

Accepted Manuscript

Heterogeneous Oxidation of Zinc Vapor by Steam and Mixtures of Steam and Carbon Dioxide

Luke J. Venstrom, Paul Hilsen, Jane H. Davidson

PII: S0009-2509(18)30150-7
DOI: <https://doi.org/10.1016/j.ces.2018.03.020>
Reference: CES 14094

To appear in: *Chemical Engineering Science*

Received Date: 29 August 2017
Revised Date: 24 January 2018
Accepted Date: 7 March 2018

Please cite this article as: L.J. Venstrom, P. Hilsen, J.H. Davidson, Heterogeneous Oxidation of Zinc Vapor by Steam and Mixtures of Steam and Carbon Dioxide, *Chemical Engineering Science* (2018), doi: <https://doi.org/10.1016/j.ces.2018.03.020>

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.



Heterogeneous Oxidation of Zinc Vapor by Steam and Mixtures of Steam and Carbon Dioxide

Venstrom, Luke J.¹

Department of Mechanical Engineering, Valparaiso University
1900 Chapel Drive, Valparaiso, IN 46383
luke.venstrom@valpo.edu

Hilsen, Paul

Department of Mechanical Engineering, University of Minnesota—Twin Cities
111 Church Street, Minneapolis, MN
hils0022@umn.edu

Davidson, Jane H.

Department of Mechanical Engineering, University of Minnesota—Twin Cities
111 Church Street, Minneapolis, MN
jhd@me.umn.edu

ABSTRACT

The kinetics of the heterogeneous oxidation of zinc vapor by water vapor were measured in a tube flow reactor for temperatures from 800 to 1100 K, zinc vapor partial pressures up to 0.39 atm, and water vapor partial pressures up to 1.0 atm. The results extend the prior data for oxidation of zinc by water vapor from zinc partial pressures on the order of 0.01 atm to higher values appropriate for fuel production via the Zn/ZnO thermochemical cycle. Measured oxidation rates span 10^{-7} to 10^{-5} mol cm⁻² s⁻¹. A second order, reversible reaction rate expression $r'' = k_{\text{Zn-H}_2\text{O}} \left(p_{\text{Zn(g)}} p_{\text{H}_2\text{O}} - \frac{p_{\text{H}_2}}{K_{\text{eq}}} \right)$ is developed from regression of the data and a numerical model of advective and diffusive mass transfer. The kinetic parameter $k_{\text{Zn-H}_2\text{O}}$ is a non-monotonic function of temperature with a negative activation energy for temperatures between 800 and 1050 K, consistent with prior studies. In a second set of experiments, the rate of the heterogeneous oxidation of

¹ Corresponding author, e-mail: luke.venstrom@valpo.edu.

Download English Version:

<https://daneshyari.com/en/article/6588529>

Download Persian Version:

<https://daneshyari.com/article/6588529>

[Daneshyari.com](https://daneshyari.com)