## Licensing and Technology Transfer Opportunity: Manipal University

**Title of Technology Available**: **HYBRID HEAT TREATMENT METHOD FOR AGE HARDENABLE ALLOY MATRIX FERROUS METAL POWDER REINFORCED COMPOSITES**

**Brief Description of Invention**: The present invention generally relates to a method of heat treatment of metals and alloys. This heat treatment particularly relates to a method of heat treatment of the metals and alloys for enhancing the mechanical properties of the composites. The present invention is more particularly related to a hybrid heat treatment method for age hardenable alloy matrix - ferrous metal powder reinforced composites where the matrix and reinforcement both are heat treated simultaneously.

**Brief Background of Invention**: The ferrous metals (comprising steels or cast iron) are generally subjected to conventional heat treatment processes i.e., annealing, normalizing, hardening, tempering etc. The non-ferrous metals are subjected to age hardening (precipitation hardening) and thermo-mechanical treatments. In alloys, the entire material is subjected to one type of heat treatment. Generally, in composites (metal matrix composites), only matrix material is subjected to heat treatment and not the reinforcements. The alloys like aluminum (2XXX, 7XXX, 6XXX series), copper (Cu-Be), titanium (Ti-Al) with or without the addition of reinforcements are age hardenable (heat treatable) to alter the properties, especially hardness and strength.

The reinforcement (steel) undergoes phase transformation to Pearlite, Martensite and Bainite with different packing factors in conventional heat treatments like annealing, normalizing, hardening and austempering.

The researches in the heat treatment of composite material mainly analyze matrix material alone. The researches do not illustrate simultaneous heat treatment of matrix and reinforcement material. Hence, there is a need for a method of hybrid heat treatment for the reinforcement ferrous material. Also, there is a need for reinforcement and matrix simultaneously undergoing hybrid heat treatment. Further there is a need for a hybrid heat treatment in single stretch to a matrix and reinforcement steel powder to enhance the mechanical properties.

**Describe the final product**: Final product is the heat treatment method (process) to improve hardness and strength of the composite material by subjecting hybrid heat treatment to matrix (Nonferrous aluminium alloy) and reinforcement (steel powder).

**Technological Domain (Keywords)**: Metal matrix composite, Heat treatment to matrix, Hybrid heat treatment, Age hardening, conventional heat treatments

**Proof of Concept**: The theoretical concept is practically tested and the result is giving promising result. Upto 30% and 20% increase in hardness and tensile strength is found on hybrid heat treatment over conventional age hardening treatment. Aging kinetics is accelerated in hybrid treatment. The experiments are completed and results are compared and analysed. Current work is ready to publish.

**Stage of Development**: Ready to Market technology

**Provide Information on Competitors who manufacture and/or sell similar products**: NA

**What are the unique advantages your innovation has compared to the competition**: Results shows hardness and strength of the composite is very much improved by subjecting the hybrid heat treatment compared to giving heat treatment only to the matrix material.

Age hardening treatment to matrix material and conventional treatments like Annealing, Normalising, Hardening and Austempering treatments to steel powder. Different conventional treatments yield different micro constituents (phases) in reinforcement like Coarse pearlite, Fine Pearlite, Martensite, Bainite with different packing factors. Due to the phase transformation of reinforcement during particular conventional treatment, matrix experiences compressive strain. At the same time matrix undergo age hardening treatment and induces tensile strain in the matrix due to the controlled precipitation of intermetallics (Strengthening phases). The synergetic effect of these two processes develops thermal misfit strain between the reinforcement and matrix. This synergetic process improves hardness and strength of the composite.

**A few potential companies who might be interested in this technology**: Metal industries

**Intellectual Property Status: Indian Patent application with number:**

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