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Damage Pearlitic Steel in Operation

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Abstract

This paper deals high carbon pearlitic steel wires (patented wires), which used as reinforcement in vehicle tires. The aim is to achieve the production of fine-grained pearlite microstructure. The theoretical part deals with a patent in the production structure as well as the patented brass plated wires. In the experimental focused on the microstructure and macroscopic analysis, followed by degradation of the wire, from an evaluation of the mechanical properties, determination of the depth of decarburization and the detection of corrosion in operation.

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Keywords: patented wire; coat; mechanical properties; corrosion

1. Introduction

High carbon pearlitic steel wires are usually twisted together to form the steel cords used for truck/bus radial (TBR) tires due to their outstanding strength as well as acceptable ductility. The steel wires are generally produced via several steps of cold drawing from wires containing 0.6–0.9 wt. % C and patenting to produce a fine pearlite microstructure. In response to the market trend toward lighter, higher performance tires, the strength required for the steel wires has increased [1-5]. The patented wires are steel cords with a brass coating, to be used as reinforcement in tires. Their use is an effective solution to the construction of the tires mainly because tires can affect the cords reach excellent properties. The basic semi-finished product for the production of steel cord is a steel wire with a diameter of 6 to 0.2 mm. Steel cord consists of steel wires coated with brass [6]. Before the drawing process that result in achieving a specific cross section of the wire, the steel wire in the electrolytic thin layer of brass coating.

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The final coating thickness is about 0.2 μm. Steel cord gives the mechanical properties UTS (ultimate tensilestrength) 3000-4000 MPa, the brass coating provides adhesion to the rubber during vulcanization [7-10].

The term “patented wire” refers to a particular process through which steel wire is strengthened to particular specifications, rather than an actual type of wire. Sometimes called “improved plow steel” or “extra improved plow steel” wire, patented wire is high-carbon, high-tensile steel wire that has been put through a special heat-treatment process for added durability and strength. For this reason, patented wire is popular for use in the manufacturing of wire rope and high tensile applications [11].

2. Experiment

Eutectoid steel was used as a specimen in this study. The chemical composition of the steel is shown in Table 1. Steel wires were fabricated by the following procedure: 1st drawing (ϕ 5.5–3.05 mm), 2nd drawing (ϕ 3.05–1.41 mm), patenting and final drawing (ϕ 1.41–0.18 mm). The patenting consisted of ausutenitizing at 1000 °C for 22 s followed by the isothermal transformation for 10 s in a lead bath at 600 °C. The final steel wires were annealed at temperatures ranging from 100 to 500 °C for 60 s and then cooled down to room temperature in air [1].

Table 1.The chemical composition of the steel.

	C	Si	Cr	Mn	Ni	Cu	S	P
w [%]	0.7-0.75	0.15-0.3	0.08	0.46-0.6	0.08	0.08	0.015	0.012

Experimental samples were patented wire of diameter 1.98 mm and 1.34 mm coated and uncoated, and the twisted cord made up of nine patented wires.

2.1. Metallographic analysis

To establish patented wire degradation in the environment of use SARS [0.01 m moll of HNO_3; 1 m moll NaCl; 1 m moll of $(NH_4)_2SO_4$] microstructure analysis was performed, and the macroscopic analysis.

2.2. Microstructural analysis

Sample preparation was carried out in a standard way: grinding and polishing. Samples were etched in 2% Nital solution. The thus prepared sample was observed at the optical microscope Olympus Vanox - A.
Comparative Sample conditions:

- initial state
- After 1 week of exposure to SARS
- After 3 weeks of exposure to SARS.

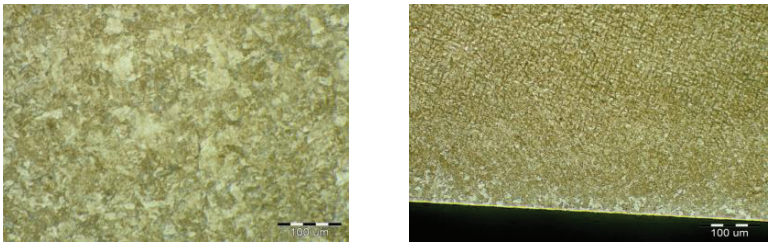

Fig. 1. (a) The microstructure of patented wire in the initial state, (b) coated brass layer.