VARIATION IN YIELD STRENGTH AND ELONGATION OF RE-BARS MANUFACTURED USING LOCAL INGOTS

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or a Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ABSTRACT

Recycling of scrap steel to produce ribbed steel bars is a common practice followed in many countries. Selection of the best composition of ingredients for the melt is a huge challenge faced by the manufacturers in the scrap recycling industry. A major problem faced by them during the recycling process is the difficulty they have in controlling the levels of undesirable residual elements such as Cu, Ni, Sn, As, Cr, Mo, Pb, etc., that come with scraps. In SLS 375:2009 and BS 4449 Standards, the 'maximum percentage by mass' of residual elements is represented by the "Carbon Equivalent Value". Carbon Equivalent (CE) value is used to understand how different alloys and residual elements affect the strength of steel. In ingot casting, a good control of ladle treatment is required for the proper control of de-oxidation and de-sulphurisation chemicals and residuals. An extensive study was carried out by referring to the literature and benchmarking the best practices of several steel makers to improve the ingot casting process. In this dissertation, the results of the experimental investigation on the effects of alloying and residual elements on yield strength and elongation of TMT bars is presented.

The experimental study was focused on identifying the most suitable mixed proportion of ferro-silicon to ferro-silico-manganese, and the best controllable range of CE values to be used during melting to ensure that the products manufactured are consistent in quality. The quantities of the main alloying chemicals mixed together are changed to make the diluted percentage of manganese content in the bath solution to be 0.8% by mass. The ingots and TMT bar samples prepared were tested to see how the Carbon Equivalent value and the mixed proportion of alloying chemicals affect the yield strength and elongation of the finished bars. It was revealed that a consistent yield strength and elongation of each TMT bar of a set can be achieved by having the Carbon Equivalent value in the range $0.37 < CE < 0.4$ % by mass and by mixing of ferro-silicon and ferro-silico-manganese (Si : Mn) approximately in the proportion of 1 : 4.

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LIST OF ABBREVIATIONS

Abbreviation	Description
BCC	Body Centered Cubic
BS	British Standard
CE	Carbon Equivalent
CTD	Cold Twisted Deformed
DOE	Design of Experiments
DRI	Direct Reduced Iron
EL	Elongation
FCC	Face Centered Cubic
IIW	International Institute of Welding
ppm	Parts per million
QST	Quenched & Self Tempered
QTB	Quenched & Tempered Bar
Rebar	Reinforcement Bar
SLS	Sri Lanka Standard
SLSI	Sri Lanka Standards Institution
STD	Standard Deviation
TT	Temperature Time
TMT	Thermo Mechanically Treated
UTM	Universal Testing Machine
YS	Yield Strength