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DIELESS DRAWING- TECHNOLOGICAL PARAMETERS AND MECHANICAL PROPERTIES

M.Gliga, T.Canta

Technical University of Cluj-Napoca

ABSTRACT: The aim of this paper is to give a presentation of the dieless drawing- a nonconventional process of plastic deformation. This process is applied with success to materials with high deformation resistance and/or high friction resistance. For all tested materials large reductions of area were obtained in a single pass. The study of influence of thermo-mechanical parameters on physical-mechanic properties of drawn semiproducts have included the influence of: deformation temperature, drawing speed and cooling rate on material hardness

KEYWORDS: drawing, incremental, temperature, hardness

1. INTRODUCTION

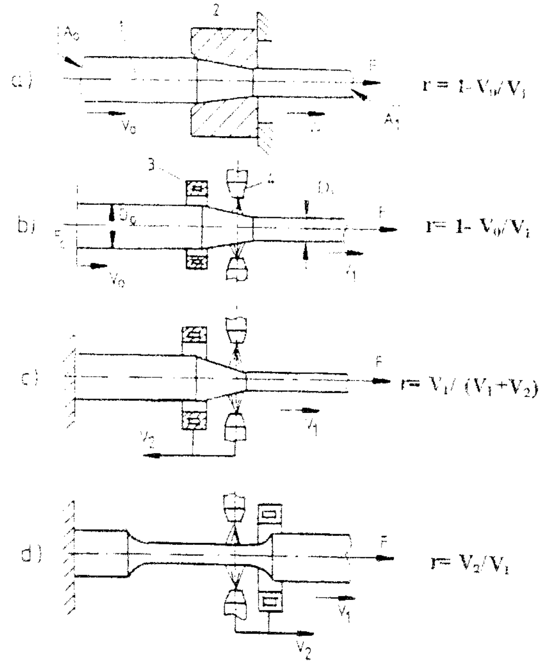
Dieless drawing is an incremental process of plastic deformation, which permits the deformation of usual industrial materials like: wires, tubes, bars by controlling the heat temperature/local cooling and without dies.

Figure 1 shows the principle of dieless drawing(a. traditional process, b.c.d.dieless drawing); to cause necking the wire is locally heated and to stop further deformation the necked part is cooled. In order to otain a continuous deformation it is neccessary to assure a relative stable movement between the deformation zone of semiproduct and the heating-cooling device.

The parameters of the process which have a great influence on the successful drawing are: heating/cooling speeds and the temperature distribution in the deformation zone. The design of the heating-cooling device is very important for the process stability and for the dimensional precison of the drawn products.

2. EXPERIMENTAL METHOD

The scheme of a discontinuous drawing equipment is presented in figure 2, where the heating-cooling device is fixed[1]. This equipment was designed and realised in the Department of Plastic Deformation of Metals from the Technical University of Cluj-Napoca. The main part of the device is the drawing-counterdrawing mechanism that realises the drawing through the heating-cooling system. The device is mounted on an already existent hot testing machine. Inductor coil 11, with 4 turns of copper wires of 6mm internal diameter provide the local heating. Cooling is achived with the help of compressed air directed over the specimen through device 5. The system for measuring the main parameters of the process(temperature, force, displacements) consist of traducers, amplification and recording device. Recording of the main parameters is made with the help of a data aquisition system atached toa personal computer.



1-semiproduct; 2-die; 3-inductor; 4- cooling nozzle

Fig.1

3.EXPERIMENTAL RESULTS

The chemical composition of the studied materials is presented in table 1[1,2,4].

Table 1

Material	C	Si	Mn	P	S	Ni	Cr
OLC 10	0,011	0,14	0,17	0,007	0,016	-	-
OLC65A	0,6	0,22	0,41	0,01	0,001	-	-
18Cr-9Ni	0,06	0,61	1.8	0,003	0,02	9,19	18,82

The tested specimens were all the dimensions ∅3,6×400 mm.

Some results obtained for the tested materials are presented in table 2 [1,2,4], where T_0, T_1 are the temperatures in the entrance and exit zones of deformation, σ_0, σ_1 are the flow stress in the entrance and exit zones, r_t is the theoretical reduction and r_e is the experimental reduction.

Table 2

Material	T_0[°C]	T_1[°C]	σ_0[MPa]	σ_1[MPa]	r_t[%]	r_e[%]
OLC 10	700	400	150	520	73	41
	800	400	80	520	85	47
	900	400	60	520	89	54
OLC65A	700	400	190	490	68	39
	800	400	170	490	75	48
	900	400	120	490	81	53
18Cr-9Ni	900	400	210	510	59	40
	1000	400	190	510	63	50

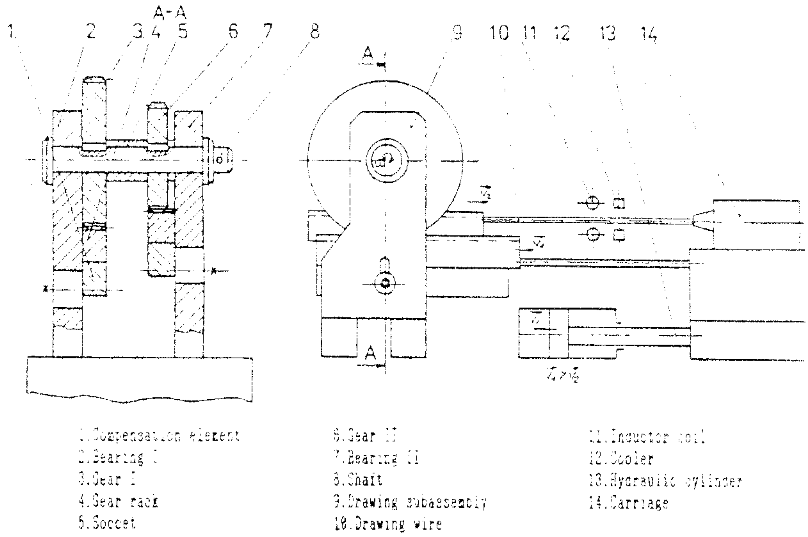


Fig.2

The influence of drawing stress on reductions obtained for different drawing temperatures for OLC10 are presented in figure 3[1]. It can be seen that the experimental curve has the same shape like the thoretical one, but at smaller values of reductions caused by modification of deformation resistance in the necking zone.

Some profiles of deformed semiproducts with different reductions are presented in figure 4 for a stainless steel[5].

The study of influence of thermo-mechanical parameters on physical-mechanic properties of drawn semiproducts have included the influence of deformation temperature, drawing speed and cooling rate on material hardness.

The variation of hardness vs the cooling rate for a spring steel is presented in figure5[6].
It can be seen that the cooling rate is the parameter that determine the surface durification, the reductions has no influence on hardness values.

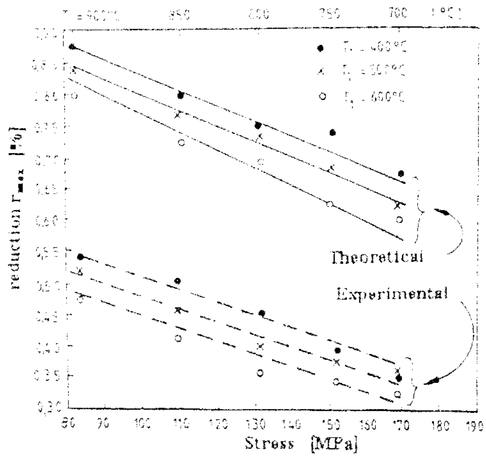


Fig.3

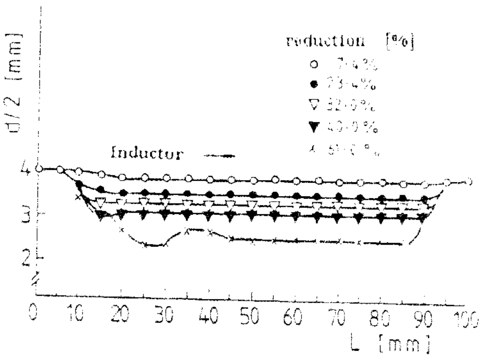


Fig.4

The variation of hardness vs the deformation temperature for the material OLC 10 is presented in figure 6[1].In this case temperature is the parameter that increase the material hardness, the reduction having a very small influence on it.

Thermal treatments can be applied to the workpieces during or after processing. The dieless drawing can be considered a thermo-mechanical treatment. The forming process influences the kinetics or phase and structural transformation mechanism that happens during the thermal treatment, influencing in this way the material final properties.

4.CONCLUSIONS

Dieless drawing has developed like a new metal forming process. It is an nonconventional and incremental process of plastic deformation which permits the deformation of industrial materials by control of heating/cooling temperature and without dies.

The experimental results which were realised on discontinuous dieless drawing equipment shown that for all studied materials can be obtained larger reductions of area in a single pass than in the classical process.

Temperature and cooling rates are the parameters which determine the surface durification. The reductions has a very small influence on hardness values .

Dieless drawing being a thermo-mechanical treatment the future research will concentrate on technological parameters which determine the results of this kind of treatment(deformation temperature, cooling rate, strain) and also on mechanical properties resulted after treatment.

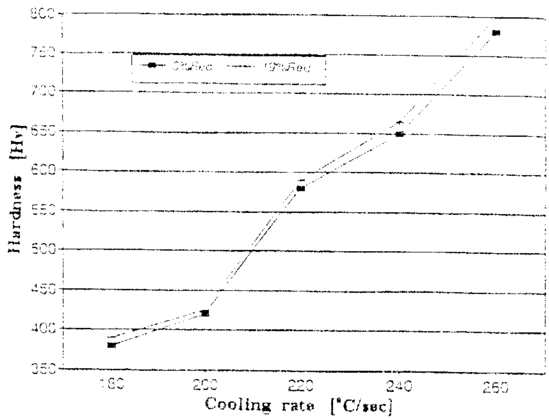


Fig.5

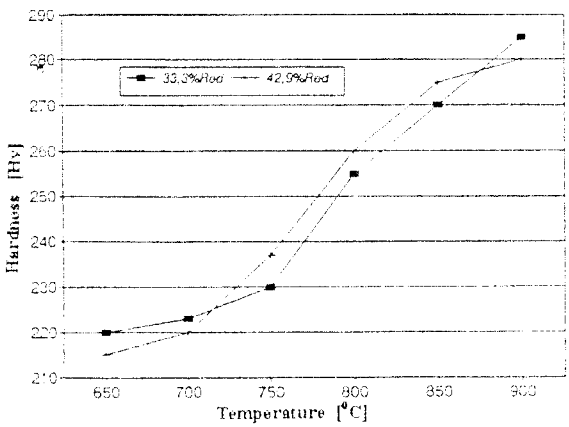


Fig.6

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