Title

Comparing the Performance of the Use of Recycled Vegetable Oil and Biosolids as Collectors of Copper Sulfide Flotation and Their Effect on the Foam Stability

Abstract

Flotation is the traditional process used for concentrating sulfide ores, based on the differences in hydrophobicity exhibited by the minerals which are enhanced by collectors. Xanthates are the collectors widely used in the flotation of minerals such as common sulfides (Cu, Mo, Pb, Zn, Co, Ni) and native metals. However, xanthates have negative impacts on biota and pose a risk to human and animal health. This study explores recycled vegetable oils (RVO) and biosolids (BSs) as alternative collectors in mineral flotation. Tests at pH 8, conducted with an Edemet Cell, compared their performance with traditional xanthate collectors and assessed their impact on foam stability. Collectors were tested at dosages ranging from 20 to 100 g/ton, with 15 ppm of MIBC frother, while fixed dosages of 60 g/ton were used for kinetic and foam volume analysis. The results revealed that RVO and BSs exhibited greater selectivity in separating chalcopyrite from pyrite compared to Potassium Amyl Xanthate (PAX). Interestingly, RVO reduced foam volume when used alongside MIBC frother, while BSs had minimal impact on foam volume. In ores rich in chalcopyrite, RVO and biosolids significantly improved flotation kinetics, outperforming PAX. Synthetic samples also showed BS1 to have kinetics similar to the conventional collector. These findings suggest that RVO and biosolids have the potential to replace traditional collectors in cleaner flotation processes, promoting more environmentally responsible mining practices. Graphical Abstract: (Figure presented.) © The Minerals, Metals & Materials Society 2024.

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Biosolids; Flotation kinetics; Froth flotation collectors; Metallurgical indexes; Recovery; Vegetable oil

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Copper compounds; Flotation; Health risks; Kinetics; Pyrites; Recycling; Sulfur compounds; Flotation collectors; Flotation kinetics; Foam stability; Froth flotation collector; Frothers; Impact on biotas; Metallurgical index; Performance; Potassium amyl xanthates; Sulphide ores; Vegetable oils

References

Bulatovic S.M., handbook of flotation reagents: chemistry, theory and practice: volume 1: flotation of sulfide ores, (2007); Amrollahi A., Massinaei M., Zeraatkar Moghaddam A., Removal of the residual xanthate from flotation plant tailings using bentonite modified by magnetic nano-particles, Miner Eng, 134, pp. 142-155, (2019); Chockalingam E., Subramanian S., Natarajan K.A., Studies on biodegradation of organic flotation collectors using Bacillus polymyxa, Hydrometallurgy, 71, pp. 249-256, (2003); Deo N., Natarajan K.A., Biological removal of some flotation collector reagents from aqueous solutions and mineral surfaces, Miner Eng, 11, 8, pp. 717-738, (1998); Brandao P.R.G., Caires L.G., Queiroz D.S.B., Vegetable lipid oil-based collectors in the flotation of apatite ores, Miner Eng, 7, 7, pp. 917-925, (1994); Greene M.G., Et al., Collectors for flotation of molybdenum-containing ores, Google Patents, 14 Jun, (2012); Owusu C., Quast K., Addai-Mensah J., The use of canola oil as an environmentally friendly flotation collector in sulphide mineral processing, Miner Eng, 98, pp. 127-136, (2016); Wang S., Xiao W., Ma X., Li J., Chen L., Yao H., Analysis of the application potential of coffee oil as an ilmenite flotation collector, Minerals, 9, 9, (2019); Williams C., Peng Y., Dunne R., Eucalyptus oils as green collectors in gold flotation, Miner Eng, 42, pp. 62-67, (2013); Young T.L., Greene M.G., Bauer K., Young S.K., Reber N.R., Flotation of sulfide mineral species with oils. Google Patents, 9 Dec, (2008); Dong J., Liu Q., Yu L., Subhonqulov S.H.,

Activation mechanism of copper ion in arsenopyrite flotation in high pH value, Miner Eng, 179, (2022); Arcos F., Uribe L., Evaluation of the use of recycled vegetable oil as a collector reagent in the flotation of copper sulfide minerals using seawater, Recycling, 6, 1, pp. 1-17, (2021); Cheng G., Zhang M., Cao Y., Lu Y., Feng Y., Zhao S., Preparation and evaluation of lignite flotation collector derived from waste hot-pot oil, Fuel, 267, (2020); Zhu X.-N., Et al., Cleaner approach to fine coal flotation by renewable collectors prepared by waste oil transesterification, J Clean Prod, 252, (2020); Cheng G., Zhang M., Zhang Y., Lin B., Zhan H., Zhang H., A novel renewable collector from waste fried oil and its application in coal combustion residuals decarbonization, Fuel, 323, (2022); Kim M., Park J., Kang H., Jeong D., Efficiency evaluation of the bottom ash flotation collector by removed saturated fatty acids from soybean oil, Physicochem Prob Miner Process, 58, 1, pp. 126-137, (2022); Nie C.-C., Zhu X.-N., Wang Q., Lyu X.-J., Qiu J., Li L., Gutter oil, an alternative collector to traditional diesel collector for cleaner flotation of fine coal, Energy Sources, Part A, 43, 8, pp. 1007-1018, (2021); Nie C.-C., Et al., Environmentally-friendly emulsion-like collector prepared from waste oil: application in floatation recovery of unburned carbon in coal fly ash, J Clean Prod, 379, (2022); Wang L.K., Shammas N.K., Hung Y.-T., Biosolids engineering and management, (2009); Metcalf L., Eddy H.P., Tchobanoglous G., Wastewater engineering: treatment, disposal, and reuse, (2002); Dignac M.-F., Urbain V., Rybacki D., Bruchet A., Snidaro D., Scribe P., Chemical description of extracellular polymers: Implication on activated sludge floc structure, Water Sci Technol, 38, 8, pp. 45-53, (1998); Murthy S.N., Novak J.T., Holbrook R.D., Surovik F., Mesophilic aeration of autothermal thermophilic aerobically digested biosolids to improve plant operations, Water Environ Res, 72, 4, pp. 476-483, (2000); Reyes-Bozo L., Herrera-Urbina R., Saez-Navarrete C., Otero A.F., Godoy-Faundez A., Ginocchio R., Rougher flotation of copper sulphide ore using biosolids and humic acids, Miner Eng, 24, 14, pp. 1603-1608, (2011); Reyes-Bozo L., Et al., Role of biosolids on hydrophobic

properties of sulfide ores, Int J Miner Process, 100, 3, pp. 124-129, (2011); Reyes-Bozo L., Et al., Use of humic substances in froth flotation processes, J Environ Manage, 252, (2019); Zhang J., Lu M., Ren F., Knothe G., Tu Q., A greener alternative titration method for measuring acid values of fats, oils, and grease, J Am Oil Chem Soc, 96, 10, pp. 1083-1091, (2019); Fereidooni L., Enayati M., Abbaspourrad A., Purification technology for renewable production of fuel from methanolysis of waste sunflower oil in the presence of high silica zeolite beta, Green Chem Lett Rev, 14, 1, pp. 2-14, (2021); KoohiKamali S., Tan C.P., Ling T.C., Optimization of sunflower oil transesterification process using sodium methoxide, Sci World J, 2012, (2012); Naik B.D., Meivelu U., Experimental studies on sodium methoxide supported bentonite catalyst for biodiesel preparation from waste sunflower oil, Environ Prog Sustain Energy, 39, 4, (2020); Lostarnau C., Et al., Stakeholder participation within the public environmental system in Chile: Major gaps between theory and practice, J Environ Manage, 92, 10, pp. 2470-2478, (2011); Prno J., An analysis of factors leading to the establishment of a social licence to operate in the mining industry, Resour Policy, 38, 4, pp. 577-590, (2013); Newbold J., Chile's environmental momentum: ISO 14001 and the large-scale mining industry—case studies from the state and private sector, J Clean Prod, 14, 3, pp. 248-261, (2006); Laurence D., Establishing a sustainable mining operation: an overview, J Clean Prod, 19, 2, pp. 278-284, (2011); Swart P., Dewulf J., Quantifying the impacts of primary metal resource use in life cycle assessment based on recent mining data, Resour Conserv Recycl, 73, pp. 180-187, (2013)

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