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RESEARCH ARTICLE

Artificial Intelligent In Thermal Power Plants For Losses Control

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Abstract

This paper considers an approach to design a controller used for blow down optimization in the losses reduction process of a power plant boiler. The optimization of the BD will maintation TDS level and reduce the indirect heat losses.. Efficiency of any Boiler depends upon minimization of various indirect losses of the boiler so that amount of energy input in the boiler by burning the fuel can be maximum utilized for generation of steam and cost of steam can be minimized ultimately. Artificial intelligent can prove to be a very effective tool for evaluating and maintain boiler efficiency and indirect losses. This Artificial intelligent technology offers a best method for designing a neuro control based on back propagation. The advantages of using a Artificial intelligent to represent a system are it's ability to perform a nonlinear mapping between inputs and outputs and the necessity of requiring minimal prior knowledge of the system.

1. Introduction

As steam is generated, water is evaporated in its pure form leaving practically all of the dissolved minerals behind. Steam is essentially distilled water. Thus the remaining boiler water contains the minerals which are left behind by the evaporating steam. As these minerals concentrate in the boiler, they too begin to cause problems and must be removed. Problems noted are the carryover of boiler water into the steam causing wet steam which has a lower overall BTU content and thus requires the generation of even more steam to provide the desired heating. This results in the loss of additional fuel. The additional water in the steam must be removed by the steam traps which can be seriously over worked and damaged, thus shortening their life. Finally it is possible for the wet steam to leave behind mineral deposits that insulate the steam side of heat exchangers preventing efficient heat transfer. To avoid unnecessary losses of heat, blow down should be kept as low as possible and part of this loss can be recovered by heat exchanger monitoring and the useful heat being used to preheat feed water heat.

Table 1. Model Report Format for Boiler Efficiency and Indirect Losses System

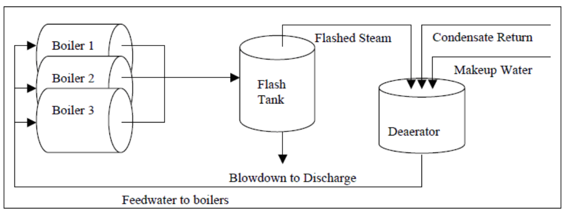
BOILER EFFICIENCY	69.35
INDIRECT LOSSES	30.65
(I) DRY FLUE GAS LOSS	7.42
(II) FUEL MOISTURE LOSS	6.31
(III) BLOW DOWN LOSSES	14.77
(IV) INCOMPLETE COMBUSTION LOSS	0.00
(V) AIR MOISTURE LOSS	0.00
(VI) RADIATION & CONVECTION LOSS	2.15

COURTESY:- THERMAX BOILER, J.K.PAPER, RAYAGADA

2. REQUIRMENT OF WORK:-

In addition to proper blowdown practices, including the use of automatic blowdown control, reducing cost and heat loss associated with boiler blowdown can also be achieved through recovering the heat/energy in the blowdown. The blowdown water has the same temperature and pressure as the boiler water. Before this high-energy waste is discharged, the resident heat in blowdown can be recovered with a flash tank, a heat exchanger, or the combination of the two. Any boiler with continuous surface water blowdown exceeding 5 percent of the steam generation rate is a good candidate for blowdown waste heat recovery.

The flash tank system shown in the figure below can be used when expense and complexity must be reduced to a minimum. In this system, the blowdowns from the boilers are sent through a flash tank, where they are converted into low-pressure steam. This low-pressure steam is most typically used in deaerators or makeup water heaters.

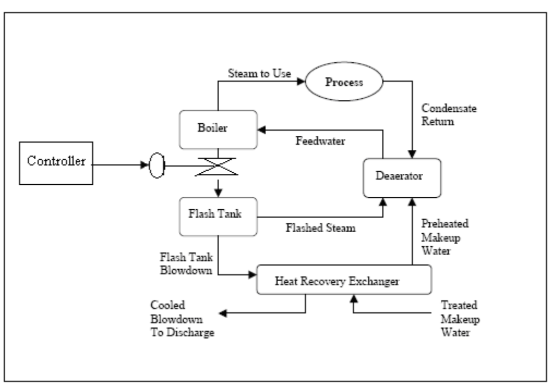


Schematics of a Flash Tank System

Fig.1

The system shown below consists of a flash tank and a heat exchanger. The temperature of the

blowdown leaving the flash tank is usually still above 220°F. The heat of this flash blowdown can be used to heat makeup water by sending it through the heat exchanger, while cooling the blowdown at the same time. Heating boiler makeup water saves on fuel costs. An additional advantage of cooling blowdown is in helping to comply with local codes regulating the discharge of high temperature liquids into the sewer system.

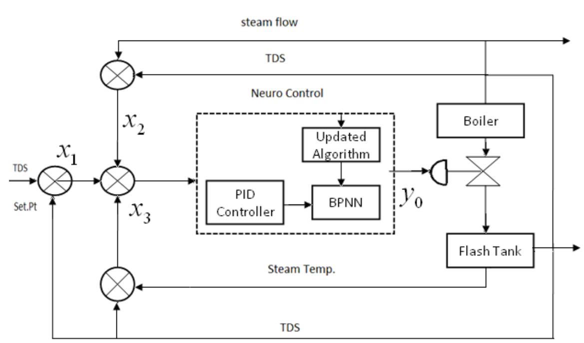


Conventional method of contorl

Fig.2

3. EXISTING NEURAL NETWORK MODEL

There are many ANN architectures for which the choice depends on the type of problem and may require experimentation of different algorithms. One of the most popular architecture is a multilayer perceptron with the back propagation (BP) algorithm. BPNN (Back propagation neural network) is applied for the prediction of TDS in flash tank It is proved that a four-layer (with two hidden layers) perceptron can be used to approximate any continuous function with the desired accuracy. BP has been used successfully for pattern classification, though its original development placed morestress on control applications. A controller is usually connected serially to the controlled plant under consideration. For a multilayer perceptron, the weights of the network need to be updated using the network's output error. For an ANN controller, the output is the control command to the system. However, when the ANN is serially connected to a controlled plant, the network's output error is unknown, since the desired control action is unknown. This implies that BP cannot be applied to control problems directly. Thus, one of the key problems in designing a neural network controller is to develop an efficient training algorithm. Fig. 3 shows the ANN architecture for the TDS control station of the power plant. This is used to control the blow down of the of the Boiler. In this model, there are three inputs: TDS level, temperature of steam on flash tank, steam flow and one output is of opening of the pneumatic valve in the blow down control system. The valve regulates the excess water in the blow down system. Trials are performed using two hidden layers with the number of neurons one hundred in each of hidden layer, three neurons in the input layer and one in the output layer. Training the ANN is an important step for developing a useful network.



Blow down control with BPNN

Fig:-3

4: DESIGN OF PROPOSE MODEL:-

4.1 Introduction

The generic non-linear solution to the system like Blow down monitoring can be provided through It is so as the dynamic relationship between various causes and effect variable is capable through

4.2 Structure & Function

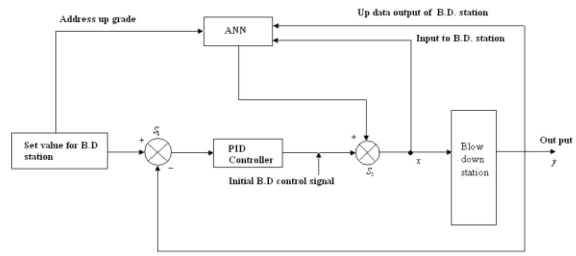
In linear model the existing neural network provide a clear view of relationship between effect variable and its causes. The real benefit of using Artificial neural network ANN in all linear modes is that they can provide better modeling of non-linear relationship. For this system there are various ANN structure but they process some common features. They are generally composed up numerous processing elements called as nodes which are arranged together to form a network. The commonly used processing element is one which weights the input signal and than sum them with a bias assigned to it. The summed weighted inputs are passing through a non-linear activation function such as the hyperbolic tangent and this is the output of neurons. The model approximation for blow down optima ion is gradual learning based on the observation of the blow down loop input/output data in real time. The functioning of blow down station describe with the differential equation

Y(K+1)=a Y(K) +b X(k)

Y(k) and X(X) are output and input to BD respectively.

K is the time step number and a,b are constant coefficient as per design of BD station with soft sensor in neural network (PNN) as shown in fig.2Here the control signal X(K) for actuating control value is determined by a pair of value y(k) and y(k+1) which are the present and next blow down station output(TDS, Drum level , BD temp.)The sequences value of y(k) for k=1,2,3,………… is assumed to be known and is provided by the reference blow down output (TDS, drum level, Blow down temp.) generator. The conventional controller initially produce the control signal x (k). The controller hear in use is _Ve feedback configuration. The reference blow down output generator inputs the present output value of thee station to summing node S1. Due to the close loop condition system between the reference plant output to the summing node S1 and the ui nit plant output .To fulfill this condition the close loop control l system must have classical controller, plant & node S1 be in stable and it is definite high gain conventional controller. At the initial training state the neuro control provides little or no input to the summing node S2.The neural controller associated with soft sensor hear is memory based. It is not initially trained and its initial output is zero to S2. There for the dominant components of the total Actuating signal (k) is the output of traditional controller. The control signal produced by PID controller in each control step x(K) is generated in PNN of y(K), y(K+1), which is due to the learning rules of w(K+1)=WK + α [X(K)W(K)]

In this weight adaption $\alpha > 0$ is a small +ve learning constant, K denots learning step number and also the number of the control step, The initial weight value are set to zero. Which corresponds to setting the entire characteristic surface to zero at the beginning of training .The conventional controller build the weight W (k) can now be interpreted as updated control signal value (K) . At the learning value W, the learning end up and x (k) the averaged value over number neuro control learning steps.



PNN frunctioning at process station

Fig 4

5. PRACTICAL APPLICATION OF PNN(BLOW DOWN MONITORING):-

The Process Neural Network which describe above can be use successfully at BD STATION for its optimization. Here the present measure valu of TDS of boiler drum water can compare with set valu , at the same time to have a successful drum level control to support the lode required by the system we have to consider the steam flow as parameter hence dischargeing BD and its monitoring is dependable to steam flow also.To reduse the heat lossess in this system ,to utilize the maximum amount of heat for heating feed water, Blow down water temp. is a parameter for feed water control which effect the boiler drum and at the end steam flow that gives required TDS in discharge water. The required algorithm regulate the error for minimization to have a control signal to Pneumatic control valve placed at three different point in BD station. The valves regulate the excess water in the blow down system and feed water line for monitoring TDS and Feed Water temp. The systematic use of PNN in BD station for its optimization is shown in the

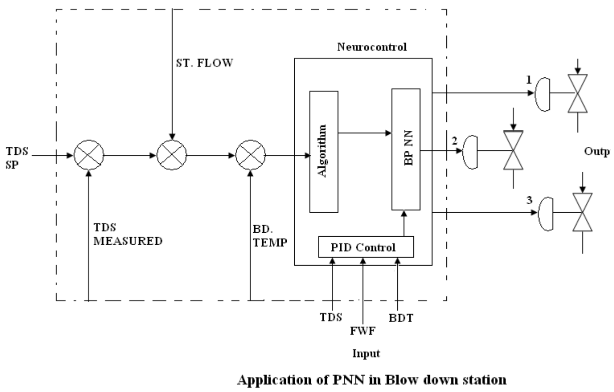
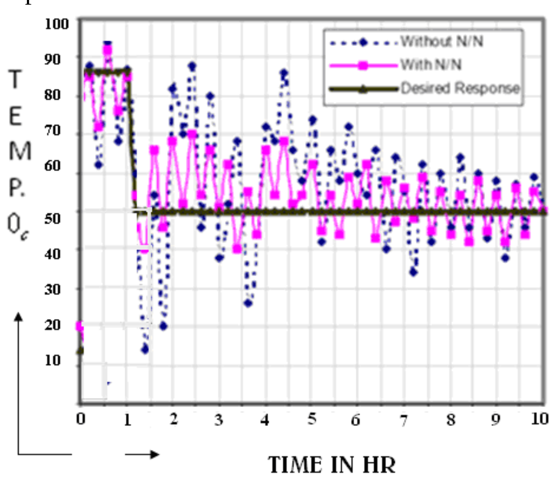


Fig:-5

6. SIMULATION & REMARKS:-

The blow down losses of the Boiler is one of the most sensitive parameter involved in all Thermal Power Plants. This parameter is directly related to the control of the temp. of feed water and the control of the TDS. A careful study was done on the existing PI controller system in the Power plant and compared with the designed PNN model.. The results obtained with the proposed neural network of the boiler plant shows that soft sensor can converge the neural network to improve performance. fig. 4 shows comparison of neural network results with desired blow down control and percentage of deviation of BD monitoring without neural network. It has been clearly proved that the PNN model is more accurate and efficient making the system robust and reliable as compared to the former..



Blowdown temp control with PNN

Fig:-6

The results of PNN are very sensitive to number of neurons. Increasing the number of neurons in hidden layer will decrease the number of calculation steps with subsequent decrease in summed squared error. The proposed PNN controller can replace a conventional controller, and is shown to overcome most of the problems mentioned above. A training algorithm is derived based on BP, enabling the neural network to be trained with system output errors, rather than the network-output errors. In the BP algorithm, weights need to be modified by using the network-output error that is not known when a multilayer perception is applied directly to the controlled plant. Therefore, the proposed algorithm enhances the NN's ability to handle control applications. The only a priori knowledge about the controlled plant is the direction of its response, which is usually easy to determine. The proposed PNN controller has been applied to the BD control in a thermal power plant and extensive simulations conducted show promising results. we determine that the maximum effective operating range is between 4500 µ mhos and 5000 µ mhos, then we can set the controller to control blow down at that range (as shown below). Below 4500 µmhos we are wasting water, chemical, and fuel. While above 5000 µ mhos we are risking the generation of wet steam. This shows that inadequate treatment of boiler water can waste as much as 15-18% of energy and can even result in plant damage. Feed water if not properly treated shall result in scale buildup which can reduce boiler efficiency by as much as 10-12% and can even result in plant damage .It is important to maximize condensate return an additional is to 18% of boiler energy from the steam is needed to re-heat each pound of coal makeup water.

7.CONCLUSIONS:-

The proposed back propagation neural network Artificial intelligent proves to be an efficient modeling system for calculation and optimization of the Blow down. It significantly reduces the frequency of deviations and the degree of deviation of the TDS that can reduce indirect losses .the tripping of the boiler during load fluctuations. Focusing on process control systems, a new direct adaptive controller using neural networks has been designed and tested for the Blow down control in a thermal power plant. For such a control system, the negative effects of a long system response delay and nonlinear elements are the main obstacles in designing a high performance controller and fine-tuning its parameters. Good performance, a simple structure and algorithm, and the potential for fault tolerance make the proposed ANN controller attractive for process-control applications by proper use of this ANN technique it is possible to increase boiler efficiency and also consistency of boiler efficiency can also be maintained. This may serve as an important tool for the management to exercise effective energy conservation and cost control measures. In order to compete with international products, there is no other alternative but to go for automation in near future. This approach may act as a precursor to that.An approach to design a ANM controller used for the blow down control optimization in the process of a power plant boiler has been presented. The optimization of the BDC will reduce the in direct losses and improve the efficiency in the boiler system.

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