



# AUTOMATION IN RECTIFIED SPIRIT (RS) PRODUCTION IN DISTILLERY UNIT

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**ABSTRACT:** Rectified Spirit production Automation in distillery unit in the production of Rectified Spirit (RS) is a necessary system which is not implemented in this distillery unit. The present technology involves the manual control of the RS production process. This involves a huge wastage of time with manual effort. Hence there is a decrease in quality and less production of RS. The quality of RS should be greater than 66 for a normal Rectified Spirit. When the control used is manual, there is a probability of getting RS whose quality is less than 66. In order to get the desired quality and high production of RS, automation of RS using PLC is implemented in this proposed work. Here, the wash and steam are fed in an automated manner. There is no need of manual support, hence it reduces errors and it ensures high production.

**Keywords:** Rectified Spirit, SCADA, Top Temperature, Bottom Temperature, Differential Pressure Transmitter (DPT), Steam, Wash, PLC

## I. INTRODUCTION

Distillation of fermented wash is based on the fractional distillation. In this method, Ethyl Alcohol and other impure alcohol are separated at respective boiling point [2]. The distillation process involves,

1. Separation of alcohol from fermented wash.
2. Concentration of alcohol.
3. Separation of Rectified Spirit and impure spirit.

The distillation plant consisting of analyser column, rectifier column. The analyser column built along with degasifying column[2]. Each column is attached with condensers. The separate cooler for RS and IS provided. The fermented wash pumped from the clarified wash tank is fed into an analyser column on continuous basis and steam is injected at the rate of 2.1 Kg/Lt. of alcohol for separating alcohol and spent wash from fermented wash in analyser column. The counter current circulation separates spent wash at the bottom of the analyser with 100 – 105 deg. C and alcohol vapours with 78 deg. C are injected into rectifier column and alcohol content increased to 95 – 96 % v/v the concentrated Ethyl Alcohol is availed and received at receiver after following the quality and quantity assurance. The Impure Spirit produced along with the Rectified Spirit 7 – 8% is separated in a heads column and it is cooled and received in a separate receiver tank.

The present technology involves the manual control of the RS production process. This involves occurrence of errors with high process time. Hence, In this work, we move to automation technology where the stem and wash feed are controlled without manual assistance.

The paper is organized as follows: Section 1 is the introduction of the Rectified Spirit production. Section 2 is the Block diagram. Section 3 is the Piping and Instrumentation diagram. Section 4 includes the description of the work. Section 5 comprises of programmable Logic Controller (PLC). Section 6 involves SCADA. Section 7 involves Results. Section 8 involves Conclusion and future work.



## II. BLOCK DIAGRAM

The block diagram of this work is shown below which mainly consists of two columns namely analyser and rectifier column. The automation is done with the help of Programmable Logic Controller (PLC). The Supervisory Control And Data Acquisition (SCADA) system is used for monitoring purpose [10].

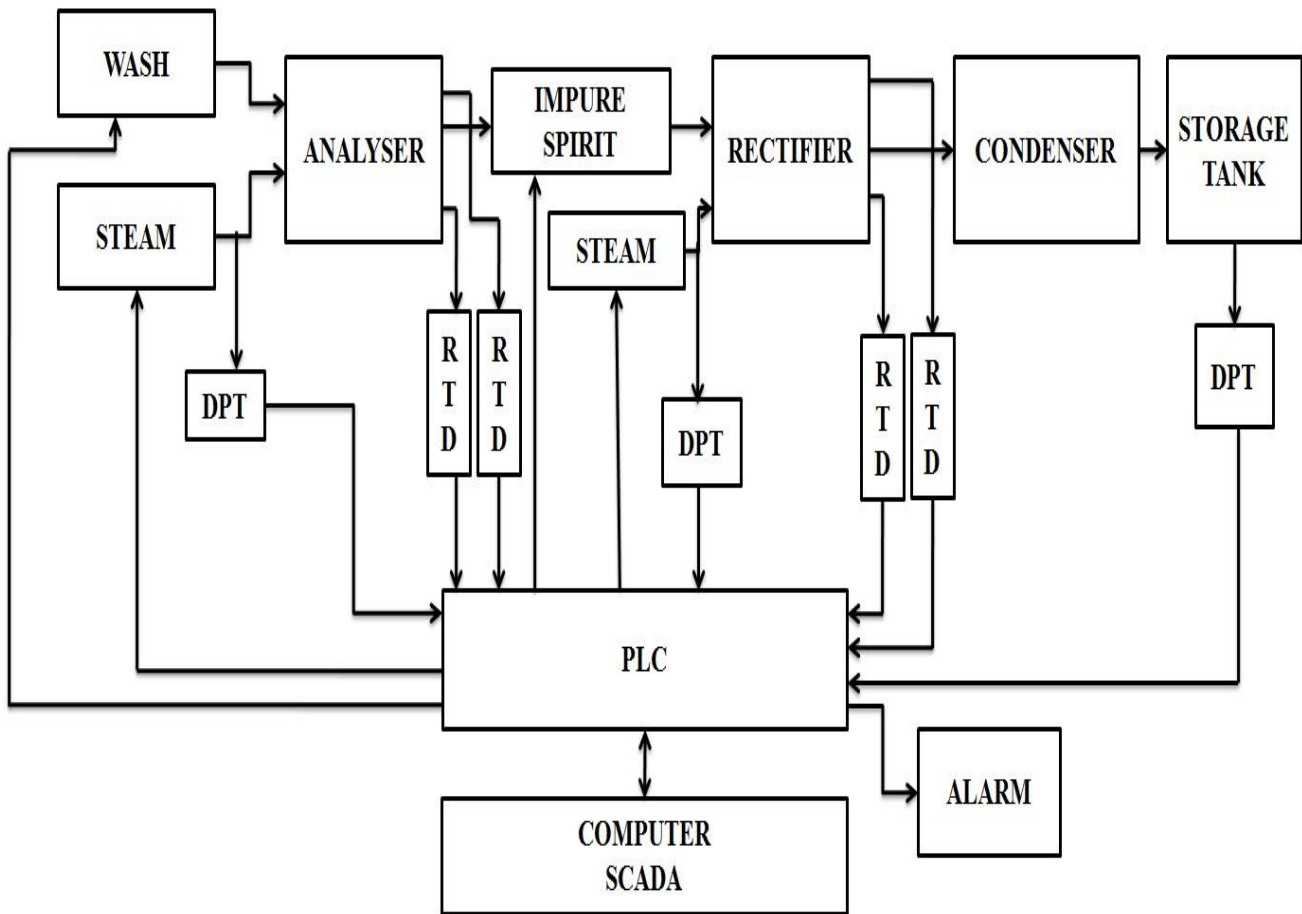


Fig.1 Block diagram of process

RTD - Resistance Temperature Detector  
DPT - Differential Pressure Transmitter  
PLC - Programmable Logic Controller  
SCADA - Supervisory Control And Data Acquisition



### III. PIPING AND INSTRUMENTATION DIAGRAM

The Piping and Instrumentation diagram for the automated RS production process is shown in this section.

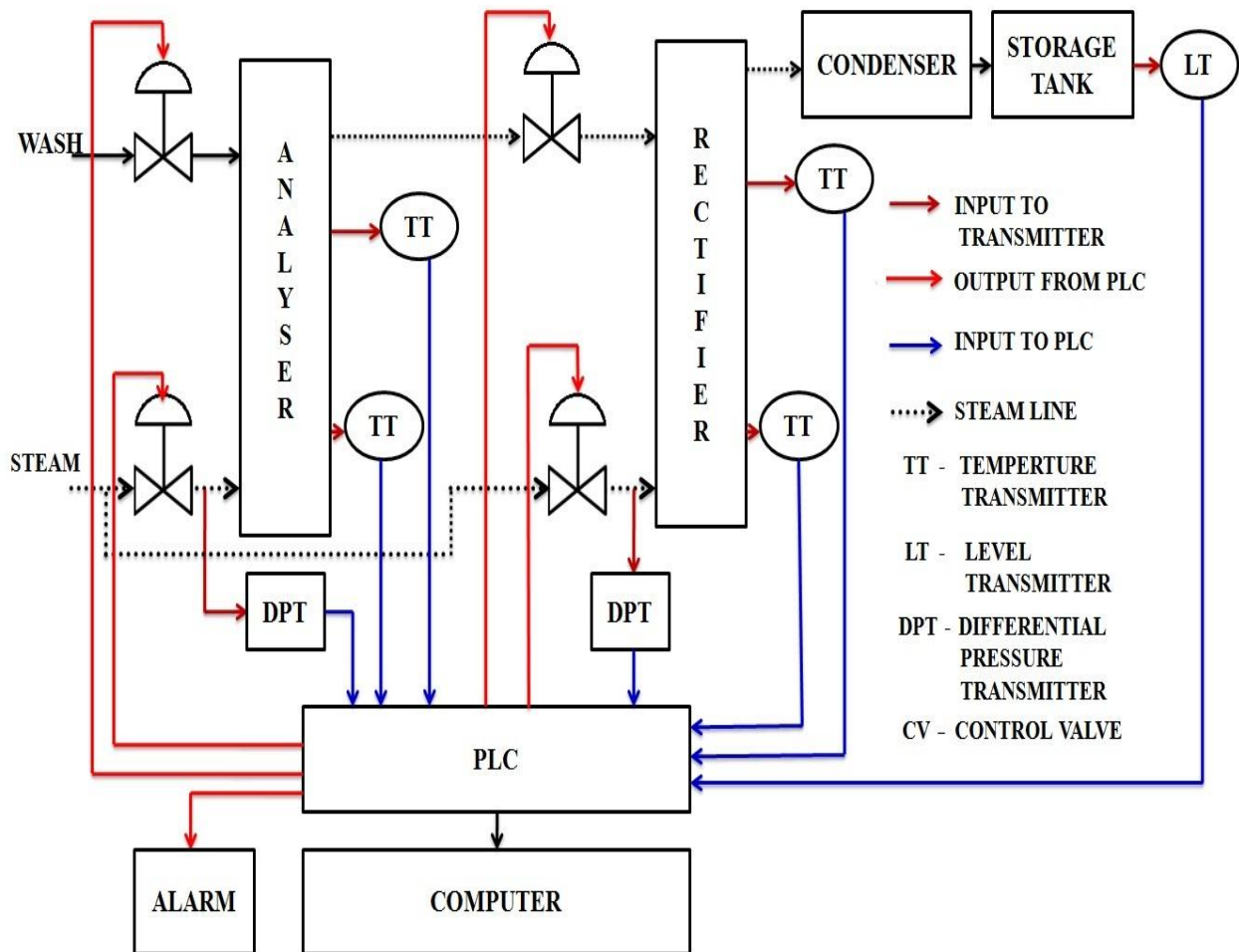


Fig.2 Piping and Instrumentation diagram of process

It consists of two distillation columns namely analyser column and rectifier column. The objective of this work is to maintain the top and bottom temperature of the analyser and rectifier column and also to monitor the level of the storage tank. The input steam feed is also monitored [11].

### IV. PROPOSED WORK

The wash is a diluted molasses that is fed to the top of Analyser which is in room temperature. The steam is fed to the bottom of the analyser. The Analyser column is divided into ten segments and 18 trays which are arranged in zigzag manner. Each tray consists of 95 bubble caps which are used to remove the sludges. In the analyser column the top and bottom temperature should be maintained in a specified range. The top temperature range is 94 - 96 degree Celsius. The bottom temperature range is 104 – 105 degree Celsius. In addition to that, steam pressure is also maintained. The steam pressure at the analyser is 1.5 Kg/cm<sup>2</sup>[1][3].



The temperature is measured by a 3 wire RTD (PT - 100) and passed to the PLC through a Temperature Transmitter. The steam pressure value is passed to the PLC via a Differential Pressure Transmitter (DPT). If the analyser column temperature goes below the specified range, the steam feed is increased by the PLC by opening the control valve. Similarly, If the analyser column temperature goes above the specified range, the steam feed is decreased by closing the control valve by the PLC or by increasing the wash input.

The top product of the analyser column (Impure spirit) is fed to the bottom of the Rectifier column. Steam also fed to bottom of rectifier column. The Rectifier column is divided into five segments and 44 trays are arranged in zigzag manner. Each tray consists of 65 bubble caps which are used to remove the sludges. In the Rectifier column the top and bottom temperature should be maintained in a specified range. The top temperature range is 77 - 78 degree Celsius. The bottom temperature range is 94 – 97 degree Celsius. In addition to that steam pressure is also maintained. The steam pressure at the rectifier is 1.5 Kg/cm<sup>2</sup>. If the rectified column temperature goes below the specified range, the steam feed is increased by the PLC by opening the control valve. Similarly, if the rectifier column temperature goes above the specified range, the steam feed is decreased by closing the control valve by the PLC or by increasing the wash input

The top product of the rectifier column is the Rectified Spirit in vaporized form that is fed to the condenser in which the vaporized Rectified spirit is cooled and stored in storage tank in liquid form. The level of the storage tank is monitored by PLC with the help of Differential Pressure Transmitter (DPT). Hence the level is measured and if it exceeds the limit, It triggers the alarm [4].

## V. PROGRAMMABLE LOGIC CONTROLLER(PLC)

In PLC, by means of simple programming techniques, user can automate any industrial process in an easy manner[1][10]. It has reduced Space, Energy saving, Modular Replacement, Easy trouble shooting, Error diagnostics programmer, Economical, Greater life and reliability, The Compatibilities of PLC'S, Logic Control, PID control, Operator control, Signalling and listing, Coordination and communication[10].

### A. Operation of PLC

Basics of a PLC function are continual scanning of a program. The scanning process involves three basic steps.

#### Step 1: Testing input status

First the PLC checks each of its input with intention to see which one has status on or off [5]. In other words it checks whether a switch or a sensor etc., is activated or not. The information that the processor thus obtains through this step is stored in memory in order to be used in the following steps.

#### Step 2: Programming execution

Here a PLC executes a program instruction by instruction based on the program and based on the status of the input has obtained in the preceding step, and appropriate action is taken. The action might be activation of certain outputs and the results can be put off and stored in memory to be retrieved later in the following steps.

#### Step 3: Checking and Correction of output status

Finally, a PLC checks up output signals and adjust it has needed. Changes are performed based on the input status that had been read during the first step and based on the result of the program execution in step two – following execution of step three PLC returns a beginning of the cycle and continually repeats these steps.

Scanning time = Time for performing step 1+ Time for performing step 2+ Time for performing step 3.

### B. Allen Bradley PLC

Programmable Logic Controller or PLC is an intelligent system of modules, which was introduced in the control, & instrumentation industry for replacing relay based logic. Over a period of time, better I/O handling capabilities and more programming elements have been added along with improvement in communication.

### PLC Working

At the beginning of each cycle the CPU brings in all the field input signals from the input signals from the module and store into internal memory as process of input signal [3]. This internal memory of CPU is called as process input image (PII).

User program (Application) will be available in CPU program memory. Once PII is read, CPU pointer moves in ladder program from left to right and from top to bottom. CPU takes status of input from PII and processes all the rungs in the user program. The result of user program scan is stored in the internal memory of CPU. This internal memory is called process



output image or PIQ. At the end of the program run i.e., at the end of scanning cycle, the CPU transfers the signal states in the process image output to the output [13 to 18]

**C. Interfacing**

The PLC connected through different protocols and using drivers. In this work PLC is interfaced with SCADA using RS232C and RS 485 protocol. The interfacing method is shown below.

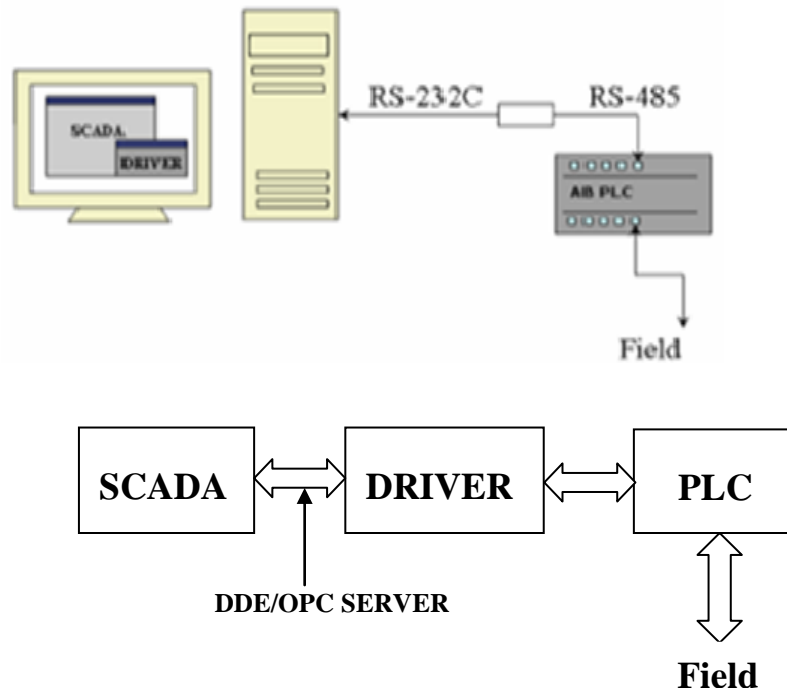


Fig.3 Interfacing PLC with SCADA

Most of PLC drivers communicate with SCADA package using DDE [12], DDE requires three parameters namely name of the DDE server, topic name and item name. In case of reading a number of items from a particular PLC driver application name topic name are common, so this application name that is name of the DDE server and Topic name combine to form an access name. Access name is required to be defined only once then other items of driver can be accessed by using the Access name and item name. These details will be provided by the driver vendor or developer [10].

**VI. ROLE OF SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)**

SCADA stands for Supervisory Control and Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level [6 to 9]

It is used to monitor and control plant or equipment. The control may be automatic or initiated by operator commands. The data acquisition is accomplished firstly by the RTU’s scanning the field inputs connected to the RTU (it may be also called a PLC – programmable logic controller.). This is usually at a fast rate. The central host will scan the PTU’s (usually at a slower rate). The data is processed to detect alarm conditions, and if an alarm is present, it will be displayed on special alarm lists [12][11].



### VII.RESULTS

The simulated results of temperature in Rectified Spirit production are shown below.

#### A. ANALYSER COLUMN

Below figure shows the top and bottom temperature of the analyser column for five hours that shows both temperatures which are maintained in its range. If temperature exceeds in its range the control action takes place. So top and bottom temperatures are maintained

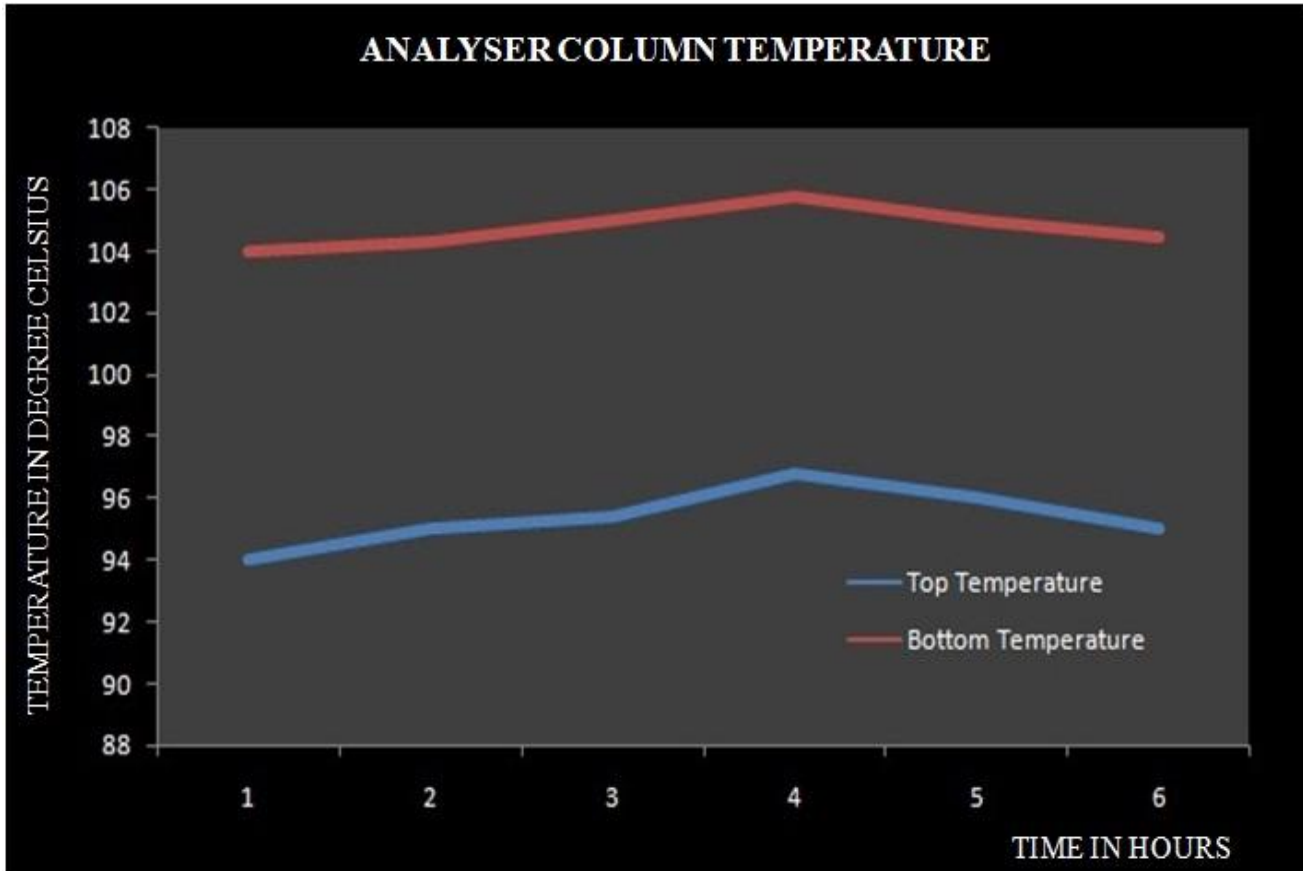


Fig.4 Analyser column temperature

#### B. RECTIFIER COLUMN

Below figure shows the top and bottom temperature of the rectifier column for five hours that shows both temperatures which are maintained in its range. If temperature exceeds in its range the control action takes place. So top and bottom temperatures are maintained within the range.

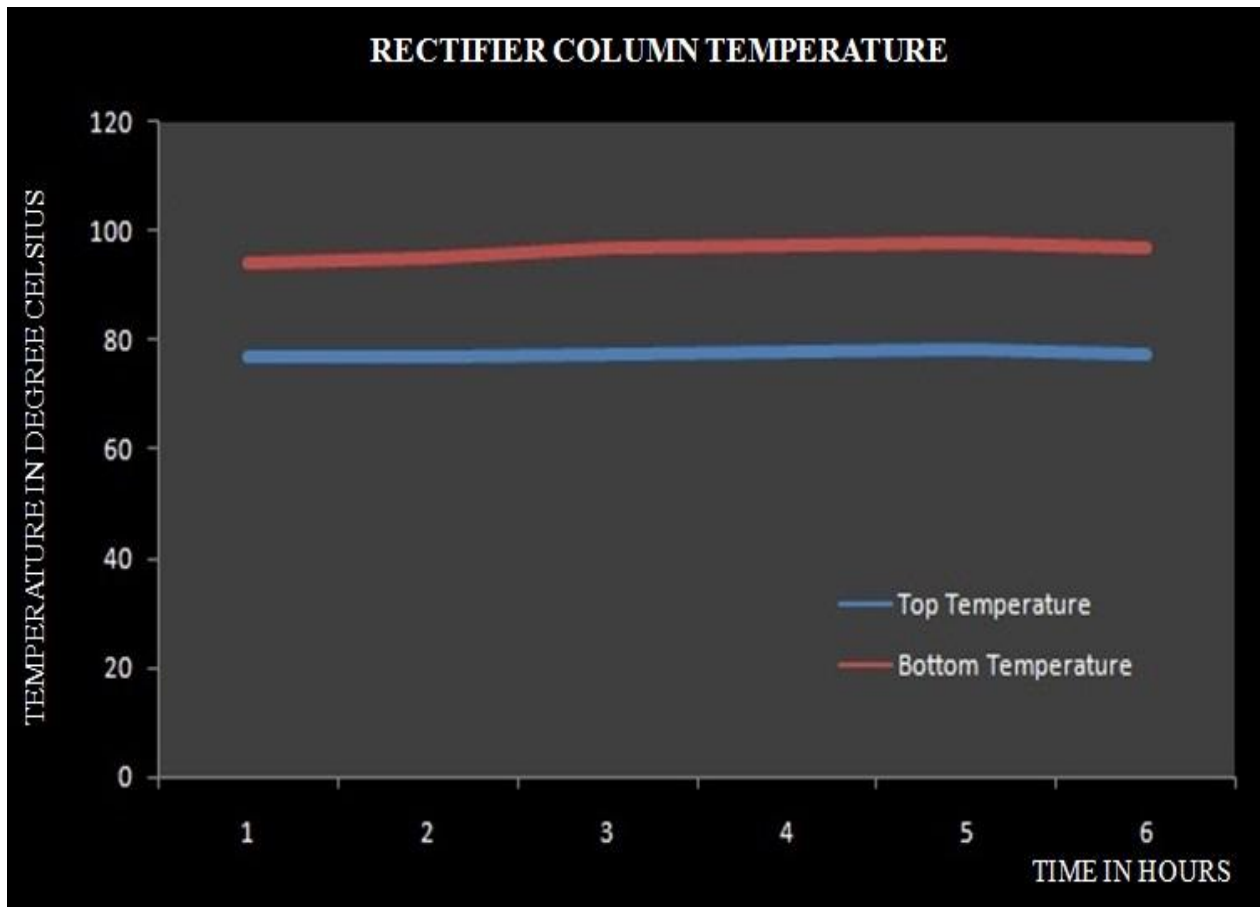


Fig.5 Rectifier column temperature

### VIII. CONCLUSION AND FUTURE WORK

In this proposed work, the RS production process is automated with high accuracy and quality. A new protocol called as International Communication Group (ICG) is to be implemented which is the future work of this project. This International Communication Group (ICG) is used for the online updating and monitoring of the concerned values of the plant. It is concluded that the production process is improved to a better quality due to the automation.

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## BIOGRAPHY



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