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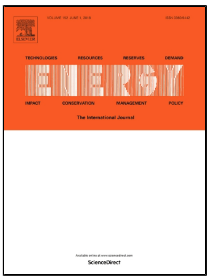

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PII:	S0360-5442(18)30878-8
DOI:	10.1016/j.energy.2018.05.058
Reference:	EGY 12893
To appear in:	*Energy*
Received Date:	15 February 2018
Revised Date:	23 April 2018
Accepted Date:	08 May 2018

Please cite this article as: Huining Zhang, Chong Gao, Ben Chen, Jiang Tang, Dongfeng He, Anjun Xu, Stainless Steel Tailings Accelerated Direct Carbonation Process at Low Pressure: Carbonation Efficiency Evaluation and Chromium Leaching Inhibition Correlation Analysis, *Energy* (2018), doi: 10.1016/j.energy.2018.05.058

Stainless Steel Tailings Accelerated Direct Carbonation Process at Low Pressure: Carbonation Efficiency Evaluation and Chromium Leaching Inhibition Correlation Analysis

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Abstract: Chromium leaching from stainless steel tailings is an urgent problem risking of the environments, calcite integument of tailings by accelerated direct gas-solid carbonation process can be formed and the inhibition factor of carbonation degree on chromium leaching rate is discussed in detail. Stainless steel tailings accelerated direct gas-solid carbonation process is investigated at 300℃ to 700℃ and 0.2-0.4MPa, and the effect of temperature, reaction time, particle size and CO_2 pressure on carbonation degree are analyzed by TGA-DSC, FTIR, SEM-EDS analysis. The results show that the maximum CO_2 uptake obtained (8.2%), corresponding to 16% carbonation degree can be obtained when 48-75μm stainless steel tailings are carbonated for 90min at 300℃ and 0.4MPa. Tailings particle size, carbonation time, and carbon dioxide pressure display a positive relationship with carbonation degree, but carbonation temperature has a negative relationship. 48-75μm carbonated tailings with varied carbonation degree and original tailings are investigated for the inhibitory factor between carbonation degree and Cr leaching rate, when leaching process is at 60℃ for 90min on the condition that *L*/*S* ratio equals 20ml/g. The results show the inhibitory factor is fitted by random function better, and the value decreases from 31.5% to 9.7%, when carbonation degree is from 2% to 8%, and then keeps stable, when carbonation degree is still increases from 8% to 14%, which illustrates that carbonation process as a better strategy of tailings innocuous treatment at high temperature is valid for restricting Cr leaching behavior.

Keywords: stainless steel tailings, carbonation efficiency, thermodynamic analysis, Cr leaching rate, inhibitory factor

Introduction

Carbon capture and storage (CCS) is a systematic engineering process[1], including CO_2 capture technology from the combustion process such as power generation, transportation process and CO_2 storage process such as ocean storage, geological sequestration and mineral carbonation. Among these CO_2 storage strategies, CO_2 sequestration capacity, stability and economical analysis of mineral carbonation are the best[2]. Mineral carbonation developed from rock natural weathering process, has the direct and the indirect routine, and the latter has a better carbon storage efficiency than the former. Adsorption carrier of CO_2 needs firstly to be considered, magnesium silicate mineral like the serpentine[3], and the wollastonite[4] as a possible feedstock are applied for CO_2 storage through gas-solid reaction, but the carbonation efficiency and timeliness are very bad, and the cost and energy are spent on crushing and grinding process. In order to optimize the carbonation process and improve the economical performance, industrial alkaline residual carbonation process is sprung up, which is a better strategy of waste resourceful