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THE CURRENT STATUS OF AUSTEMPERED DUCTILE IRON (ADI)

A. A. Nofel*

ABSTRACT

In the last three decades, the revolutionary material, the Austempered Ductile Iron (ADI) with its unique combination of mechanical properties, has been offering the design engineer alternatives to conventional material/process combinations. The excellent properties of this material have opened new horizons for cast iron to replace steel castings and forging in many engineering applications with considerable cost benefits. Currently, ADI with its super strength can successfully compete with the lightweight alloys, a point that has yet to be fully understood by many design engineers.

An attempt to compile the results of the worldwide explosion of research and development followed the announcement of the first production of this material will be reviewed. Meanwhile, reference is made to the work carried at Central Metallurgical R & D Institute (CMRDI) over the past decade. It is intended to present a macro-analysis of the current state of metallurgy, processing and applications of ADI.

The present lecture starts with discussing the effect of the foundry parameters (chemical composition of ductile iron, casting thickness) and heat treatment variables (especially the austenitizing and austempering temperatures and times on the kinetics of austempering reaction and properties of the resulted ADI). Some examples, for better understanding of the strength mechanisms of ADI, which led to the development of the new techniques enhancing strength and toughness of the alloy such as ausformed ADI, squeeze cast ADI, and two-step austempering, will be discussed. Moreover, the lecture analyses the key feature of important processing techniques of ADI such as cold rolling, welding and some of machining difficulties, which related to work hardening and deformation induced martensitic formation from retained austenite.

Case studies will be shown with emphasis of the experience of CMRDI in production gears of different types and agricultural parts on its experimental foundry. ADI and steel properties related to gear performance will be compared such as structural integrity, abrasion resistance, bending fatigue, teeth conformation, noise and vibration reduction, manufacturing cost, weight reduction and gear power loss, the comparison seems to be in favor of ADI. The CMRDI experience with the use of ADI in agricultural applications will be discussed. Production of thin wall ADI components may offer potentials for new applications. Thin wall ADI castings are capable of building complex thin wall parts of high strength.

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* Professor of metal casting and former president of Central Metallurgical Research and Development Institute (CMRDI), Cairo, Egypt.