Materials Today: Proceedings 45 (2021) 2391–2393

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Computer aided testing of materials through interfacing device

P. Asha [a,*], D. Prabakar [b], Sruthi Anand [c], M. Karthik [d], J.S. Sujin [e], R. Ramesh Kumar [f]

[a] *Department of Computer Science and Engineering, Sathyabama Institute of Science and Technology, Chennai, Tamilnadu, India*
[b] *Department of Computer Science and Engineering, SNS College of Technology, Coimbatore, Tamilnadu, India*
[c] *Department of Information Technology, Sri Krishna College of Engineering and Technology, Coimbatore, Tamilnadu, India*
[d] *Department of Electrical and Electronics Engineering, School of Electrical Sciences, Kongu Engineering College, Erode, Tamilnadu, India*
[e] *Department of Electronics and Communication Engineering, Sri Krishna College of Technology, Coimbatore, Tamilnadu, India*
[f] *Department of Information Technology, Sri Krishna College of Technology, Coimbatore, Tamilnadu, India*

ARTICLE INFO

Article history:
Received 16 September 2020
Received in revised form 23 October 2020
Accepted 24 October 2020
Available online 08 December 2020

Keywords:
Computer aided material testing
Data acquisition
Computer control system
Tensile test
Rated current
Interface system

ABSTRACT

The computer aided material testing is playing an essential role in manufacturing industries to enhance the quality of the products. In recent years, the conventional machines are converted in to computer based control. The present paper was discussed about the material testing equipments have been updated with data acquisition and computer control system. The sensors and actuators were interfaced with computer control system. It was used to test the advanced material with high accuracy. The experimental purpose, aluminium and steel were used as testing materials. Tensile test and impact test were conducted. The experimental results were compared with or without interface system. The improved results were also discussed with pareto chart.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Advances in Materials Research – 2019.

1. Introduction

The computer based control equipments were provided testing and compare the data with high accuracy and speed. The computer control and its applications have been increased in quality and inspection. The different tests were performed with the aid of computer control such as load test, stress, strain and tensile test. In recent days, the computerized control was used in hydraulic, pneumatic and mechanical systems. The computer control and automated testing were processed in welding. The visualization and data acquisition was also included [1]. The control system and digital image correlation method were used to cyclic/fatigue tests of polymer materials [2]. The computer measurement and control system was applied in tensile testing machine to measure substance properties [3]. Digital control system and design information was used for material testing [4]. The digital correlation method was used to determine the deformation and displacement [5]. The advanced system of measurement and testing has been provided for high accuracy [6,7]. X-ray computer control based tomography systems have been used for material testing and inspection [8]. The software based image processing techniques and computer modeling of inspections were used to energy related process [9–11]. The computed tomography was used to test the polymeric materials [12]. The ultrasonic CT system was applied to investigate the weld metal [13]. Ultrasonic tomography was used to test the material quality and concrete reinforcement [14,15]. X-ray computed tomography was played an important role in metrology [16]. An integrated CAD and computer-aided inspection planning have been studied [17,18]. An importance of testing and their developments were used in many industries to improve the processes [19]. Planning, verification and validation were the different phases of testing process [20]. This paper was describes the computer aided testing of materials through interfacing device.

2. Experimental details and methodology

The developed interface system with UDAC was shown in Fig. 1. It has been DB9 connectors which were used to connect the device to material testing machines. It consists of three modules namely as USB, ADC and motion control. USB module was used to connect the equipment and system. The important functions of the module include communication with analog to digital, motion control, read and write the data. Piezoelectric load cell and strain gauges were used in impact test machine to achieve automation process. The

* Corresponding author.
E-mail address: ashapandian225@gmail.com (P. Asha).

https://doi.org/10.1016/j.matpr.2020.10.732
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the International Conference on Advances in Materials Research – 2019.

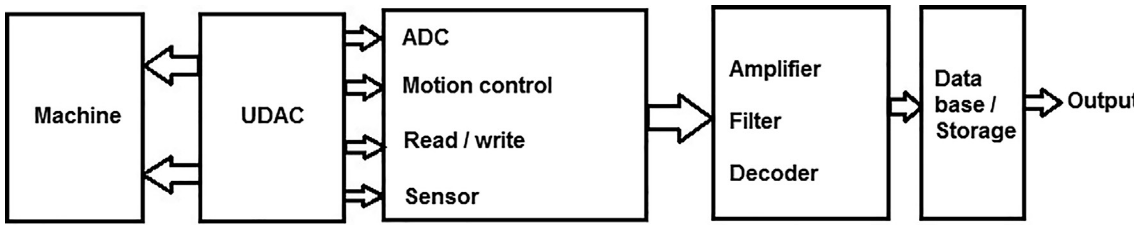

Fig. 1. Interface system with UDAC.

Table 1
Experimental results for aluminum.

System	Tensile strength (MPa)	Impact strength (J)	% of elongation
Normal	639	11	10
With interface	641	12	12
Deviation	2	1	2

Table 2
Experimental results for mild steel.

System	Tensile strength (MPa)	Impact strength (J)	% of elongation
Normal	367	16	12
With interface	370	17	13
Deviation	3	1	1

signals were transferred through four channels along with ADC lines. ADC module consists of convertor, decoder, amplifier and filter. The 24 bit ADC 7780 was used to convert the data. The filter was used to reduce the noise in frequency which was observed in input signals. The logic signals were received from output. These signals were converted into numerical values. The motion control module consists of relays and their driver line circuits. The PC software was used to analyze the specimen dimension and it was stored in data base of the software.

The present concept describes the material testing apparatus has been modified with data acquisition and computer interfaced control system. This developed system was used to test the materials with better accuracy. Aluminium and mild steel have been considered as the work material. The tensile strength and impact strength have been improved through computer aided testing and interface system.

3. Experimental results and discussion

The computerized and electronic function based universal testing machine was used to experimental investigations. The load capacity was 60 T with provide better accuracy for full load condition. It has electronic extensometer EE 1 to calculate material extension with 1 μm resolution. The allowed gauge length was up to 50 mm. The length of the specimen was 210 mm with 20 mm diameter. It has reduction length of 70 mm and 12.5 mm diameter (ASTM E8). The computerized charpy impact tester was used to measure the impact strength up to 30 J. The minimum resolution on scale was 0.02 J. The allowable power supply was 230 V,

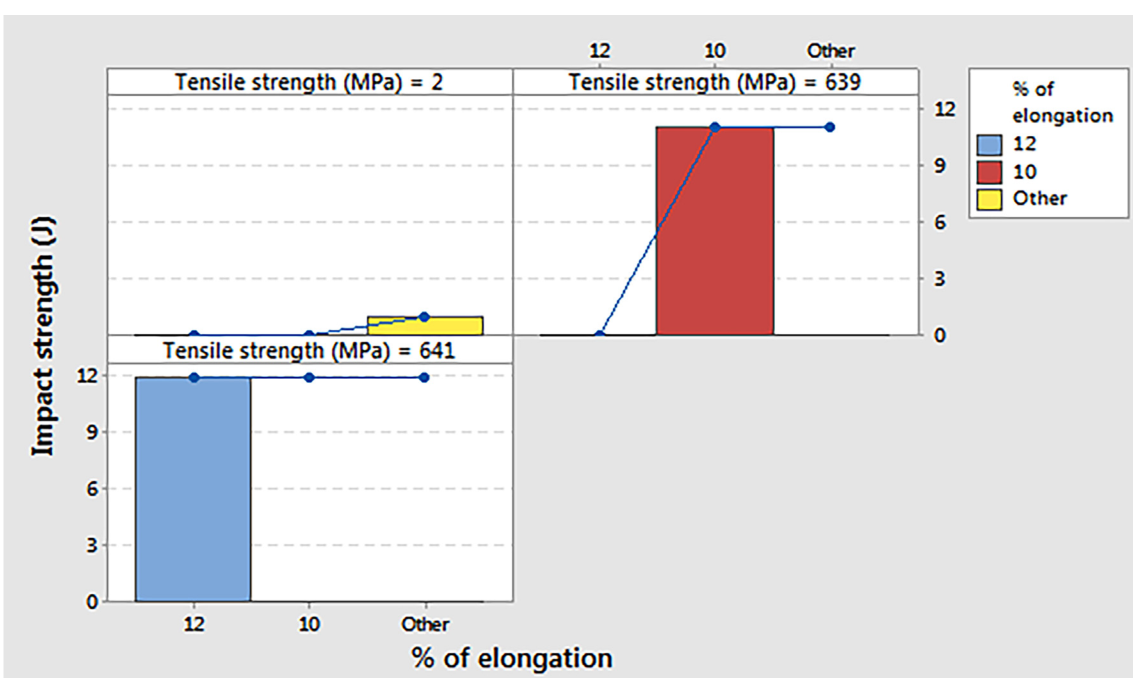

Fig. 2. Pareto chart for tensile and impact strength- Al 7068.

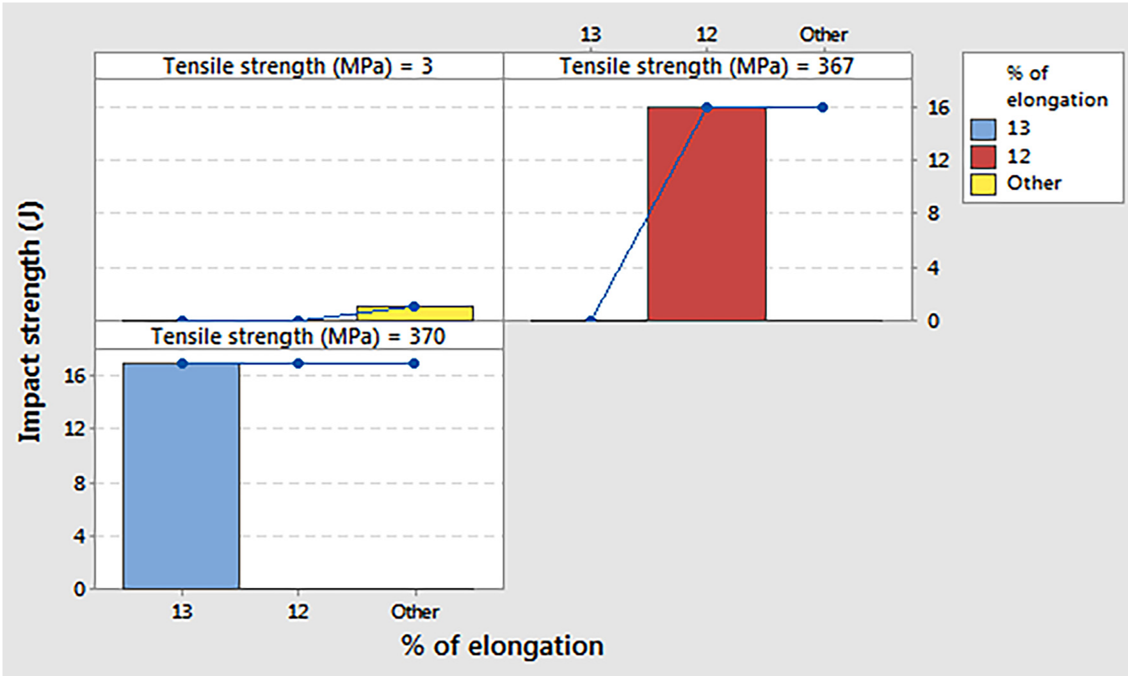

Fig. 3. Pareto chart for tensile and impact strength- Mild steel.

50 Hz and single phase. As per ASTM E23, the test specimen has 55 mm long and 10 mm square rod. The V-notch has radius of 0.25 mm with 2 mm depth and 45 degrees. The aluminium7068 and AISI 1018 mild steel was used for experimental work. The experimental results were shown in Tables 1 and 2. The tensile strength, impact strength and % of elongation were presented. The improvement of properties has been observed using computer aided testing with interface system.

Pareto chart for tensile and impact strength was shown in Fig. 2. The deviations of strengths were shown in terms of percentage in Pareto chart. The results were improved through interface system was 2 MPa. Pareto chart for tensile and impact strength for mild steel was shown in Fig. 3. The deviations of strengths were shown in terms of percentage in Pareto chart. The results were improved through interface system was 3 MPa.

4. Conclusions

- The universal testing machine and impact testing machines were interfaced with UDAC system.
- The tensile and impact strengths were evaluated through with or without interface system. Results were compared with or without interface system.
- The tensile strength of 2 MPa and impact strength of 1 J have been improved for aluminium through interface system.
- The tensile strength of 3 MPa and impact strength of 1 J have been improved for mild steel through interface system.
- In aluminium, 2% of elongation was improved.
- In mild steel, 1% of elongation was improved.
- By comparison of results, computer aided testing of materials through interfacing device was provided the better performances.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Piotr Borkowski, E. Walczuk, Measurement 44 (9) (2011) 1618–1627.
[2] G. Tao, Z. Xia, Polym. Test. 24 (7) (2005) 844–855.
[3] D. Simbeye, J. Inform. Sci. Comput. Technol. 5 (2) (2016) 456–465.
[4] K.D. Ives, Exp. Mech. 11 (1971) 524–528.
[5] M. Sutton, W. Wolters, W.H. Peters, W. Ranson, S. McNeill, Image Vis. Comput. 1 (1983) 133–139.
[6] S. Carmignato, CIRP Ann. Manuf. Technol. 61 (1) (2012) 491–494.
[7] J.P. Kruth, M. Bartscher, S. Carmignato, R. Schmitt, L. De Chiffre, CIRP Ann. Manuf. Technol. 60 (2) (2011) 821–842.
[8] S.P. Osipov, V.A. Udod, Y. Wang, Russ. J. Non Destruct. Test. 53 (2017) 568–587.
[9] Gavrish, N. Yu, Berdnikov, A. Ya, D.O. Spirin, A.N. Perederii, M.V. Safonov, I.V. Romanov, Probl. At. Sci. Technol. 3(2010)123–125.
[10] V.T. Lazurik, V.G. Rudychev, D.V. Rudychev, Visn. Kharkiv Nats. Univ. 863 (2009) 144–157.
[11] V. Rebuffel, J.M. Dinten, Insight 49 (10) (2007) 589–594.
[12] A. Plessis, M. Meincken, T. Seifert, J. Non Destr. Eval. 32 (2013) 413–417.
[13] K. Kim, H. Fukubara, H. Yamawaki, KSME Int. J. 15 (2001) 52–60.
[14] T.J. Comm, J.A. Mauseth, Mater. Eval. 57 (7) (1999) 747–752.
[15] N. Mita, T. Takiguchi, Pac. J. Math. Ind. 10 (2001) 6–10.
[16] H. Villarraga-Gómez, E. Herazo, S. Smith, Precis. Eng. 60 (2019) 544–569.
[17] A. Kamrani, E. Abouel Nasr, A. Al-Ahmari, Int. J. Adv. Manuf. Technol. 76(2015) 2159–2183.
[18] Y.A. Ghaleb, H.S. Ketan, M.B. Adil, Arabia. J. Sci. Eng. 30 (2005) 245–260.
[19] K. Tahera, D.C. Wynn, C. Earl, Res. Eng. Des. 30 (2019) 291–316.
[20] J. Shabi, Y. Reich, R. Diamant, J. Eng. Des. 28 (3) (2017) 171–204.