

ALKALINE HYDROMETALLURGICAL APPROACH FOR STEEL SLAG MANAGEMENT

Fernando PEREIRA ^(1, 2, 3), Olivier FAURE ^(1, 2, 3), Véronique LAVASTRE ^(2, 4, 5),
Didier GRAILLOT ^(1, 2, 3), Jean-Michel HERRI ^(1, 2, 3), Jean-Yves COTTIN ^(2, 4, 5)

- (1) Mines Saint-Étienne - Centre SPIN ("Sciences des Processus Industriels et Naturels") - Département PEG ("Procédés pour l'Environnement et les Géo-ressources") - 158, cours Fauriel - 42 023 Saint-Étienne Cedex 2 ;
- (2) "Groupement d'Intérêt Scientifique du redéploiement Post-Industriel Loire Territoires urbains" (GIS PILoT) - 23, Rue du Docteur Paul Michelon - 42 023 Saint-Étienne Cedex 2 ;
- (3) CNRS ("Centre National de la Recherche Scientifique") UMR ("Unité Mixte de Recherche") EVS ("Environnement, Ville et Société") 5600 - Bureau 612 - 18, rue Chevreul - 69 362 Lyon Cedex ;
- (4) Université Jean-Monnet de Saint-Étienne - Laboratoire Magmas et Volcans - 23, Rue du Docteur Paul Michelon - 42 023 Saint-Étienne Cedex 2 ;
- (5) CNRS UMR LMV ("Laboratoire Magmas et Volcans") - Campus Universitaire des Cézeaux - 6, avenue Blaise Pascal - 60 026 Aubière Cedex.

Steel slags are artificial mineral matrices produced by the steel and iron industry. While they are considered as industrial waste, these slag heaps represent an important potential economic resource. The importance of hydrometallurgy in production and recycling of strategic metals cannot be stressed enough. Nevertheless, their use is increasingly under economic pressure since 2014. Clearly, improving or even optimizing these processes is required. In addition, although steel slags are classified as non-hazardous thermal waste, it is well known that most metals they contain are quite toxic to living organisms and pose serious environmental issues. Thus, reusing steel slags appears the option of choice to ensure their sustainable management.

At present, a number of technical options are available for contaminated mineral matrices (such as slags) treatment. Presently, the metals, oxides and hydroxides recovery from slags has been and still is the subject of numerous studies. The techniques implemented generally use hydrometallurgy and involve mechanical, magnetic, chemical and/or physicochemical separation processes in various combinations. The solutions reported in the literature for the dissolution of the metallic parts are, moreover, generally exclusively acid. Incorporated into mineral matrices and sometimes committed in the form of ferrites type, strategic metal-based (Cr, Mo, *etc.*) non-ferrous oxides have rarely been the subject of specific treatments. When keeping the mineral matrix intact is desired for its subsequent valorization, processing technologies with acid leaching agents are inapplicable and to be avoided. The alkaline earth metals rich composition of steel slags are attractive materials for potential users. When acid leaching, the release of lime presents a major inconvenience. Hence, this causes an overconsumption of reagents and an excess of salt production.

The EAF-S ("Electric Arc Furnace slags from Stainless steel production") considered in this study results from the mechanical treatment of part of Dorian's (Loire department) heap. The current mechanical process, developed by Harsco Minerals France, recovers 99,7 % of the EAF-S metals. However, it doesn't allow the metal oxides extraction limiting thus the metals compounds exploitation in terms of reuse. The innovation was implementing selective unitary operations set on the chemical nature of (EAF-S) non-ferrous metals. The scientific approach consisted in adapting the alkaline middle (use of soda ash as leaching agent) of selective lixiviation and the separation methods in order to optimize the strategic metals extraction rates while choosing conditions and environments that do not present side effects and allow a minimization of the environmental impacts. Soda ash's weak corrosion power and selectivity showed many benefits. Iron and calcium, present in (EAF-S), were poorly leached at the end of alkaline treatment (mineral matrix preservation). Moreover, adding lime in a soda ash solution precipitated the silicates and carbonates thus returned the leaching solution to its initial state. The poster will propose to give a brief report on the principal results obtained.