ISSN: 2096-3246
Volume 58, Issue 02, 2026

ANN FOR PREDICTION OF CORROSION AND WEAR PROPERTIES OF A356 /AL$_2$O$_3$/RHA PARTICULATES REINFORCED HYBRID COMPOSITES

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Abstract

The characteristics of wear and corrosion of Al_2O_3 and RHA particulates reinforced with Aluminium A356 were first experimentally studied,after that ANN were actualized so as to demonstrate the Specific wear rate and Corrosion resistance. Following ASTM-compliant machining, the test sample underwent a solution heat treatment and artificial ageing. The wear characteristics have been examined, and double-aged people's stretching conditions have significantly improved. The additional exposed with ANNs can be utilized in enhancing the procedure parameters of aluminum alloys. The ppredicted values from the Test samples and experimental values are in close agreement and this shows the usefulness of applying ANNs in predicting results.

Key words: Al_2O_3, RHA, A356Aluminium alloy, Artificial Neural Network.

1. INTRODUCTION

The Aluminum A356 alloy, it is normally utilized for aerospace, marine and engineering industries due to the outstanding cast-ability and corrosion resistance. The high modulus expansion of refractory particles to a malleable metal grid delivers properties of a material.The properties of composites is shows improvement in elements of the shape, size, volume fraction and spatial reinforcement dispersal [1].

The ANN is an in direct strategy factual study and is particularly appropriate for reproduction of frameworks, they are difficult to be depicted by physical models [2]. It provides a data input method.connecting to data using a lot of in direct works. ‘Aarchitecture’ term refers to the quantity of layers in the system and neurons number in each layer. Shockingly the method of progression is generally experimentation and different conditions are required to be attempted [3].

The corrosion and wear characteristics of the hybrid composite A356 with RHA and Al2O3-reinforced particulates were first investigated experimentally in the current study. After that, the characteristics were modelled using artificial neural networks which can be integrated with the software MAT LAB for mechanical and tribological property prediction.

2. METHODS AND MATERIAL

The matrix material is an aluminium A356 alloy, which shows outstanding properties of casting with improved strength. This is a heat treatable popular aluminium alloy; it is suitable for mass production of starting lightweight metal castings [4]. The below Table 1 lists the constituents of the aluminium A356 alloy for reinforcement, 75 micron RHA and 100 micron Al2O3 particles are utilised. The composition of RHA and Al2O3 is shown in Tables 2 and 3, respectively.

Table 1: The A356 alloy's chemical composition

Element	Weight%
Si	6.6
Mg	0.45
Fe	0.10
Ti	0.10
Cu	0.05
Mn	0.055
Zn	0.005
Ni	0.005
Al	Balance

Table 2: The RHA Chemical Composition

Element	Weight (%)
Silica	90.23
Graphite	4.77
Calcium Oxide	1.58
Magnesium Oxide	0.53
Potassium Oxide	0.39
Ferric Oxide	0.21

3. HYBRID COMPOSITE PREPARATION

Aluminum A356 was dissolved to a temperature of 650ºC, and then it is superheated by 750ºC over the liquids temperature of the matrix alloy. The stir casting process was embraced to manufacture the examples wherein a vortex was made in soften of the lattice composite utilizing mechanical stirrer. 1% of Magnesium, which increases the wet ability of the reinforcing phase, was included before presenting reinforcement materials. The preheated Al_2O_3 particulates (400ºC) and RHA were brought into the liquid slurry [5]. Blending was completed persistently till the interface between the

particles and matrix, which advances wetting at last filled the metallic shape. Six castings of different arrangements were created as appeared in table 3.

Table 3: RHA and Al2O3 Composition by Weight Percentage

Sample	RHA (%)	Al_2O_3 (%)	A356 (%)
A0	0	0	100
A1	1	1	98
A2	2	2	96
A3	3	3	94
A4	4	4	92
A5	5	5	90

4. HEAT TREATMENT

Figure 1 illustrates the heat treatment.

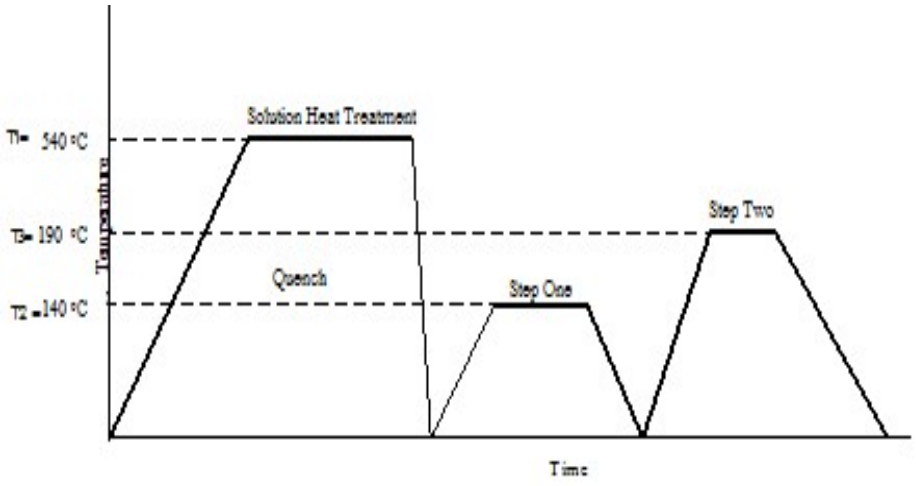

Figure 1: Heat treatment

5. ARTIFICIAL NEURAL NETWORKING

ANN was utilized to predict outcomes using a database of 24 values. The loads and inclination were used in the back engendering computation for augmentation. Trial results are nourished with the neural system and comparing loads, predispositions are extracted [7]. These loads and predisposition were incorporated to ascertain anticipate the qualities [11, 12].

6. RESULTS AND DISCUSSIONS

Table 4 to 5 and Figure 2 to 3 below display the anticipated and experimental values of the corrosion and wear rate of the hybrid composites with various reinforcements.

Table 4 demonstrates the variation in specific wear (mm³/N•m) amongst samples with different ageing conditions and reinforcements.

Sample	As-Cast (Exp.)	As-Cast (ANN)	Single aged (Exp.)	Single aged (ANN)	Double aged without strain (Exp.)	Double aged without strain (ANN)	Double aged with strain (Exp.)	Double aged with strain (ANN)
A0	21.907	21.895	21.014	21.22	18.776	18.945	16.542	16.788
A1	21.014	21.099	19.223	19.356	17.436	17.348	14.755	14.866
A2	20.567	20.661	19.673	18.925	16.542	16.65	13.411	13.523
A3	19.673	19.323	18.329	18.478	16.989	16.872	12.071	11.826
A4	17.436	17.458	15.201	15.255	11.624	11.638	7.824	7.842
A5	19.223	19.52	17.436	17.125	15.201	15.601	12.964	12.366

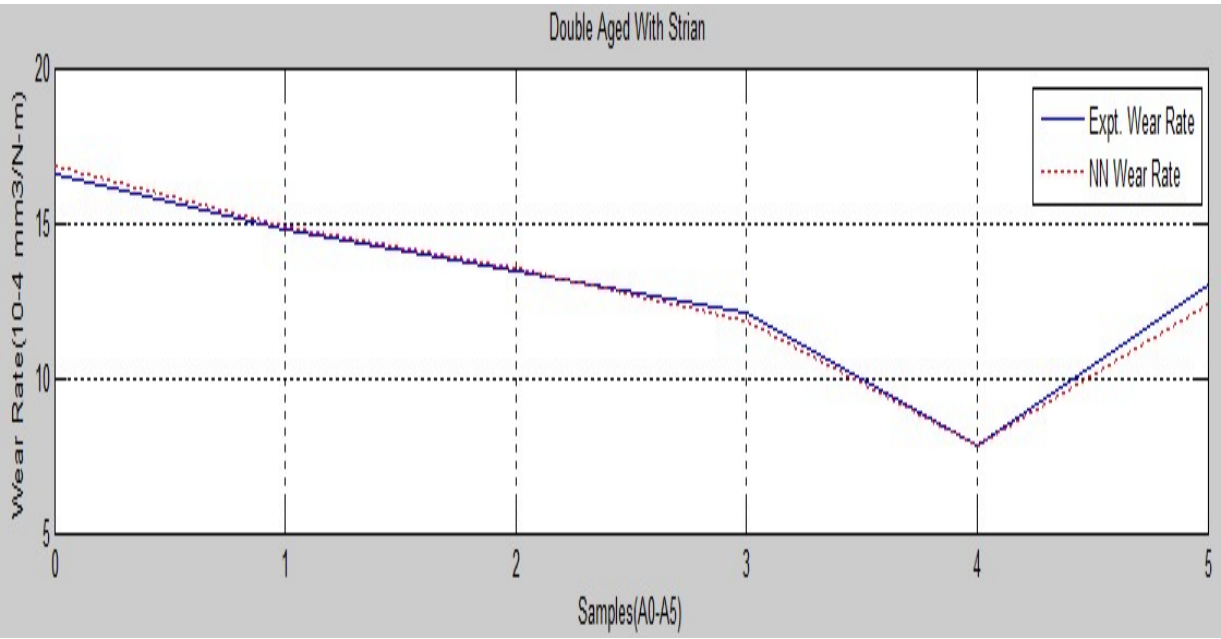

Figure 2: Plotting experimental values against expected ANN values (wear rate)

Table 5: The fluctuation of corrosion rate (%) in several samples with varying ageing circumstances and reinforcements in seawater

Sample	As-Cast (Exp.)	As-Cast (ANN)	Single aged (Exp.)	Single aged (ANN)	Double aged without strain (Exp.)	Double aged without strain (ANN)	Double aged with strain (Exp.)	Double aged with strain (ANN)
A0	1.6	1.658	1.51	1.622	1.15	1.162	0.7	0.716
A1	1.41	1.368	1.1	1.121	0.9	0.928	0.44	0.458

A2	1.2	1.238	0.6	0.562	0.47	0.499	0.23	0.212
A3	0.7	0.731	0.42	0.436	0.32	0.298	0.17	0.183
A4	0.48	0.491	0.23	0.236	0.21	0.216	0.11	0.114
A5	0.52	0.586	0.29	0.312	0.27	0.332	0.16	0.181

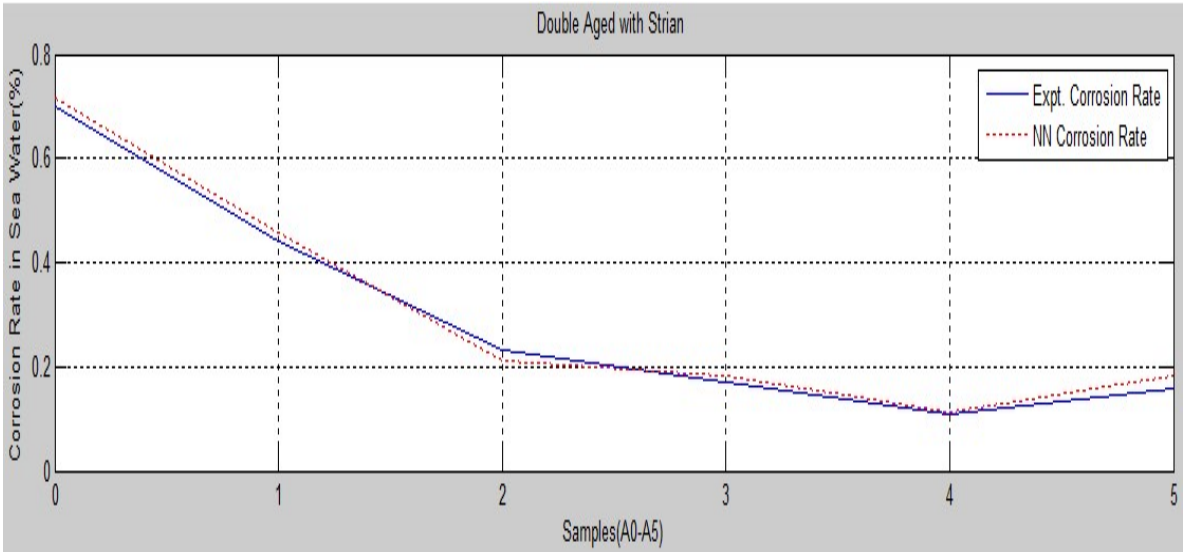

Figure 3: Experimental data plotted against predicted ANN values (corrosion rate)

ANN demonstrating was done to interface of the factors input to the Performance output measures. The examined tests and ANN anticipated information of Corrosion rate and Wear properties disclose a good agreement. The most extreme mistake got is under 5%which is mediocre and henceforth model is approved. The stretching of the composites shows that the ANN output and the experimental results closely correspond [9].

7. CONCLUSION

The result of investigational values the Wear and Corrosion Resistance were validated utilizing by the model ANN and forecast of model ANN is perceived, it will be in great agreement with the trial information. It is reason that important investment funds as far as time and expense could be acquired by using model neural system and when used appropriately, artificial neural networks are a powerful teaching tool.

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Acknowledgments: The authors would like to express their sincere gratitude to the department of Mechanical Engineering, Sri Siddhartha Institute of Technology and Sri Siddhartha Academy of higher education, Tumkur for providing the necessary
R and D facilities to carry out this research work.