IJCPE
Iraqi Journal of Chemical and Petroleum Engineering

Iraqi Journal of Chemical and Petroleum Engineering
Vol.10 No.4 (December 2009) 39-43
ISSN: 1997-4884

University of Baghdad
College of Engineering

Monitoring of Evaporated Cooling Tower

Salam K .Al-Dawery and Mahmood K. H. Al-Mashhadani

Chemical Engineering Department - College of Engineering - University of Baghdad – Iraq

Abstract

The present study was conducted for monitoring of the evaporative cooling tower in methanol production plant using digital computer. Visual Basic computer program was used for the monitoring of the performance of the cooling tower. The structure program consists of sub programs and forms to show all the related variables such as temperature, flow rate, pressure ....etc, that affect the cooling tower operation and give alarms and important functional information regarding these variables.

Keywords: Monitoring, cooling tower

Introduction

Although computer control is widely employed in large process plant, there are many variables can directly or indirectly affect the efficiency and control system of industrial unit and full short of automatic control in the present of major hardware. The deviation of variable from its desired value is signaled by a series of the process alarms which must be interpreted and acted upon by a plant operator. The diagnosis of this deviation, the screening of potential remedial actions and the administration of corrective action lead to the increase performance of this plant and the key to successful completion of the monitoring dependent on the set of information provided by process alarms and manner in which this information is provided. Such monitoring can be performed using the digital computer systems (1,2). The capability and flexibility of the digital computer in handling large volumes of information extremely quickly, combined with the additional facilities of rapid sequential operation and time sharing, have directed the development of computer control firmly into the digital field(3).

Interface unit is a device responsible of the communication between the computer and the process to be controlled or monitoring. It receives the signals from the measuring sensors and transducers associated with the various measured process variables, these signals may be continuous, analogue electrical voltages (e.g. thermocouple, pressure transducer signal), or simple digital information(on-off), from various replays, and so on. For control the interface, also, sends out command signals from the computer to the manipulating variables in analogue form.

In the computer performance (information function), the computer gathers the plant data, processes it, stores it, and communicates it to the operators and other personnel; the computer makes no direct changes in the process operation in this instance(4). This is called monitoring, which is observing all parameter, which directly or indirectly affect the performance of industrial unit through the computers monitoring and control panel. In the chemical industry, where process monitoring finds its widest application, the process consists of the chemical engineering operation, necessary to convert one or more raw materials into finished products, often the necessary to monitor and observe all parameter or variable which effect on this process such as (temperature, flow rate, pressure).

Monitoring program

The monitoring program of the cooling tower was written using Microsoft Visual Basic which has many forms to mention all variables of the cooling tower and codes to use many relationships showing all the problems and the performance of the process. Also, this program has main screen shoot from which many variables are shown and processed under control system such as water level in the basin and pH. (see Figure (1)). And thus, the monitoring of basin is separated from the monitoring of performance of the cooling tower.

The monitoring of industrial unit was achieved by using two different computer programs, first one is for data collection, while the second for data analysis, these programs are as followings:

1) Program is used to read the plant data and store it along with its real time in a specified file which can be material for any other programs; the flow of chart of such program is shown in Figure (2).
2) Program is used for processing the data and using it for relationships, drawing the results that show the effect of this data on the process the chart of such program is shown in Figure (3).

Monitoring of Basin Variables

One important variable is the pH which is considered to be a measure indicator for corrosion and or scales are built up.

The monitoring of pH of water in the basin was carried out via building a computer program for such purpose. This program has a simple way to see whether particular water has a tendency to form scale or corrode the equipment and piping based on special formula such as the Langlier and Ryznar index (5,6).

The Langlier and Ryznar index are two such commonly used indicators and both assign number that shows scaling or corrosion tendency based on pH readings. The formulas is calculated as shown below:

pHs=(9.3+Ns+NT)+(Nh+NA)

Langulier index= pH-pHs

Ryznar index= 2pHs-pH

When the Langlier Index has positive number indicate that a scale formation exist and the negative number indicates corrosion formation, while all values are positive in the Ryznar Index, values for the index above 6.5 indicate a corrosion tendency and values for the index below 6.5 indicate an increasing tendency to scale. However the application of the above equation gives an acceptable result as shown in Figure (4), it also allow the operator to easily understand that scaling or corrosion can minimize by adjusting the water's pH to be close or equal to the recommended value.

Monitoring of the Performance of

Cooling Tower

There is a growing demand for cooling towers in the industry, not only towers required for supplying large water, but also they are called upon to supply this water at temperatures very closely approaching the wet bulb temperature and to be closely approaching the wet bulb temperature of surroundings. Therefore, there are methods needed to be analyzed and predicted for the performance of the cooling tower. The Merkel's integral correlation, see equation below, can be calculating the performance of the cooling tower.

The integral of the above equation is solved by integral numerically using Simpson's ruleand Tchebychef method (7,8).

$$\frac{KaV}{L} = \int_{T_2}^{T_1} \frac{dT}{h^* - h1}$$

The screen shoot for performance of cooling tower is shown in figure (5) in which many variables are monitored such inlet and outlet water temperatures, water-air ratio, etc.

Filter monitoring

The monitoring of the filter in a cooling tower system is preformed by measuring pressure drop signal across the filter and produces a signal from which an alarm signal is given to the operator, and also, some of recommendation can be given concerning the timing of filter cleaning. Figure (6) shows screen shoot for monitoring of the filter.

Monitoring of others Variables

The temperature, water flow rate, and pressure for input and output of water that in process within the cooling tower are need to be continuously monitored in order to show their effect on the operation of cooling tower. Thus, these variables were considered to be one of the objectives of this work. So, these variables are measured and fed to the computer for data logging and then processing it as required. Figure (7) shows a screen shoot for monitoring of these above variables. The developed program is able to show any error or deviation of these variables from their desired values and also can give an alarm signal to the operator.

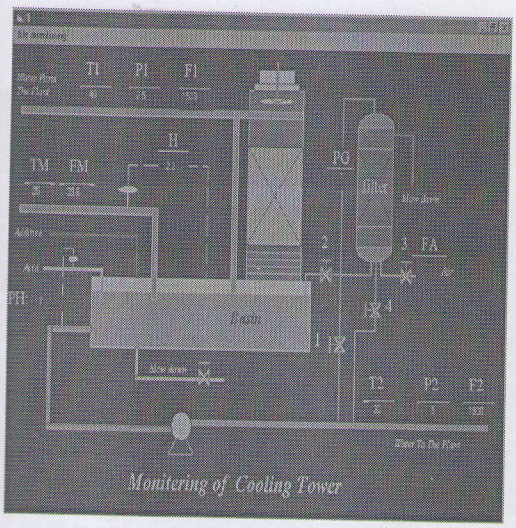

Fig. 1 Screen shoots of cooling tower

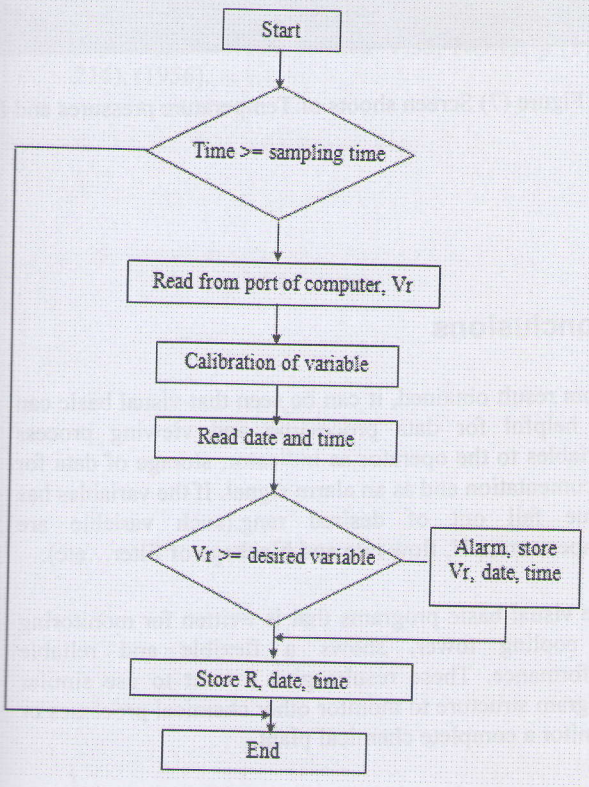

Figure (2) Algorithm of Program Reading

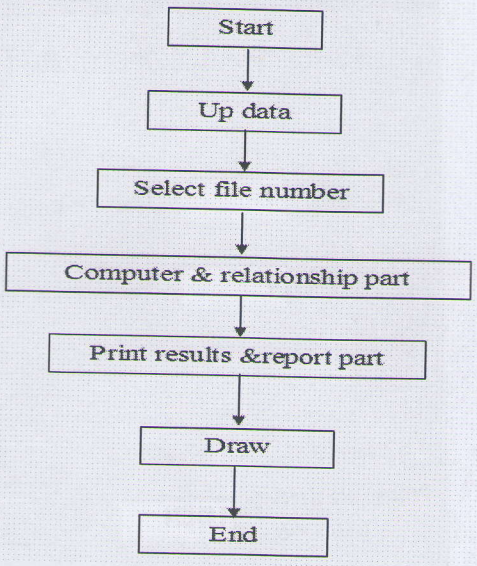

Figure (3) Algorithm of Reports

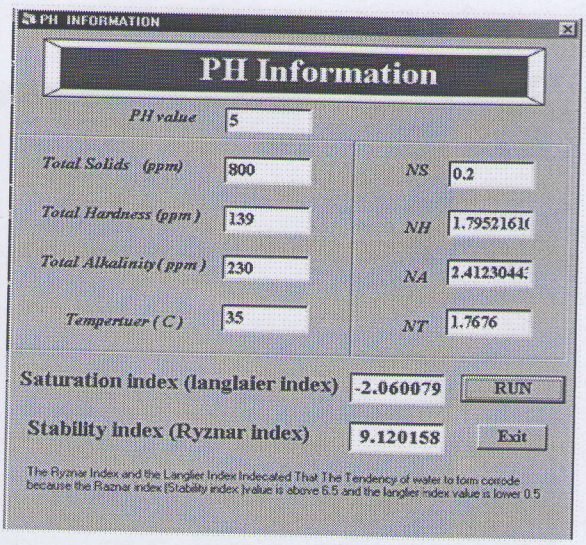

Figure (4) Screen shoot for pH monitoring

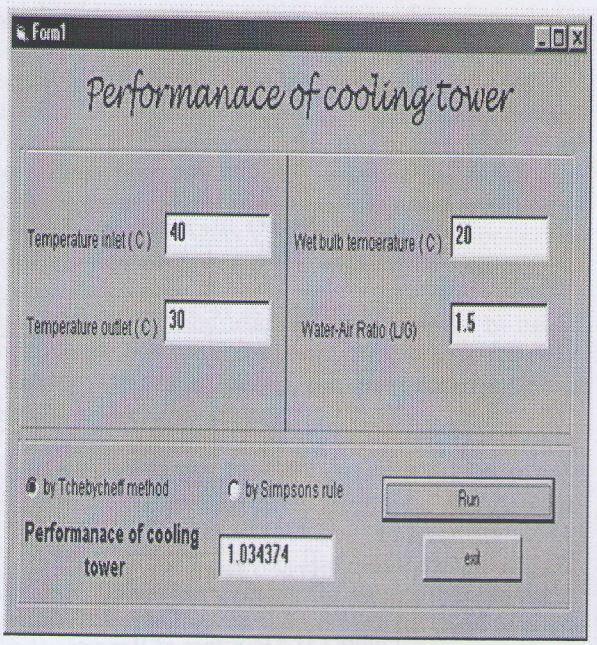

Figure (5) Screen shoots for performance of cooling tower

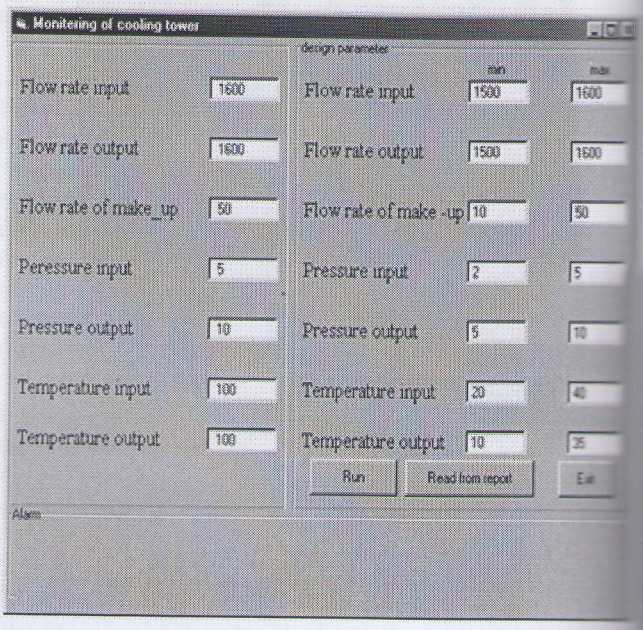

Figure (7) Screen shoots of Temperature pressures and flow

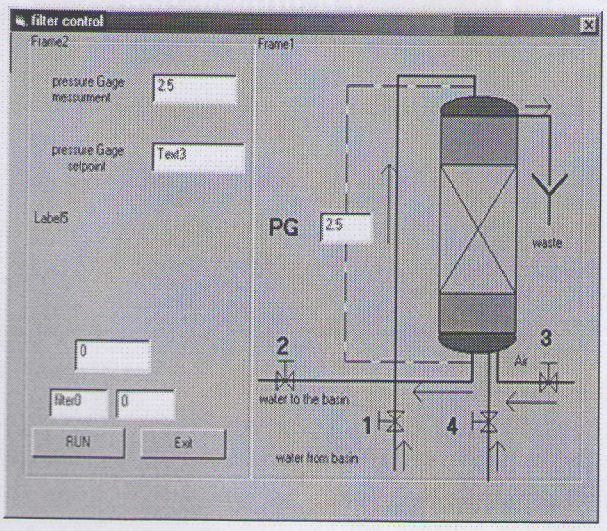

Figure (6) Screen shoots of filter in cooling tower

Conclusions

From result obtained, it can be seen that visual basic can be helpful for data processing and viewing process variables to the operator as indicator, storage of data for documentation and as an alarm signal. If the variables has value fall out of desired rang.(such variable are temperature, pH, flow rate and blockage of filter…etc).

The visual basic programs that is written for monitoring of cooling tower, shows a flexible and reliable performance. These results give a trust to use similar program structure to monitor other chemical processes or monitor a complete chemical plant.

References

1) Modarrfs M., Cadman .T "A Method Of Alarm System Analysis For Process Plants", Computer & Chemical Engineering V 10, No. 6, p (557), (1986).
2) Seborg, D.E., Edgar, T.F. and Millichamp, D.A. "Process Dynamics and Control", 2nd ed, John Wiley and Sons, (2008).
3) Webb G. R., "Automatic control an introduction", McGraw-Hill publishing com (1964).
4) Deshpande P. B., Raymond H., Ash, "element of computer process Control", Instrument society of america ,(1982).
5) Mchelvey K. K.,Brroke M. "The industry Cooling Tower", Elsevier publishing com.(1959).
6) Mayenkar K.V., "Quick Way To Determine Scaling Or Corrosive Tendencies Of Water", Chemical Engineering, May 30, P(85-86), (1983).
7) British Standard "Water-Cooling Tower", Part 2, Bs 4485, (1988).
8) Fuller A. L. "Computer Evaluates Cooling Towers", Petroleum Refiner V.35, NO.12, p (211-214), (1956).