AUTOMATION OF HCL SYNTHESIS UNIT USING LAB VIEW

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Abstract In this paper we have made an attempt to automate an industrial process using LabVIEW software. The Synthesis of Hydrogen chloride (HCL) has great importance in industrial, chemical, and commercial fields. This process involves a number of discrete operations which are to be performed in correct sequence to get the final product. Automation of this process reduces human intervention and results in increased productivity. This paper deals with automation using LABVIEW which is a simple and powerful tool for

I. INTRODUCTION

This paper tries to automate a Hydrochloric acid synthesis unit using LABVIEW. Hydrogen, Chlorine and water are the raw materials for the production of hydrochloric acid.. Industrial automation for the production of hydrogen chloride involves the control of hydrogen, chlorine, nitrogen. A constant monitoring system is essential in such industrial process which demands a high level safety considerations.. This project is aimed to implement the model of automation of HCL plant using LABVIEW .

II. PROCESS DESCRIPTION

The large scale production of hydrochloric acid, as a desired primary finished product, is almost always integrated in a large scale chloro-alkali facility. The salt solution is electrolyzed producing chlorine, sodium hydroxide and hydrogen. The pure chlorine gas can be re-combined with the hydrogen gas forming hydrogen chloride.The reaction takes place in what is commonly called as an acid burner. Nitrogen is used for the purging process. The Oxygen content should be in control to ensure safety. By adjusting the LPG, which is the fuel, hydrogen is made to ignite. After this, Chlorine is passed into the burner. The synthesis takes place in the burner which is conveniently cooled by means of water. Hydrogen and chlorine are mixed in a specific ratio inside the burner. This needs special attention. The burner output will be HCL fumes. It is then sprayed with demineralized water. Thus obtained solution of HCL acid is taken for further processing and for other commercial applications..

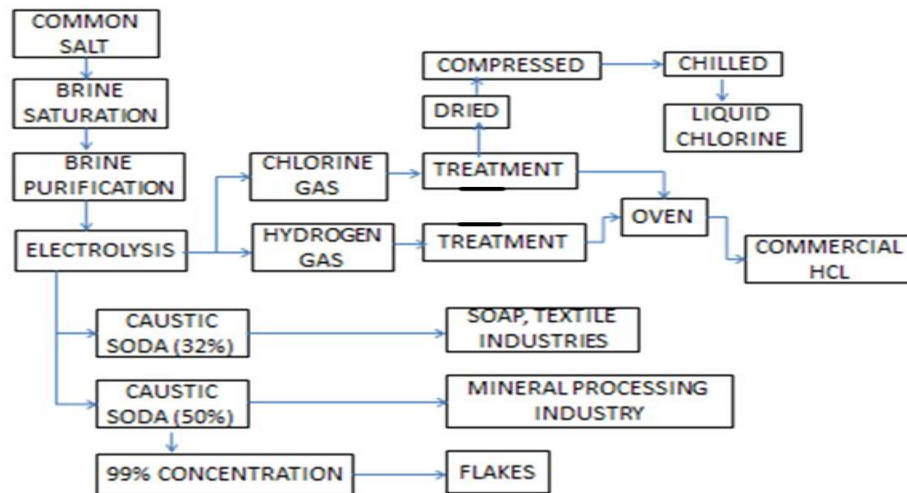[1] *Dept. Of Electronics and Instrumentation Engg. FISAT, Angamaly Kerala, India*

Fig 1. Block diagram of HCL synthsis Unit

III. INSTRUMENTATION IN THE PROCESS

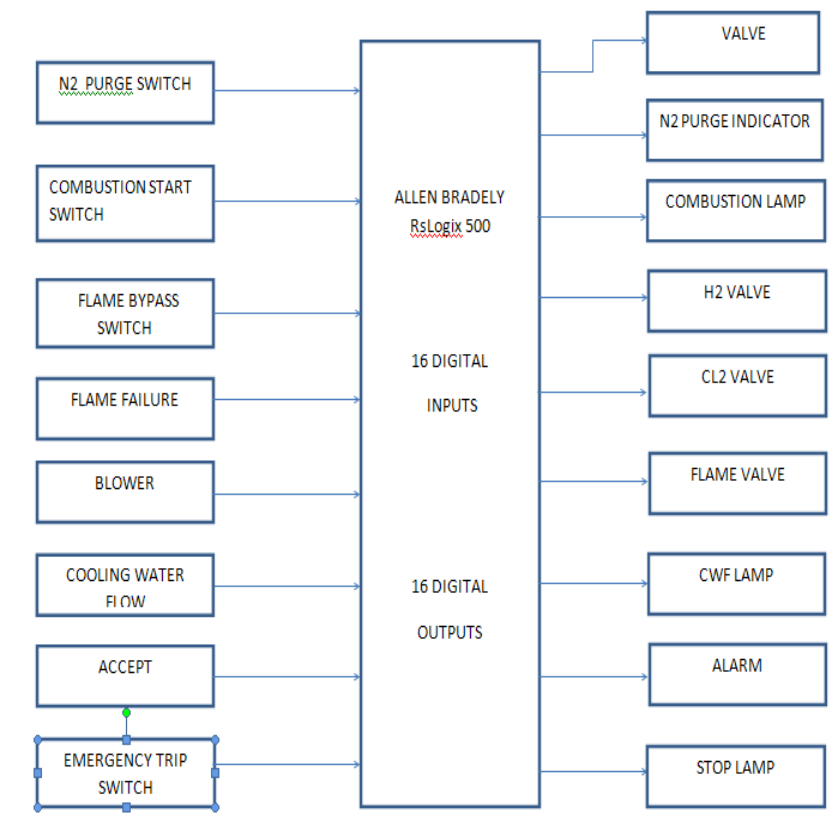The block diagram gives the overview of the instrumentation part of the process incorporating PLC automation.

Fig 2. Automation Using PLC

IV. FLOW CHART OF DISCRETE OPERATIONS

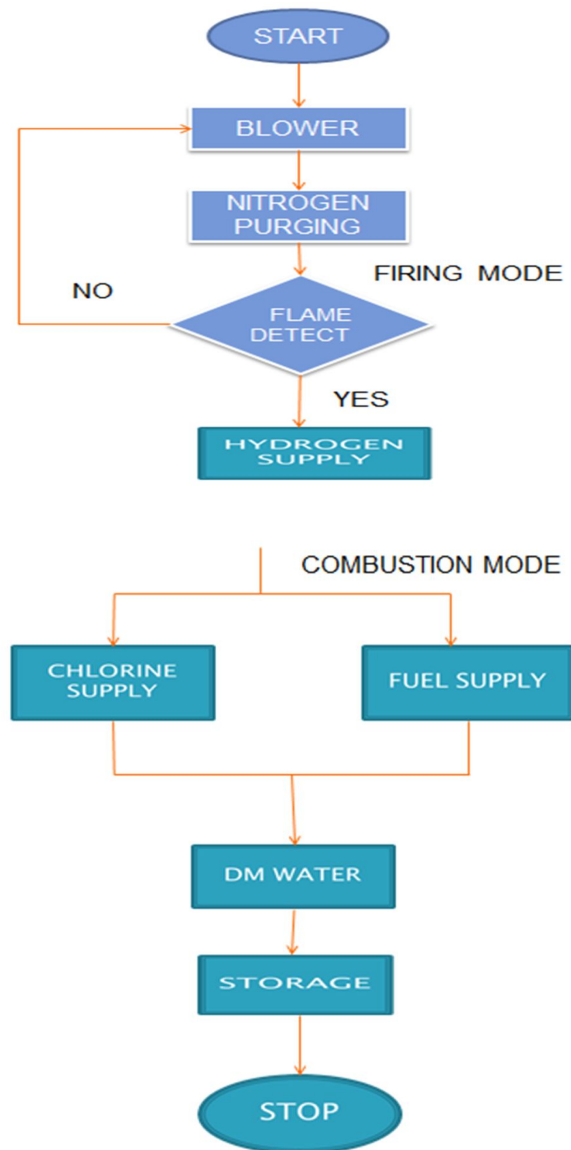The following flow chart explains the sequence of operations taking place in HCL synthesis

Fig 3. Flow chart of process

V. SEQUENCE OF OPERATIONS

In the start of the process, as the part of eliminating the unwanted residues inside the oven, a blower is switched on. This blower will act as a vaccum pump, so that all dust or other wastes are exhausted outside. The blower action is made active for a predefined time. After this, the blower goes off.Nitrogen purging is the next step. This is to pull out the oxygen content inside the oven. Oxygen is not allowed inside the oven to ensure the limit of combustion. The nitrogen with a pressure of 5kg/cm^2 is pumped into the oven for a definite time.

Now the hygrogen is given into the oven. The hydrogen control valve open to 20% and the shut off valve opens to 25%. The nitrogen valves get closed. Firing mode operation is started. Flame will be produced if the required hydrogen volume is there inside the oven. The presence of the flame is detected by the light detecting resistor (LDR) or UV sensor (flame). If there is no flame, or the LDR output is less than the required level, the blower will start operation and the cycle is restarted. A flame bypass valve is employed in the loop for safety and to ensure the presence of flame.

If the flame is there, the system enters the combustion mode. After it enters the combustion mode , the chlorine is allowed to enter along with the LPG for combustion process to take place. The temperature that is to be achieved is 1600 degree celcius. The LPG fuel is burned to achieve this temperature. The hydrogen and chlorine molecules will combine to form HCL fumes.

VI. AUTOMATION USING LABVIEW

LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) is an integrated development environment designed specifically for engineers and scientists building measurement and control systems. LabVIEW is a graphical programming environment developed by National Instruments (NI), which allows high-level or system-level designs. LabVIEW graphical programs are called virtual instruments (VIs). VIs run based on the concept of data flow programming .It is a simple and powerful tool for automating measurements and processing signal data. LabVIEW comprise a completely configurable virtual instrument, which can be modified according to the requirement. It has extensive libraries of functions and subroutines also contain application specific libraries of code for data acquisition, general-purpose interface bus (GPIB) and serial instrument control, data analysis, data presentation, data storage and communication over internet. LabVIEW is inherently a data presentation package.
In this paper an attempt to automate a discrete process using LABVIEW is done.

VII. FLAT SEQUENCE IN LABVIEW

This paper shows how a flat sequence in LabVIEW can be used to automate a discrete process in industries. Flat sequence is very successively used for the sequential execution of the processes. A sequence structure contains one or more subdiagrams, or frames, that execute in sequential order. Within each frame of a sequence structure, as in the rest of the block diagram, data dependency determines the execution order of nodes.

There are two types of sequence structures—the Flat Sequence structure and the Stacked Sequence structure. The Flat Sequence structure, shown as follows, executes frames from left to right and when all data values wired to a frame are available. The data leaves each frame as the frame finishes executing. This means the input of one frame can depend on the output of another frame.
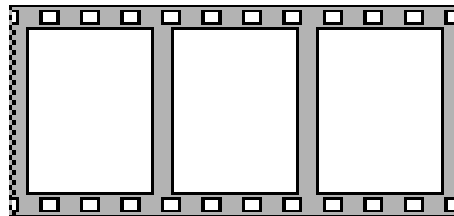

Fig 4. A flat sequence

VIII. VI FOR THE PROCESS

The basic files you create with LabVIEW are called Virtual Instruments, or VIs. A VI consists of two major components; a front panel (FP) and a block diagram (BD). The FP provides the user-interface of a program, while a BD incorporates its graphical code. LabVIEW. VIs are modular, meaning that any VI or subVI can be run by itself..The simulation of the whole setup is achieved using the structures available in the LabVIEW software.

### 8.1. Block Diagram (BD) of VI
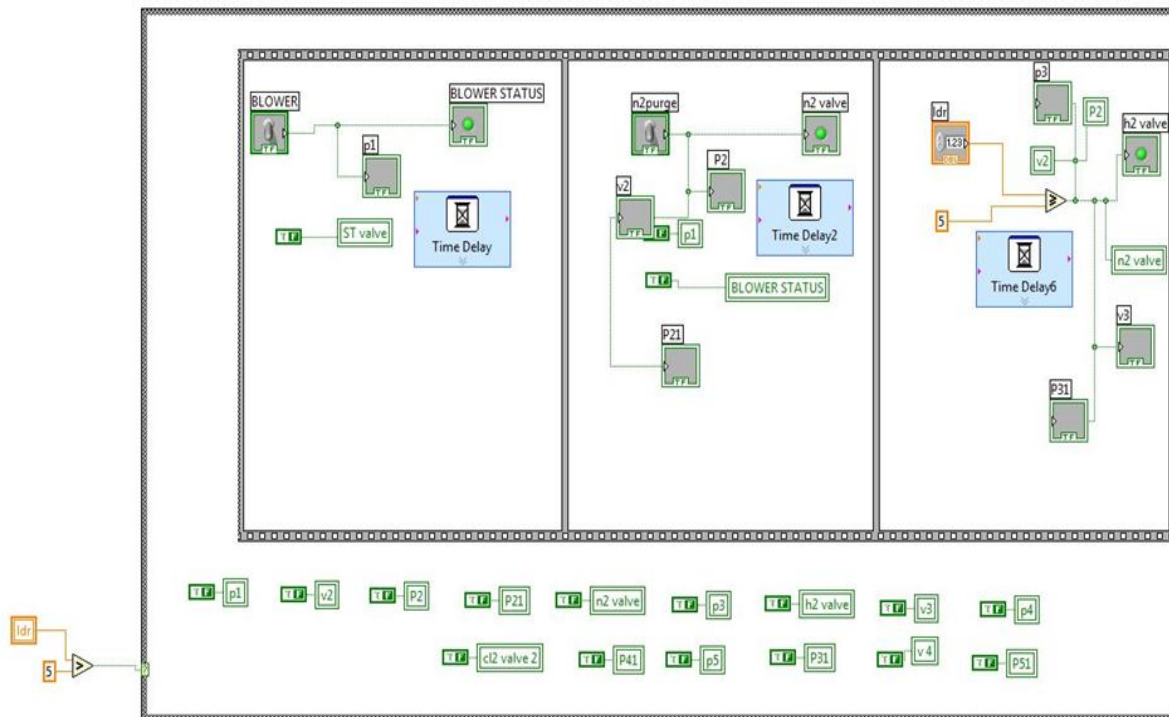
In the first flat structure, the blower is made on for a particular time delay. In the next flat structure, nitrogen valve is opened and nitrogen flows into the oven for another delay. LDR input is compared with the value 5. If the input is greater than 5, it goes to the next structure. Else it goes to the first structure.
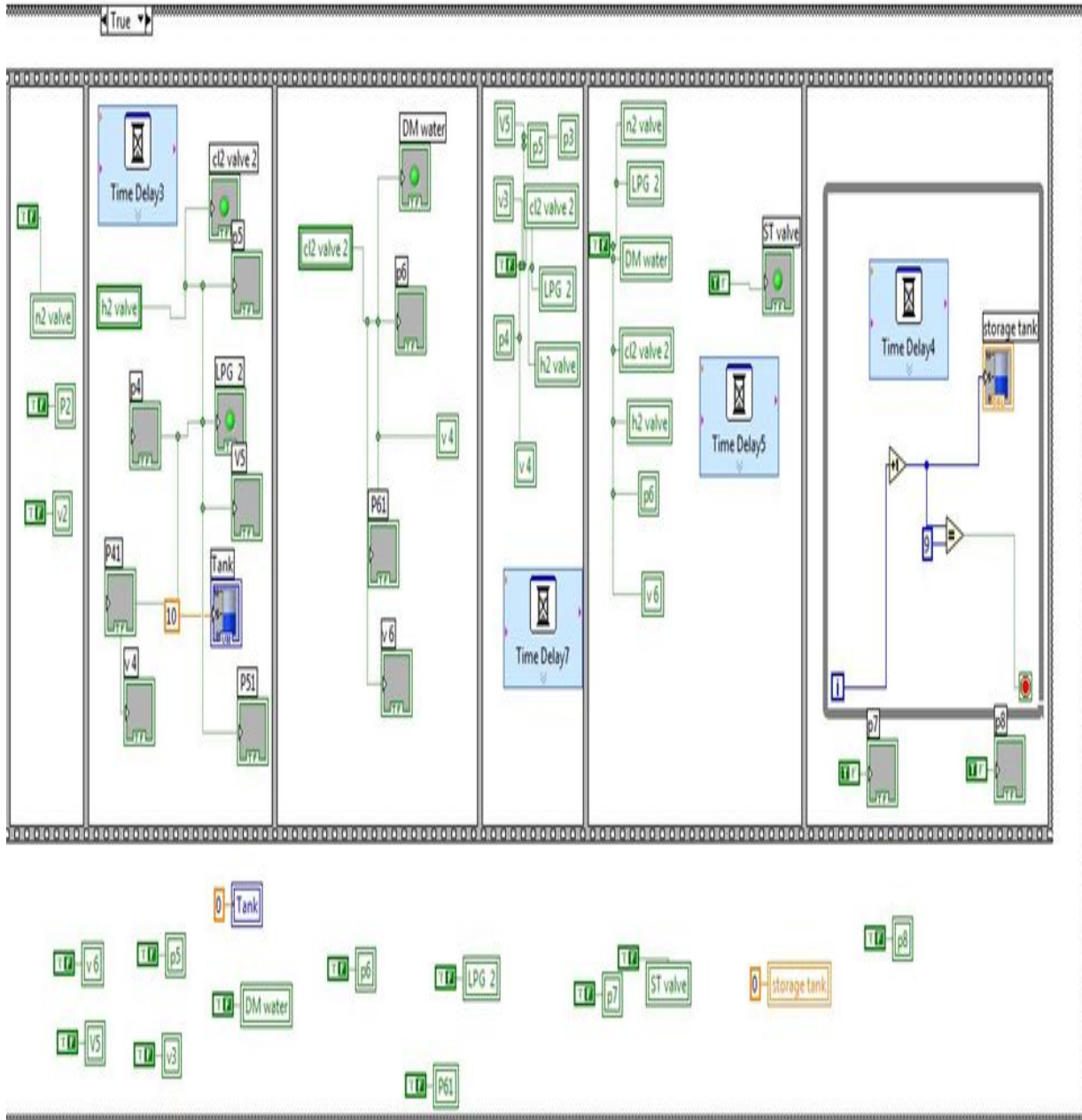
In the next structure, the blower is made off. Hydrogen valve is opened and hydrogen is pumped to it in the next structure. Nitrogen valve is closed. Chlorine and LPG fuel is given to the oven the next structure. As the combustion starts the oven goes red. As the required level of HCl is achieved, the supply of hydrogen, oxygen and the LPG is rrestricted by closing their respective valves. The demineralised water is sprayed. The output is collected at the storage tank.

8.2.   Front panel of VI
The front panel gives a visual representation of the process in which the discrete operations in the HCL synthesis can be executed in sequence.
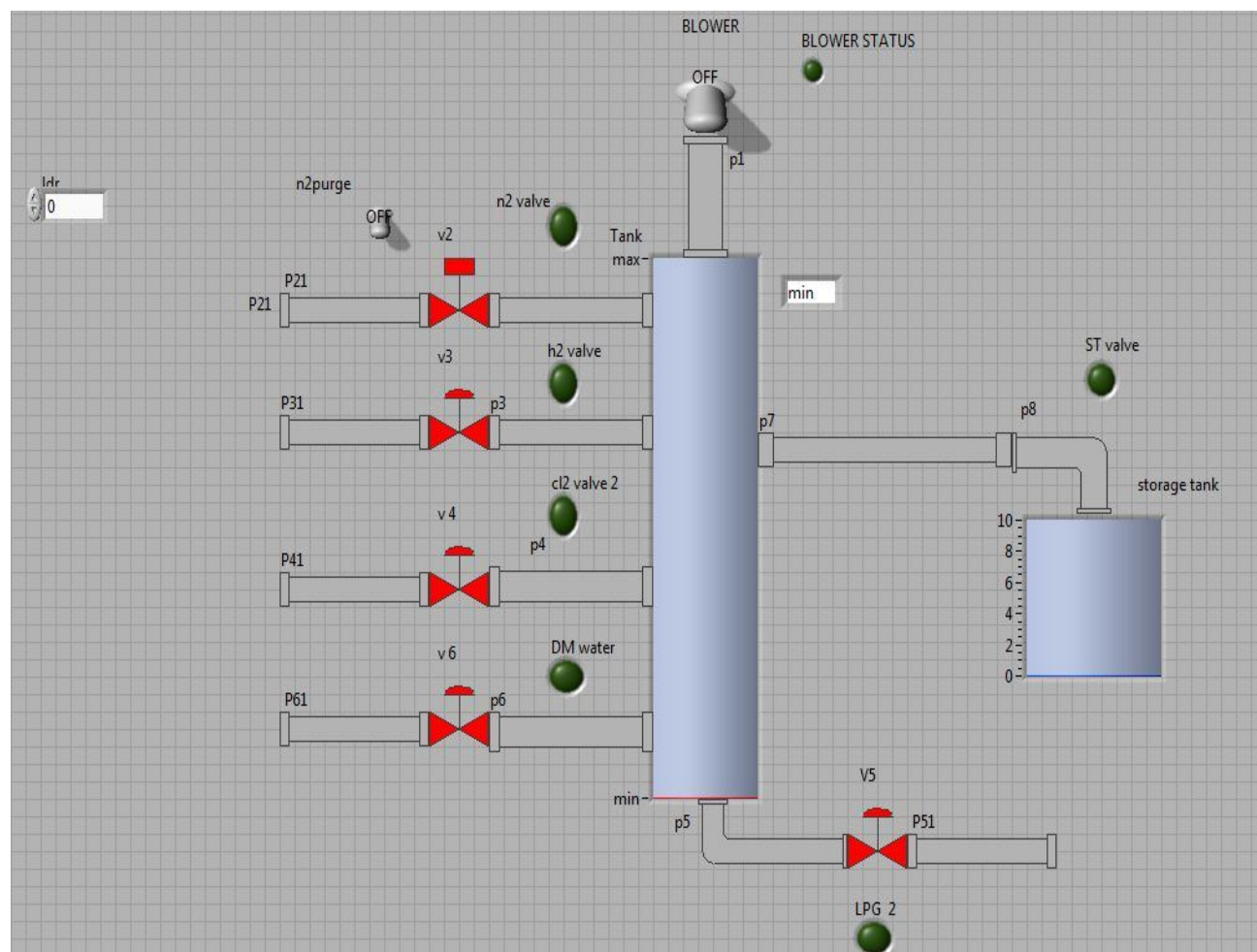
IX. CONCLUSION

The automation of HCL synthesis using LABVIEW is done successfully.. By using case structures in LABVIEW, discrete sequences in the process have been done more efficiently. The flat sequence structure ensures the proper sequencing of the process. Graphical user interface in the LabVIEW made the process and automation system morre convient and understandable

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