ABSTRACT

The present investigation relates to the development of aluminium cast irons with 5% and higher Al content and with nodular/compacted graphite in the structure. The broad objectives of the study were :

i) optimisation of alloy composition, melting and casting technique and heat treatment cycle ;

ii) microstructural characteristics;

iii) elucidation of the solidification characteristics of the chosen alloys ;

iv) evaluation of the oxidation characteristics in the temperature range of 700-1000^{o}C ;

v) assessment of the mould-metal interaction.

The studies concerned melting, casting, and heat treatment practice. Techniques adopted for characterisation included light and scanning electron microscopy (with EDAX) ; X-ray diffraction and thermal analysis, mass gain measurements for evaluation of isothermal oxidation behaviour and general mechanical testing for strength and hardness were undertaken. A range of alloy compositions (5-24% Al, 2.0-2.5% Si, 3.0-3.5% C) conforming to Fe-Al-C and Fe-Al-Si-C systems were studied. A broad evaluation revealed that an alloy with around 5Al-2.5Si-3.5C would possess an optimum melting and casting characteristics, strength, structural stability and oxidation resistance at temperatures upto 1000^{o}C. Treatment with 0.1% mischmetal and post inoculation with 1% calciumsilicide yielded a pearlitic nodular iron structure which could be rendered ferritic by a short homogenising anneal. Plain Fe-5Al-C alloys as well as un-

inoculated Fe-5Al-Si-C alloys solidified with a primary carbide matrix through a set of peritectic and eutectic reactions. The 15Al cast irons developed a ferritic compacted/flake graphite structure after mischmetal-calcium silicide treatment. The oxidation resistance of the Fe-5Al-2.5Si-3.5C alloy was found to be reasonably good. This is attributed to the formation of a protective adherent multilayered-film of complex aluminates and silicates. Similar complex scale formation on the casting surface minimises metal-mould reaction, particularly in case of castings poured in sodium silicate bonded sand moulds. The study further showed that cast irons with 10% Al & higher Al possess attractive oxidation resistance properties, but their use in service would be seriously impaired by a cracking tendency in ambient atmosphere.

Key Words : Heat treatment, Solidification, Oxidation, Inoculation, Peritectic, Scale, Metal-mould reaction.