廢IC中貴金屬資源回收之研究

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摘 要

國內每年可產生為數可觀的廢IC，這些廢棄IC中含有各種有價金屬（例如金、銀、銅），如任其棄置實屬可惜，且這些金屬若未妥善處置亦會造成嚴重環境污染，因此本研究針對報廢數量龐大之樹脂封裝廢IC，利用焙燒、研磨、篩分、浸漬、置換、溶媒萃取、電解等方法，來回收廢IC中之金、銀、銅等有價金屬，並研擬出廢IC有價金屬回收再生之技術與流程。根據本研究之成果顯示，以高溫焙燒及研磨篩分方式，可將樹脂封裝材料予以灰化並粉碎，使廢IC中金屬與樹脂灰份單離。焙燒、研磨後之廢IC樣品經篩分後，大於50目者因明顯為大塊金屬，可以直接出售，小於50目者主要成份為樹脂灰份，但因其中尚含有價金屬，具有回收之價值，故本研究探討以硫酸、氨水、王水及硫月尿 浸漬這些篩下物中金、銀、銅之效率，本研究成果顯示以硫月尿 浸漬效果最好，其最佳浸漬操作條件為：硫月尿 14 G，硫酸濃度3.6 N，硫酸鐵2.6 G，在室溫下浸漬7小時。另本研究以溶媒萃取法、置換法及電解法探討回收浸漬液中有價金屬之可行性，由實驗結果得知在室溫下以0.5 G銅粉置換1小時，可得到最佳金、銀之回收率。 另本研究根據硫月尿 浸漬實驗數據，利用統計軟體以非線性迴歸方式推估金之浸漬回收率（R）與硫月尿 濃度（U）、硫酸濃度（S）、硫酸鐵添加量（F）、時間（T）以及溫度（T）之間的關係式，所得之推估公式為：R=0.174 × U0.356 × S0.196 × F0.078 × T0.077 × T0.01

關鍵詞 : IC、回收、金、銀、銅、濕式冶煉法

目錄

參考文獻

1.賴耿陽譯，"IC厚膜化技術"，復漢出版社，73年10月。 2.杜錦坤、蔡尚林，"自廢IC回收金屬技術"，工研院能資所，87年6月。 3.成大上課講義教材。 4.李文鐘，"選礦學"，世界書局印行，63年10月。 5.賴耿陽編著，"金銀白金理論實務"，復漢出版社，87年2月。 6.簡正雄、蔡尚林，"貴金屬回收技術"，工研院能資所。 7.H. E. HILLIARD, B. W. DUNNING, JR., AND H. V. MARKAR,"HYDROMETALLURGICAL TREATMENT OF ELECTRONIC SCRAP CONCENTRATES CONTAINING PRECIOUS METAL", REPORT OF INVESTIGATION. 8.賴耿陽編著，"非鐵金屬材料"，復漢出版社，87年6月。 9.樂頌光、魯君樂編著，"再生有色金屬生產"，中南工業大學出版社，1997，PP. 35-130。 10.王英傑，"廢IC板有價物之分離與回收研究(II)-硫月尿 浸漬法回收廢IC板中金銀之研究"，國立成 功大學資源工程研究所碩士論文，81年6月。 11.M. F. ALMEIDA, M. A. AMARANTE,"LEACHING OF A SILVER BEARING SULPHIDE BY-PRODUCT WITH CYANIDE, THIOUREA AND CHLORIDE SOLUTIONS", MINERALS ENGINEERING, VOL. 8, NO. 3, PP. 257 -271, 1995. 12.賴耿陽編著，"貴金屬元素化學與應用"，復漢出版社，79年11月。 13.C. K. GUPTA, T. K. MUKHERJEE,"HYDROMETALLURGY IN EXTRACTION PROCESSES", CRC PRESS, PP. 74-229, 1990. 14.工業技術研究院礦業研究所，"金瓜石金銀礦浸漬應用研究第一期－金銀硫月尿浸漬之初步研究"，民國66年8月。 15.J. BRRENT HISKEY,"THIOUREA AS A LIXIVIANT FOR GOLD AND SILVER", INTERFACING TECHNOLOGI -ES IN SOLUTION MINING, SOCIETY OF MINING ENGINEERS OF A. I. M. E., PP. 83-91, 1981. 11. 16.R. A. PYPER, J. L. HENDRIX,"EXTRACTION OF GOLD FROM A CARLIN-TYPE ORE USING THIOUREA", INTERFACING TECHNOLOGIES IN SOLUTION MINING, SOCIETY OF MINING ENGINEERS OF A. I. M. E. , PP. 93-108, 1981. 11. 17.T. GROENEWALD,"THE DISSOLUTION OF GOLD IN ACIDIC SOLUTIONS OF THIOUREA", HYDROMETALLURG -Y, VOL. 1, PP. 277-290, 1976. 18.S. ARDIWILAGA,"EFFECTS OF CYSTEINE AND OXYGEN ON RECOVERY

OF CEMENTED GOLD FROM LEACH LIQUORS IN A THIOUREA SYSTEM", MINERALS ENGINEERING, VOL. 12, NO. 6, PP. 645-653, 1999. 19.PIERRE LACOSTE-BOUCHET, GUY DESCHENES, EDWARD GHWARED,"THIOUREA LEACHING OF A COPPER- GOLD ORE USING STATISTICAL DESIGN", HYDROMETALLURGY, VOL. 47, PP. 189-203, 1998. 20.GEORGE OWUSU,"SELECTIVE EXTRACTION OF COPPER FROM ACIDIC ZINC SULFATE LEACH SOLUTION US -ING LIX 622", HYDROMETALLUGY, VOL. 51, PP. 1-8, 1999. 21.GARY A. KORDOSKY,"RECOVERY OF COPPER FROM OXIDE ORES, TODAY'S PRACTICE", PROCESS AND FUNDAMENTAL CONSIDERATIONS OF SELECTED HYDROMETALLURGICAL SYSTEMS, PP. 3-15, 1981. 11. 22.J. D. MILLER, H. H. HAUNG AND E. F. PEREIRA,"EQUILIBRIUM AND KINETICS OF COPPER FROM AM -MONIACAL SOLUTIONS BY HYDROXOXIMES WITH PARTICULAR EMPHASIS ON TRANSPORT PHENOMENA", PROCESS AND FUNDAMENTAL CONSIDERATIONS OF SELECTED HYDROMETALLURGICAL SYSTEMS, PP. 211 -241, 1981. 11. 23.F. J. ALGUACIL,"RECOVERY OF COPPER FROM AMMONIACAL/AMMONIUM CARBONATE MEDIUM BY LIX 97 3N", HYDROMETALLURGY, VOL. 52, PP. 55-61, 1999. 24.SUNG-GYU KIM, HWA-YOUNG LEE, JONG-KEE OH,"STOICHIOMETRIC RELATION FOR THE EXTRACTION OF THE GOLD-THIOUREA COMPLEX WITH D2EHPA", HYDROMETALLURGY, VOL. 38, PP. 7-13, 1995. 25.HWA YOUNG LEE, SUNG GYU KIM AND JONG KEE OH,"CEMENTATION BEHAVIOR OF GOLD AND SOLVER ONTO ZN, AL, AND FE, POWDERS FROM ACID THIOUREA SOLUTIONS", CANADIAN METALLURGICAL QUAR -TERLY, VOL. 36, NO. 3, PP. 149-155, 1997. 26.P. FORNARI, C. ABBRUZZESE,"COPPER AND NICKEL SELECTIVE RECOVERY BY ELECTROWINNING FROM ELECTRONIC AND GALVANIC INDUSTRIAL SOLUTIONS", HYDROMETALLURGY, VOL. 52, PP. 209-222, 1999. 27.蔡尚林，"燃油飛灰性質及資源化研究"，國立成功大學博士論文，1998。 28.濱田善久，"尖端產業金屬類廢棄物的處理技術"，演講稿。 29.楊淵洲，"由廢料電解回收銅的研究"，國立成功大學礦冶及材料科學研究所碩士論文，1981。 30.ERNEST H. LYINS, JR., 吳政賢譯，"電化學入門"，黎明書店，1976。 31.GEORGE M. POTTER AND ROSHAN B. BJAPPU,"THE CHEMISTRY OF GOLD AND SILVER RECOVERY NATUR -AL RESOURES", PROCESS AND FUNDAMENTAL CONSIDERATIONS OF SELECTED HYDROMETALLURGICAL SYSTEMS, PP. 27-35, 1981. 11. 32.ROBIN J. HICKSON,"HEAP LEACHING PRACTICES AT ORTIZ GOLD MONE, SANTA FE COUNTY, NEW MEX -ICO", INTERFACING TECHNOLOGIES IN SOLUTION MINING, SOCIETY OF MINING ENGINEERS OF A. I. M. E., PP. 209-221, 1981. 11. 33.L. GUZMAN, M. SEGARRA, J. M. CHIMENOS, M. A. FENANDEZ, F. ESPIELL,"GOLD CYANIDATION US -ING HYDROGEN PEROXIDE", HYDROMENTALLURGY, VOL. 52, PP. 21-35, 1999. 34.E. PETERS, G. M. SWINKELS AND A. VIZSOLYI,"COPPER RECOVERY FROM SULFIDE CONCENTRATES BY THE U. B. C. -COMINCO FERRIC CHLOPIDE LEACH ROUTE", PROCESS AND FUNDAMENTAL CONSIDERAT -IONS OF SELECTED HYDROMETALLURGICAL SYSTEMS, PP. 71-81, 1981. 11. 35.CHING-HWA LEE,"RECOVERY OF GOLD AND SILVER FROM TOLOVANA ORE, FAIRBANKS, ALASKA"，M. S. THESIS, UNIVERSITY OF ALASKA , SEPEMBER 1985. 36.TADEUSZ STEANOWICZ, MALGORZATA OSINSKA, STEFANIA NAPIERALSKA-ZAGOZDA, "COPPER RECOVERY BY THE CEMENTATION METHOD", HYDROMETALLURGY, VOL. 47, PP. 69-90, 1997. 37.GEORGE KYUCHOUKOV, MARIUSZ B. BOGACKI, JAN SZYMANOWSKI,"COPPER EXTRACTION FROM AMMONIAC -AL SOLUTIONS WITH LIX 84 AND LIX 54", AMERICAN CHEMICAL SOCIETY, PP. 4084-4089, 1998. 9. 38.A. SANDHIBIGRAHA, P. V. R. BHASKARA SARMA,"CO-EXTRACTION AND SELECTIVE STRIPPING OF COP -PER AND NICKEL USING LIX 87QN", HYDROMETALURGY, VOL. 45, PP. 211-219, 1997. 39.S. MARTINEZ, A. M. SASTRE, F. J. ALGUACIL,"SOLVENT EXTRACTION(III) BY THE CHLORIDE SALT IF TERTIARY AMINE HOSTAREX A327. ESTIMATION OF THE INTERACTION COEFFIEIENT BETWEEN AUCL －AND H＋"，HYDROMETALLURGY, VO.L52. 63-70, 1999. 40.KATHRYN C. SOLE, J. BRENT HISKEY,"SLOVENT EXTRACTION OF COPPER BY CYANEX 272, CYANEX 30 2 AND CYANEX 301", HYDROMETALLURGY, VOL. 37, PP. 129-147, 1995. 41.BRIAN TAIT,"TWO-PHASE POTENTIOMETRIC METAL EXTRACTION TITRATIONS OF SILVER(I), COPPER(II) AND CADMIUM(II) USING SOME CATION-EXCHANGERS AS EXTRACTANTS", TALANTA, VOL. 42, NO. 1, PP. 137-142, 1995. 42.F. A. BACZEK, B. C. WOJCIK, D. M. LEWIS, R. C. EMMETT,"THE ELECTROSLURRY PROCESS FOR COPPER RECOVERY FROM SMELTER AND WASTES", PROCESS AND FUNDAMENTAL CONSIDERATIONS OF SEL -ECTED HYDROMETALLURGICAL SYSTEMS, PP. 125-141, 1981. 43.FRANCOIS CODERRE, DAVID G. DIXON,"MODELING THE CYANIDE HEAP LEACHING OF CUPRIFEROUS GOL -D ORES", HYDROMETALLURGY, VOL. 52, PP. 151-175, 1999. 44.JOHN D. PRATER, W. JOSEPH SCHLITT, KENNETH J. RICHARDS，"KENNECOTT PROCESS FOR TREATING SMELTER FLUE DUSTS", PROCESS AND FUNDAMENTAL CONSIDERATIONS OF SELECTED HYDROMETALLURG -ICAL SYSTEMS, PP. 143-1152, 1981. 45.F. J. ALGUACIL, A. COBO,"SEPARATION OF COPPER AND NICKEL FROM AMMONIACAL/AMMONIUM CARB -ONATE SOLUTIONS USING ACORGA PT5050", SEPARATION SCIENCE AND TECHNOLOGY, VOL. 33, NO. 14, PP. 2257-264, 1998. 46.楊能輝編著，"廢IC板有價物之分解與回收研究"，成功大學碩士論文。 47.陳文祥編著，"貴金屬實用技術"，科技圖書股份有限公司，80年7月。 48.陳克紹編著，"粉末冶金概論"，金華科技圖書股份有限公司，80年3月。 49.賴耿陽編著，"粉末冶金學概論"，復漢出版社，73年8月。 50.田中正三郎著，賴耿陽譯，"應用電化學"，復漢出版社，1994. 7。 51.郁仁貽譯，"實用理論電化學"，徐氏基金會，1984. 11。 52.田福助編，"電化學－基本原理與應用"，五洲出版社，1988. 10。