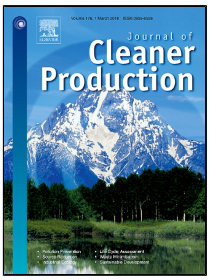
Accepted Manuscript



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A.O. Oni, D.A. Fadare, S. Sharma, G.P. Rangaiah

PII:	S0959-6526(18)30270-1
DOI:	10.1016/j.jclepro.2018.01.239
Reference:	JCLP 11919
To appear in:	*Journal of Cleaner Production*
Received Date:	17 July 2017
Revised Date:	26 January 2018
Accepted Date:	29 January 2018

Please cite this article as: A.O. Oni, D.A. Fadare, S. Sharma, G.P. Rangaiah, Multi-objective optimisation of a double contact double absorption sulphuric acid plant for cleaner operation, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.01.239

Multi-objective optimisation of a double contact double absorption sulphuric acid plant for cleaner operation

A.O. Oni[1 *], D.A Fadare[2, 3], S. Sharma[4], G.P. Rangaiah[4]

[1]Department of Mechanical Engineering, University of Alberta, 10-203 Donadeo Innovation Centre for Engineering, Edmonton, Alberta T6G 1H9, Canada
[2]Department of Mechanical Engineering, University of Ibadan, Ibadan, Oyo State, Nigeria
[3]Department of Mechanical Engineering, Landmark University, Omu Aran, Kwara State, Nigeria
[4]Department of Chemical & Biomolecular Engineering, National University of Singapore, Engineering Drive 4, Singapore 117585, Singapore

* Corresponding author email: fem2day@yahoo.com

Abstract

The release of oxides of sulphur (SO_x) and acid mist (H_2SO_4) during the production of sulphuric acid in the double contact double absorption (DCDA) process is hazardous to the environment. It is a challenging task to minimise these emissions while keeping plant operation within the production requirements and maximise revenue. In this study, SOx emissions, acid mist emissions, and net revenue are considered as objectives for multi-objective optimisation (MOO) of the DCDA process. Firstly, the process is modelled and simulated in Aspen HYSYS, and validated with plant data. MOO is then performed using the elitist non-dominated sorting genetic algorithm to predict sets of Pareto-optimal operating conditions for improved environmental and economic performance. The effect of operating parameters such as air flow rate and pressure, inlet temperatures to catalytic beds and absorbers, demineralised water flow rate, and boiler feed water flow rate on the process performance is also studied. The results show that the DCDA process can be operated at different optimal conditions, each of which involves some trade-off among the objectives of interest. A multi-criteria decision-making technique (known as technique for order of preference by similarity to ideal solution, TOPSIS) is used to determine the most suitable optimum operating point. Among the optimal conditions, the chosen solution through TOPSIS has 9.5 ppm of SO_x