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Automation In Adaptive Batch Reactor

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ABSTRACT— In Industries all processes such as extraction& distillation of crude oil, manufacturing of chemicals and fertilizers etc. are classified mainly in two types such as continuous as well as batch processes. In plywood industry preparation of good quality of particle boards depend upon the quality and quantity of pest added to pulp made from bagasse. The proper mixer of resin and glue is prepared in batch to mix with pulp. These batch processes vary with time. In the design of a batch control system, time based process condition and traction phenomena must be handled. Charging, reacting, agitating and discharging are example of sequential events in time requiring, corresponding control action actions. Each control action may be require many process step such as opening and closing of valves, starting and stopping of pump and setting and resting of control loop. In addition to normal step by step control action batch processes control requires many other functions for example responding to abnormal or failure condition, kipping batch record, maintain recipes and scheduling batch processes.

KEYWORDS- extraction& distillation of crude oil, manufacturing of chemicals and fertilizers, bagasse, resin and glue.

I. INTRODUCTION

Batch reactors that are cooled and heated through a water jacket are common in chemical, pharmaceutical, biotechnological and similar industries. Therefore, many papers discussing the temperature control of such systems have been published. Dynamic systems that involve continuous and discrete states are called hybrid systems. Most industrial processes contain both continuous and discrete components, for instance, discrete valves, on/off switches, logical overrides, etc. The continuous dynamics are often inseparably interlaced with the discrete dynamics.

Bagasse Depither:

The waste bagasse from the sugar mill is brought to bagasse yard where it is store .In this section the pith from the bagasse is extracted and pure bagasse is made available for further process pith effect the strength of the particleboard and the removal on the pith in this section improves the quality of the board.

***Wet Bin** :

Wet bagasses from depither is collect in bin through a conveyor . Wet bagasses has to reach a sufficient level and then it is passed on to a dryer for removal of the moisture content from bagasses. Optical sensors are used for level detection.

Dryer:

The moisture present in bagasse is remove in the dryer. The source of heat is steam from boiler. Thermistor is used for temperature measurement in the dryer. In case of temperature, fire may arise this is detect by flame detector .

***Hammer Mill:**

Bagasse is hammer and converted in to small fiber. The bagasses from hammer mill is stored in a screening mill to separate small and big fiber. The long fiber are recycled in hammer mill to convert them in to small fiber. The flame detectors are also install in a conveyor for security purpose .

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Dry Bin :

The screen bagasse is brought to dry bin through conveyor .The bagasses level is maintained in a dry bin by optical sensors. If the level of dry bin drops by any means, the supply of dry bagasse from dry bin to glue section is stopped.

***Glue section:**

Urea formaldehyde(U.F) resin is a synthetic adhesive used for bonding of bagasse fibres. Hardener and wax emulation are also added to provide strength and shine respectively to the particleboard. The bagasse along with resin, hardener & wax are mixed together in a blender to form a uniform mixture of all the content. The material in a blender is monitored at certain level by optical sensors to avoid any difficulty in the next unit. The level of the mixture is maintained according to desired width of particle board selected.

Forming section:

Uniform distribution of the mixture is done in a forming machine.The distribution of the material on a belt is according to the thickness of the board decided. The level of material is maintained by optical sensors to avoid any irregularities in the board.

Pressing section :

The uniformly distributed material on the belt is pressed by rollers to form a ribbon like structure. The pressure applied by rollers depends upon thickness of the desired board. The rollers are maintained at certain temperature by steam. The pressure on roller is controlled by hydraulic system

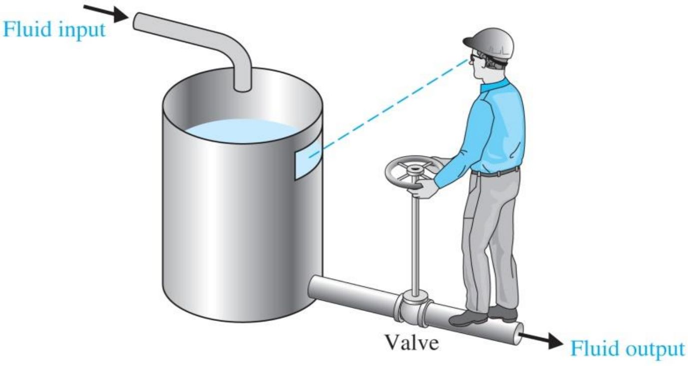

Fig 1. Manual operation system

Replacing manual system :=>

1. Consistent operation round of the clock.
2. Accurate measurement of raw material & other resources for operation of all the batches
3. Improvement in product quality.

II. LITERATURE SURVEY

HISTORY OF THE SYSTEM:

Batch Reactor:

A batch reactor is like a giant washing machine. There is a big vat where all of the reagents are agitator that keeps them stirring. A batch Reactor is great if a company wants to make the same thing over & over . This is because the reactor must be emptied & cleaned after every batch is made. This takes a lot of time & money, & every batch can be

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just a little bit different due to small changes in reaction condition, equipment aging, or because the operator drops a little bit of something foreign into the reactor.

PLC:

PLCs are well adapted to a range of automation tasks. These are typically industrial processes in manufacturing where the cost of developing and maintaining the automation system is high relative to the total cost of the automation, and where changes to the system would be expected during its operational life. PLCs contain input and output devices compatible with industrial pilot devices and controls; little electrical design is required, and the design problem centers on expressing the desired sequence of operations. PLC applications are typically highly customized systems, so the cost of a packaged PLC is low compared to the cost of a specific custom-built controller design. On the other hand, in the case of mass-produced goods, customized control systems are economical. This is due to the lower cost of the components, which can be optimally chosen instead of a "generic" solution, and where the non-recurring engineering charges are spread over thousands or millions of units.

For high volume or very simple fixed automation tasks, different techniques are used. For example, a consumer dishwasher would be controlled by an electromechanical cam timer costing only a few dollars in production quantities.

A microcontroller-based design would be appropriate where hundreds or thousands of units will be produced and so the development cost (design of power supplies, input/output hardware and necessary testing and certification) can be spread over many sales, and where the end-user would not need to alter the control. Automotive applications are an example; millions of units are built each year, and very few end-users alter the programming of these controllers. However, some specialty vehicles such as transit buses economically use PLCs instead of custom-designed controls, because the volumes are low and the development cost would be uneconomical.[9]

III. SYSTEM DEVELOPMENT

Growing demand of accurate process automation in many engineering & industries. In most engineering streams like process Automation, Production, Automobile engineering etc. & for industrial purposes accurate & optimized automation is necessary & important. The developed PLC based adaptive Batch Reactor system has a high accuracy, high speed, better resolution than existing manual & other operating system. The auto configuration feature allows the design of the modules to be quite generic as the address according section is identical hence ensuring case of manufacture. Details of Circuit Diagram Of PLC Based Adaptive Batch Reactor System.

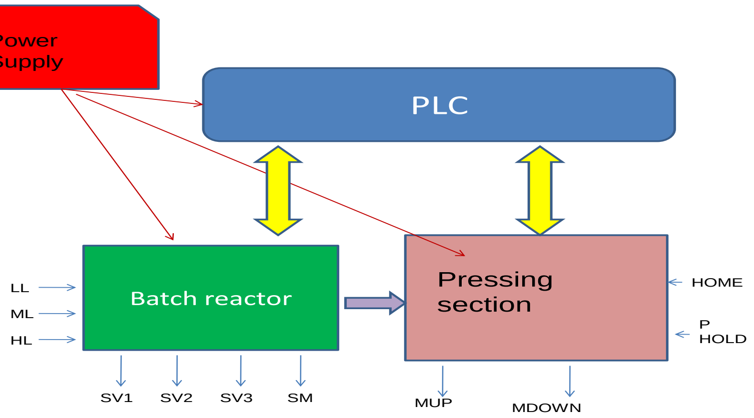

Fig 2. Block Diagram Of PLC Based Adaptive Batch Reactor System

Programmable Logic Controller (PLC) :

It gets the input signal from different switches, operate as per the algorithm/ program & activate various output devices like valves & motors.

Specification of PLC:

*Model No. : 07KR51

*Power Supply : 24 V DC

*Current consumption : 120 mA.

*Number of Inputs : 8

*Number of Outputs : 6(Relay type)

*Input Voltage : 24 V DC

Working of PLC :

Relay based operation is replaced by PLC. It is Digital Electronic device that uses a programmable memory to store instruction, implement specific function such as logic, sequence, timing, counting & arithmetic operation to control machine & process. The PLC gets input-Executes program-turning on/off its outputs.

Process Description:

In industries all processes such as extraction & distillation of crude oil, manufacturing of chemicals & fertilizers etc. are classified mainly in two types such as continuous as well as batch process. In plywood industry preparation of Good quality of particle boards depends upon the quality & quantity of pest added to pulp made from bagasse. The proper mixer of resin & glue is prepared in batch to mix with pulp. Batch reactor process is better for making special chemical for one batch at a time. For batch reactor process, mixing of two reactant for sticking & hardening. Reactant A &B mixed together with stirrer for certain interval. Final solution mixed with bagasse for specific interval in blender. Then mixer

Pressing Unit:

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we are receiving mixer of product from reactor added with Bagasse in blender through conveyor. The pressing is done for fix interval to get final quality product (Plywood board). In pressing Mechanism we have used up & down motor to move the pressing pad to press the received material from blending unit. Also we have used press home & press done limit switches to sense the position of pressing pad.

Adaptive Batch Reactor:

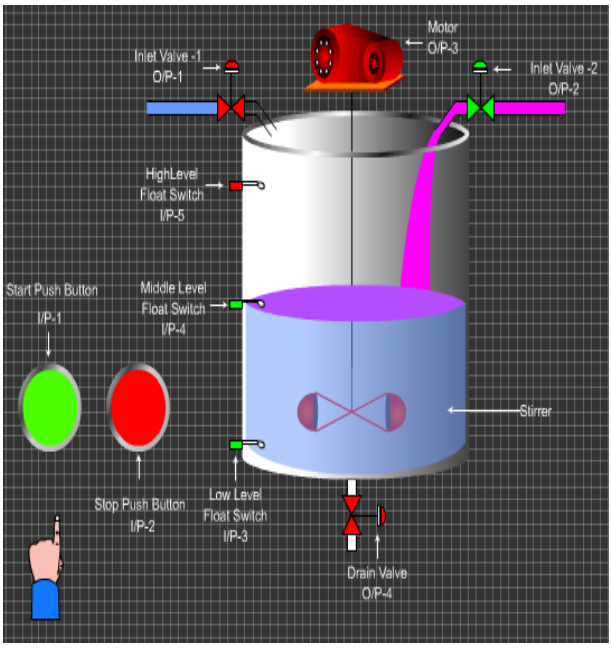

Fig 3. Adaptive Batch Reactor.

PLC Interfacing:

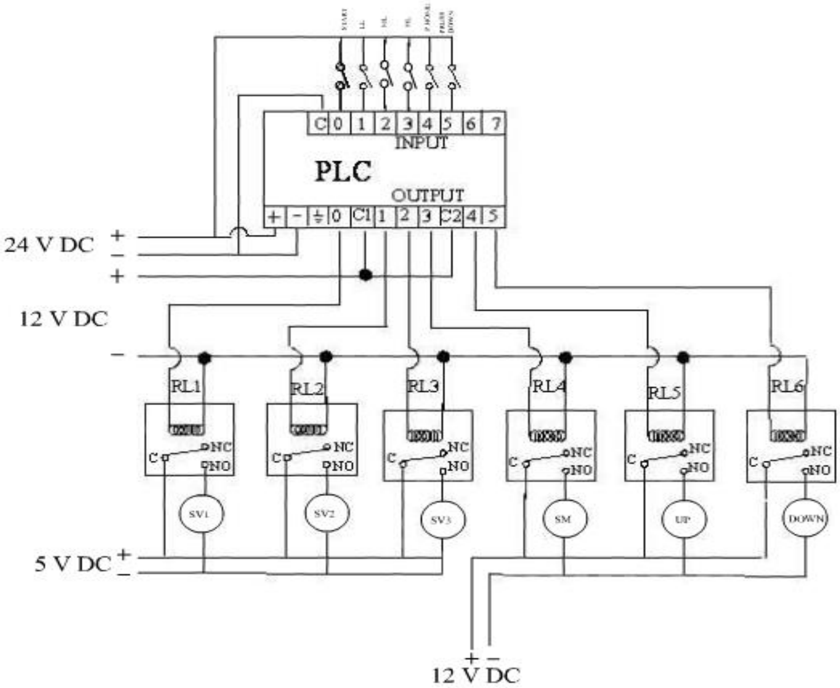

Fig 3. Interfacing diagram of a PLC with Adaptive Batch Reactor

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IV. PERFORMANCE ANALYSIS

System analysis is the critical element of measure of quality assurance & represents the ultimate review of specification & system design. There are number of testing objectives. Testing is the process of executing hardware with intent of finding an error.The system can be tested using following types of analysis.

1. Experimental analysis.
2. Statistical analysis.
3. Theoretical analysis.

Experimental Evaluation:

After the many times doing the experimentation to evaluate the performance of designed system ”Adaptive Batch reactor system using PLC”, we found out that current developed system. Although the comparison of practical results are better, We have not been able to achieve the result 100% error free operation because there are some variation in different parameters which are because of limitation of physical properties of the different devices which can not be avoided. In brief the practical results are in agreement with the satisfactory expected result.

System operation timing analysis:

Table 1 : System operation timing:

Device Operation	Time		
	Manual	Electrical	PLC
SV1 open	9 min	4.5 min	90 sec
SV2 open	6 min	3 min	60 sec
Stirrer Motor on	2 min	1 min	20 sec
Wait Time	2 min	1 min	20 sec
SV3 open	15 min	7.5 min	150 sec
M down on	2 min	1 min	20 sec
Press hold	2 min	1 min	20 sec
M UP ON	2 min	1 min	20 sec
Total cycle time	40 min	20 min	400 sec

Comparison:

Table 2: Comparison with & without PLC.

With PLC	Without PLC
*Flexible. *Reduced maintenance *Fine control possible. *Data logging possible. *On line process monitoring using SCADA *Adopted today by all industry.	*Not flexible. *More maintenance. *Fine control not possible *Data logging not possible *On line process monitoring not possible. *Adopted previously by old industries.

V. APPLICATION

Applications:

I. Used in different area of industries like

1. Chemical & fertilizer industries.
2. Oil & natural gas industries.
3. Pulp & paper industries.
4. Cement industries.
5. Process industries.
6. Glass industries.
7. Automobile & production industries.
8. Filling & packing industries.
9. Power generation plant.

II. This system is also useful in pharmaceutical industries.

1. Drug mixing process.
2. Preparation of various size and volume of tablets.

III. It is also useful in sugar factories:

1. Mixing of two reactant.
2. Distillation process.
3. Cleaning of sugar juice.
4. Crystallizer.
5. Evaporator.

IV. Data logging helps to trouble shoot the problem & improve product quality

VI. CONCLUSION

PLC Based batch reactor system & pressing mechanism is best suitable for demand of automation. System is flexible to produce good quality product with minimum investment of raw material Energy resources .Accurate measurement for all the batches of operation. Flexible for changing the operation time for different element .Give fast operation then other existing system Batch reactors, such as the one used in the experiment, have a highly nonlinear and hybrid nature. What is more, such a process cannot be treated as a simple time-invariant process, especially when a strong exothermic reaction with unknown kinetics is involved. In this paper we showed how to avoid some of the Difficulties in the control design for such processes.

Future Scope:

By connecting multiple PLCs & processes in networking, Major plant can be monitored & controlled.

The following are the suggestions for the future work.

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*The hardware can also be used by engineering students for testing different PLC programmers, as there are various types of inputs & outputs associated in the hardware.

*The setup is also useful to electrical engineering students to learn the interfacing of PLC, relays, motors, & switches because PLC, relays, motors, & switches are of different specification.

*The setup can also be useful for electronic technicians to develop an test various PLC program in FBD (Functional Block Diagram) IL(Instruction list), ST(Structured Test), SFC(Sequential Function Chart) language.

*System can also be useful in quality control, and analytical laboratories for analysis and preparation of different drugs as well as solution

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