The 36th Ichimura Prizes in Industry - Contribution Prize (2003)

HTUFF® : Super High HAZ Toughness Technology with Fine Microstructure Imparted by Fine Particles

Plate Sales Division

1. Background of the Development

Steel plates manufactured by the steel industry are important materials used in large welded structures, such as in shipbuilding, high-rise buildings, bridges, offshore structures and pipelines. In recent years, this industry has witnessed an increase in the societal demands on welded structures in the form of improved reliability, larger sizes, lighter weights and improved welding performance. There were increasing demands for the development of high tensile strength steel plates in which welds do not easily fail even when high efficient welding is applied thereto. As a result, there were many technical issues to overcome in increasing resistance (toughness) toward failure at the HAZ (heat affected zone) of steel plates.

2. Overview of the Technical Development

Nippon Steel Corporation developed "HTUFF® (pronounced H-tough) which is a Super High HAZ Toughness Technology with Fine Microstructure Imparted by Fine Particles" which exceeds conventional limits with the purpose of especially increasing the HAZ toughness of steel plates. This epoch-making technology utilizes oxides and sulfides as nano-particles to make the microstructure of HAZ finer.

3. Features and Effects of the Technical Development

In an effort to strongly suppress the growth of HAZ crystal grains that are heated to high temperatures over 1,400℃, this technology finely and in high concentration diffuses oxides and sulfides and has superior thermal stability at high temperatures. To realizes this, the inventors noted magnesium and calcium which have powerful chemical affinity to oxides and sulfides and determined that by including these special base elements in appropriate amounts in the steel, the sizes of oxides and sulfides became finer (up to 1/100 to 1/10 of conventional sizes), and thus were able to establish this technology for dispersing them in high concentration as nano-particles for industry. The development of steel using this technology has made the HAZ grains finer to approximately 1/5 of conventional steels, even with highly efficient high heat input welding, so welds resist failure, and HAZ toughness (absorbed energy from impact failure) is improved two-fold. To date, over 280,000 tons of this developed steel has been used in large welded structures of various types both domestically and internationally. It has greatly contributed to improved structure safety, lowered construction costs, and improved transporting efficiency.

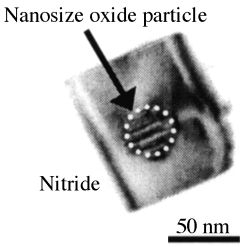

Fig. 1 Example of nanosize particles in HTUFF steel

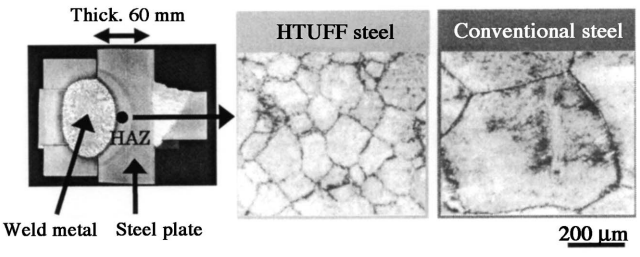

Fig. 2 Comparison of HAZ microstructure between HTUFF steel and conventional steel

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