11/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***C22B 3/02*** (2013.01); ***B01D 11/028*** (2013.01); ***B01D 11/0488*** (2013.01); ***C22B 3/20*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC C22B 3/02; C22B 3/26; C22B 3/20; C22B 3/44; B01D 11/0288; B01D 11/0488; C25C 7/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,614,669 A 1/1927 Greenawalt
1,798,255 A 3/1931 Greenawalt
(Continued)

FOREIGN PATENT DOCUMENTS

EP 1063307 12/2000
JP 2001239139 9/2001
(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion from corresponding International Application No. PCT/US2008/075037 dated Dec. 10, 2008.
(Continued)

Primary Examiner — Scott R Kastler
(74) *Attorney, Agent, or Firm* — Snell & Wilmer L.L.P.

(57) **ABSTRACT**

The present disclosure relates to a metal recovery process comprising a solvent extraction process. In an exemplary embodiment, the solution extraction system comprises a plant with a first and second circuit. A high-grade pregnant leach solution ("HGPLS") is provided to the first and second circuit, and a low-grade pregnant leach solution ("LGPLS") is provided to the second circuit. The first circuit produces a rich electrolyte, which can be forwarded to a primary metal recovery, and a low-grade raffinate, which can be forwarded to a secondary metal recovery process. The second circuit produces a rich electrolyte, which can also be forwarded to the primary metal recovery process. The first and second circuits are in fluid communication with each other.

17 Claims, 5 Drawing Sheets