

## Chapter 25

# Quantum Backpropagation Neural Network Approach for Modeling of Phenol Adsorption from Aqueous Solution by Orange Peel Ash

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### ABSTRACT

*The chapter describes a multilayer quantum backpropagation neural network (QBPNN) architecture to predict the removal of phenol from aqueous solution by orange peel ash, guided by the application of three types of activation functions and characterized by backpropagation of errors. These activation functions are Sigmoid function, tanh function and tan1.5h function. First by a classical multilayer neural network architecture with three types of activation functions is discussed in this chapter. It takes 6000000 iterations to train the network with a learning rate of 0.01. Among these three types of activation functions tan1.5 function shows the best prediction result. Next, QBPNN is discussed in this chapter. It takes 22000 iterations to train the network with the same learning rate. Here also tan1.5h function shows the best result in prediction of removal of phenol. Thus QBPNN is much faster than the classical multilayer neural network architecture. Different graphs are also given for comparison between the experimental output and network output using different activation functions. This particular chapter basically deals*

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*with a model application by which experimental results can be comparing with the model output. Because of their reliable, robust, and salient characteristics in capturing the non-linear relationships existing between variables (multi-input/output) in complex systems, it has become apparent that numerous applications of ANNs/QBNN have been successfully conducted in various parts of environmental engineering. Fuzzy Logic is also used as alternate method to predict the removal of phenol from aqueous solution by orange peel ash, but QBPNN shows the best result.*

## **INTRODUCTION**

Phenol is an organic chemical usually present in industrial waste water. The substance is very dangerous to human even in small concentration. Phenols are long term effect pollutants and can be found in industries which produce chlorophenols that are widely used as fungicides and insecticides for the agriculture sector. Ingestion of phenols in concentration from 10 to 240 mg/l for a long time causes mouth irritation, diarrhea, and excretion of dark urine and vision problems. There are many methods such as oxidation, precipitation, ion change, solvent extraction and adsorption for removing phenols and its derivatives from aqueous solution. Adsorption is a well-established and powerful technique for treating domestic and industrial effluents.

In recent years artificial neural networks (ANN) have become a popular choice among engineers and scientists as one of the powerful tools for predicting contamination and concentration of different effluents and chemicals in drinking water, wastewater and aquifers. A part of the goal of studying neural networks is to learn the mechanism of our brain.

A neural network is made up of neurons and synapses. We have many variants of neural networks, based on how the constituent neurons are connected.

This chapter introduces quantum neural networks. There are two main reasons to discuss quantum neural networks. One has its origin in arguments for the essential role which quantum processes play in the living brain. A second moti-

vation is the possibility that the field of classical artificial neural network can be generalized to the quantum domain by an eclectic combination of that field with the promising new field of quantum computing. Both considerations suggest new understanding of mind and brain function as well as new unprecedented abilities in information processing. Here, we consider quantum neural networks as the next natural step in the evolution of neurocomputing systems, focusing our attention on artificial rather than biological systems.

The objective of this study is to evaluate the efficiency of a quantum backpropagation neural network for predicting the efficiency of orange peel ash for the removal of phenol from aqueous solution and to investigate the effects of initial phenol concentration, contact time, pH and adsorbent dosage of the adsorption of phenol on orange peel ash.

This QBNN based prediction can be used On-line also. So, it has a great agricultural significance. Everyone can use this model for prediction from any corner of the world.

## **REMOVAL OF PHENOL BY VARYING DIFFERENT OPERATIONAL FACTORS**

The different parameters which affect the adsorption of phenol from an aqueous solution are:

1. pH,
2. Initial Concentration,
3. Adsorbent Dosage,

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