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Data Article

Dataset on experimental investigation of optimum carburizing temperature and holding time of bi- nano additives treatment of AISI 5130 steel



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ARTICLE INFO

Article history:

Received 3 June 2018
Received in revised form
28 June 2018
Accepted 9 July 2018
Available online 19 July 2018

Keywords:

Bi-nano additive
AISI 5130 steel
Carburizing temperature
Time
Optimum

ABSTRACT

Investigation of optimum carburizing temperature and holding time on bi- nano additives treatment of AISI 5130 steel was presented in this study. AISI 5130 steel of 100 kg mass of 0.35% carbon content was buried in pulverized additives consisting of palm kernel and coconut shell using eggshell as an energizer. Four sets of $150 \times 150 \times 150 \text{ mm}^3$ steel boxes packed with additives mixed at varying weight ratio of 50: 30:20 and sixty-four pieces of $20 \times 20 \times 5 \text{ mm}^3$ AISI 5130 steel were case hardened using muffle furnace (2500 °C max capacity) at respective temperatures and time of 950, 1000, 1050, 1100 °C and 60, 90, 120, 180 min. The core, interface and surface hardness of the treated samples with their respective weight loss, wear volume and rate were investigated. This dataset could be used in nano-composite match mixed ratio and optimization of carburizing medium and time for any industrial used case hardened steel.

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Specifications Table

| | |
|----------------------------|---|
| Subject area | Mechanical Engineering and Surface Engineering. |
| More specific subject area | Production Engineering and Materials Engineering. |
| Type of data | Table, text and graph. |
| How data was acquired | Elemental composition of the steel was checked using spectrometer 675 × 321. Hardness tester (Brinell with 3000 kg test force and 10-mm diameter carbide) was used to analyze the surface, interface and core hardness of the treated samples. The weight loss, wear volume and rate were checked using Rotop-V machine. |
| Data format | Raw and analyzed. |
| Experimental factors | Four sets of 150 × 150 × 150 mm ³ steel boxes packed with additives mixed at varying proportion ratio of 50:30:20 and sixty four pieces of 20 × 20 × 5 mm ³ AISI 5130 steel were used. |
| Experimental features | AISI 5130 steel of 100 kg mass with 0.35% carbon content was buried in pulverized additives consisting of palm kernel and coconut shell using eggshell as an energizer. Four set of steel boxes packed with additives mixed at varying proportion ratio of 50:30:20 and sixty-four pieces of 20 × 20 × 5 mm ³ AISI 5130 steel were case hardened using muffle furnace (2500 °C max capacity) at respective temperatures and time of 950, 1000, 1050, 1100 °C and 60, 90, 120, 180 min. |
| Data source location | Covenant University. Ota. Ogun-State. Nigeria. |
| Data accessibility | Data are available within this article |

Value of the data

- The dataset for the surface, interface and core hardness can be used to predict optimum carburizing temperature of the treated sample.
- Data on the holding time of bi- nano additives treatment of AISI 5130 could be used to determine additives concentration in mix match ratio.
- The data could be used to predict critical temperatures for the optimum carburizing index parameters.
- Also, the dataset obtained could be used in studying the heat treatment behaviour during carburization.
- Data acquired for weight loss, wear volume and rate could be used to check the rate of the case-carbon index during heat treatment.

1. Data

The research work engaged the used of eggshell as energizer with palm kernel shell and coconut shell as carbon additives. The method can be applied as a part of the heat treatment of steel materials intended to be used to produce industrial tools and devices. Elemental compositional analyses were checked as indicated in [Table 1](#). The dataset of the hardness values that was shown in [Table 2](#) represents the sampling test template. Weight loss and wear volume data were recorded in [Table 3](#) while [Table 4](#) showed the summary of the surface, interface and core hardness of the treated sample. The values for the wear rate and average hardness of each sample were recorded in [Table 5](#).

Table 1
Elemental composition of AISI 5130.

| Elements | Composition (%) |
|----------|-----------------|
| Fe | 97.377 |
| C | 0.350 |
| Mn | 0.950 |
| P | 0.050 |
| S | 0.045 |
| Cr | 1.000 |
| Al | 0.022 |
| Mo | 0.206 |

Table 2
Sampling test template.

| Carburizing temperature (°C) | Holding time (min) | Wear rate test | Hardness test |
|------------------------------|--------------------|----------------|---------------|
| 950 | 60 | 1A | 1B |
| 950 | 90 | 2A | 2B |
| 950 | 120 | 3A | 3B |
| 950 | 180 | 4A | 4B |
| 1000 | 60 | 5A | 5B |
| 1000 | 90 | 6A | 6B |
| 1000 | 120 | 7A | 7B |
| 1000 | 180 | 8A | 8B |
| 1050 | 60 | 9A | 9B |
| 1050 | 90 | 10A | 10B |
| 1050 | 120 | 11A | 11B |
| 1050 | 180 | 12A | 12B |
| 1100 | 60 | 13A | 13B |
| 1100 | 90 | 14A | 14B |
| 1100 | 120 | 15A | 15B |
| 1100 | 180 | 16A | 16B |
| | Control | 17A | 17B |

Table 3
Results for the weight loss and wear volume.

| Sample | Weight loss (g) | Wear volume (cm ³) |
|---------|-----------------|--------------------------------|
| 1A | 0.22 | 0.028 |
| 2A | 0.21 | 0.027 |
| 3A | 0.20 | 0.026 |
| 4A | 0.19 | 0.024 |
| 5A | 0.18 | 0.023 |
| 6A | 0.17 | 0.022 |
| 7A | 0.16 | 0.020 |
| 8A | 0.11 | 0.009 |
| 9A | 0.13 | 0.018 |
| 10A | 0.12 | 0.017 |
| 11A | 0.11 | 0.015 |
| 12A | 0.10 | 0.014 |
| 13A | 0.09 | 0.012 |
| 14A | 0.10 | 0.013 |
| 15A | 0.11 | 0.014 |
| 16A | 0.12 | 0.015 |
| Control | 0.15 | 0.019 |

Table 4

Summary of results for surface, interface and core hardness.

| Sample | Surface hardness (HV) | Interface hardness (HV) | Core hardness (HV) |
|---------|-----------------------|-------------------------|--------------------|
| 1B | 72.3 | 81.1 | 87.0 |
| 2B | 89.7 | 94.2 | 93.1 |
| 3B | 110.2 | 106.7 | 101.6 |
| 4B | 119.6 | 118.3 | 105.2 |
| 5B | 94.7 | 97.3 | 107.1 |
| 6B | 120.1 | 96.1 | 97.1 |
| 7B | 140.3 | 93.8 | 98.2 |
| 8B | 146.9 | 91.7 | 99.8 |
| 9B | 107.1 | 103.2 | 103.8 |
| 10B | 113.0 | 141.0 | 169.1 |
| 11B | 118.0 | 120.1 | 117.6 |
| 12B | 124.7 | 129.0 | 118.7 |
| 13B | 116.1 | 120.2 | 112.6 |
| 14B | 137.6 | 124.2 | 119.2 |
| 15B | 138.0 | 121.4 | 115.6 |
| 16B | 140.9 | 122.2 | 117.9 |
| Control | 110.9 | 106.9 | 103.6 |

Table 5

Table of results from wear rate and hardness test.

| Carburizing temperature (°C) | Holding time (min) | Wear rate ($\times 10^{-7}$ cm ²) | Hardness (Average) (HV) |
|------------------------------|--------------------|--|-------------------------|
| 950 | 60 | 2.97 | 80.13 |
| 950 | 90 | 2.82 | 92.33 |
| 950 | 120 | 2.68 | 106.17 |
| 950 | 180 | 2.53 | 114.37 |
| 1000 | 60 | 2.39 | 99.7 |
| 1000 | 90 | 2.24 | 104.43 |
| 1000 | 120 | 2.10 | 110.77 |
| 1000 | 180 | 1.95 | 112.80 |
| 1050 | 60 | 1.80 | 104.70 |
| 1050 | 90 | 1.16 | 141.03 |
| 1050 | 120 | 1.51 | 118.57 |
| 1050 | 180 | 1.37 | 124.13 |
| 1100 | 60 | 1.22 | 116.30 |
| 1100 | 90 | 1.35 | 127.22 |
| 1100 | 120 | 1.49 | 125.23 |
| 1100 | 180 | 1.62 | 127.11 |
| Control | | | 107.13 |

2. Experimental design, materials and methods

Bi- nano additives consisting of pulverized palm kernel and coconut shell with eggshell as an energizer were used as raw materials [1–5]. Steel boxes of four sets with a dimension of $150 \times 150 \times 150$ mm³ and sixty-four pieces of AISI 5130 steel ($20 \times 20 \times 5$ mm³) were also used during the research work. The elemental composition shown in Table 1 was first carried out with spectrometer before carburization. Sixteen boxes contained four each of AISI 5130 steel (0.35% carbon) were packed with additives mixed at varying weight ratio of 50:30:20 [6–10]. Four set of steel boxes contained sixty pieces of AISI 5130 steel were carburized using muffle furnace (2500 °C max capacity) at respective carburizing temperatures and time of 950, 1000, 1050, 1100 °C and 60, 90, 120, 180 min. The sampling template of each carburizing temperature and holding time was carefully considered as indicated in Table 2 in order to obtain the optimum temperature and time at regular interval [11–17].

Weight loss and wear volume of each sample was investigated using Rotopol-V during machining as recorded in Table 3. The test for core, interface and surface hardness of the samples were done using hardness tester shown in Table 4 [18,19]. The values for the wear rate and average hardness of each sample were carried out and all were indicated in Table 5 [20].

Acknowledgements

We acknowledge the financial support offered by Covenant University in the actualization of this research work for publication.

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at <https://doi.org/10.1016/j.dib.2018.07.025>.

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