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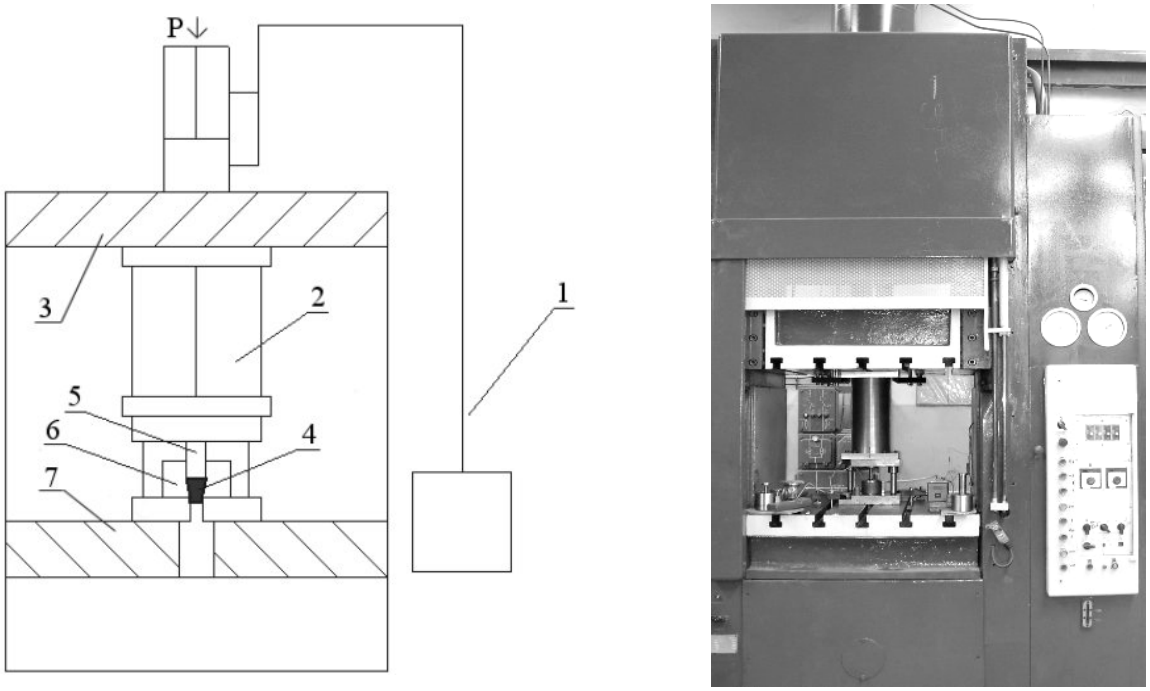
MEASUREMENT SYSTEM FOR RECORDING PARAMETERS OF BIMETAL EXTRUSION PROCESS

Equipping the press with modern measurement system makes easier the operating and automation press work and also it enables to increase the accuracy of manufacturing. In many cases using a very precise measurement systems for monitoring of working parameters of different kind of machines is unnecessary from production technology or quality demanding point of view [1]. However for the most metal forming processes such systems are essential especially for optimization of machine and process parameters [2].

The main subject of the work is designing and preparing measurement system for PHM hydraulic press with nominal pressure 2500 kN. Designed measure system should satisfies following conditions:

- simultaneous acquisition of parameters like: extrusion speed, pressure and temperature minimal sample rate 0,1 sec;
- mobile measure system;
- possibilities of development of the measure system (additional strain gauge inputs or thermocouples).

To execute the laboratory tests of the measurement system a cold extrusion process was chosen. Such process is characterized by high pressure. The process is realized in die installed on press table equipped with set of distance elements which are used as a elastic elements for pressure measurement (fig. 1, a). Schema of the die and distance element is presented in fig. 1, a.



a b

Fig. 1. Hydraulic press PHM 250C:
a – schema of hydraulic press and set of die (1 – hydraulic system; 2 – distance element; 3 – press moving plate; 4 – extruded sample; 5 – punch; 6 – matrix; 7 – press table); b – view of the press with open working space and set of tools for direct extrusion

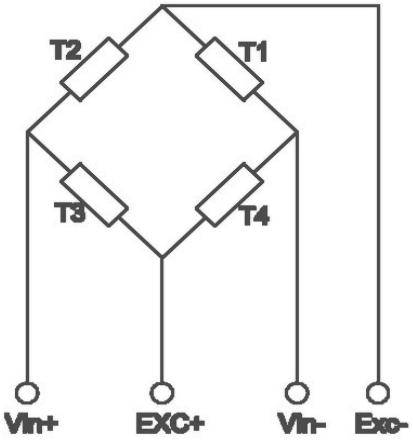


Fig. 2. Schema of strain gages in full Wheatstone bridge

To measure the punch load Wheatstone bridge was built. The bridge was composed of 4 foil strain gages XY/3-6/120 symmetrical sticking on elastic element and connected just like it is presented in Fig. 2. Temperature of the die measurement was realized with thermocouple J connected with module A/C (Fig. 3). The displacement of the punch was registered with the help of the linear motion potentiometer CLP21-100 installed on press moving plate. Analog signals from strain gauge bridge, thermocouple and displacement sensor were converted in A/C converters (ADAM modules) [3] and registered in software installed on mobile PC which enables various types of interpretation and presentation of registered data. A schematic diagram of connected system elements for measuring hydraulic press working parameters was presented in Fig. 3.

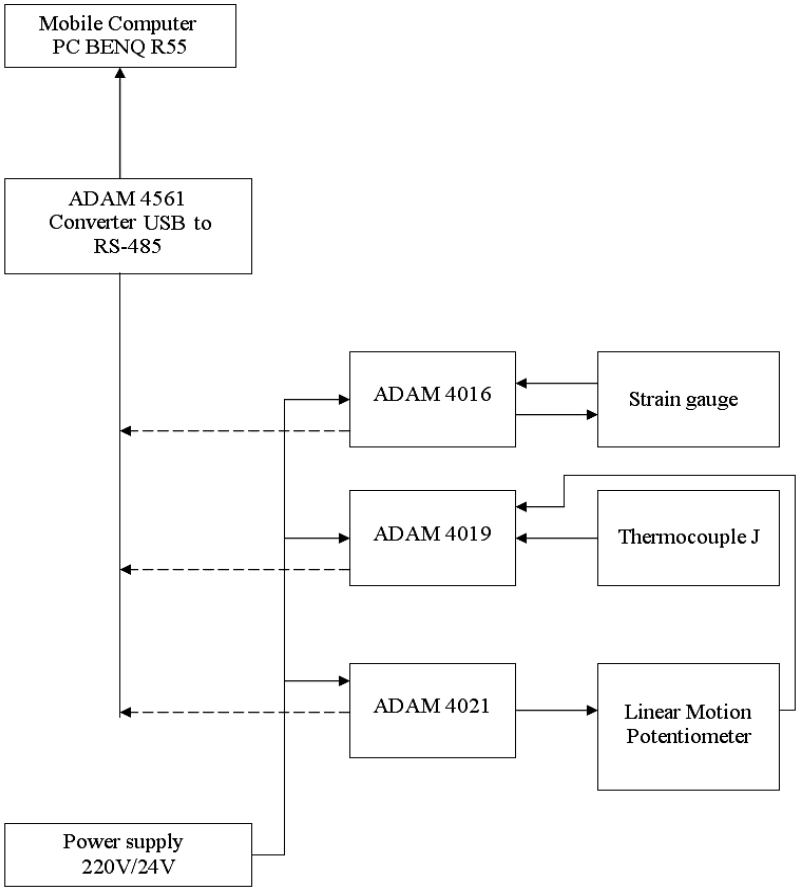


Fig. 3. Schematic diagram of connected system elements for measuring process parameters

The laboratory tests mainly consisted in direct extrusion of bimetal samples in hydraulic press PHM 250 C through conical die with 45º die angle and extrusion ratio $\lambda = 10$. During the process of extrusion the process parameters were registered. Samples were composed of copper sleeve and aluminum core and initially joined by explosive method [4]. The diameter of aluminum core was 20 mm and thickness of copper layer was 1 mm. Samples before and after extrusion process were presented in Fig. 4. More details about bimetal Al/Cu extrusion were presented in literature [5].

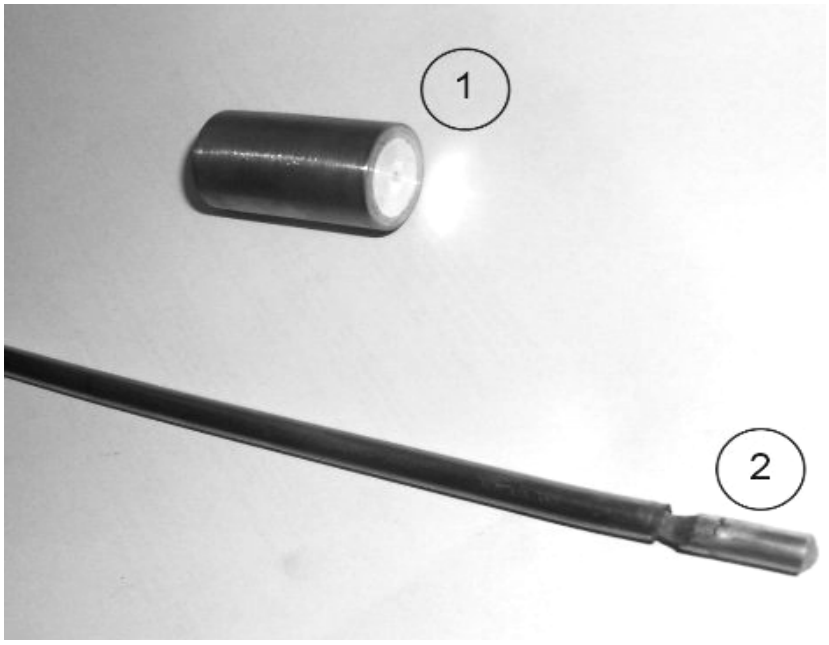


Fig. 4. Samples used for extrusion process (1 – before the process of extrusion, 2 – bimetal wire obtained after extrusion)

Measurement of temperature was realized by using thermocouple J installed on the die. The thermocouple indicated temperature of the work space of the process. According the data saved into a log temperature file it can be stated that temperature was oscillated between 25 ºC and 27 ºC and and was not strict connected with the extrusion process but such choose of measured value makes easy to verify this temperature.

Measurement of the punch load of the hydraulic press was realized by using the strain gauge revealed changes of the punch load due to the punch displacement of course. Values of voltage on strain gauge input were used to calculate punch load during the extrusion process of the sample. The calculations were made on-line during the registration of the parameters. On the base of the parameters registered by the measuring system the dependency between punch load and punch displacement were obtained and presented in Fig. 5.

In this figure the typical relationship between force and displacement during the extrusion process was presented. It can be observed some fluctuations of the force in the first stage it is connected with characteristical metal flow during extrusion of soft/hard bimetals. The fluctuations in the next stages are connected with extrusion more than one sample one by one.

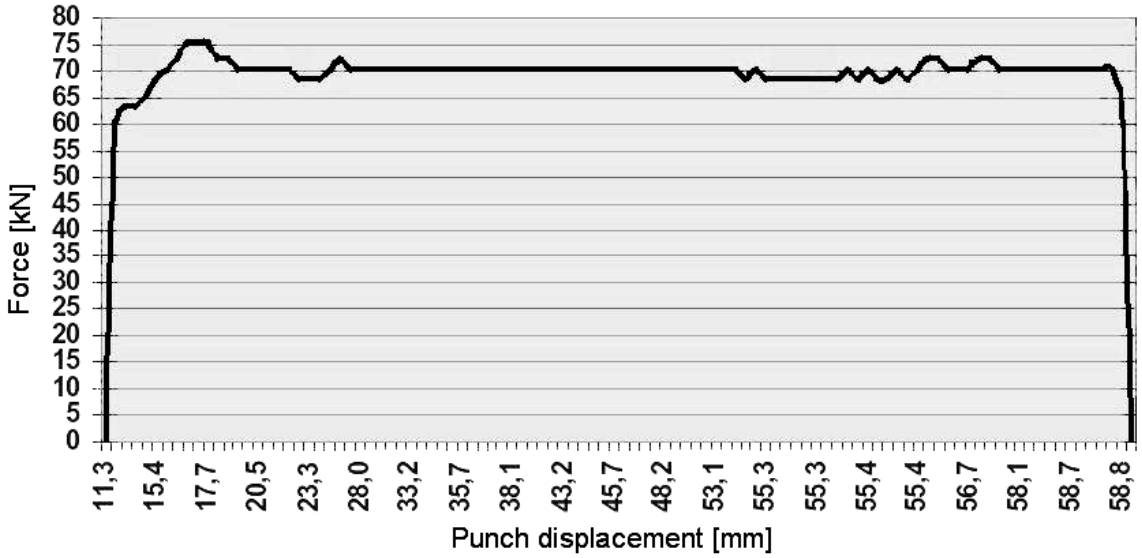


Fig. 5. Relationship between punch load and displacement

CONCLUSIONS

On the base of worked out laboratory tests and analysis results it can be stated that:

– the measuring system is enabled to register such parameters like temperature, displacement and load of punch;

– the different parameters can be simultaneously registered;

– using ADAM modules enables moving the system and installing in different research stations;

– the presented measuring system can be optionally developed. Modules used in the system are compatible with additional modules (quantity of the modules is restricted only by standard RS-485) and sensors (strain gauges, thermocouples, etc);

– initial calibration of strain gauge was not enough for good verification of punch load therefore the additional more accurate calibration is needed.

LITERATURE

1. Kostro J. Elementy, urządzenia i układy automatyki, Wydawnictwa Szkolne i Pedagogiczne / J. Kostro. – Warszawa, 2007.

2. Winiecki W. Graficzne zintegrowane srodowiska programowe / W. Winiecki, J. Nowak, S. Stanik. – Wydawnictwo MiKOM, 2001.

3. [Электронный ресурс]. – Режим достуапа : http: // www.advantech.pl/products/Distributed-I-O-Modules/sub_1-23HXZV. – Aspx, march 2008.

4. Dyja H. Technologie wybuchowe w inżynierii materiałowej / H. Dyja, A. Maranda, R. Trębinski. – Wydawnictwo WIPMiFS Politechniki Czestochowskiej, Częstochowa, 2001.

5. Analysis of quality of bimetallic rod after extrusion process / S. Berski, H. Dyja, A. Maranda, J. Nowaczewski, G. Banaszek // Journal of Materials Processing Technology, volume. – 2006. – № 177. – P. 582–586.

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