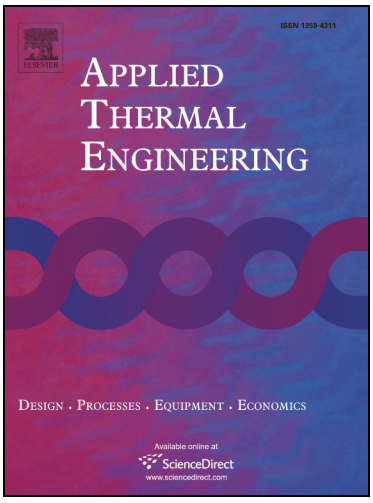
Accepted Manuscript



Evaporation and heat transfer of aqueous salt solutions during crystallization

S.Y. Misyura

PII: S1359-4311(17)34174-1
DOI: https://doi.org/10.1016/j.applthermaleng.2018.04.068
Reference: ATE 12065

To appear in: *Applied Thermal Engineering*

Received Date: 21 June 2017
Revised Date: 13 March 2018
Accepted Date: 12 April 2018

Please cite this article as: S.Y. Misyura, Evaporation and heat transfer of aqueous salt solutions during crystallization, *Applied Thermal Engineering* (2018), doi: https://doi.org/10.1016/j.applthermaleng.2018.04.068

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

Evaporation and heat transfer of aqueous salt solutions during crystallization

Misyura S.Y.[1,2]

1. National Research Tomsk Polytechnic University, 30 Lenin Ave., Tomsk 634050, Russia,
2. Kutateladze Institute of Thermophysics of the Siberian Branch of the Russian Academy of Sciences, Lavrentiev Ave. 1, Novosibirsk, 630090, Russia

Abstract

Evaporation, heat transfer and surface crystallization of thin layers of aqueous solutions of $CaCl_2$, LiBr and LiCl salts have been studied experimentally. The control of crystallization rate is extremely important for a wide range of modern technologies, associated with both slow cooling rates and extremely rapid droplet and film crystallization (for example, in nanocoatings). Usually, when calculating the crystallization, the heat transfer coefficient and the evaporation rate are assumed quasi-constant, and the effect of evaporation rate of solution on the rate of crystallization is not taken into account. In this paper, it is shown that even without crystallization the heat transfer coefficient may vary several times, when the height of the film rapidly decreases. This study has shown that the character of crystallization curve and crystallization rate strongly depend on the rate of solution evaporation before the onset of phase transition. Abnormally high crystallization rates 30-50 mm/s are achieved at extremely low supersaturations of solutions (the salt solution is in the quasi-equilibrium region), and this is associated with the rapid growth of dendritic forms. With the growth of the surface crystalline film, the evaporation rate of the solution in metastable state increases significantly and has a non-stationary "oscillation" character. The coefficient of heat transfer before the onset of crystallization also changes significantly. The formation of dendrites is possible if crystallization is realized in thin supersaturated layers with high gradients of temperature and concentration. In this case, very high crystallization rates will be provided by dendritic forms.

Key words: crystallization rates, evaporation rate, heat transfer, salt solutions

*****_E-mail address_: misura@itp.nsc.ru

Download English Version:

https://daneshyari.com/en/article/7045115

Download Persian Version:

https://daneshyari.com/article/7045115

Daneshyari.com