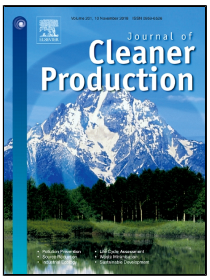
Accepted Manuscript



A holistic framework for assessing hot-dip galvanizing process sustainability

Jose D. Hernández-Betancur, Hugo F. Hernández, Luz M. Ocampo-Carmona

PII:	S0959-6526(18)32906-8
DOI:	10.1016/j.jclepro.2018.09.177
Reference:	JCLP 14312
To appear in:	*Journal of Cleaner Production*
Received Date:	13 February 2018
Accepted Date:	21 September 2018

Please cite this article as: Jose D. Hernández-Betancur, Hugo F. Hernández, Luz M. Ocampo-Carmona, A holistic framework for assessing hot-dip galvanizing process sustainability, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.09.177

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

ACCEPTED MANUSCRIPT

A holistic framework for assessing hot-dip galvanizing process sustainability

Jose D. Hernández-Betancur[1a], Hugo F. Hernández[b], Luz M. Ocampo-Carmona[a]

[a] *Facultad de Minas, Universidad Nacional de Colombia, Medellín, Colombia, jodhernandezbe@unal.edu.co, lmocampo@unal.edu.co*

[b] *ForsChem Research, Medellín, Colombia, hugo.hernandez@forschem.org*

Abstract

Hot-dip galvanizing is considered one of the most important corrosion protection alternatives for steel; however, its poor environmental performance has been a matter of concern. Even though many researchers have dealt with this topic in the past none of them have jointly dealt with the triple bottom line of sustainable development, and with the random and epistemic uncertainty of its measurement. For that reason, in this work, the sustainability of the hot-dip galvanizing process is investigated integrating: (a) 17 indicators taken from the 4 categories of the GREENSCOPE methodology and one quality performance indicator which is directly related to ISO 1461. (b) The additive utility method for multi-criteria decision-making. (c) The fuzzy analytic hierarchy process used to calculate the relative weights of both indicators and categories by means of a survey. (d) The hierarchical partitioning analysis used for determining the process stages that have a higher impact on sustainability variation, and others useful and suitable statistical tools for data analysis. Furthermore, the proposed framework is tested for a particular hot-dip galvanizing process, considering a random generation of each batch size, steel item characteristics and operating conditions via the kinetic Monte Carlo method. The results show that the stages of pickling and fluxing are critical for the analyzed system and they are not expected to be improved without a significant modification of the process. The proposal outlined in this paper might help designers, process engineers and researchers for a better decision-making process, focusing on the most critical stages while considering the trade-off between the three dimensions of sustainable development.

Keywords

Hot-dip galvanizing, sustainability, GREENSCOPE, additive utility methods, fuzzy analytic hierarchy process, hierarchical partitioning analysis

1. Introduction

Steel is the most frequently used structural metal in the world, and given that it is highly vulnerable to corrosion, it needs to be protected. One of the most common methods for steel protection is the hot-dip galvanizing (HDG) process. HDG consists of the coating of steel by dipping it in a molten-zinc bath at 450°C to produce a Zn-Fe alloy. Many wastes and by-products are produced as a result of the production line activities of HDG, some of

[1] Corresponding author:
E-mail address: jodhernandezbe@unal.edu.co (Jose Hernández)

Download English Version:

https://daneshyari.com/en/article/11019796

Download Persian Version:

https://daneshyari.com/article/11019796

Daneshyari.com