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DRAWING TECHNOLOGIES OF NICHROME WIRE

Abstract: The processes descriptions of drawing of nichrome wire with the diameters of 0.3 and 0.4 mm on the special equipment of Chinese and Italian productions were given in the article.

Key words: drawing, wire, a die, a machine.

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Introduction

Metal wire is obtained by drawing. Drawing consists in multiple pulling of a workpiece through working holes of dies for achieving of a required wire diameter [1 – 10]. Essence of drawing is based on

simultaneous reducing of a cross section and elongation of the workpiece. The different drawing processes are used depending on material and the diameter of processed wire. Reducing of the diameter can cause to break of wire. Therefore, at this stage of

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drawing it is necessary to choose material of the die and processing modes. Drawing of metal wire is carried out on the special equipment installed in the line: drawing machines, baths for washing, straightening devices and etc. Features of cold drawing of nichrome wire on the various technological equipment were subject to consideration.

Technological part

The wire drawing process was carried out on the automated lines consisting of the drawing machines of Chinese (Jiangyin Sanheng Machine) and Italian (Italtec) productions and the other equipment. Strip plate with the diameter of 1 mm, made of NiCr 60/15 and NiCr 80/20 alloys was subjected to drawing. NiCr 60/15 is heat-resistant material that is used in various corrosive environments. NiCr 80/20 has high physical and mechanical properties. These alloys have the following chemical compositions (in percentage): Ni – 59/75, Cr – 16.5/20, Fe – 22/1, C – 0.15/0.15, Si – 1.25/1.25, Mn – 2/1, Cu – 0.5/- (in the numerator – NiCr 60/15, in the denominator – NiCr 80/20 and so on). Elongation of nichrome wire in the diameters range from 0.2 mm to 1 mm is 18 – 45%. Strength limits of NiCr 60/15 and NiCr 80/20 alloys are 600 and 650 MPa, respectively. The main physical properties of alloys are: density (g/cm^3) – 8.2/8.3, electrical resistance at 20°C ($\Omega \text{ mm}^2/\text{m}$) – 1.11/1.08, the melting temperature (°C) – 1390/1400.

Wire shall have the diameters of 0.4 mm (NiCr 60/15) and 0.3 mm (NiCr 80/20) after drawing. The tolerances for the wire diameters sizes should be 0.01/0.024 mm. The tolerance on the weight of wire after drawing shall be 2.7...3.3/0.2...5.5 kg. Finished wire must be wound on coils.

The equipment for implementation of the drawing process of nichrome wire of the different diameters is presented in the Fig. 1 – 11.

Wire drawing was performed with additional processing (steam, water) and without it. The workpiece is wound on the vertically arranged coil. The workpiece is moved from the coil to the equipment of Chinese production through a roller of a looper. A signal is sent to a control panel and drawing stops on the machine in case of the loop formation. The workpiece is pulled through seats with the installed dies and wound on the driving and driven drums. The several dies with the different diameters of the working holes are installed in the device. Wire drawing occurs in the special bath, which is filled with liquid. Plastically deformed nichrome wire is wound on the horizontally arranged coil through the range of the guide and bypass rollers. This technology does not allow to remove internal stresses in wire material. Therefore, wire breaks are possible, which are eliminated by welding on the special welding machine.



Figure 1 – The coil with strip plate for drawing of wire on the machine of Chinese production.



Figure 2 – The loopers: A – the drawing machine of Chinese production; B – the drawing machine of Italian production.

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Figure 3 – The guide roller of the drawing machine of Italian production.



A



B

Figure 4 – The driving and driven drums, the seats for the dies: A – the drawing machine of Chinese production; B – the drawing machine of Italian production.

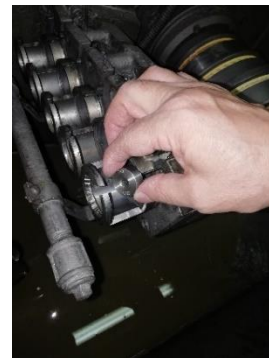


Figure 5 – The die for installation in the seats of the drawing machine of Italian production.



A



B

Figure 6 – The guide and bypass mechanisms: A – the drawing machine of Chinese production; B – the drawing machine of Italian production.

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Figure 7 – The laser device for measuring of the diameter and the oval of wire.



A



B

Figure 8 – The baths for wire processing with hot water and steam (A) and processing with cold water and air under high pressure (B) on the drawing machine of Italian production.



Figure 9 – The straightening mechanism.



A



B

Figure 10 – The control panels of the machines: A – the drawing machine of Chinese production; B – the drawing machine of Italian production.

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Figure 11 – The welding machine.

Additional processing of wire with hot and cold water, steam and air under high pressure in the special baths is feature of drawing on the equipment of Italian production. Control of a geometric shape of processed nichrome wire is carried out on the special laser device. Possible warping of wire after drawing is eliminated on the straightening mechanism.

Conclusion

Drawing of nichrome wire from the diameter of 1 mm to the diameters of 0.3 – 0.4 mm should be

carried out in liquid environment on the special automated equipment. The more stringent requirements are imposed on the final sizes of wire, taking into account the lower strength limit of NiCr 60/15 alloy. Additional processing of wire in the special baths provides reducing of internal stresses in deformed material and achieving of the required physical and mechanical properties.

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