RESEARCH PAPERS
FACULTY OF MATERIALS SCIENCE AND TECHNOLOGY IN TRNAVA
SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

2009 Number 27

RE-ENGINEERING TUBE PRODUCTION THREE-DRAW SINGLE-RUN TECHNOLOGY

Martin RIDZOŇ, Andrej MALÍK, Jozef BÍLIK

Abstract

This contribution discusses the re-enginnering production of precision seamless steel tubes, cold drawn three-draw single-run technology. The aim of the experiment is to verify the possibility of hauling rolled tubes (material E355) of size ∅ 70 x 6,3 mm without intermediate re-crystallising annealing to obtain the final size ∅ 44 x 3 mm, in terms of mechanical properties for tensile testing of the base and in terms of internal pipe surface roughness.

Key words

three-draw single-run technology, mandrel drawing of tubes, reduction, material E355, surface roughness

Introduction

It's known as drawing tubes with cold-forming means, whereby the starting material (pipe) ductile beams in such a way that reduces the cross-section, resulting in thinner or thick wall tubes, and increases its length. Forming takes place in a number of routes, depending on the source and ultimate size of the pipes. An important role performs a proportional reduction in choice for the individual sections because the uneven distribution has resulted in reduction of tension and the deformation or cracks by drawing, which are then reflected on the surface roughness of tubes.

Martin Ridzoň, MSc. Eng., Andrej Malík, MSc. Eng. Jozef Bíllik, Assoc. Professor, PhD. - Department of Forming, Institute of Production Technologies, Faculty of Material Science and Technology in Trnava, Slovak University of Technology Bratislava, Paulínska 16, 917 24 Trnava, Slovak Republic, e-mail: martin.ridzon@stuba.sk, andrej.malik@stuba.sk, jozef.bilik@stuba.sk

Experiments

The experimental material is non-alloy structural steel grade E355 (see Table 1), which were subsequently produced with a hot rolled pipe diameter ∅ 70 x 6.3 mm.

CHEMICAL COMPOSITION OF EXPERIMENTAL MATERIAL E355 Table 1

C	0,1800	Mn	1,1800	Si	0,2300	P	0,0150	S	0,0140	Cr	0,0500
Ni	0,0800	Mo	0,0200	Ti	0,0020	V	0,0030	Nb	0,0010	N	0,0090
Al	0,0230	Zr	0,0020	Ca	0,0022	As	0,0060	W	0,0100	Zn	0,0040
Cu	0,2000	Sn	0,0160	Pb	0,0010	O	0,0032	Sb	0,0040	Ce	0,0010

The experiment was conducted on pipes with a rolling temperature at 830 ° C according to the following procedure: Deburring - chemical treatment - drawing tube at a fixed mandrel roller, and other operations. Technological parameters of the drawing tube size ∅ 70 x 6.3 mm in size ∅ 44 x 3 mm are listed in Table 2. Detailed view of the internal pipe surface is shown in Figure 1.

TECHNOLOGICAL PARAMETERS OF DRAWING TUBES
(THREE-DRAW SINGLE-RUN TECHNOLOGY) Table 2

O.D.	W.T.	DÍžka	L hrotu	hrotu	O.D.	W.T.	r	I.D.1	I.D.2	r W.T.	r O.D.	predÍž	L po ťahu
70,00	6,30	4300	300	40	57,00	5,00	35,21	57,4	47	20,63	18,57	1,54	6174
57,00	5,00	6174			50,00	3,75	33,29	47	42,5	25,00	12,28	1,50	9255
50,00	3,75	9255			44,00	3,00	29,08	42,5	38	20,00	12,00	1,41	13050
							69,35						

O.D. – outer diameter tube [mm], W.T. – wall thickness tube [mm], L mandrel – mandrel length [mm], r – reduction, length – length tube, I.D.1 – internal diameter before drawing, I.D.2 – internal diameter after drawing

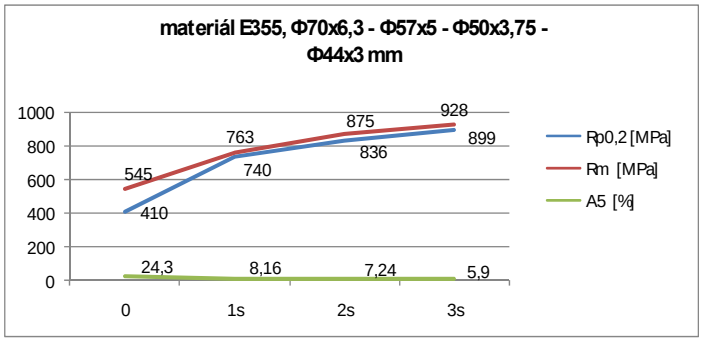
a) *b)* *c)*

Fig. 1. *Detail of internal tube surface, material E355*
a) Ø57x5, 1. - draft, b) Ø50x3,75, 2. - draft, c) Ø44x3,3. - draft

Evaluation experiment

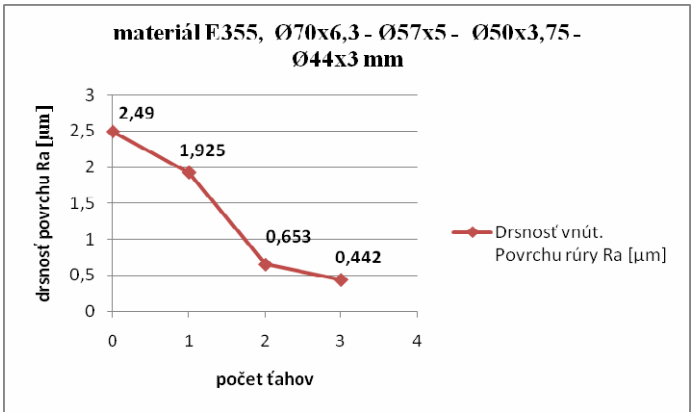
Sequence sampling for mechanical testing of tubes:
1.) After first draft – from size ∅ 70 x 6,3 mm in size ∅ 57 x 5 mm
2.) After second draft – from size ∅ 57 x 5 mm in size ∅ 50 x 3,75 mm
3.) After third draft – from size ∅ 50 x 3,75 mm in size ∅ 40 x 3 mm

Measured values of mechanical properties of pipes to individual drafts are shown in Graph 1 and values of the internal pipe surface roughness after different drafts are shown in Graph 2. Graph 2 shows the mean values of measured surface roughness. Surface roughness measurements were performed on the device Taylor Hobson Surtronic 3 +.



Graph 1. *The resulting measured values of mechanical tube*

0 – rolled tube (intermediate input), 1s – first draft, 2s – second draft, 3s – third draft



Graph 2. *The resulting measured values of surface roughness tube Ra*

(Arithmetical deviation of the assessed profile) [µm]

The required mechanical properties according to EN 10305-1, thus forming and heat-treated steel E355 +C (+C = no heat treatment after the last cold forming) are: Rm min 640 MPa, A5 min 4%, and the resulting roughness Ra 4 µm. Roughness measurement was carried out in accordance with EN ISO 4287th.

Conclusion

A comparison of mechanical values imposed by EN 10305-1, where Rm = min 640 MPa and A5 = min 4 %, and the resulting roughness Ra 4 μm measured mechanical values obtained by static tensile test where Rm = 928 MPa, A5 = 5,9 % and measurement of internal surface roughness tubes Ra 0,442 μm. This shows that the material meets the requirements in standard EN 10305-1 and is suitable for further forming operations.

References:

[1] VELES, P. *Mechanical properties and testing of metals*. Bratislava: ALFA, 1985.
[2] IŽDINSKÁ, Z., EMMER, Š., GONDAR, E. *Engineering Materials*. Bratislava: STU, 2006, ISBN 80-227-2488-2
[3] RIDZOŇ, M. *Research on technological parameters affecting the production and properties of steel pipes*. Písomná práca k dizertačnej skúške. Trnava, 2009.
[4] STN EN 10002-1
[5] EN ISO 4287

Reviewers:

Zdenko Lipa, Professor, PhD. - Department of Forming, Institute of Production Technologies, Faculty of Material Science and Technology in Trnava, Slovak University of Technology Bratislava

Viliam Pálka, Assoc. Professor, PhD. - Slovak Academy of Sciences, Institute of Materials and Machine Mechanics, Bratislava