

For ultimate solutions to thermo-metallurgical problems through numerical modeling

### Technology demonstrations

SI No	Company	Steels tested	Quenchant(s) tested and conditions of testing
1	Automotive Axles Ltd, Mysore, India	AISI 8822 H	Unknown (supplied by the plant) in container without agitation
2	Bharath Earth Movers Ltd., KGF, India	C 45	(i) Servo 707 Oil in quench tank under agitation (ii) P180 (5%) Hard Castle Polymer Solution in quench tank under agitation
3	Bharath Forge Ltd., Pune, India	41Cr 4	(i) 6% Polymer solution in quench tank under agitation (ii) 14% Polymer solution in quench tank under agitation
4	HAL, Bangalore, India	C 45	(i) Used oil 707 in quench tank under agitation (ii) New oil 707 in container (iii) Water in quench tank under agitation
5	L&T, Hazira, India	SA 542	Water in container
6	LVM, Bangalore, India	(i) DAC (ii) H13 (iii) ORVAR	Vacuum heated and gas quenched
7	Mahindra Forge Ltd., Pune, India	C 45	(i) 4.5% solution of a polymer in quench tank under agitation (ii) 13.5% solution of a polymer in quench tank under agitation
8	NBC Bearings, Jaipur, India	100 Cr 6	(i) Castrol 798 in quench tank under agitation (ii) Nippon 303 in quench tank under agitation
9	SKF Bearings, Pune, India	52100	Unknown, supplied by Company in quench tank under agitation
10	SSS Springs, Siriperambudur, India	SUP 9	Daphne Oil in quench tank under agitation
11	IIT Madras, India (Lab trials)	(i) 4140 (ii) C 45	(i) Oil 44 (ii) Daphne Oil (iii) Water (iv) Brine (v) Polymer solution - all quenchant in containers without agitation

## Publications

### **Research Theses (Ph.D. and M.S.)**

1. K.Babu "Mathematical Modeling of the Quenching Heat Treatment" – Ph.D.. Thesis, IIT Madras (2011)
2. P.V.D. Ramesh "Heat Flux Estimation During Gas Tungsten Arc Welding Using Inverse Method" – M.S. Thesis, IIT Madras (2009)
3. S. Arun Kumar "Analysis of Interface Heat Flux Distribution Along the Vertical Mould Wall Using Inverse Method" – M.S. Thesis, IIT Madras (2008)
4. K.V.Srinivasa Rao "Spatial and Temporal Variation of Metal-mold Interface Heat Flux During Gravity Die Casting" – Ph.D.Thesis, IIT Madras (2008)
5. H.C.Kamath "Assessment of Multiple Heat Flux Components at the Metal-Mold Interface During Solidification of Aluminum Alloys" - Ph.D.Thesis, IIT Madras - (2005)
6. K.Narayan Prabhu "Investigation of Heat Transfer at the Casting/Die-Wall Interface during Solidification of Aluminum Base Alloys" – Ph.D.Thesis, Mangalore University (1990)

### **Sponsored/Research Based Industrial Consultancy Projects**

1. "Modeling Interface Heat Transfer Characteristics in Die Casting Aluminum Base Alloys", DST, Govt of India, 1986-89
2. "Parameter Estimation and Inverse Solution of Non-Linear Heat Conduction Problems" VSSC, Trivandrum, 2005-2008
3. "Improving Die Life for Casting Gray Iron Auto Components" Brakes India Ltd., Chennai, 2004-2005
4. "Estimation of Heat Flux on PFC form Temperature Measurements by Inverse Conduction Method", Institute for Plasma Research, Bhat, Gandhinagar, 2006-2008

### **International Journal Papers**

1. T.S.Prasanna Kumar, "**Coupled Analysis of Surface Heat Flux, Microstructure Evolution and Hardness during Immersion Quenching of a Medium Carbon Steel in Plant Conditions**", Materials Performance and Characterization, Vol. 9, No. 5, Paper ID MPC10447
2. K.Babu and T.S.Prasanna Kumar, "Estimation and Analysis of Surface Heat Flux during Quenching in CNT Nano Fluids", **Transactions of the ASME, Journal of Heat Transfer**, July 2011, vol 133, pp 07150-1-8
3. K.Babu and T.S.Prasanna Kumar, "Effect of CNT Concentration and Agitation on Heat Transfer during Quenching in CNT Nano-Fluids", **Intl J of Heat and Mass Transfer**, v 545, 2010, pp 106-117
4. K.Babu and T.S.Prasanna Kumar, "Mathematical Modeling of Surface Heat Flux during Quenching", **Metall. and Materials Trans. B**, vol 41, 214-224, Feb 2010

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5. S. Arunkumar, K. V. Sreenivas Rao, T. S. Prasanna Kumar, "Spatial Variation of Heat Flux at the Metal-Mold Interface due to Mold Filling Effects in Gravity Die-Casting", **International Journal of Heat and Mass Transfer**, 2007
6. Sreenivas Rao, K.V., Phanikumar, G., Prasanna Kumar, T. S., "Numerical Simulation of Boundary Heat Flux during Alloy Solidification and it's Effect on Natural Convection, Macro segregation and Microstructure Evolution", **Multiphysics** 2007, 12-14 Dec.2007, Manchester, UK, P 23
7. T.S.Prasanna Kumar "A serial solution for the 2-D inverse heat conduction problem for estimating multiple heat flux components"- **Numerical Heat Transfer Part B-Fundamentals**, Vol 45, n 6, June 2004, pp 541-563
8. T.S.Prasanna Kumar and H.C.Kamath "Estimation of Multiple Heat Flux Components at the Metal/Mold Interface in Bar and Plate Aluminum Alloy Castings"- **Metallurgical and Materials Transactions B**, Vol 35 B, June 2004, pp 575-585

#### International / National Conferences

1. T.S.Prasanna Kumar "**Reference QuenchProbe' A New Tool for *in-situ* Quality Testing during Quenching of Hardenable Steels**", Heat Treatment and Surface engineering Conf. and Expo, May 16-18, 2013, Chennai, India
2. T.S.Prasanna Kumar, Ashok Pareek, N. Arjun "**Determination of Heat Transfer Coefficient during Quenching of an Alloy Steel by *In-Situ* Plant Testing**", 6<sup>th</sup> Intl. Quenching and Control of Distortion Conference, September 10-13, 2012, Chicago, IL, USA
3. Babu, K., and Prasanna Kumar, T.S., "Effect of Bath Temperature on Surface Heat Flux during Quenching in CNT Nanofluids" Proceedings of the **26<sup>th</sup> ASM Heat Treating Society Conference**, Oct 31 – Nov 3, 2011, Cincinnati, Ohio, USA.
4. T.S.Prasanna Kumar, "**A new quality assurance tool for quench heat treatments**" Heat Treatment of Industrial Components, 29-30, July 2011, IIT Madras
5. T.S.Prasanna Kumar "QuenchProbe" – An Advanced Tool for Computing Cooling Rates, Microstructure and Hardness during Immersion Quenching", **The American Society of Metals, Bangalore Chapter, India**, Jan 29, 2011
6. K.Babu and T.S.Prasanna Kumar, " Enhancement of Quenching Heat Transfer using Nanofluids", **Proc. Of the 3<sup>rd</sup> Intl. Conf. On Advances in Mechanical Eng., SVNIT, Surat**, - 395007, January 4-6, 2010.
7. K.Babu and T.S.Prasanna Kumar, "Finite Element Modeling of Quenching Heat Treatment of AISI 4140 Steel with Phase Transformation", **4<sup>th</sup> Int. Conf. on Thermal Process Modeling and Computer Simulation**, Shanghai, China, May 31-Jun 2, 2010
8. T. S. Prasanna Kumara, P. V. D. Rameshb, D. R. G. Achar, "Estimation of Heat Flux in GTAW Process using Inverse Heat CONduction Method", **IIW, IC 08**, Jan 2008, Chennai, India
9. Sreenivas Rao, K. V., Phanikumar, G., Prasanna Kumar, T. S., "Effect of Boundary Heat Flux Transients on the Solidification Behavior and Microstructure of Al-Cu Alloys" , **TMS Annual Meeting and Exhibition**, 9-13, March 2008, New Orleans, US, P 98

10. Sreenivas Rao, K. V., Phanikumar, G., Prasanna Kumar, T. S., "Effect of Mold Material on Boundary Heat Flux Transients, Macro Segregation and Microstructure Evolution during Gravity Die Casting", **The 10<sup>th</sup> Asian Foundry Congress (AFC-10)**, 21-24 May 2008, Nagoya, Japan,
11. S. Arun Kumar, K.V.Srinivas Rao, T.S.Prasanna Kumar, "Effect of Mold Filling on the Formation of Air Gap along the Vertical Mold Wall During Solidification of Al-Cu Alloy", **Proceedings of IMECE2007, ASME, International Mechanical Engineering Congress and Exposition**, November 11-15, 2007, Seattle, Washington, USA.
12. K.Babu, K.C.Hari Kumar, T.S.Prasanna Kumar, "Estimation of Surface Heat Flux during Quenching of Stainless Steel Probe Using Inverse Heat Conduction Algorithm", **NMD, ATM 2007**, New Delhi
13. Sreenivas Rao, K.V., Arunkumar, S., Phanikumar, G., Prasanna Kumar, T. S., "Quantification of Transient Boundary Heat Flux during Casting", **Diamond Jubilee symposium on Advances in Materials Engineering**, 4-6 July 2007, IISc, Bangalore
14. Sreenivas Rao, K. V., Arunkumar, S., Phanikumar, G., Prasanna Kumar, T. S., "Effect of mold material on heat flux and cooling rate of Al-Cu alloys solidified in rectangular cavity" **NMD, 12-15 Nov. 2007**, Bombay, India, 1D1-2,4 C3(A11291), P 104
15. Kun Xu & T.S.Prasanna Kumar, "Coupled Heat Transfer Optimization Calculation of ABAQUS and DOT for Beam Blank Mold", **Mathematical Models of Continuous Casting of Steel, Annual Report 2006**, Continuous Casting Consortium, Dept. of Mechanical and Industrial Eng., University of Illinois at Urbana-Champaign, Urbana, IL, USA, June 2006
16. T.S.Prasanna Kumar, "Estimation of Heat Flux in a Thin Slab Continuous Casting Mold by Inverse Thermal Analysis" **International Conference on Continuous Casting Past, Present & Future, Jamshedpur**, 24th & 25th October 2005, IIM and TATA STEEL
17. H.C.Kamath and T.S.Prasanna Kumar: "Multidimensional Analysis of Interface Heat Flux in Metallic Molds during Solidification of Aluminum Alloy Plate Castings" **Proceedings of 108<sup>th</sup> Casting Congress of American Foundrymen's Society**, Rosemont, IL, USA in June 2004
18. T.S.Prasanna Kumar, B.Raghunatha Rao, V. Choudhury, "Mathematical Modeling of Heat Transfer Coefficients during Quenching Heat Treatment", **International Heat Treat 2004**, American Society of Metals, Chennai , Jan 2004
19. T.S.Prasanna Kumar and H.C.Kamath, "Importance of Heat Transfer Modeling at the Metal /Mold Interface in Solidification Simulation", **Proc. Materials Science and Technology 2004**, Sept 26-29, 2004
20. A Pani Kishore, T S Prasanna Kumar, "Fixing Boundary Conditions for Solidification Simulation of Aluminum Alloy Plate Casting", **International Symposium for research scholars 2004**, Dept. of Metallurgical and Materials Eng., IIT Madras, Dec 2004