

Investigation on Characterization and Variability of Mechanical
Properties of Reinforcing Steel Bars made from Scrap

Bernard Bukaragire Munyazikwiye

A thesis submitted in partial fulfilment for the Degree of Master of
Science in Mechanical Engineering in the Jomo Kenyatta
University of Agriculture and Technology

2010

ABSTRACT

The quality requirements for concrete reinforcement have increased interest in optimizing the mechanical properties of reinforcing bars used for the construction of all types of structures such as buildings, piers and hydraulic jibs. The variability of mechanical properties of reinforcing steel bars manufactured from scrap metals by local manufacturers in Kenya have been investigated in this research. This was motivated by the fact that it has been noticed that the use of the substandard reinforcing bars in construction industry could lead to collapse of the structures reinforced with these bars in many developing countries.

Therefore a complete understanding and knowledge of the extent of variability of mechanical properties and the real behavior of these construction materials was of prime importance for the proper behavior and integrity of the building structures.

To address the above problem, a survey was carried out on a sample of manufacturers of reinforcing steel bars, construction companies and main distributors of steel bars in the country.

Some bars were randomly selected from hardwares, rolling mills and other from outside the country and a few samples from construction sites. Laboratory tensile tests, chemical composition analysis, microstructure examination, micro hardness tests and heat treatment were carried out on a set of the bars. The heat treatment behavior of reinforcing steel bars was investigated in this study and the results were evaluated using the microvickers hardness tests.

The results were compared with the existing set standards for specified class of reinforcing steel bars and a statistical model on the variability of the mechanical

properties of these bars was established and possible sources of the variation was identified. The yield strength of the bars sampled from the rolling mills complied with standards except in one case.

The result show that the yield strength of 69% of reinforcing steel bars collected from distributors failed in yield strength because the mean value for YS was below the BS 4449 standard value of 460 N/mm². The possible cause of variability was the inconsistency in chemical composition. It was found that the twisted bars exhibited higher value of yield strength than self tempered ribbed bars. It was also found that the grain size have high influence on the tensile properties of the bars. It was observed that the yield strength of bars tested decreased with an increase of grain size. Grain size greater than 28 μ m resulted in yield strength less than the standard value.