8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

SOLUTION OF MELTING PROBLEMS BY A MESHLESS TECHNIQUE

***Gregor Kosec** [1] **and Božidar Šarler** [2]

[1] University of Nova Gorica
Vipavska 13, SI-5000 Nova Gorica, Slovenia
gregor.kosec@p-ng.si, www.p-ng.si

[2] University of Nova Gorica,
Vipavska 13, SI-5000 Nova Gorica, Slovenia.
bozidar.sarler@p-ng.si , www.p-ng.si

Key Words: *Melting, Local Radial Basis Function Collocation, Multiquadrics, Gobin - Le Quéré Test Case.*

ABSTRACT

This paper explores the application of the mesh-free Local Radial Basis Function Collocation Method (LRBFCM) [1] in solution of coupled heat transfer and fluid flow problems [2,3] associated with meeting of a pure substance [4]. The problem is formulated within the one-domain mixture-enthalpy framework and the phase-change of a pure substance is modelled through a narrow temperature interval. The involved temperature, velocity and pressure fields are represented on overlapping sub-domains through collocation by using multiquadrics Radial Basis Functions (RBF). The involved first and second derivatives of the fields are calculated from the respective derivatives of the RBF's. The energy and momentum equations are solved through explicit time stepping. The pressure-velocity coupling is calculated iteratively, with pressure correction, predicted from the local continuity equation violation. The pressure correction is entirely local and does not require solution of pressure Poisson or pressure correction Poisson equations. The solution procedure is represented for Gobin Le Quéré melting benchmark spectra for tin at Stefan number (Ste) 0.01, Prandtl number (Pr) 0.02, and Rayleigh numbers (Ra) 2.5e4, 2.5e4 and paraffin with Ste = 0.1, Pr = 50, and Ra = 10e7, 10e8. The results of the present method are compared with the results of other combinations of different numerical methods and formulations which attempted this benchmark in the past. The results of the novel method compare well with other contributions. The advantages of the new method are its simplicity, accuracy and straightforward applicability in non-uniform node arrangements.

REFERENCES

[1] B. Šarler and R. Vertnik, "Meshfree local radial basis function collocation method for diffusion problems", *Computers and Mathematics with Application,* Vol. **51**, pp. 1269-1282, (2006).

[2] G. Kosec and B.Šarler, "Solution of thermo-fluid problems by collocation with local pressure correction", *International Journal of Numerical Methods for Heat & Fluid Flow,* (in print).

[3] G. Kosec and B. Šarler, "Local RBF collocation for Darcy flow", *Computer Methods in Engineering and Sciences,* (in print).

[4] D. Gobin and P. Le Quéré, "Melting from an isothermal wall. Synthesis of a numerical comparison exercise", *Computer Assisted Machanics and Engineering Sciences*, Vol. **7**, pp. 289–306, (2000).