High Carbon Steel Wire Rod for Ultra-high Tensile Strength Tire Cord, KTC80H*

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1 Introduction

Ultra-high tensile strength steel tire cord is in urgent demand by the automobile industry, because it is partly responsible for reducing the weight of automobiles. Kawasaki Steel has long been studying a manufacturing method for ultra-high tensile strength steel tire cord and, as the first step, developed the wire rod for tire cord in the 3 500 N/mm^2 class, which has high practical applicability.

However, as shown in **Fig. 1**, the production process is so complicated that the demand for improvement in

Wire rod → Descaling → Coarse drawing → Patenting → Medium drawing → Patenting → Galvanizing → Fine drawing → Cabling → Tire cord

Fig. 1 Production process for tire cord

its productivity is also high. Reducing the incidence of wire breakage during drawing and stranding has become an important task, and Kawasaki Steel is urgently seeking improvements in product quality. This paper describes the quality characteristics of high-carbon steel wire rod for ultra-high tensile strength tire cord, KTC 80H, and the result of quality enhancing efforts which have contributed to its improvement in drawability.

2 Ultra-high Tensile Strength Steel Tire Cord

2.1 Chemical Composition

Table 1 shows the chemical composition of newly developed KTC80H, and of the currently used KTC80 in the 3 100-N/mm^2 class. In order to ensure adequate ductility of the steel tire cord, the level of C is minimized, and Mn and Cr are used as micro-alloying elements. For this reason, the holding time during lead patenting needs to be slightly longer than normal.

Table 1 Comparison of chemical composition between the conventional high-carbon steel KTC80 and the newly developed one with ultra-high strength, KTC80H (mass%)

	C	Si	Mn	P	S	Cr
KTC80H	0.81 ~0.85	0.15 ~0.25	0.75 ~0.90	≤0.015	≤0.010	0.10 ~0.25
KTC80	0.81 ~0.85	0.15 ~0.25	0.45 ~0.55	≤0.015	≤0.015	—

2.2 Strength and Ductility after Drawing

The relationship between drawing strain and filament tensile strength is shown in **Fig. 2**, and that between the drawing strain and the number of torsions is shown in **Fig. 3**. Newly developed KTC80H gives a tensile strength of 3 500 N/mm^2 or more at a drawing strain of 3.45 and above, and its number of torsions is suffi-

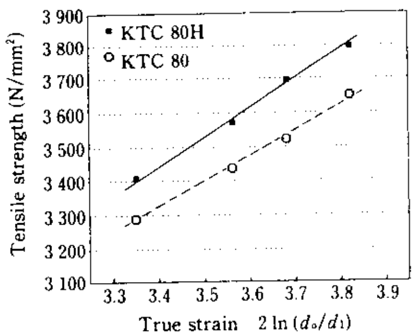

Fig. 2 Relationship between true strain and tensile strength after final drawing

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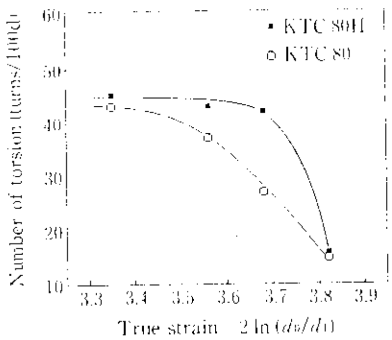


Fig. 3 Relationship between true strain and number of torsion after final drawing

ciently high, until the drawing reaches 3.70. Conventional KTC80 also shows an increase in tensile strength as its drawing strain increases, but its number of torsions limits it to a low strain of drawing. Consequently, for steel tire cord of the 3 500-N/mm^2 class, newly developed KTC80H is most suitable.

3 Improving the Drawability

3.1 Surface Roughness Effect on the Flatness of the Wire Rod after Drawing

For descaling the surface of the wire rod prior to drawing, pickling or mechanical descaling is used; with the latter method, the quality of the surface after descaling greatly affects the die life. When a certain degree of drawing work has been given, the relationship between the surface roughness after descaling and the flatness after drawing is shown in **Fig. 4**. If the initial period roughness value is small, the flatness may only sometimes exceed 80%, causing reduced die life.

3.2 Surface Roughness of the Wire Rod

Because wire rod drawn after mechanical descaling must have an appropriate surface roughness, Kawasaki Steel controls the surface condition of the hot-rolling rolls to produce the best surface condition of the wire rod. **Figure 5** shows an example of the surface roughness.

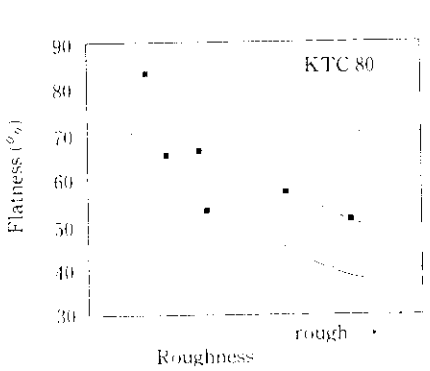
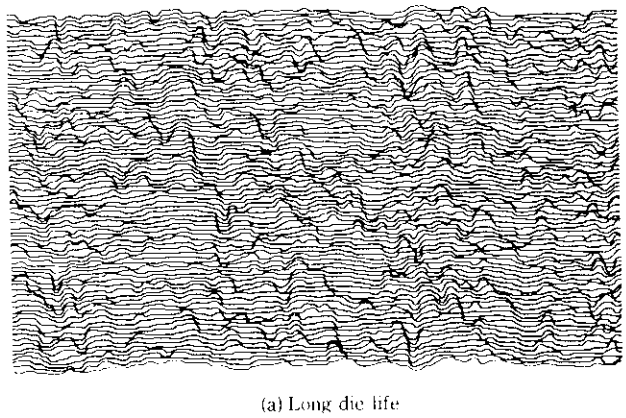


Fig. 4 Relationship between roughness after mechanical descaling and flatness after drawing



(a) Long die life

(b) Poor die life

Fig. 5 Wire rod surface profile after mechanical descaling

4 Concluding Remarks

Kawasaki Steel Corp. has developed an ultra-high tensile strength tire cord steel, KTC80H, with a filament strength of 3 500 N/mm^2 and more. This will contribute in the future to auto weight reduction and greater tire cord productivity.

Kawasaki Steel is also improving the quality of the conventional wire rod for steel tire cord to improve productivity.

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