

NONCONVENTIONAL ASPECTS OF THE ROLLER WELDING TECHNOLOGY FOR THIN SHEET STEEL

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ABSTRACT: The concentrated energies form the basis of the unconventional technologies. The concentrated energies form the basis of the unconventional technologies. The technological solutions and functional-constructive of the welding in line systems for the thin sheet, applied in the modern manufacturing can present significant unconventional multiple issues. The paper includes an analysis of the performance of an automatic welding line roller and copper wire used in the construction of ventilation systems. Also carry out a comparative study between thin sheet welding using the method by points and using the welding in line using roller and wire by copper.

KEY WORDS: roller welding, non-conventional technologies, thin sheet steel, equipment, performances

1. INTRODUCTION

The welding joints of thin sheet steel is the subject of many studies and research because the joint quality and processing costs, as in many other situations, are inversely proportional ratio. For that is a great difficulty to find a satisfactory solution, especially through the exclusive use of technologies conventional.[1], [2]

In the last 30 years many manufacturing gaining the knowledge required to develop own seam welders. Now are a lot of welding systems with both circumferential and longitudinal models, with knurl drives, direct drives, with filtered re-circulating drip pans, and special tooling that is compatible with the equipment. For the producers are necessary new tenders for to have a wide selection of used seam welders on hand to refurbish, should the need arise for a more economical solution.[3],[6], [8]

To do this, the constructive and technological design of machinery is increasingly based more on assumption of the principles in the area of unconventional technologies. It is searching to use the concentrated energy generation by multiple methods.[4],[5],[8]

In order to solve the problem of optimal welding of thin sheet for ventilation networks, were sought many combinations of principles used of the energies of concentrates and fillers, to ensure that the conditions of performance. These conditions relate in particular to very good impermeability, heat-affected zone minimized without significant structural change, aiding by high productivity equipment.[7],[9],[11]

2. METHOD AND MATERIALS

The experimental research was undertaken for to optimize the weld of the thin sheets at the company SC DOSETIMPEX SRL, Timisoara. After analyze of overall working conditions was observed modernized technical equipment, this company representing an important landmark in designing, executing and delivering installation equipment for constructions. One of the company's prime constituting characteristics is innovation. The company portfolio contains numerous projects in the field of building installations. The company can execute the following types of installations: central heating installations, heating installations, ventilation and air-conditioning installations, sanitary installations, pneumatic document transport installations, radial floor heating installations, frigorific installations for constructions, fire-extinguishing installations.[2][12]

In order to optimize the technological process of realization of ventilation networks were studied two technologies types for welding: points welding (used previously) and the line welding (in a new constructive embodiment and implemented in the technological flow)

Spot (points) welding technology has multiple applications due to many advantages such as: very good weld-ability, high productivity, requires no filler, small stress and strain, no polluting, low cost, easily mechanized, automated or for robotic.[5][11]

The *welding in line* (welding with roller) pressure and electric resistance is really a strong welding in successive points in which the contact electrodes as

nails are changed with copper roller of contact performing which realizes the gathering and the discharge of the sheets for welding, the transmission of the welding current, and, with a continuous or intermittent rotary motion made the advance of the welding parts.[1],[2],[10]

Roller seam welding is a kind of resistance welding and is derived directly from spot welding. The electrodes are designed as copper rollers. The rollers above and below the sheets to be welded press the sheets together and simultaneously, transfers the weld current. Roller seam welding can only be used for joining thin sheets. Different seam geometries are possible, from lap welds to butt welds.[2]

That it applies to the non-alloy steel plates, low alloy, alloy or high alloy (stainless steels). Also is a very good technology for the aluminum alloys, thick sheet of 0.2 to 4 mm

It can obtain a high productivity in the mechanized variant, seam sealed, but with high cost machine. Also, it is better to use the welding in current pulses.

For the experiments were used a welding machines with rollers and with copper wire, produced in a new model (2014), delivered by JOUANEL INDUSTRIE from France, (but made by JINWOONGTECH.CO., LTD. from South Korea). (Figure 1)

In order to determine the optimum of the processing conditions were tested operating modes of the machine offered by producer:



Figure 1. Welding machine with roller and wire by copper. (source:[12])

The type of this machine is stitch and continuous, with welding speed max. 10 m/min.

- Processing diameter: 75-1000mm;
- The length of the welding: 50-1270mm;
- Sheet thickness: max 1,2mm;
- Power supply: 380V, 50Hz; 3 PH;
- Maximum Dimensions (LxWxH): 3000x1500x2500mm (for reasons of space available);
- Maximum weight: 2250 kg (maximum allowable load considerations floor-500 kg /m²);
- Seam overlap – 6 mm;

The machine includes a cooling system with water.



Figure 2. Detail from the welding area. (source:[12])

Welding in line with wire and roller by Cu, continuous or not, is performed on the generator sheet shells, achieving a permanent joining between the welded parts.

In order for to achieve weld the two sheet edges are overlapped (3+3) mm, and these are fixed by means of jaws operated by compressed air.

In performing the welding, it determines a longitudinal movement on the generator sheet shells between the two copper rolls.

The welding process is based on Joule-Lenz effect, by which the melting point of the metal reach at the passage of electric current between the contact rollers

To avoid the deposition of zinc on the pinch copper rollers, they are provided with one slit through which is run a copper wire, with 1.8 ... 2mm diameter and 99.9% purity. In this case, during the

welding galvanized sheets, the zinc sticks on the mesh wire and the rolls of copper remains clean.



Figure 3. The control panel of the automatic welding machine, in line, with roller and wire by copper.(source:[12])

The automatic welding machine in line, with rollers and with copper wire (Figure 3) is used for joining by welding of galvanized steel shells, black sheet steel or stainless steel sheet. Thus one can obtain circular canals or special circular parts (elbows, tees, reducers, etc.) which are used in ventilation systems and to the production of chimneys. The specifications of the copper wire are shown in the table 1.

Table 1. Specification of copper wire

Cupru (Cu)	99.9%
Oxygen (O2)	0.005 ... 0,040%
Rezistență (20°C)	Max. 0,01730 ($\Omega \times \text{mmp}$)/m
Thermal expansion coefficient	1.7×10^{-5} / Kelvin
Wire form	Round
Diameter	1.8mm
Cross section	2.54 mmp
Tensile strength	235 ... 255N/mmp
Breaking strength (0,2%)	98 ... 108N/mmp
The ultimate elongation	41 ... 48%
Modulus	$11 \times 14,4\text{N/mmp}$

The experiment consisted of the welding on along the generator of a truncated cone-shaped shell of sheet stainless steel, with a thickness of 1 mm, in the two technological variants selected. (Figure 4)



Figure 4. Stainless steel shell non-welded.

3. RESULTS AND DISCUSSIONS MATERIALS

After the welding, the two shells were compared, both technologically and economically. It was analyzed the quality aspects of the welded joint and the labor productivity issues.



Figure 5. Stainless steel shell welded.

For to analyze and compare labor productivity using the two methods of welding, the weld will clock times required a length of 300 mm shells in the two cases: spot welding and welding wire line roller and Cu.

After the comparative analysis of the weld line and spot welding, it can be observed if the seam appearance of the welding were compared, it is visible the better quality of the welding made by the welding in line, with rollers and wire made by copper. (Figure 6 and Figure 7)



Figure 6. Stainless steels shell after spot welding.

T_{prep} – Time during the preparation of the piece for to weld

T_{weld_l} – Time for the welding in line

T_{weld_p} – Time for welding in points/spots

The timing times above, it obtains the results as in table 2.

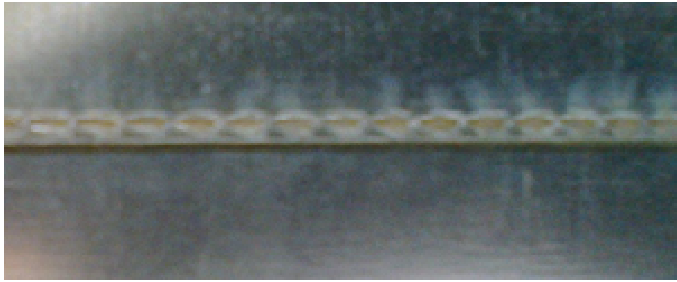


Figure 7. Stainless steels shell after line welding.

Table 2. Results after welding timing

	Point/Spot welding	Line welding
Figure 8. Preparation time, T_{prep} , [s]	5	5
Figure 9. Welding time, T_{weld} , [s]	72	3,6
Total time	77	8,6

For analyzing of the labor productivity, using the two methods of welding, it denote by:

Both the Table 2, but especially from the graph from Figure 8, it is shown the impressive difference between the two methods applied.

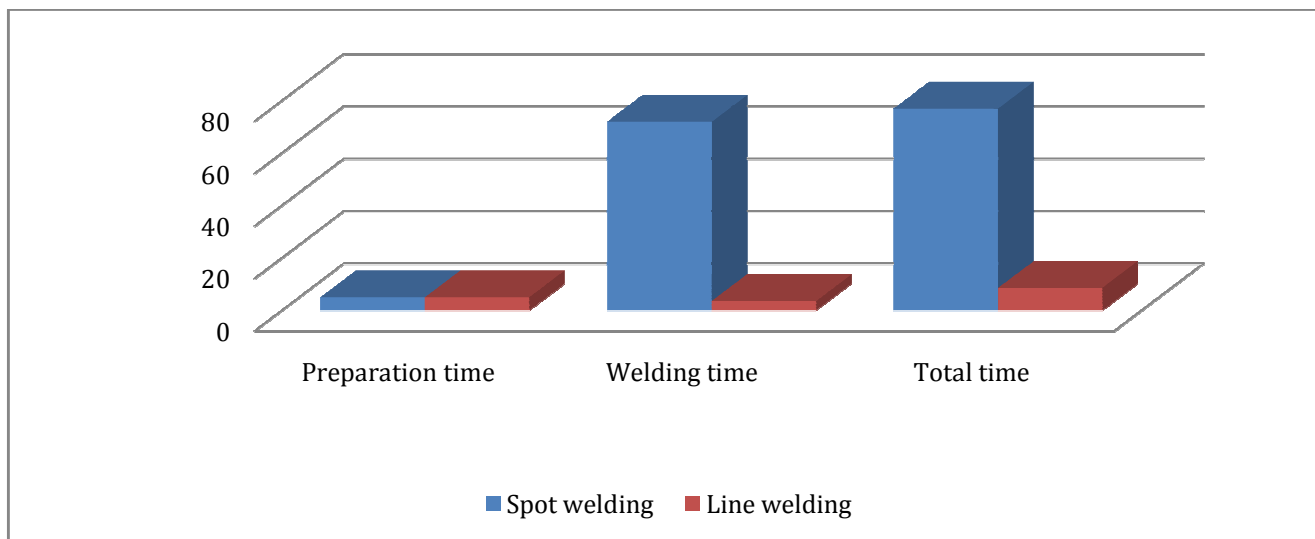


Figure 8. – Graph with the comparison image of the welding time in the 2 variants

Unlike spot welding, roller seam welding is a continuous process – at least as far as the relative motion of electrode and work piece is concerned. The rollers run along the sheet and do not have to be opened for the feed process. For the same reason, wear on the electrodes is reduced. The weld spots are generated by means of current pulses. The higher the pulse frequency (with constant feed), are the closer together the weld spots. If the welding current flow is not interrupted, seal welds can also be produced.

4. CONCLUSIONS

The essential advantage of the spot welding rollers and wire line - is the high productivity, the welded joints being superior in terms of economic as other types of joint (seam, rivets, spot welding, screws, etc.)

Also, the pieces obtained by spot welding parts obtained are aesthetically inferior weld line pieces welded wire line roller and can be fitted with apparently both in ventilation systems and chimneys as well.

Another advantage of the weld line is high tightness of the pieces thus obtained, which helps avoid oversize of ventilation and air conditioning, including related equipment (fans, central air handling etc.)

And from this research it was confirmed that the principles of non-conventional technologies, based on the concentration of the energies, can be found in multiple constructive variants, for the resolution of some important industrial technologies.

Acknowledgement:

The study was performed on basis a applied research program about non-conventional technologies as modern technical solutions in the manufacture of the installations for ventilation, between Romanian Association of Non-Conventional Technologies, Branch Timisoara, and the company SC DOSETIMPEX SRL, Timisoara, founded and headed by Eng. IoanSilviuDobos and Drd.Eng. Stefan Dună.

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