

## A Novel Welding Wire Surface Preparation

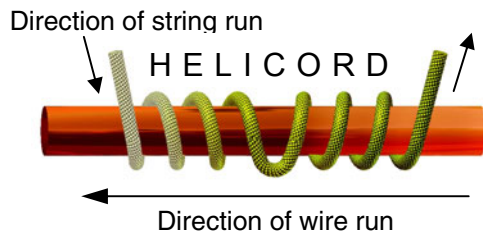
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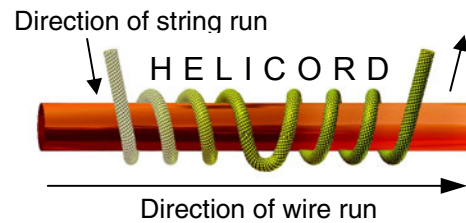
### INTRODUCTION

Welding among other wire applications has and is developing high requirements for surface preparation. Wire surface properties as feedability, slippage on the drive rolls, electrical conductivity, require flakes, oxides and liquid or dry drawing lubricants to be removed. Liquid or solid post lubrication along with the application of enhancement materials, anti corrosive or arc stabilizers can also be effected with the following technology.

This paper will describe a unique method of wire surface preparation by means of wrapping or looping, under high tension, constantly renewed and moving, high tensile strings, in 360 degree contact with the wire (pictures 1 and 2).



**Picture 1:** Cleaning with the opposite run of wire and wrapped string

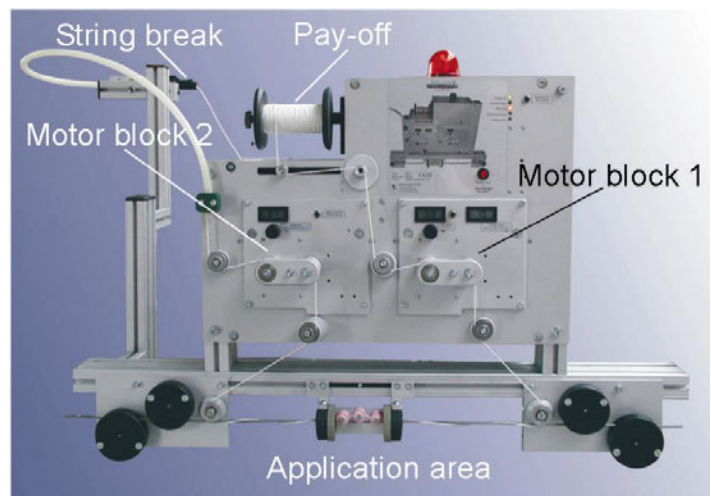


**Picture 2:** Application with the same run of wire and wrapped string

### TECHNICAL APPROACH

Prior to this, for about 5 decades, this technology failed because one could not prevent blocking and then breaking of the string.

However, during the 1990's it was shown with a simpler machine, that magnet wire can be covered with lubricants, accurately and reliably by using wax impregnated strings. This technology was advanced by mechanically regulating the speed and pretension of the string by two motor blocks (picture 3) and by the development of braided, round and flat textile strings (picture 4) composed of different materials (e.g. Polyamide, Cellulose, or Aramid).



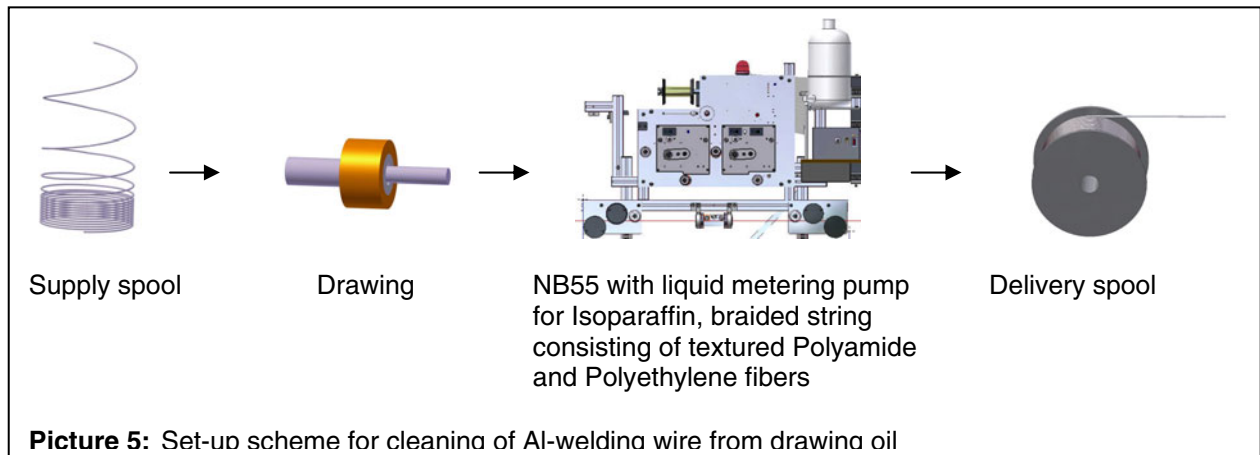
**Picture 3:** HELICORD unit NB55

RESULTS AND DISCUSSION

With these one can today prepare the wire surface very reliably by grinding, polishing, wiping, and washing (picture 5, table 1). In addition, powders, waxes, arc stabilizers, or liquid substances can be applied (table 2).



**Picture 4:** Braided round string (left) and flat, shoelace-like string (right) wrapped around a wire of diameter 1.2 mm



**Picture 5:** Set-up scheme for cleaning of Al-welding wire from drawing oil

**Table 1:** Application examples for wire cleaning

Purpose	Machinery and settings	Materials	Results
Removal of drawing oil from Al-welding wire (Ø = 1.6 mm, speed 15 m/s)	NB55 with liquid metering pump; Pre-tension 8 N Friction Force 30 N 8 turns, 1.0 m/min	Isoparaffin, T <sub>BP</sub> : 160 - 190°C, (4,0 ml/min), braided string based on textured filaments of Polyamide 66 and textured Aramid filaments	Reduction of oil residues from initially 20 - 50 mg/m <sup>2</sup> down to less than 2 mg/m <sup>2</sup>
Removal of metal flakes from copper wire (Ø = 1.9 mm, speed 15 m/s)	NB55; Pre-tension 5 N Friction Force 55 N 6 turns, 0.3 m/min	braided string based on Cellulose and textured Aramid filaments	removal ca. 200g copper dust per 1t Wire.
Removal of dry drawing lubricants (Ca-Stearate) from solid steel welding wire (Ø = 1.0 mm, speed 10 m/s)	1. Step - NB55 with liquid metering pump; Pre-tension 10 N Friction Force 80 N 8 turns, 0.5 m/min	Water based cleaning liquid NH10H001 a braided abrasive string with Al <sub>2</sub> O <sub>3</sub> resin bonded, grid mesh 150 µm	Reduction of Ca-Stearate residues from initially 103 mg/m <sup>2</sup> down to less than 30 mg/m <sup>2</sup>
	2. Step NB55 with liquid metering pump; Pre-tension 15 N Friction Force 80 N 8 turns, 0.5 m/min	Water based cleaning liquid NH10H001 a braided string based on Cellulose and textured Aramid filaments	

**Table 2:** Application examples for wire coating

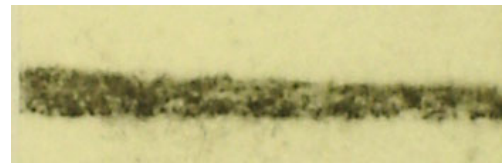
Purpose	Machinery and settings	Materials	Results
Application of oil on solid steel welding wire (Ø = 1.2 mm, speed 40 m/s)	NB55 with liquid metering pump; Pre-tension 10 N Friction Force 30 N 8 turns, 0.6 m/min	Special oil (1 ml/min), braided string based on textured filaments of Polyamide 66 and textured Aramid filaments	about 10 mg/m <sup>2</sup>
Application of wax on flux cored mild steel welding wire (Ø = 1.2 mm, speed 10 m/s)	NB59 with Heating placed between drawing and winder; Pre-tension 0.5 N 6 turns, 0.55 m/min	Yarn impregnated with low melting Paraffin (T <sub>MP</sub> ~ 42°C) and additions of an sulfonate corrosion inhibitor	about 110 mg/m <sup>2</sup> ; increased corrosion resistance in humid atmosphere

For the repeatable and accurate verification of the results of the treatment it is necessary to

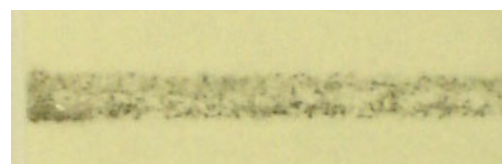
- know the initial state of the wire and to define the desired properties after the treatment
- know which components, in which amounts, have to be attained
- determine, after the treatment, the amount of residues or applied components by suitable analytical methods and/or the surface properties with appropriate testing methods
- also verify the success by operational tests

**Note:** Visual methods, as e.g. non-standardized wiping tests, lead to false results (picture 6). Infrared spectroscopy is a suitable means to analyze qualitatively and quantitatively many organic compounds used in wire production. Also pyrolytic methods are valuable.

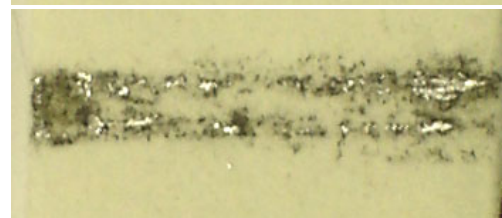
a) As drawn without any treatment



b) After wiping with a string



c) After intense cleaning with application of an abrasive medium cleaned off with a dry string



**Picture 6:** Wipe traces on a filter paper from the surface of an Aluminum welding wire

## CONCLUSION AND FUTURE PROSPECTS

HELICORD string technology has proven to be a suitable and cost effective means for both cleaning and coating all types of welding wire. It is under constant development, especially with respect to enhancement materials.

For example, a unique method of application of PTFE using string eliminating the break-up of dispersions under shear has succeeded to apply and polish on aluminum with reduction of the coefficient of friction from 0.300 to 0.011. Similar results have been found on other substrates. In addition in the case of the Aluminum the welding arc is stabilized by Fluor containing organic compounds.

