

DIRECTED STUDY COURSE WORK

Title: Modelling of welding and heat treatment methods for boiler applications

Credits: 3

Syllabus:

Unit I

Basics of physical metallurgy –unit cell, crystal structure, slip planes, plastic deformation, various strengthening mechanisms in steels, strain hardening behavior, annealing effects after plastic deformation.

Unit II

Fusion welding processes – SMAW, GTAW, GMAW, SAW, PAW, LASER – Processes, equipment and techniques, Analysis of heat flow in welding using Rosenthal model, thermal cycles and temperature distributions around welding arcs, weld thermal simulator. Electrode classifications.

Unit III

Fluid flow in arcs – Lorentz force, driving forces for fluid flow in weld pools, effect of surface active agents in weld pool, role of active flux in GTAW, metal evaporation in welding.

Unit IV

Welding metallurgy – weld metal solidification – epitaxial and non-epitaxial growth of crystals, weld metal grain structure control, factors affecting microstructure of weld, weld cracking phenomena and mitigation methods.

Unit V

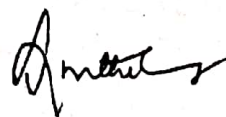
Heat affected zone formation in steel welds – correlation with Iron carbon diagram, grain refinement in multi-pass welding, welding residual stresses and distortion – control mechanisms, heat treatment – various types of heat treatment processes for welds – Preheat, post-heat, post weld heat treatment – techniques for field erection sites and shop floors.

Reference books

- (1) Gorge E. Dieter "Mechanical Metallurgy", SI Metric Edition, McGraw Hill Book Company Limited, London, 1988.
- (2) Sindo Kou "Welding Metallurgy", second edition, John-Wiley and Sons Publication, New Jersey, 2003.
- (3) ASM Hand Book, Volume 6A, Welding Fundamentals and Processes, Materials park, Ohio, 2011
- (4) D.N. Croft "Heat treatment of welded steel structures", Abington Publishing, Cambridge, 2003.
- (5) American Welding Society (AWS), "AWS D10.10 - Recommended Practices for Local Heating of Welds in Piping and Tubing", Reaffirmed third edition, American welding society, Miami, 2009.

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