

PRODUCTION AND
CHARACTERIZATION OF KILN
CAST COMPOSITE ALLOYS

BY

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

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Signature of Student

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%Carbides = $12.33 \times C\% + 0.55 \times Cr\% - 15.2$	Equation 2.1	12
Metal + O ₂ → Metal Oxide	Equation 3.1	36
$\rho_{\text{mole}} = \frac{\Delta x_{\text{scale}}}{\Delta t} = K_{S/O} \frac{\Delta m_O / \Delta t}{A}$	Equation 3.2	36
$\sigma_f = \frac{PL}{\pi R^3}$	Equation 3.3	44
$\epsilon_f = \frac{6Dd}{L^2}$	Equation 3.4	44
$M_s(^{\circ}C) = 539 - 423C - 30.4Mn - 17.7Ni - 12.1Cr - 7.5Mo$	Equation 3.6	50
$\sigma_f = \frac{PL}{\pi R^3}$	Equation 3.7	53
$\frac{1}{E_R} = (1 - \nu_i^2)/E_i + (1 - \nu_s^2)/E_s$	Equation 4.1	84
$H = \frac{P_{\text{max}}}{A_r}$	Equation 5.1	95
$E_r = \frac{1}{\beta} \frac{\sqrt{\pi}}{2} \frac{S}{\sqrt{A_p(h_c)}}$	Equation 5.2	95
$S = \frac{dP}{dh}$	Equation 5.3	95
$J = -D \frac{\partial \phi}{\partial x}$	Equation 6.1	128
$\frac{\partial \phi}{\partial t} = D \frac{\partial^2 \phi}{\partial x^2}$	Equation 6.2	128
$D = A \cdot e^{\left(\frac{-Q}{RT}\right)}$	Equation 6.3	128
$\sqrt{Dt} \geq d/0.8$	Equation 6.4	135
$D_{\text{eff}} = gD_{\text{gb}} + (1-g)D$	Equation 6.5	135
$g = \frac{q_{\sigma}}{d}$	Equation 6.6	135
$C_x = C_0 - (C_s - C_0) \times \left(\text{Erf} \left(\frac{x}{(Dt)^{0.5}} \right) \right)$	Equation 6.7	138
$Dt = \left[\frac{x}{\left(\text{invErf} \left(\frac{C_x}{C_0 \cdot (C_s - C_0)} \right) \right)} \right]^2$	Equation 6.8	157
$\int_0^T C_0 - (C_s - C_0) \times \left(\text{Erf} \left(\frac{x}{(Dt)^{0.5}} \right) \right) dx$	Equation 6.9	158
Mass of Carbon = Mass of Substrate $\times \left(\frac{\text{Area Under Curve}}{(T \times 100)} \right)$	Equation 6.10	158

PUBLICATIONS AND AWARDS ARISING FROM THIS WORK

Refereed Papers

- [1] T. Lucey, R. Wuhrer, K. Moran, M. Reid, P. Huggett and M. Cortie. "Interfacial reactions in white iron/steel composites." *Journal of Materials Processing Technology* 212(11): 2349-2357. 2012
- [2] T. Lucey, R. Wuhrer, P. Huggett, K. Moran, W.Y. Yeung and M. Cortie. "Solidification Phenomena during Casting of Stainless Steel/Cast Iron Composites." *Supplemental Proceedings: Materials Properties, Characterisation and Modelling*, John Wiley & Sons, Inc.: 267-274. 2012

Conference Papers

- [3] T. Lucey, R. Wuhrer, K. Moran, P. Huggett and M. Cortie. "Microstructural Analysis of the Interfacial Development of White Iron/Steel Composites." *Microscopy and Microanalysis* 18 (Supplement S2): 1670-1671. 2012
- [4] T. Lucey, R. Wuhrer, P. Huggett, K. Moran, W.Y. Yeung and M. Cortie. "Solidification Phenomena during Casting of Stainless Steel/Cast Iron Composites", in *Defects and Properties of Cast Metals*, M. Jolly, B. Thomas and C. Reilly (eds.), *Proceedings of the 141st TMS Annual Meeting & Exhibition*, March 11-15, 2012, Orlando, Florida, USA.
- [5] T. Lucey, P. Huggett, R. Wuhrer and W.Y. Yeung. "Effect of Soak Time on the Microstructural Evolution at the Interface of Kiln Cast White Iron/Steel Composites." *The 7th Pacific Rim International Conference on Advanced Materials and Processing (PRICM 7)*, Cairns, Australia. 2010

- [6] T. Lucey, P. Huggett, R. Wuhrer, K. Moran and W.Y. Yeung. "X-Ray Mapping and Analysis of the Interfacial Region of Kiln Cast Composites." Microscopy and Microanalysis 16(Supplement S2): 1674-1675. 2010
- [7] T. Lucey, P. Huggett, R. Wuhrer and W.Y. Yeung. "Production and Characterisation of Vacuum Cast Composite Alloys." Materials Australia & Austceram 2009, Gold Coast, Australia. 2009

Awards

- [1] Castaing Award – Best Student Paper, Microscopy Society of America, 2012
- [2] 2nd Prize, Presentation, Materials Australia Jules Byrnes Student Presentation Night, 2009
- [3] 2nd Prize, Poster, Materials Australia Jules Byrnes Student Presentation Night, 2009
- [4] 1st Prize, Poster, UTS Student Research Showcase Poster Competition, 2009