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AN INFLUENCE OF REDUCTION SIZE ON MECHANICAL PROPERTIES OF PIPES AND SURFACE ROUGHNESS

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ABSTRACT
This paper discuss about influence of reduction size on mechanical properties of pipes and surface roughness. The aim of this experiment is to verify the option of pulling rolled pipe (material E355) size ∅ 70 x 6,3 mm without intermediate recrystallising annealing has final size ∅ 45 x 3,75 mm looking at its mechanical features which determination is based on basic pulling test and from the point of view of roughness of inner surface of pipes.
KEYWORDS:
mechanical properties, two-draw single-run technology, mandrel drawing of tubes, reduction, material E355, roughness of surface

1. INTRODUCTION

It's called drawing tubes, cold-forming means, during which the original material (pipe) forms in beams, its cross-section shrinks, thins up or the thickness of wall of pipe enlarge and length increases. The process of forming happens in several moves, depending on the original and final size of pipe. The important task is the choice of proportional reduction for the particular cross-sections because the unbalanced decomposition of reduction results into tension and deformation or cracks during the pulling, that will consequently influence the roughness of pipes' surfaces.

2. EXPERIMENTS

The material used for this experiment was non-alloy structural steel cllass E 355 (see tab.1). This material was used to manufacture pipes size ∅ 70 x 6,3 mm. by process of hot rolled.

Table 1. Chemical composition of experimental material E355

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 at rolled by rolling temperature - 830 ° C according to the following procedure: Deburring - chemical treatment - drawing tube at a fixed mandrel roller - other operations. Technological parameters of the pipe pulling - size C 70 x 6.3 mm to size C 45 x 3.75 mm are listed in Table 2. Detailed view of the internal pipe surface is shown in Fig.1.

Table 2. Technological parameters of the pipe pulling (two-draw single-run technology)

O.D.	W.T.	Lenght	L tip	∅ tip	O.D.	W.T.	r	I.D.1	I.D.2	r W.T.	r O.D.	extension	L after pull
70,00	6,30	4600	300	40	55,00	4,35	45,10	57,4	46,3	30,95	21,43	1,82	7832
55,00	4,35	7832			45,00	3,75	29,79	46,3	37,5	13,79	18,18	1,42	11155
							61,45						

O.D. – Outer pipe diameter [mm], W.T. – The wall thickness of pipe [mm], L tip – tip length [mm], r – reduction, Length – The length of pipe, I.D.1 –Internal diameter before pulling, I.D.2 – Internal diameter after pulling

a) b)

Figure 1. Detail of the inner surface of the pipe grade OR-3
a) Ø55x4,35, 1-pull, b) Ø45x3,75, 2-pull

Figure 3 shows the mean values of measured surface roughness. Surface roughness measurements were performed on the instrument Taylor Hobson Surtronic 3 +.

The required mechanical properties according to EN 10305-1 and thus shaped and heat-treated steel E355 + C (C + acronym means - 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 4287.

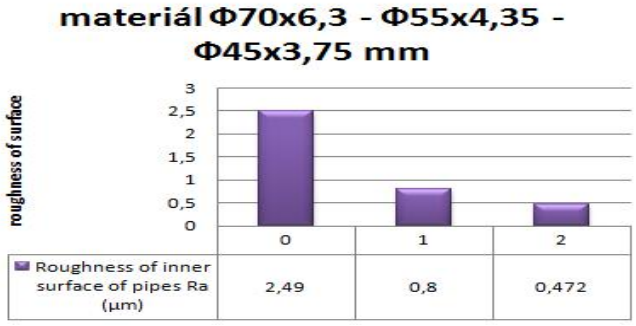

Figure 3. The resulting roughness values of pipes Ra [μm] 0 – rolled tube (intermediate input), 1 – first draft, 2 –second draft

3. RESULTS AND DISCUSSION

The sequence of sampling for mechanical testing of pipes:

1.) After the first pull – from size ∅ 70 x 6,3 mm to size ∅ 55 x 4,35 mm

2.) After the second pull –from size ∅ 55 x 4,35 mm to size ∅ 45 x 3,75 mm

Measured values of mechanical properties of pipes after individual pulls are shown on Figure 2 and values of the internal pipe surface roughness after individual pulls are shown on Figure 3.

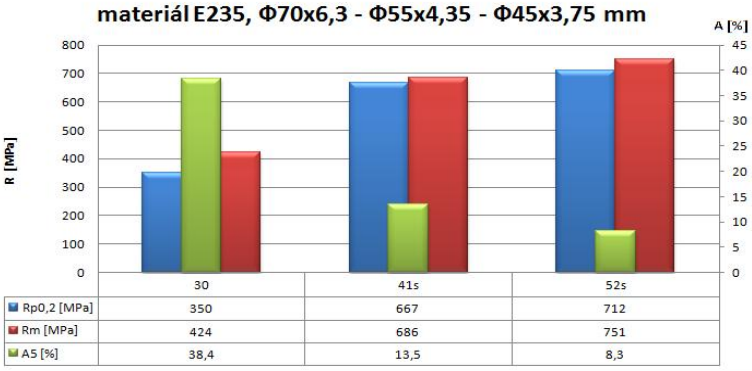

Figure 2. The resulting measured mechanical values of pipes 30 – rolled tube (intermediate input), 41s – first draft, 52s –second draft

4. CONCLUSION

A comparison of mechanical values imposed by standard EN 10305-1, where Rm = 640 MPa min and A5 = min 4%, and the resulting roughness Ra of 4 μm measured mechanical values obtained by static tensile test where Rm = 900 MPa, A5 = 10.8 % and measurement of internal surface roughness Ra 0.472 μm tubes shows that the material meets the requirements in standard EN 10305-1 and is suitable for further forming operations.

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