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IMPROVING THE TECHNOLOGY OF WELDING CHROMIUM – NICKEL STEELS

Abstract: *In this article, the quality of the weld depends on the type of material, weldability, thickness of the weld, the degree of preparation of the weld, the welding equipment, welding method, mode, the nature of the weld, the qualifications of the welder and other parameters. There are also several welding methods and economic indicators.*

Key words: *Welding, liquid, electric arc, electric slag welding, horn, diffusion, ultrasonic, cooling, plasma, galvanic and chemical coating, diffusion chromium titration.*

Language: *English*

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Introduction

Nowadays, the restoration of parts by welding is of great importance in the national economy. However, the efficiency and quality of the restoration of details depends on the chosen method. According to the literature, the following methods of detail restoration are widely used.

Table 1 – Classification of methods used in the restoration of parts by welding

№	Method group	Applicable recovery methods
1	Liquid welding (liquefied metal coating)	Electric arc welding, electric slag welding, under flux layer, shielding gas, water vapor welding, vibration arc, gas, plasma, electron beam, laser beam welding
2	Pressure welding	Electrical contact, friction, blasting, horn, under the board, diffusion, ultrasonic, cooling, induction welding
3	Metal Spray Coating	Plasma, Gas – plasma spray coating
4	Metallization	Gas, electric, high frequency current, plasma metallization

5	Welding	Welding with soft, hard and aluminum welds
6	Electrolytic coating	Chromium plating, plating, nickel plating
7	Use of synthetic materials	False liquid layer, gas-plasma method, pressure injection method, board coating
8	Pressure processing	Expansion, sinking, circling, elongation, partial sinking, electromechanical processing
9	Plumbing-mechanical processing	Mixing, grinding, grinding, milling, grinding, expanding, pinning, threading, pulling and other elements
10	Electrical treatment	Anode-mechanical, electro-chemical, electro-contact, electro-pulsed
11	Thinning processing	Thermal, thermo-mechanical, chemical-thermal, surface plastic deformation, machining with diamond tools

Several scientists and researchers have grouped the available methods into ten groups, depending on the physical nature, technological and other characteristics of the process of recovery of worn parts.

Table 2 – Methods of restoration of details by welding

№	Method group	Methods
1	Welding – mechanical processing methods	Restoration of details to the size of recycling, restoration of details with additional elements, cutting and removal of traces of corrosion and its correct geometric shape, reassembly
2	Methods of plastic deformation	Stretching, straightening, mechanical, hydrothermal or electrohydraulic expansion, surface treatment with balls or rollers, mechanical or thermoplastic compression, sinking, immersion, electromechanical treatment
3	Coating with polymer material	Powder coating, press coating, pressure casting coating, mechanical coating
4	Methods of welding on the handle	Gas flame, electric arc, argon gas arc, electric arc, plasma, termite, electric contact
5	Mechanized methods of arc welding and coating	Automated under flux, shielding gas environment: argon, is gas, water vapor, etc., mixed shielding gas environment, gas flame shielded electric arc, vibration arc, with powder wire or tape, with wide layer, laid electrode, plasma, cop electrode, simultaneous deformation, simultaneous mechanical processing
6	Mechanized methods of arc welding	Induction (high frequency), electric slag, contact welding and coating, friction, gas flame, electron beam, ultrasound, diffusion, laser, termite, blasting, magnetic pulse, horn heating
7	Gas flame coating (metallization)	Electric arc, gas flame, plasma, detonation, high frequency current, electric pulse, ionic plasma
8	Galvanic and chemical coating	Alternating current, alternating current, electrolyte current, bathless bath, chromium plating, electrolyte chromium plating, copper plating, galvanizing, alloy coating, composite coating, electric contact coating (electric friction), galvanic – mechanical, chemical nickel plating
9	Thermal and chemical-thermal treatment	Annealing, discharge, diffusion exploration, diffusion galvanizing, diffusion titanium, diffusion chromium plating, diffusion chromium titration, diffusion chromation, refrigeration
10	Other methods	Liquid metal casting, freezing, heat sealing, welding, brazing, electric sparking and alloying

MATERIALS AND METHODS

Mechanical processing method it is used in the preparation or finishing of worn surfaces, as well as in the restoration of parts to the size of the repair or in the restoration of additional elements. When the details are machined to the size of the repair, the geometric shape of the work surfaces is restored, and when installing additional elements, its size is adjusted to the size of the new detail.

Galvanic coating method based on the property of the separation of metals from a solution of metal salts under the influence of an electric current.

Galvanic coatings are obtained to cover the worn surface of the part. It is possible to recover less worn parts using galvanic methods. The advantage of these methods is that the mechanical properties of the selected metal can be changed by changing the modes of the electrolysis process. The friction resistance of the layer obtained by the process is low and the hardness is 75% of the hardness of high-frequency current – treated steel 45, the fatigue strength is 25 ... 30% less, the complexity of preparation operations and labor – intensive, the need for large production area, There are drawbacks such as harm to the health of service providers.

Coating methods of welding. Welding and coating methods are the most basic methods of repairing machine parts. At present, more than 70% of parts are restored by repair and welding methods in repair shops. Of this, 80% is done using electricity and 20% using gas flame. Welding is used to eliminate mechanical defects of parts, and liquefied coating is used to restore worn work surfaces with a layer of metal. Although many types of liquid coating methods are used in repair shops, a number of welding methods, such as laser, plasma and electrocontact, using a gas flame under the flux layer, are considered promising.

The widespread use of these methods in repair is characterized by the following factors: their efficiency and relative simplicity of the process, strong adhesion of the coating to the base metal, the possibility of obtaining a quality weld layer (high hardness, corrosion resistance, increased elasticity, etc.).

Taking into account the advantages of these methods, we have chosen a promising coating method for flux welding of future parts of our graduate work.

It is known that under normal conditions, the welded joints contain rust, oil, dirt, which negatively affects the quality of welds. Therefore, gas molecules (O_2, H_2, N_2) in the air pass to this surface, even if the welding areas are cleaned before welding these products. Therefore, in order to clean them and obtain high-quality welds, a special compound called flux is used in welding. In other cases, the hardness of the metal is a problem. Therefore, the welds are heated and melted to form a small-volume shaft, which cools during the crystallization, as well as heats the welds of the welded parts until they become highly plastic and compresses them with the required pressure (1 - 4 kgf / mm²). At the same time, the adsorbed gas molecular membranes on the welding surfaces are separated, and the surfaces are so close that under these conditions, the molecular bonds are formed and a fine weld is obtained.

Arc welding under flux is arc welding, in which the arc burns under the flux. Under the influence of the arc, the wire melts and, depending on its capacity, is transferred to the welding zone. The bow is covered with a layer of flux. the welding wire (along with the arc) is moved by a special mechanism (automatic welding) or manually (semi – automatic welding) depending on the direction of welding. Under the influence of summer heat, the base metal and flux melt. Melted wires, flux, and base metal form a welding bath. The flux in the form of a liquid film protects the welding zone from the air. With the help of an arc, the molten weld metal drips into the welding bath, where it mixes with the molten base metal. As the arc moves away, the metal in the bath begins to cool as the heat begins to dissipate and then hardens to form a weld. The molten flux (slag) solidifies to form a layer of slag on the weld surface. The undissolved excess flux part is cooled and reused.

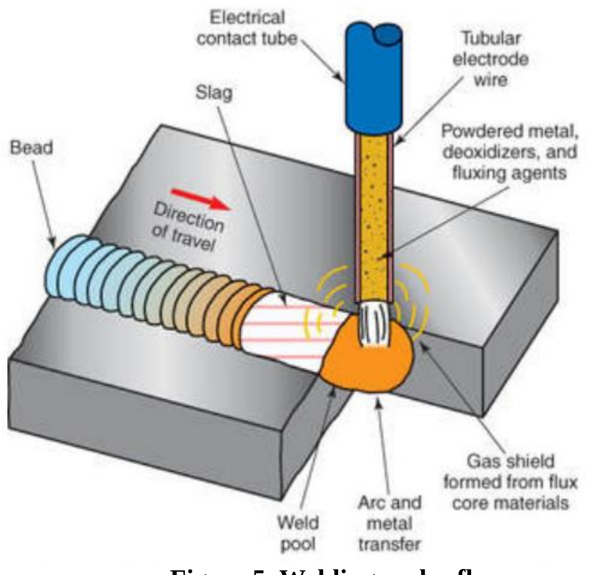

Figure 5. Welding under flux
1 – detail of the coating; 2 – flux layer; 3 – welding wire; 4 – welding arc; 5 – dissolved flux; 6 – slag layer; 7 – flux residue; 8 – welding seam; 9 – welding bath

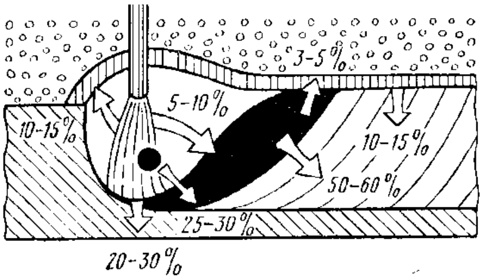

Figure 6. Scheme of heat input to the coating under the flux
Welding materials used in welding under flux are welding wire

The solder cores of the coated electrodes are made of welding wire. When welding under flux and in a shielding gas environment, the weld wire is used as an electrode without a fusible coating. Welded steel wire 0.3; 0.5; 0.8; 1; 1,2; 1.4; 1.6; 2; 2.5; 3.0; 4; 5; 6; 8; Produced in diameters of 10 and 12 mm. The first seven diameter wires are mainly designed for semi – automatic and automatic welding in shielding gases. Wire with a diameter of 2 – 6 mm is used for semi – automatic and automatic welding under flux. The cores of the electrodes are made of wire with a diameter of 1.6 – 12.0 mm. The wire is produced in bundles weighing up to 40 kg with a copy.

It involves the development of the following 77 brands of steel wires of various chemical compositions:

a) low – carbon wires containing up to 0.12% of carbon and intended for welding low and medium carbon, as well as some low-alloy steels, including Sv – 08, SV – 08A, Sv – 08AA Sv – 08GA, Sv – 10GA, Sv – 10G2;

(b) manganese, silicon, chromium, nickel, molybdenum and titanium alloy wires used in the welding of low – alloy steels of appropriate grades; such wires make up a total of 30 types of wires, including wires Sv – 08GS, Sv – 08G2S, Sv – 12GS, etc;

d) multi – alloy wires of special grades Sv – 12X11NMF, Sv – 12X13, Sv – 08X14GNT and other grades for welding and soldering of special steels; a total of 41 brands.

The symbol of the welding wire is marked with the letter Sv (welding) and a letter – numeric symbol indicating its composition. The first two digits represent the percentage of carbon in the wire. Then the names and percentages of the alloying elements are indicated by letters and numbers (numbers), respectively. If the content of the alloying element is less than 1%, only the letter representing the name of the element is used. The symbols of the alloying elements are shown in Table 3.

Table 3 - Definition of alloying elements

Name	Symbol of the element in the Mendeleev periodic table	Marking on metal marking
Nitrogen	N	A*
Niobium	Nb	B
Tungsten	W	V
Manganese	Mn	G
Mis	Cu	D
Selen	Se	E
Cobalt	Co	K
Molybdenum	Mo	M
Nickel	Ni	N
Boron	B	R
Silicon	Si	S
Titan	Ti	T
Vanadium	V	F
Chrome	Cr	X
Aluminum	Al	Yu

** High – alloy steels cannot be marked with the last mark.*

The letter A at the end of the steel mark indicates that it is of very high quality and low in sulfur and phosphorus. the diameters of the welding wires are numbered in front of their marks.

Example: 3 – Sv10G2SMA.

It reads as follows: wire diameter – 3 mm, for welding, carbon – 0.10%, manganese – 2 %, silicon and molybdenum – about 1 %, sulfur and phosphorus content is reduced from 0.01%. In most cases, we can find the letters at the end of the brands of welding wires:

"O" means that the surface of the wire is covered with a layer of copper.

"E" means that this wire is used to make a coated electrode.

"Sh" means that the wire is made of molten steel by electro – slag method.

"VD" means that the wire is made of vacuum – arc melted steel.

"VI" means that the wire is made of vacuum – induced molten steel.

The surface of the wire should be clean and smooth, free of burns, rust and grease. copper can be coated on the surface of the wire used in mechanized methods of welding.

Welding fluxes. Welding fluxes are made of various non – metallic elements with a grain size of 0.25 to 4 mm. fluxes are used when working with mechanized welding. Fluxes melt under the action of arcs, form gaseous and slag protective phases, clean the welding bath from contaminants, and slag solidifies on the weld surface by attaching sulfur and phosphorus.

There are a number of requirements for fluxes used in welding:

1. Ensure stable arc ignition during welding.
2. Provide the weld with the required chemical composition and the desired properties.
3. Ensure a well – formed weld seam.
4. Ensure that the weld seam is obtained without defects.
5. Ensure that the slag moves easily over the seam surface.

Stable arc combustion is ensured by the addition of light ionizing components to the flux. the composition of the weld is mainly provided by the flux interaction of the welded metal and electrode wires. Good formation of the weld and easy removal of slag from the weld surface is achieved by controlling the physicochemical properties of the flux (melting temperature of the flux, liquid flow rate, metal-slag additives, the absence of pores, mainly alloying and oxidizing agents included in the flux) components.

Considering the factors listed above, fluxes are very diverse and varied and can be classified by several of their characteristics. Classification of fluxes. Fluxes can be classified according to the following main characteristics:

1. How to make flux:

a) molten fluxes.

b) insoluble (ceramic) fluxes.

d) flux pastes

2. By purpose:

a) for a specific welding method (for arc welding, for electric slag welding).

b) for welding a certain metal (for welding steel, for welding aluminum, titanium, copper, magnesium, bronze, etc.).

3. Chemical composition:

a) Oxidizing fluxes. They add a lot of manganese and silicon oxides, partially oxidize the bath metal during welding, and enrich themselves with pure manganese and silicon in the form of solder. Oxidizing fluxes are mainly used in the welding of carbon and alloy steels.

b) Non – oxidizing fluxes. They contain almost no manganese and silicon oxides, and are mainly composed of stable bonded oxides. These include calcium oxide, magnesium oxide, aluminum oxide, and calcium fluoride.

These fluxes are mainly used for welding medium and high alloy steels.

d) Oxygen – free fluxes. They are composed of fluorinated and chlorinated salts of alkali and alkaline earth metals and other oxygen-free compounds. These fluxes are used for welding non – ferrous metals with high chemical activity. Including aluminum, magnesium, titanium and others.

It is prepared by melting the components of molten fluxes. Molten fluxes are involved as the main welding material in automatic welding of metal. AN – 348 – A, AN – 348 – AM, AN – 348 – V, AN – 348 – VM, AN – 60 and FTS – 9 type fluxes are used for mechanical welding of carbon and low-alloy steels with carbon and low-alloy welding wire. used for welding. AN – 8 fluxes are used for welding low-alloy steels with carbon and low – alloy welding wire and for electric slag welding of carbon and low – alloy steels.

AN – 15M, AN – 18, AN – 200, AN – 20SM and AN – 20P fluxes are used for welding of medium – alloy steels and high – alloy steels, as well as for automatic arc welding. The AN – 22 flux is designed for electric slag welding and automatic arc welding and welding of low and medium alloy steels. AN – 26S, AN – 26SP and AN – 26P fluxes are used for automatic and semi – automatic welding of stainless, corrosion-resistant and heat-resistant steels. AN – 17M, AN – 43 and AN – 47 fluxes are used for arc welding and melting of high – strength carbon, low and medium alloy steels.

Advantages of molten fluxes:

- homogeneity of chemical composition;
- high mechanical strength;
- high humidity.

Disadvantages of molten fluxes. Its only drawback is that it does not contain pure metal powder when making molten fluxes.

Development of molten fluxes. Production of flux involves the following processes: grinding of raw materials (manganese ore, quartz sand, chalk, fluorspar, etc.) to the required size; they are mixed in specific weight ratios; the gas is melted in a flame or electric furnace; granulated, that is, to have specially sized flux grains. To granulate the flux, the dissolved flux must be drained so that the flux cools in water and breaks into small pieces. The flux is then dried in drums or drying cabinets, sieved and separated into fractions.

In the wet method, the flux melted in the furnace is removed from the furnace and poured into a pool with a special tap water in the form of a thin stream, in some cases this flow of flux is blocked by a stream of water. The flux collected at the bottom of the pool is collected, dried and sifted.

Fluxes can be glassy or flaky, depending on how long the fluxes are melted in the oven and then taken out of the oven. Foam flux of the same composition is 1.5 – 2 times lighter than glass flux. Fluxes are mainly used for welding at high welding currents and speeds, and provide good weld formation. Prepared fluxes are stored in special metal or polyethylene containers

Selection and justification of welding materials

The main coating material in the arc coating under automatic flux is the flux and wire. We choose Np – 30XGSA cable and AN – 348A flywheel, taking into account the mechanical properties, function and hardness of our coating product.

Table 4 - Chemical composition of AN-348-A flux %.

SiO_2	MnO	CaO	MgO	Al_2O_3	CaF_2	Fe_2O_3
41-44	34-38	10	7	6	2-4	2

He size of flux grains is 0.35 – 3 mm. The structure of the flux is glassy. The grains are yellow and brown.

Table 5 - Chemical composition of Np-30XGSA sheath wire.

Wire brand	C	Si	Mn	Cr	Ni	Mo	Ti	S	P	Other elements
								At least		
Np-30XGSA	0,27-0,35	0,80-1,10	0,90-1,20	0,80-1,10	<0,40	-	-	0,030	0,040	-

The cover wire should be brought to the factory in large batches. Each incoming batch of wire must be provided with a certificate that meets the requirements of one brand, one diameter, one casting, for one task and the surface has the same appearance.

In the central laboratory of the plant, the cladding cable is inspected for access:

1. By chemical composition.
2. In terms of tensile strength.

The wire is brought to the cover section in a wire bay. The weight of the bay should not exceed 80 kg.

Selection and justification of welding equipment

We choose the machine “UNK-112” with the rectifier “VDU-601” as welding equipment for coating under the flux.

The semi – automatic is designed to cover the entire wire under the flux.

Technical description of “UNK – 112” submachine gun:

Table 6

№	Sizes	Range
1	Nominal voltage of three-phase alternating current V	380
2	Rated welding current PV = 100%	420
3	Current type.	Permanent
4	Spatial change of welding torch, mm / min	0.6-2000
5	Welding current setting limits, A	60-600

6	Electrode wire diameter, mm	1,6- 4,0
7	Electrode wire transmission speed m / h	16 – 553
8	Qayta tiklanadigan detal diametri,mm	120-1200
9	change the spatial position of the welding torch in the horizontal position, mm in the vertical position, mm	 1000 1770
10	Control cabinet dimensions length breadth height	 510 380 1100
11	Maximum weight of the machine to be installed, kg	1580

The “UNK-112” machine consists of a supply source, a control cabinet mounted on this source, a holder and cables for controlling welding conductors. The machine itself includes a cassette mounting base and a wire transfer mechanism. The cassette acts as a container to keep the electrode wire in order. The base cassette installation and control serves for the orderly installation of electrical cables. The transmission mechanism serves to pass the electrode wire to the welding zone. It is powered by a 0.18 kW AOL – 12 – 4 electric motor. Wire transmission is done using transmission and clamping rollers. The clamping force is applied by means of a clamp mounted on the top of the transmission.

In order for the electrode wire to be passed evenly and continuously, the channel guide of the wire must be precisely and firmly aligned with the groove of the transmission rollers. Changing the speed of the electrode wire is done using a flywheel located on the front wall of the transmission.

The control cabinet is designed for installation of elements of the automatic control circuit. “VDU – 601” rectifier is designed for single – post mechanized welding at constant current.

Table 7 - Technical characteristics of “VDU – 601” rocker

№	Sizes	Range
1	Voltage of alternating current three – phase supply network with frequency 50	220 or 380
2	Rated welding current	500
3	Salt walking voltage	70-80
4	Rated operating voltage; for solid external characteristics	50

He welding rectifier consists of a power transformer, a block of powerful thyristors, a choke, a welding line, a magnetic amplifier, an automatic circuit breaker, a control block, a fan transformer with an electric motor, a mains transformer, a semi-automatic, a gas heater .

In the solid mode of external characteristics, smooth voltage control is carried out using a patesiometer mounted on the control block.

Connecting the rectifier to the mains and protecting it from short circuits is carried out by means of an automatic circuit breaker mounted on the back wall of the rectifier.

Ventilation of the fan using continuous wind. Disconnection and connection of the welding current is carried out by means of a circuit breaker mounted on the hose holder.

RESULT

The distribution of the volume of recovery by the methods currently used in the repair of worn – out parts in the repair of agricultural machinery is given in Table 8 below.

Table 8 - Distribution of recovery volume according to the methods used in the restoration of worn parts by welding

№	Recovery methods	Recovery capacity,%
1	Electric arc coating, Including: under the flux layer using an oscillating arc in an environment of shielding gases with powdered wire others	74 32 19 14 4 5
2	Contact welding of the metal layer	7
3	Electro – arc metallization, plasma coating, electrophysical methods	6
4	Galvanic coating	3
5	Coating with polymeric materials	5
6	Plastic deformation recovery	2
7	Liquid metal casting coating	1
8	Restoration using repair size and additional details	2

CONSLUSION

This article analyzes several methods of welding.

Mechanical processing method used in the preparation or finishing of worn surfaces, as well as in the restoration of details to the size of the repair or in the restoration with the installation of additional elements.

Galvanic coating method based on the property of the separation of metals from a solution of metal salts under the influence of an electric current. Galvanic coatings were obtained by the method of coating the worn surface of the part.

Coating methods of welding. Welding and coating methods are the most basic methods of repairing machine parts. At present, more than 70% of parts are restored by repair and welding methods in repair shops. Of this, 80% was done using electricity and 20% with the help of a gas flame.

It is recommended to use the above welding methods, depending on the size of the seam and the degree of wear of the parts that have become unusable due to the results obtained.

It is also recommended to use alloy arcs when repairing or welding parts made of alloy steels. Only then it is possible to obtain quality welded details without compromising the strength of the seams.

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