Design of an Artificial Neural Network (BPNN) to Predict the Content of Silicon Oxide (SiO₂) based on the Values of the Rock Main Oxides: Glass Factory Feed Case Study

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Abstract: Artificial neural network (ANN) is one of the practical methods for prediction in various sciences. In this study, which was carried out on Glass and Crystal Factory in Isfahan, the amount of silica purification used in industry has been investigated according to its analyses. In this discussion, according to the artificial neural network algorithm back propagation neural network (BPNN), the amount of silica (SiO_2) was predicted according to rock main oxides in chemical analysis. These studies can be used as a criterion for estimating the purity for use in the factory due to the high accuracy obtained.

Keywords: artificial neural network (ANN), back propagation neural network (BPNN), silica (SiO_2), mineral processing, prediction, Glass and Crystal Factory.

1. INTRODUCTION

From the nineteenth century, simultaneously but separately, neuropsychologists tried to learn the system and analyze the brain. The other mathematicians tried to discover a mathematical model built to learn and analyze issues. The first attempt in the same building using a logical model and Walter Pitts was made by Mac Klvk basic building blocks of most networks today by artificial neural. The hypothesis about the function of neurons provides this performance-based model of input and output establishment. If the sum of the inputs is greater than the threshold value, the so-called neurons get into an Excited state. The result of this model is the implementation of simple functions. [1-6]

Not only neuropsychologists but also psychologists and engineers tried to develop a network of nerves. In 1958, the Perceptron network was introduced by Rosenblatt. This network was like the previously modeled units. Perceptron has three layers, and a middle layer serves as the bond layer Known. The system also can learn to apply the corresponding random data input-output. [7-10] [11-13]

Other system linear model neurons comparative to that in 1960 by Widrow-Hoff (Stanford University) was the first network of nerve employed in the real issues were. Adaline A simple electronic device that component consisted method used to train with the perception was different. [2, 3, 10, 14-16]

Minsky and Papert wrote a book in 1969 that limits the single-layer and multi-layer Perceptron system described. This book results from prejudice and cuts capital investment for research on the same network nerve. They can solve any problem with the perception that the design is not attractive. Investigations in this field for many years stopped. [17-26]

Despite the general enthusiasm and capital investment available to its minimum, some researchers to build machines that can solve problems such as pattern recognition Have continued, including network Grabs entitled Avalanche For continuous speech recognition and robot hand control. He also co-founded ART networks with Carpenter, which differed from natural models. Anderson and Cohennon were also people who developed learning techniques. Verbal in 1974 Post-publication training method (Back Propagation) The error was that a multi-layer perceptron network was, of course, with stricter training rules. [27-36]

The progress that was achieved in 1970 and 1980 to draw attention to the network of the nerve was very important. Some factors are also involved in escalating this issue, including books and conferences of range for people in a variety presented. Today, too, there are many developments in technology ANN Created is. [37-39]

2. FACTORY AND ITS LOCATION

Isfahan Crystal and Glass Factory are located six kilometers from Isfahan's beautiful and historical city in Dolatabad. The factory was built on land with more than 90,000 square meters, with about 500 staff. This factory has various technical, research, design and development, production, mold making, repair, quality control, packaging, goods clearance, and administrative affairs. The factory's production unit consists of two relatively large furnaces with a daily melting capacity of 65 tons and nine production lines. Except for one line in which the press-wind method is used to produce goods, all other lines use the press method. Isfahan Crystal and Glass Factory continuously produce about 300,000 pieces daily with a total capacity. Utilizing the most advanced production methods and modern equipment, machinery, and equipment from countries such as Germany, Italy, and Switzerland,

which are the pioneers of the crystal and glass industry in the world, as well as the presence of young, outstanding, and experienced people in different factory units. It can be considered as one of the main reasons for the success of Isfahan Crystal and Glass Company in producing and introducing one of the best and most well-known crystal products among Iranian families. (Figure 1)

Figure 2 : Regression of Train Data Set.

Figure 1 : a view of glass and crystal factory production line.

3. DISCUSSION

According to the copper processing plant data, which was analyzed 43 times in different conditions, The amount of silica oxide was estimated by the rock main oxides in the table 1.

Table 1 : The Rock Main Oxides which used in SiO$_2$ Content Prediction.

SiO$_2$	CaO	Al$_2$O$_3$	MgO	Fe$_2$O$_3$	Na$_2$O	K$_2$O	MnO

After reviewing the data in MATLAB software, the results of this survey were presented in the form of the following graphs (Figures 2-5):
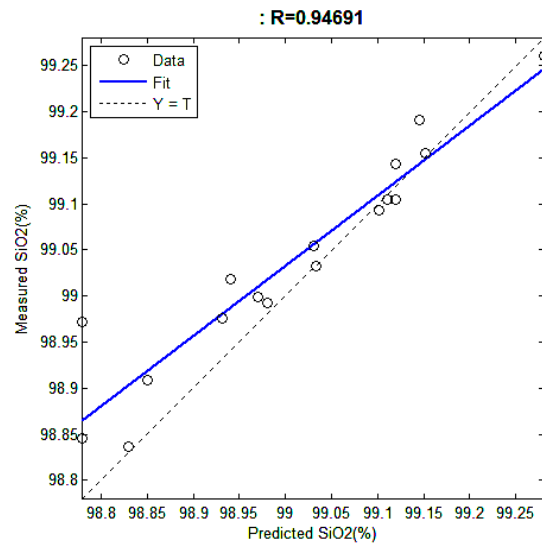
Figure 3 : Regression of Test Data Set.
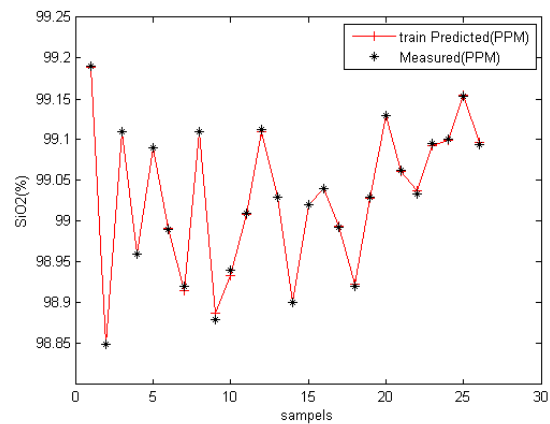

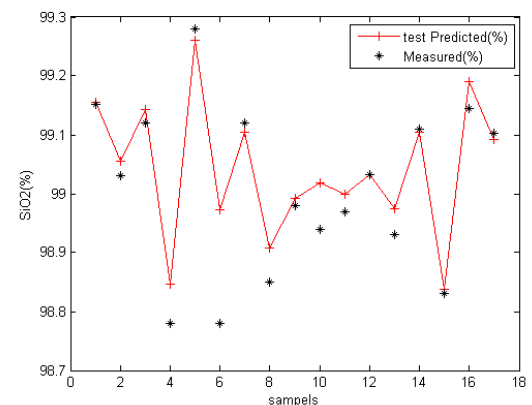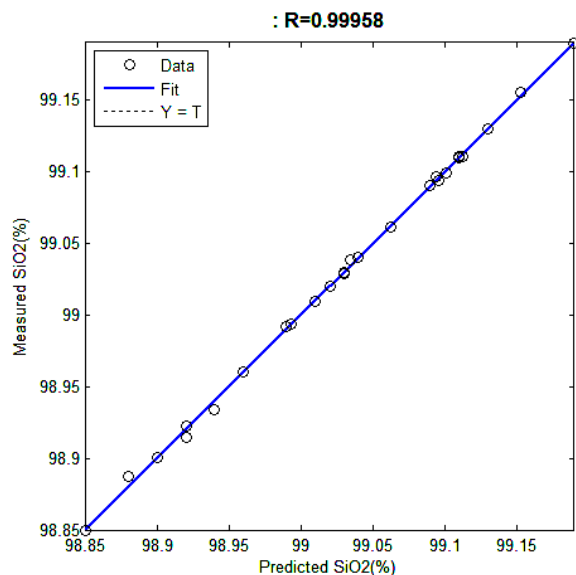**Figure 4 : Predicted and Actual Values of Train Data**

Figure 5 : Predicted and Actual Values of Test Data.

4. CONCLUSION

Place Artificial neural network (ANN) is one of the practical methods for prediction in various sciences. In this study, which was carried out on Glass and Crystal Factory feed, the amount of silica purification used in industry has been investigated according to its analyses. In this discussion, according to the artificial neural network algorithm back propagation neural network (BPNN), the amount of silica (SiO2) was predicted based on rock main oxides in chemical analysis. This study shows 99.9% accuracy of silica prediction for train data and 94% optimum accuracy for the prediction of test data. Due to the desired percentage, this study can predict the amount of silica in this plant.

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