Research Article

Treatment of Textile Plant Effluent by using a Heat Exchanger

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ABSTRACT

Many developing countries, including Africa, India, etc., look forward to developing strong integrated textile industries to add value to already-available raw materials. Textile industries is one of the fastest growing industries and this industries play an important role for faster economic rate in developing countries. However, the usage of water from free water resources results in discharge of high rate of waste water. The waste water is released into the water resources like river, lake, etc,. leading to water pollution. Individual wastewater treatment through physical, biological, or chemical method is done and 10% of this waste water is again purified with the help of Heat Exchanger. The purified water can be reutilized in the Textile industries.

INTRODUCTION

Heat Exchangers are used to transfer the heat between two fluids in a effective way instead of mixing those two fluids[1].Heat exchangers are widely used in engineering applications such as refrigeration and air conditioning systems, automobiles, thermal power plants, chemical and textile processing industries, etc[2]. There are different types of heat exchangers used in industries; they are-Shell and tube type Heat Exchanger ,Plate Heat Exchanger ,Air cooled Heat Exchanger. The Shell and Tube Heat Exchanger system being most common[5]. The dynamic response is very important if these devices are to be controlled in any way[6]. Heat exchanger process is a complex system because of its non linear dynamic state and variable gain with time constant [1]. It is recommended that the (SCADA) can be used to predict the performance of thermal system in heat exchanger for heat transfer analysis[8]. SCADA stands for Supervisory Control And Data Acquisition, and revolves around the gathering and analysis of the data generated in various processes. The main aim of this paper is to show the best way to optimize the heat transfer process with ease and effective .

Procedure

Heat Exchanger

In each process of textile industry, there is frequent process of cooling and heating is done between two different temperature fluids .The reason of choosing Heat Exchanger instead of direct cooling and heating is, there will be unwanted chemical reaction between the two process fluids. Heat exchanger is the indirect heating and cooling method which is suitable mainly for process industries. A Heat Exchanger is a device used to transfer heat between two liquids. For cooling process example, Hydraulic Oil cooler Heat Exchanger is used to transfer the heat from the hot oil to the cool water passing through it and other example for heating process is, Swimming pool water heater .This process explains the heat from the

solar heated circuit or water heater is transferred to the pool cold water. The heat transfer is done by, through the exchange solid tube –one fluid flowing inside the tube and other is flowing outside the tube. As said in the introduction part, Heat exchanger is of three types- Shell and tube type Heat Exchanger ,Plate Heat Exchanger ,Air cooled Heat Exchanger A shell and tube heat exchanger passes fluids through and over tubes, where as an air cooled heat exchanger passes cool air through a core of fins to cool a liquid.

The Heat Exchanger's Flow Arrangement

The arrangement of the hot and cold fluid's flow within the heat exchanger is major way of categorizing them. The three major categories based on flow arrangement are: **Parallel-Flow** –In this parallel flow arrangement, the hot and cold fluid enters the same side of heat exchanger and they flow parallel to each other. **Counter current-Flow** –In counter current-flow heat exchangers the hot and cold fluids enter the heat exchanger from opposite sides and they flow toward each other. **Cross-Flow** –In cross-flow heat exchangers ,at different points the hot and cold fluids enter the heat exchanger and they flow at right angle cross paths.

Efficiency of Heat Exchanger

There are several factors to be considered for the

efficiency of heat exchanger. Some of the factors are given below,

Temperature differential – The difference between the hot and cold fluids is the factor to be designed before designing the Heat Exchanger. The temperature of coolant fluid should be lesser than hot temperature. The lower the coolant temperature the higher heat transfer in hot fluid.

Installation – Based on a manufacturer's guidelines, the heat exchanger should always be placed. It is recommended that heat exchanger should be placed in counter current arrangement. In Shell and Tube Heat Exchanger, the coolant fluid should enter in lower position so that coolant water always be in the heat exchanger

Lifetime of Heat Exchanger

The Heat Exchanger have no moving parts and function at various temperatures and pressures. The Heat Exchanger is usually made of moving parts. There are some factors to be considered for lifetime of heat exchanger.

Accuracy - If sending data values to the manufacture are correct, the effective heat exchanger can be manufactured. Higher the pressure leads to leak in pipe.

SCADA

Supervisory control and data acquisition (SCADA) is a system of software and hardware elements. The basic SCADA architecture begins with programmable logic controllers (PLCs) or remote terminal units (RTUs). PLC and RTU's are microcomputers that connects the devices such as sensors, HMI(Human machine interface),valves ,etc., to the computer through SCADA software. The data values are

entered and saved in SCADA Software of computer for future references. For example, the SCADA system quickly notifies the machine operator by alarming the operator that the machine is showing errors. The operator reviews the data in the computer in which the machine is connected through HMI and SCADA software notifies the operator that the machine is malfunctioning. SCADA helps to indicate the device malfunctioning and reduce the further loss of product. The Wonder ware In Touch software is used as the SCADA software in this process.

Procedure

Experimental system

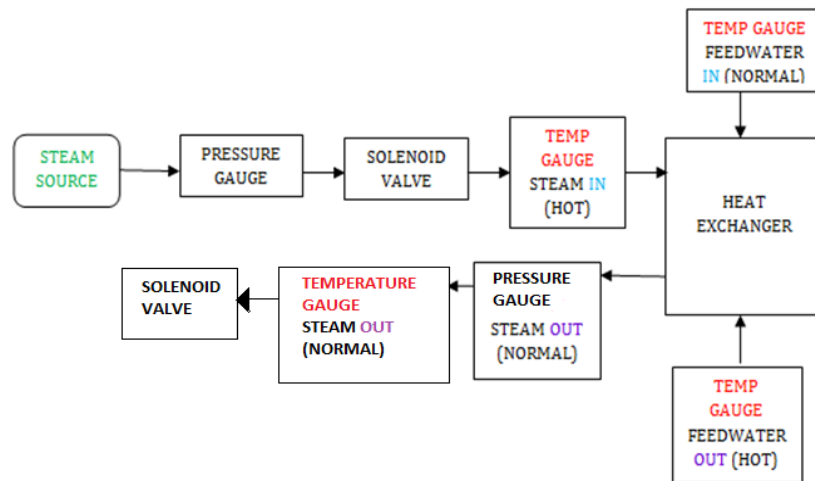Experiments are conducted on a shell and tube heat exchanger. .

Table 1 : Geometrical Parameters of the Heat Exchanger	
Shell Inner Diameter	23.5 cm
Shell length	100 cm
Tube Inner Diameter	0.8 cm
Tube Length	110 cm
Number of Pass	3
Table 2 : Selected Parameters and their levels	

Condensate Flow	6.1-7.8 m^3/hr
Feed Inlet Temperature	20-27 degree Celsius
Steam Flow	5-7 kg/cm
Condensate Temperature	68-72 degree Celsius

Results And Discussion

When the steam of high pressure which is measured by the pressure gauge, is given to the Heat Exchanger through the opening of control valve, there will be heat transfer between steam and the waste water from dye industries. The steam comes out from the outlet with low pressure and the waste water becomes purified water that can be reutilized again as in the textile industries.
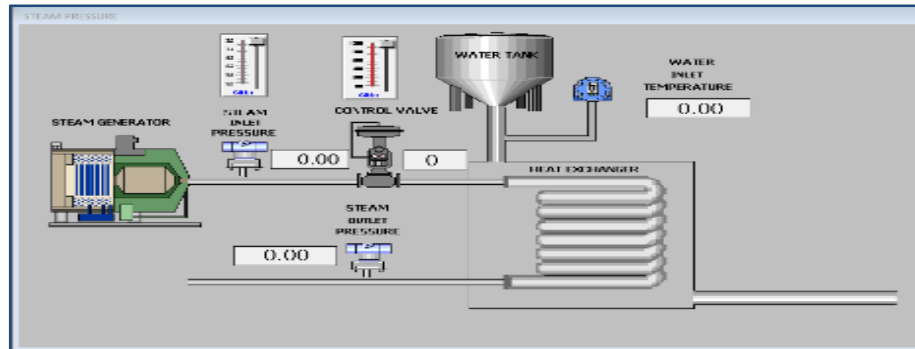
Conclusion

In conclusion, this paper has shown how SCADA is used in the waste water treatment plant. SCADA is to automate the treatment plant processes and provides efficient maintenance procedure for waste water management across the world. At present, high requirement of recycling waste water to minimize the scarcity of water around the globe is creating immense opportunities for the growth of SCADA market for waste water treatment plant. SCADA system allows the waste water treatment plants to be automated, as well as manage and organize the operation data automatically. SCADA helps to control the operation and monitor the status and readings via HMI screens, get important data logged and generated into reports and graphs asily. SCADA can not only give you centralized control and automation but also real-time and historical visualization into your plant processes and performance. By using Heat exchanger method, the purification of waste water can be done successfully.

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