CHAPTER 1

INTRODUCTION AND AIM OF THE WORK

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Introduction

1.1 Introduction

Steel is the most important commercial alloy. It is the most effective alloy for our industrial applications. A wide variety of steels are in common use today. Of course, "steel" is not a single alloy, but instead is a bewildering array of compositions whose common component is iron. The microstructure of steel is the key to its behavior. The crystal structure, grain size, carbon content and arrangement of the microconstituents (bcc ferrite, bct martensite, fcc austenite, orthorhombic cementite, etc.) determine steel properties. The present study deals with cast carbon low alloy steel. Alloy steels contain alloying elements other than carbon and iron. The alloying elements mainly make it easier to obtain the phase transformations necessary for successful heat treatment. A few alloying elements are added for solid-solution strengthening, and a couple of these alloying elements are added for control of undesirable and unavoidable impurities. Alloy steels can be classified into low alloy steels and high alloy steels. Low alloy steels contain alloying elements less than 10% although high alloy steels contain more than 10% of the alloying elements.

Critical structural components must be fabricated from steels that exhibit adequate low-temperature fracture toughness because of the serious consequences of failure due to brittle fracture.
Low alloy steel is used for steel castings which operate at low temperature applications. It is known that the ambient temperature has a great effect on the mechanical behavior of steel. Generally, steels behave brittle as they are subjected to low temperature as shown from figure 1.1.

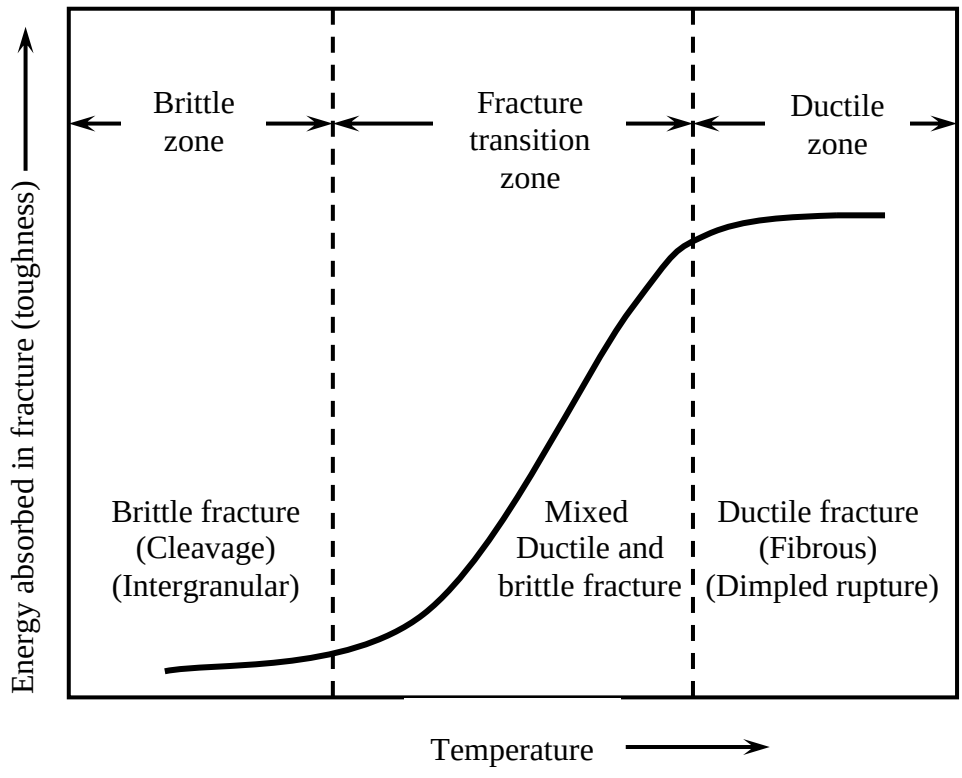

Figure 1.1 Effect of temperature on toughness

It is also clear that steel changes from ductile phase to brittle phase through fracture transition zone.
Consequently steel must be designed to overcome or to delay the ductile to brittle transition temperature to withstand high toughness to resist the impact load at subzero temperatures. The impact transition temperature for all alloys created to manufacturing gas pipe fitting must be shifted toward the subzero degrees. The transition temperature can be shifted to the subzero degrees by two techniques. The first one could be implemented by adding alloying elements such as Nickel and Niobium …… etc. where Nickel increase toughness and shifts to sub-zero transition temperature. Niobium operates as a grain refiner to the low alloy steel. Grain refinement is considered as the most effective tool to fulfill the previous requirements (high strength combined with excellent toughness). The most effective means for grain refinement at reasonable costs is achieved by microalloying processing. Heat treatment like quenching and tempering is a second technique which affects on the transition temperature. Heat treatment to low alloy steel increases toughness at low temperature.

1.2 Aim of the work

- The aim of this investigation was to develop cast carbon low alloy steel grades suitable for low temperature applications by micro alloy technology.
- The developed grades are subjected to quenching and tempering heat treatment to enhance the mechanical properties.