Repairing the Roller of a Rolling Machine Used in SMAW Welding Processes

Course: Welding technology

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ABSTRACT

The Rolling machine is used in the manufacturing processes of metallic structures such as tanks, ducts, kicks, cyclones, etc. For the production process of different industrial processes.

An SMAW welding process, to avoid failures during the forming operation of the equipment, can repair the reconstruction of mechanical parts up to 2.5 mm deep, such as the rollers of the rolling machines.

This process must be controlled and executed with a correct welding procedure (WPS); this procedure is based on the variables of the base material and the stresses undergone during its work.

INTRODUCTION

The present project arises from the necessity to extend the life of the roll-forming machine of a rolling machine due of the high cost of its replacement.

After making a set of possible solutions, we chose to use the SMAW process for the filling of worn parts.

The processes of repair and reconstruction of mechanical parts do not have procedures defined by variability of variable, with this investigation we obtain a procedure for the repair of rolling machine SAE 1045 material with E 6 - UM - 60 welding.

DESCRIPTION OF THE PROBLEM

In mechanical production workshops, at present demand for a number of tools and equipment; one of these is the rolling machine which by the rolling process a manual or automated mechanism of three rollers or more that

allows to give the desired curved shape to the sheet in order to obtain cylindrical pieces, With the use and the time the rollers of the machine tend to wear out since these are subjected to compression efforts in addition the wear they have with the sheets and various other factors lead to the rollers no longer fulfilling their proper function.

OBJETIVES

GENERAL OBJECTIVE

The general objective of this present work is to reconstruct a roll of a rolling machine making use of our knowledge in processes of welding in order to thus select the process suitable for the respective reconstruction.

SPECIFIC OBJECTIVES

- Select the appropriate welding process based on the required parameters with the help of specifications and standards.
- Weld a specimen that will be tested under the respective standards by destructive and non-destructive tests.

DESCRIPTION OF THE SOLUTION

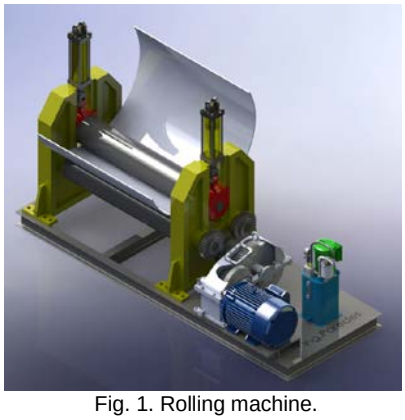

Fig. 1. Rolling machine.

REPAIRING ROLLER OF ROLLING MACHINE FOR SMAW WELDING PROCESS

Welding is a process widely used in the repair, reconstruction and maintenance of mechanical parts.

1 MAIN CAUSES OF WEAR

1. - Abrasive (3 categories).
2. - Impact.
3. - Adhesive (Metal-Metal Wear).
4. - High temperatures.
5. - Corrosive.

For our case, abrasive wear and adhesives are the most important factors in the wear of the rollers.

ABRASIVE WEAR

Foreign materials rubbing against a metal part cause abrasive wear. It corresponds to 55 or 60% of the wear of the industrial components. Abrasive wear is actually a set of wear problems. It can be divided into three main categories:

a) Pure Abrasion

It is usually the least severe type of abrasion. Metal parts wear out due to the action of repeated tearing that produce sharp, sharp particles moving along the metal surface at varying speeds.

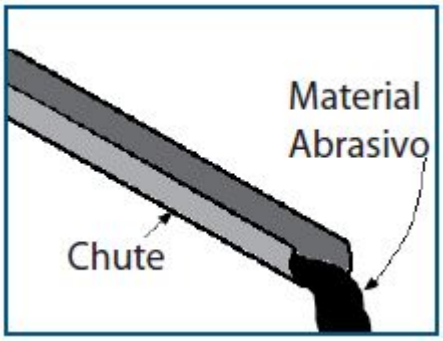

Fig 2 pure abrasion

The sliding abrasive material is slightly tearing the metal surface, gradually wearing it off.

b) Abrasion of high tension or effort.

It is more intense than simple tearing and happens when small and hard abrasive particles are pressed against a metal surface with enough force to break the particle to crush it.

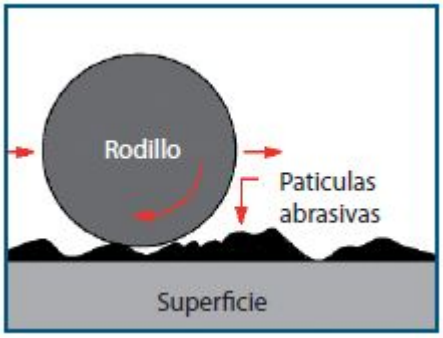

Fig3. High tensión abrasion

The micro-schematic cut shows the fracture of an abrasive particle in smaller pieces and sharper angles, which cut filaments on both metal surfaces.

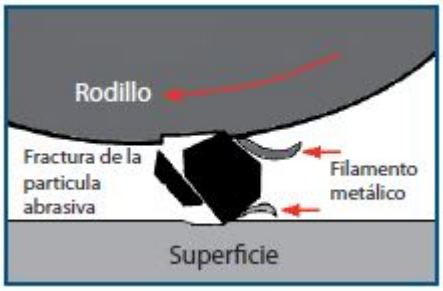

Fig. 4 wear of material by stress abrasion

Typical components subjected to high stress abrasion include augers, excavating shovels, sprayers, ball and bar mills, Brake drums, crushing rollers, rollers and mixing paddles.

c) Tearing abrasion

When abrasion of high and low voltage is accompanied with some degree of impact and load, the result of the wear can be extreme. On the surface of the metal, severe deformations and furrows occur when massive objects (often rocks) are pressed strongly against them

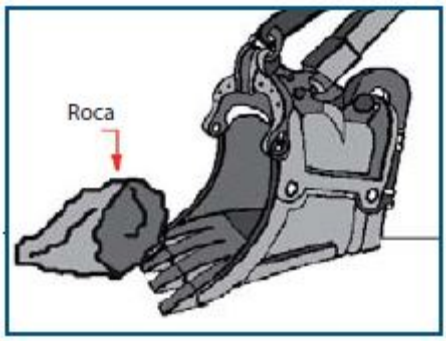

Fig. 5 abrasion by tearing

When tear abrasion is generally used, high tenacity alloys are used to replace harder and abrasion resistant alloys. Chromium carbide based alloys are only used when applied on a base of tough material, preferably austenitic manganese steel.

ADHESIVE WEAR (METAL - METAL)

Adhesive or metal-to-metal wear comprising a 15%, of general wear, results from non-lubricated friction between metal parts. Metal surfaces, regardless of their finish, are composed of high and low microscopic areas. As the metal surfaces slide against each other, the high areas are broken and tiny fragments of metal are released

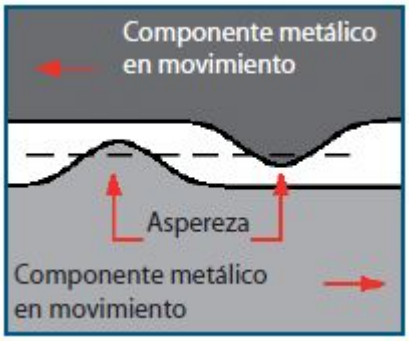

Fig. 6 adhesion wear

Contact under certain heat and pressure conditions causes the metal to flow and adhere shortly to a cold or pressure weld.

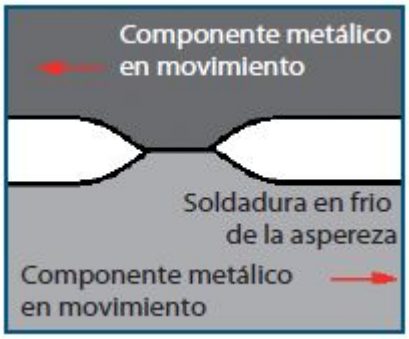

Fig 7. Adhesive wear by heat and pressure

When the strength of the equipment fractures the cold-welded roughness, the distorted metal of one of the surfaces adheres to the opposite surface, accelerating wear.

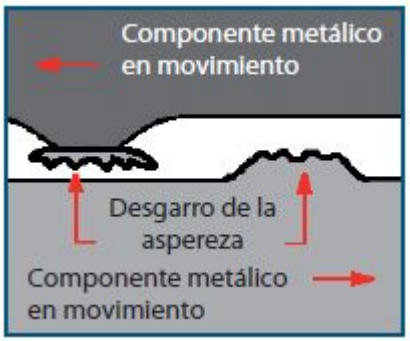

Fig 8. Adhesive wear by inclusion

Typical components subjected to wear by adhesion include steel rolling rollers, landing gear components, cutting knives, shafts, dies, non-lubricated bearing surfaces, drive rollers, guide rollers, chain drive wheel and other pieces of equipment of earth moving.

2 SURFACE FINISHING DURING THE WELDING PROCESS

Should the tank be machined, ground or flame cut? Should the component be heat-treated? Is stress relief from cracking acceptable? These questions must be answered before selecting the alloy for the coating or recovery of a part. The type of alloy generally determines the quality of the surface finish of the recovered part.

In the family of carbide, base alloys there are some that are, according to their design, sensitive to cracking and develop stress relief through the cracking of weld deposits as they cool.

Since the alloys used for the coating and recovery of parts (have different degree of machinability) it is necessary to be clear what the surface finish is required, before selecting the alloy.

Often a sacrifice is required in the degree of wear resistance to achieve the required surface finish. Check product specifications to make sure the specified surface finish can be obtained.

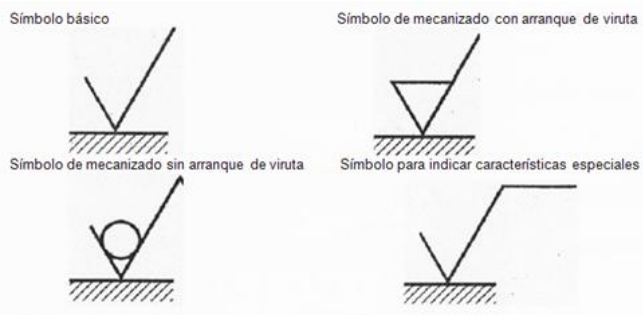

Fig 9. Welding symbols that need surface finish.

3 ALLOYS

The main products for the recovery of parts are ferrous alloys, are those containing a very high percentage of iron, such as steel or cast iron and non-ferrous alloys, are those that lack iron or have a very low level of that.

a) ferrous alloys

Ferrous alloys can be subdivided according to their metallurgical phase or microstructure. Each type resists certain types of wear in better shape than others.

In each family you can find products in which the properties of the main family are combined of alloys with properties of another family of alloys.

We can group them into 3 groups.

1.- Austenitic alloys to manganese Hadfi eld.

- Excellent impact resistance.
- Acceptable abrasion resistance.
- Suitable for filling.

Alloys that are conserved are called austenitic
An austenitic microstructure at room temperature. With compositions of 0.5 to 1% carbon and
Between 13 and 20% of alloy, mainly manganese, with a small percentage of nickel and / or chromium, are commonly called alloys "Austenitic manganese" or "Hadfield" manganese steels, and are of similar composition to the base metal. These alloys are designed to meet, or exceed, the properties of the base metal ("Hadfield" Manganese Steel).

2.- Martensitic alloys.

- Good impact resistance.
- Acceptable abrasion resistance.
- Good resistance to wear Metal - Metal.

Used for both filling and coating
Antiwear.

Martensite is a hard microstructural phase that Is formed in the steels, the product of a cooling Fast from a certain temperature. Since martensitic alloys harden in the air, the cooling rate plays an important role in the final hardness; Faster cooling usually results in a harder deposit. When working with martensitic alloys, it is generally necessary to preheat 120 ° C to 320 ° C to avoid deposits in the weld deposit, in these alloys the base metal must also be taken into account.

3.- Alloys based on Carbides.

- Excellent abrasion resistance.
- Good resistance to heat.
- Acceptable corrosion resistance - Resistance to moderate to low impact.

These alloys have a good abrasive resistance accompanied by a good toughness.
Which are used to resist a combination of abrasion and impact. As the carbon content (up to 7%) of the carbide-containing alloys increases, the abrasion resistance increases and the toughness (due to the higher percentage of carbides) decreases.

As the carbides are worn out and struck by the moving abrasive particles, additional carbides are appearing to resist the abrasive effect and retard wear.

These alloys should not be used to join parts but can be applied on carbon steels, low alloy steel, austenitic manganese steel and cast iron (with special welding procedures).

4 MATERIAL BASE - ACERO AISI-SAE 1045

It is a steel used when strength and hardness are required in the supply condition. This medium carbon steel can be forged with hammer. It responds to heat treatment and flame cure or

induction, but is not recommended for cementation or cyanide When suitable welding practices are done, it presents adequate weldability. Due to its hardness and toughness it is suitable for the manufacture of machinery components.

MECHANICAL PROPERTIES	
Hardness	163 HB (84 HRb)
Creep stress	310 MPa (45000 PSI)
Maximum effort	565 MPa (81900 PSI)
Elongation	16% (en 50 mm)
Area reduction	40%
Modulus of elasticity	200 GPa (29000 KSI)
Machinability	57% (AISI 1212 = 100%)
PHYSICAL PROPERTIES	
Density	7.87 g/cm3 (0.284 lb/in3)
CHEMICAL PROPERTIES	
0.43 – 0.50 % C	
0.60 – 0.90 % Mn	
0.04 % P máx	
0.05 % S máx	

5 WELDING E6 - A - 60

Good resistance to abrasion and moderate impact, whose deposit is composed of evenly distributed chromium carbides. The high hardnesses achieved (52-55 HRc) make their deposits non-machinable, but can be forged or tempered. The electrode E6 - UM - 60 is characterized by leaving a deposited material of good finish free of porosity and it is feasible to obtain weld beads free of cracks, for which, if necessary, the base material must be preheated. High performance electrode.

Electrode depositing chromium carbides, the deposited metal presents good resistance to abrasion and severe impact. Recommended for the protection of nails, corners, lips, mantillas, pine nuts, edges of anvils, camshafts, coplas, crosspieces, coplón, sieves, cones crushers, pumps, impellers and others in the mining industry, cement, Bricklayers, builders, etc.

Classification

AWS A5.13 / ASME SFA-5.13	EFe3
DIN 8555	E 6 - UM - 60

Welding Parameters

Para corriente alterna(AC) o continua (DC): Electrodo al polo positivo DCEP							
Diámetro	[mm]	1,60	2,50	3,25	4,00	5,00	6,30
	[pulgadas]	1/16	3/32	1/8	5/32	3/16	1/4
Amperaje mínimo		-	-	100	140	190	230
Amperaje máximo		-	-	135	5/32	240	280

Applications

Its high hardness confers excellent resistance to metal - metal friction, but it must be taken into account that it will be the component of sacrifice due to its high level of hardness.

As "preventive welding" to coat and protect new components or parts, they will be exposed to severe abrasion combined wear agents with moderate impacts.

It can be used to rebuild parts and as bed cushion special protective coatings.

It is often applicable in the mining industry for recovery and protection of equipment such as: buckets, buckets, dredgers and feathers, bulldozer blades, hammers, crushing plates and cones, pumps, impellers, etc.

Used in the cement industry, bricklayers, constructors, plastic factories, glass, etc.

Within the varied applications we have: Recovery of chain sprockets, gears, sprokets, edges of anvils, camshaft, plowshares, shavings grills, etc.

6 SMAW WELDING

The SMAW (Shielded Metal Arc Welding) electrode welding process is characterized by the creation and maintenance of an electric arc between a metal rod called the electrode and the base material to be welded

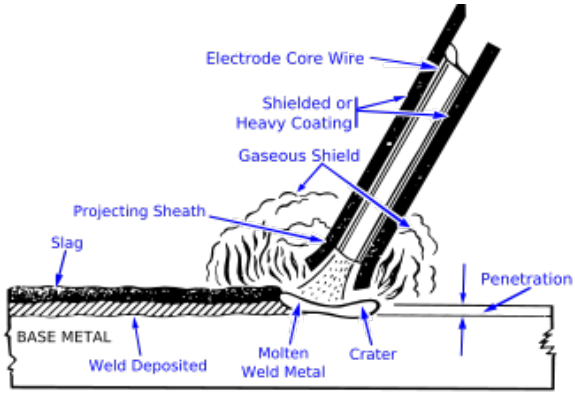

Fig 10. Electric arc

The coating of the electrode, which determines the metallic and chemical characteristics of the joint, is constituted by a set of mineral and organic components that fulfill the following functions:

- Producing protective gases to avoid atmospheric pollution and ionizing gases to direct and maintain the arc
- Produce slag to protect the metal already deposited until its solidification
- Supply deoxidizing materials, alloying elements and iron powders

The main factor that makes this welding process such a useful method is its simplicity and, therefore, its low price. Despite the wide variety of welding processes available, coated electrode welding has not been displaced from the market. Simplicity makes it a practical procedure; All you need a welder to work on is a power supply, cables, an electrode holder and electrodes. The welder does not have to be next to the source and there is no need to use compressed gases as protection. The procedure is excellent for work, repair, manufacture and construction.

In addition, SMAW welding is very versatile. Its field of applications is enormous: almost all the work of small and medium weld of workshop are realized with coated electrode; Weld metal of almost any thickness and can make joints of any type.

It is usually used with inverted polarity for greater penetration during welding.

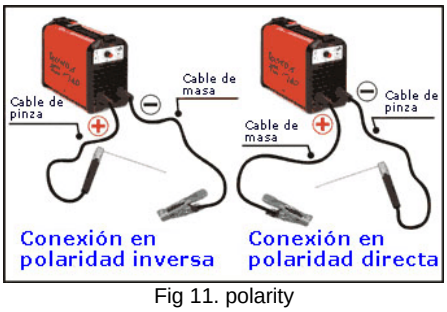

Fig 11. polarity

Variables

Welding Variables are factors that can be adjusted to control a weld. To obtain the best results in the process, it is necessary to know the effect of each variable on the various characteristics or properties of the welding process. Certain variables that can be continuously regulated or easily measured constitute better controls than those that cannot be measured or can only be modified indirectly. To start the welding process, it is necessary to define previously some of these variables, which we will call:

Preselected Variables. These are:

- Diameter of the wire-electrode,
- Chemical composition of the same.

The criteria that allow an appropriate selection of these Variables are:

- Type of material to be welded
- Thickness
- Welding Position
- Desired metallic transfer rate and mechanical properties required.
-

The Primary Variables these are who control the process after the Preselected Variables were selected: They control the shape of the cord, the stability of the arc, the welding regime (Feed rate and amount of added metal) and the quality of welding. These variables are Arc voltage, Welding current and Feed rate. Schematic of the weld bead.

SOLIDABILITY OF STEEL SAE 1045

Steel contains Si, Mn, P and S plus C. These five chemical elements are called the 5 chemical elements of steel. Steel containing 0.3% or less of C is called low-C steel or mild steel. Steel with 0.6% or more of C is called high-C steel. For example, coal from a steel tool is in this grade.

Steel with 0.3 - 0.6% is called medium carbon steel. The steel of the machine structure is in this grade. The special steel is of such a degree that it contains, in addition to the five elements, a higher Mn compared to the carbon steel. Alloy elements such as Ni, Cr and Mo are also added for the intended use.

1045 steels due of their high carbon content are not weldable by common means without compromising their strength. It must be welded with a suitable procedure by preheating the material. The increase of temperature in the zone of the weld and its subsequent cooling "templa" the steel in the zones next to the welding producing fragility and failure by the typical case of break in the zone next to the weld.

7 ROLLER REPAIR

FAILURE REQUIREMENT

The roller should not have faults larger than 2.5 mm deep.
The failure rate should not exceed 5% of the total roller surface

PREVIOUS WORKS

Cleaning materials such as oils, grease and dust, so that they do not damage the welding process.
Brush the points to be filled and if it is necessary, grind.

WORK ASSURANCE

Comply with all the requirements to be able to perform a safe work, such as signage, use of extinguishers, use of epps and tools in good condition

MATERIALS TO BE USED

- Welding machine
- Electrode E 6 - UM – 60
- Preheating equipment

Rango de variables

Temp. Heating	390 º C
Amperage	110 - 140 amp
Voltage	20 - 24 volts
Temp. interpase	90 ºC

CONCLUSIONS

- SAE 1045 steel can be welded with a suitable process.

- The developed procedure only applies to fill processes.

- With this procedure we can mitigate the faults caused by wear and tear.

REFERENCES

- AWS D1.1
- OERLIKON welding manual
- INDURA maintenance manual
- Standard ASTM E 18
- Standard ASTM G 65