16th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2012, Dubai, UAE, 10-12 September 2012

DETERMINATION OF TEMPERATURE BY RYKALIN'S THEORY AND THERMOVISION METHOD DURING THE WELDING

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ABSTRACT
In this paper are presented calculated temperatures of Rykalin's method and temperatures measured during the conduct of Thermovision method in welding a thin steel plates with small quantity of carbon (<0.1%C). These temperatures present a good consistency comparing to losses and other difficulties appeared during the welding and measurements with such method.
Keywords: welding, temperature, experiment, Rykalin, Thermovision.

1. INTRODUCTION

Temperatures that appears in the heat-affected zone and in the melted zone are the main factors for evaluation of the structure and quality of the welded seam. Depending from the temperature that follows the welding process will appear also zones with different mechanical properties and chemical composition. The maximum temperature that is achieved during welding process is different and depends from the distance of the analysed point taken from welded seam [1,2].

2. EXPERIMENTAL DETERMINATION OF TEMPERATURE FIELDS

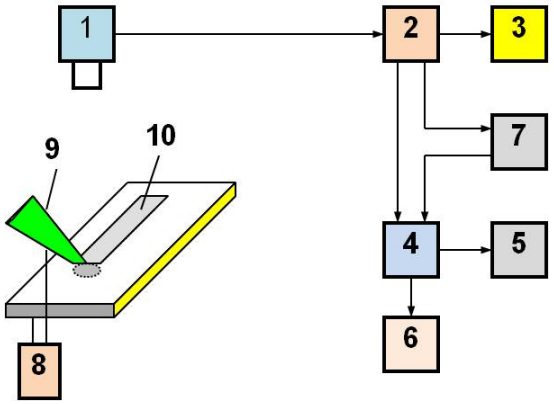
Determination of temperature fields (zones) during the welding process is done using Thermovision method.

2.1 Thermovision method

Use of thermovision method for measuring tempertures during welding process help us to solve three major problems [3];

1 Welding process (electrical arc , melted material, mixing momentum) can be followed live by the eye of the worker.
2 Thermo cycle elements can be followed and be measured during and after welding process.
3 To find the relationship between the of thermo cycle elements and mechanical feature of the basic and filling material of welded seam.

In the figure 1. is shown schematic way of preparation and welding process, whereas in the figure 2. is shown the view of temperature zones during welding with GMAW method.



Block-scheme of thermovision method;1- thermovision camera, 2-device for adjecment photos, 3-monitor, 4-device for readingthe size of temperature fields, 5-colour screen, 6-digital reader, 7-processing reader, 8-source of electricity, 9-gas nozzle, 10-welded seam

Figure 1.

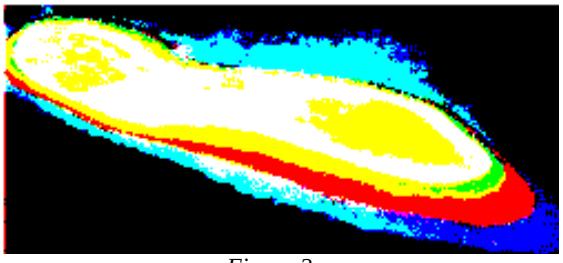


Figure 2.

3. WELDING PARAMETERS WITH GMAW METHOD

The welding parameters are determined based on the type of basic material used and type of welding process. For our study case the following parameters are measured [3,4];

- voltage ……..……. U=26 V
- electric intensity…… .I=200 A
- welding speed …… v=0.043 m/s
- utilization coefficient ……...η=0,66

3.1. Thermodynamic characteristics of the basic material

The basic material which is taken in the study is a steel slab with the thickness of s= 2mm and 0.1 % carbon. For the taken material and for the initial temperature T_o= 273 ^oK these thermodynamic characteristics are measured [3]:

- density ……..ρ=7850 kg/m^2
- specific heat …….c=0.465 KJ/kgK
- thermal conductivity ……λ=59 W/mK

For easier calculation of thermo cyclic process elements, thermodynamic characteristics are appropriate as constant.

The obtained results with calculation and those obtained in the experimental way are showed on the table 1.

Table 1. The obtained results with calculation and thermovision method[3]

Nr.	Calculated temperatures according to Rykalin		Measured temperatures with Thermovision method	
	t[s]	$T_{(t)}$[K]	t[s]	$T_{(t)}$[K]
1	0.1	2531	0.1	2380
2	0.2	2053	0.2	1781
3	0.3	1576	0.3	1438
4	0.4	1429	0.4	1390
5	0.5	1282	0.5	1343
6	0.6	1204	0.6	1305
7	0.7	1126	0.7	1268
8	0.8	1039	0.8	1233
9	0.9	996	0.9	1215
10	1.0	953	1.0	1198
11	1.5	850	1.5	923
12	2.0	781	2.0	845

The graphic interpretation of calculated temperatures and those fixed in the experimental way is shown in the figure 3.
The curved that shows the differences between calculated temperatures and those fixed in the experimental way are shown in the figure 4.
The obtained results with calculation and Thermovision method:

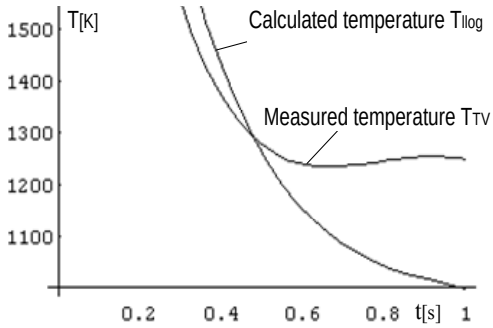


Fig. 3. Graphic display of the calculated temperature (Tllog) and those measured with Thermovision method (TTV).

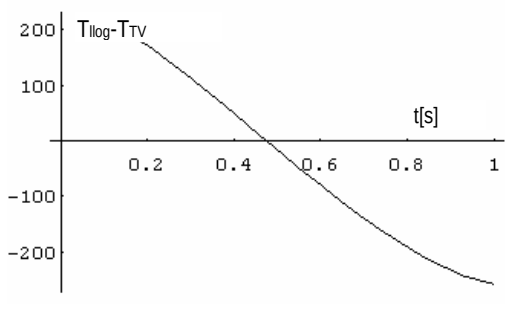


Fig.4. Curve that shows the differences between calculated temperatures (Tllog) and those measured with Thermovision method (TTV).

4. RESULT ANALYSIS

The obtained results of the temperatures measured in the analytic way according to Rykalins, and in the experimental using Thermovision method shows a definite difference for the same time interval. From the derived diagram on figure 3. it is obvious that the obtained temperatures in the analytic way are greater than those in the experimental way with Thermovision method for the time interval t = 0,1 - 0,4755 sec. While, temperatures obtained in experimental way using thermo – vision method are greater than temperatures obtained in analytical way for the time interval t>0,4755 sec. For the time approximately t = 0,4755 sec, obtained results analytically and experimentally are the same. The difference of the obtained temperatures with these two methods graphically is presented in the figure 4.

5. CONCLUSION

Based on the result analysis obtained analytically using Rycalin's expressions and the experimental method done by Thermovision method it is concluded that temperatures are having a define difference, but that is not so big. That's why these two methods can successfully be used to determine the factors which appears during and after welding process of thin metal slab with MMAW and GMAW methods.

6. REFERENCES

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