

LOW CARBON STEEL SHEETS OBTAINED BY REACTIVE ANNEALING

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Abstract - This paper deals with the possibility of reducing carbon content by heat treatment in reactive atmospheres in order to improve plastic deformations properties of steel sheets. The heat treatment involves a decarburization annealing after a cold rolling, as opposed to the traditional process that performs the heat treatment in non-reactive atmospheres.

Some of the most relevant variables were studied. For this, commercial hot rolling steel sheets were cold rolled with different grades of cold reduction (60%, 70% and 80%).

The recrystallization temperature and the decarburization kinetics were determined by heat treatments performed at temperatures varying between 600 and 700°C, for variable lengths of time up to 2 hours. The grain size evolution was monitored by metallography. In order to analyse the plastic properties of the treated sheets, the n and r coefficients were obtained by tension tests and the sheet texture was determined by X-ray diffraction.

Keywords - Cold Rolling, Decarburization, Drawability, Recrystallization,.

I. INTRODUCTION

Steel sheets for press-forming are divided into two types, hot rolled steel and cold rolled steel. The development of cold rolled steel sheets with very good drawability has been in demand in the automotive industry for the last years. Actually the research in this field is going in the direction of producing steels with ultra low carbon (as Interstitial Free quality). It is well known that a very low carbon content produces better plastic deformation characteristics in drawing-quality steels (Mizui and Okamoto, 1990). However, the technique to obtain this kind of steels to improve formability make use of vacuum degassing, is very expensive and is not available for some steelmakers.

An alternative to obtain low carbon steels is by a decarburization heat treatment after cold reduction. The use of (N_2+H_2) atmospheres is known in the industry as the protective batch annealing atmospheres. If this atmosphere is wet, it reacts with the carbon in the steel and the carbon is eliminated by CO formation.

It was used commercial hot rolling steel (0.05%C) to study the decarburization and recrystallization kinetics. The sheets were cold rolled and heat treated in a reactive atmosphere.

The steel properties obtained by these processes were analysed. The treated steels have a good grain size and acceptable mechanical properties.

II. EXPERIMENTAL

A low-carbon aluminum-killed hot rolled steel sheet of commercial quality was investigated; the composition of which is given in Table 1. Samples in the form of 2- mm thick strips, were cut into rectangular shapes and were laminated. The cold rolling was done in a laboratory rolling mill that belongs to the CEMCOR-CIMM of INTI .

Rectangular samples obtained from the cold rolled sheets (50x30 mm) were annealed with its length (rolling direction) parallel to the vertical axis of the reaction tube. The gases could reach the surface of all the samples. Before each run the samples were thoroughly cleaned and dried.

The samples were annealed in a vertical furnace. Three separate windings guaranteed that the samples, suspended in the middle of the reaction tube, were kept at a constant temperature within 4°C. The decarburization gas used was a mixture of technical purity of 85% N_2 +15% H_2 . When the gas was used together with water vapor, it was passed through a saturator filled with distilled water maintained at a constant temperature of 30°C. Under these conditions, the ratio H_2O/H_2 was ≈ 0.3 . This is less than the value at which