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Sandoval et al.

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(54) **ACID MIST SUPPRESSION IN COPPER ELECTROWINNING**

(58) **Field of Classification Search**

CPC C25C 1/12; C25C 7/06
See application file for complete search history.

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(56) **References Cited**

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U.S. PATENT DOCUMENTS

1,678,776 A 7/1928 Gravell et al.
4,484,990 A 11/1984 Bultman et al.
(Continued)

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FOREIGN PATENT DOCUMENTS
EP 0488862 6/1992
RU 2133301 C1 7/1999
(Continued)

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OTHER PUBLICATIONS

(21) Appl. No.: **18/492,514**

Tmakova, Lenka et al: "Plant-derived Surfactants as an Alternative to Synthetic Surfactants: Surface and Antioxidant Activities"; Chemical Papers, Accepted Aug. 2, 2015; DOI: 10.1515/chempap-2015-0200.

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Related U.S. Application Data

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(57) **ABSTRACT**

A method of acid mist suppression in copper electrowinning is described. In various embodiments, at least one liquid licorice root extract, powdered licorice root extract, or reconstituted licorice extract is added in an amount sufficient to the acidic electrolyte solution of the copper electrowinning process to suppress acid mist from the acidic electrolyte solution during the copper electrowinning process. In various embodiments, combinations of licorice extract and surfactant show synergies in acid mist suppression during copper electrowinning.

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21 Claims, 3 Drawing Sheets

