



International Journal of Intellectual Advancements and Research in Engineering Computations

Automation of Dye Preparation System in Paper Industry

K.Kavimalar¹, M.Nivetha¹, S.Sasikumar²

¹UG Scholars, Department of Electronics and Instrumentation Engineering,
Nandha Engineering College, Erode

²Assistant Professor, Department of Electronics and Instrumentation Engineering,
Nandha Engineering College, Erode

ABSTRACT

In this project we can reduce the man power, energy and water consumption. At the start, all the valves are closed and the agitator is also stopped. When the process is started, the Dye valve is opened and the dye is fed into the reactor. Once the level reaches to the set point of the reactor capacity, the Dye valve gets closed. In the dye tank level is maintained. Both the temperature and level were maintained in the reactor tank. The dyes are cooked up by the steam and reaches its set point. Then the heated dye is moved to the preferred storage tank for dyeing the pulp and bagasse used for making the paper in the industry.

INTRODUCTION

The aim of project is to develop an energy saving dye preparation system because the existing dye preparation system required the large amount of energy (power) and water conservation in TNPL. "Design and Development of Dye Preparation System" the paper formation process in paper machines, some chemicals added at each stage of the process. To reduce the requirement of energy and water conservation with help of modifying existing architecture. Then to implement the control and monitoring modules of dye preparation by using SCADA system. In this project we are going to monitor and control some important parameter such as level of the diluted starch. [1-3]

LITERATURE SURVEY

Marcello Cinque, [2012] proposed Wireless Sensor Networks (WSNs) are widely recognized as a promising solution to build next generation monitoring systems. Their industrial uptake is however still compromised by the low level of

trust on their performance and dependability. Whereas analytical models represent a valid mean to assess nonfunctional properties via simulation, their wide use is still limited by the complexity and dynamicity of WSNs, which lead to unaffordable modeling costs. To reduce this gap between research achievements and industrial development, this paper presents a framework for the assessment of WSNs based on the automated generation of analytical models. The framework hides modeling details, and it allows designers to focus on simulation results to drive their design choices. Models are generated starting from a high-level specification of the system and by a preliminary characterization of its fault-free behavior, using behavioral simulators [4-6].

Christoph Sosna, [2010] presents a new temperature compensation technique for thermal flow sensors that are operated in a constant temperature difference (CTD) mode by means of a simple analog circuit. The resistive heater of a thermal flow sensor is maintained at a constant temperature some tens of Kelvin's above fluid temperature with the help of Wheatstone bridge

Author for correspondence:

Department of Electronics and Instrumentation Engineering, Nandha Engineering College, Erode

circuit. In case of a change in media temperature and adjustment in the heater temperature is necessary. Otherwise the temperature difference falls/rises with respect to the temperature change and the sensor output signal deviates from the calibration. Temperature Compensation can be performed by the use of an additional resistive temperature sensor. The circuit includes a potentiometer that is capable of changing the resistance of the temperature sensor and its temperature coefficient of resistance for an easy adjustment of temperature compensation This gives freedom for any material to use such as platinum, aluminium, alloy, tungsten for the temperature sensor, regardless of its resistance value and TCR with respect to heater of a thermal flow sensor [7-9].

EXISTING AND PROPOSED SYSTEM

In the existing project, the blue and methyl violet are prepared separately and added to the

process. But in this project, by changing the set point, the required combination of blue and methyl violet are prepared and add directly to the process. The existing project consists of separate dye mixing tank with agitator, Level SENSOR and temperature SENSOR for each tank. But in This project we are only using one dye-mixing tank with an Agitator, Level SENSOR and temperature SENSOR are used. So the Hardware components used are reduced.

In the case of existing project, there are 3 pipelines from the dye Storage tank to the machine chest and silo. It can be modified to only 2 pipelines from the storage tank to the machine chest and silo. The speed of reaction of dye with the pulp is increased, so that the delay time is reduced. The flexibility of the system is increased (i.e.) we can prepare Blue separately, methyl violet separately, and both in mixed Combination. The initial cost is reduced, due to the decrease in hardware Components. The maintenance is less, due to the decrease in hardware Components [10].

BLOCK DIAGRAM

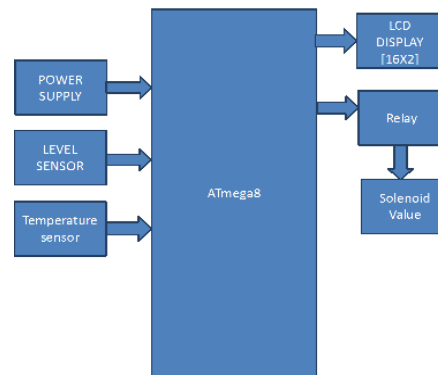


Fig:1 Block Diagram

PROCESS

There are two dye tanks with one reactor tank and storage tanks. The output of these two dye tanks are to the reactor or mixing tank. At the start,

all the valves are closed and the agitator is also stopped. When the process is started, the Dye 1 valve is opened and the dye is fed into the reactor. Once the level reaches to the set point of the reactor capacity, the Dye 1 valve gets closed and

the Dye 2 Valve is opened. Now once the reactor level reaches set point of the total capacity of the reactor the Dye 2 valve gets closed. In the reactor tank, these two dyes are mixed with the help of an agitator at a temperature of 40 degree. It is heated by the steam at a certain temperature to get a

correct composition of dyes color. In this setup Dye 1 is Methyl Violet and Dye 2 is Blue. These two dyes are cooked in the steam. When the temperature reaches the preferred set point, we have to select the preferred storage tank to store the mixed dye.

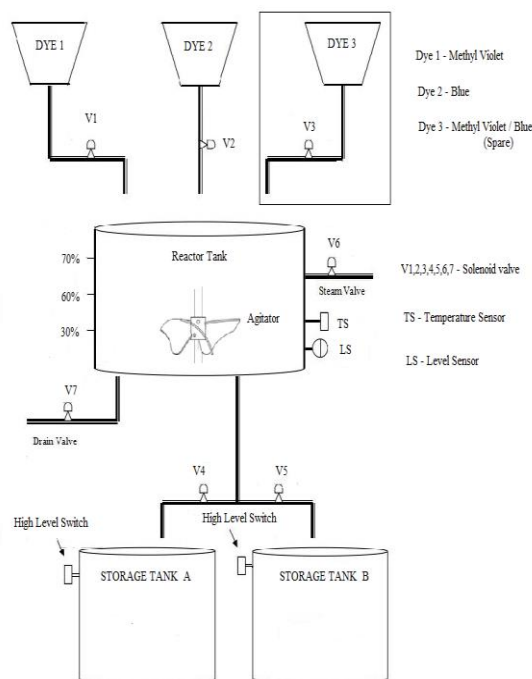


Fig:2 continuous stirred-tank reactor

CSTR (CONTINUOUS STIRRED-TANK REACTOR)

In a CSTR, one or more fluid reagents are introduced into a tank reactor which is typically stirred with an impeller to ensure proper mixing of the reagents. Dividing the volume of the tank by the average volumetric flow rate through the tank gives the space time, or the time required to process one reactor volume of fluid. Using chemical kinetics, the reaction's expected percent completion can be calculated.

Some important aspects of the CSTR:

- The reaction proceeds at the reaction rate associated with the final (output) concentration, since the concentration is assumed to be homogenous throughout the reactor.
- Often, it is economically beneficial to operate several CSTRs in series. This allows, for

example, the first CSTR to operate at a higher reagent concentration and therefore a higher reaction rate. In these cases, the sizes of the reactors may be varied in order to minimize the total capital investment required to implement the process.

The behavior of a CSTR is often approximated or modeled by that of a Continuous Ideally Stirred-Tank Reactor (CISTR). All calculations performed with CISTRs assume perfect mixing. If the residence time is 5-10 times the mixing time, this approximation is considered valid for engineering purposes. In practice it can only be approached, particularly in industrial size reactors in which the mixing time may be very large.

A loop reactor is a hybrid type of catalytic reactor that physically resembles a tubular reactor, but operates like a CSTR. The reaction mixture is circulated in a loop of tube, surrounded by a jacket

for cooling or heating, and there is a continuous flow of starting material in and product out.

ATMEGA8

It is an 8-bit microcontroller that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM. Although the MCUs are 8-bit, each instruction takes one or two 16-bit words.

The size of the program memory is usually indicated in the naming of the device itself (e.g., the ATmega64x line has 64 KB of flash, while the ATmega32x line has 32 KB).

There is no provision for off-chip program memory; all code executed by the AVR core must reside in the on-chip flash. However, this limitation does not apply to the AT94 FPSLIC AVR/FPGA chips.

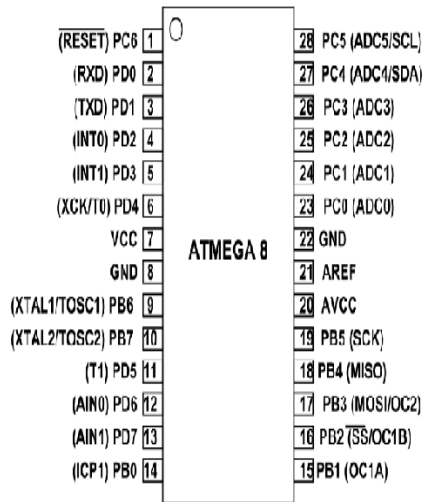
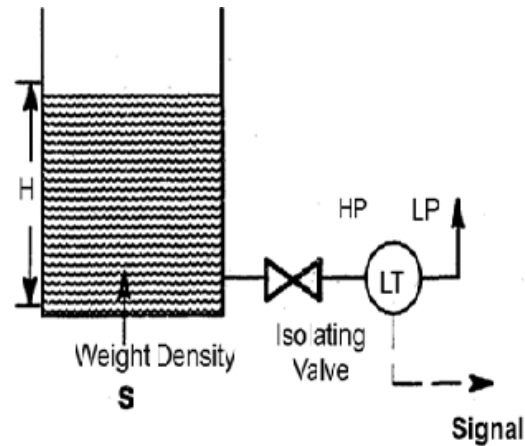


Fig: 3 Pin Diagram ATMEGA 8

LEVEL SENSOR

The level in the tank affects not only the quantity delivered but also the pressure and rate of flow in and out of the container. So it must be maintained properly. Level sensors detect the level of substances like liquids, slurries, granular materials, and powders. The substance to be measured can be inside a container or can be in its

natural form. The level measurement can be either continuous or point values. Continuous level sensors measure the level to determine the exact amount of substance in a continuous manner. Point-level sensors indicate whether the substance is above or below the sensing point. This is essential to avoid overflow or emptying of tanks and to protect pumps from dry run.



$$\Delta P = P_1 - P_2$$

P_1 = Total Pressure in the tank

P_2 = Atmospheric Pressure

$$H = \Delta P / \rho g$$

H - Height of the liquid level in the tank.

Δp - Differential pressure

ρ - Density of the liquid.

The most commonly used level SENSOR in industries is the differential pressure (DP) based capacitive type. Capacitive level transducer is an example of indirect measurement of level. They are used for wide variety of solids, aqueous and organic liquids, and slurries.

TEMPERATURE SENSOR

The temperature sensor is a two-wire SENSOR, which accepts input from a thermocouple, resistance thermometer detector (RTD) or DC voltage (mV), and converts them into a 4-20mA uniform signal for transmission.

In our project, we have used RTD as the primary sensing element. An RTD is a device which contains an electrical resistance source (referred to as a "sensing element" or "bulb") which changes resistance value depending on its temperature. This change of resistance with temperature can be measured and used to

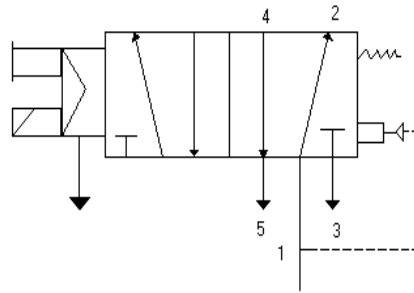
determine the temperature of a process or of a material. The RTD has a platinum resistance element (Pt 100 Ω or Pt 50 Ω) in a metal sheath, which is joined to a terminal. The metal sheath has insulating powder (MgO. Magnesium Oxide) packed tightly between the sheath and the sensor, so that the sensor cannot move. The tube is flexible, durable and mechanically strong and the sensor thermal response is fast.

SOLENOID VALVE

A solenoid valve has two main parts: Solenoid and the valve. The solenoid converts electrical energy into mechanical energy which, in turn, opens or closes the valve mechanically.

Solenoid valves may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control. A spring may be used to hold the valve opened or closed while the valve is not activated. When the voltage supply is given to the solenoid coil.

The solenoid is energized and the port changing occurs (i.e.) under no supply to the solenoid coil, the output port 2 is active, and under supply to solenoid coil the output port 4 is active. A manual override is used to change the port manual without supply to the solenoid coil.



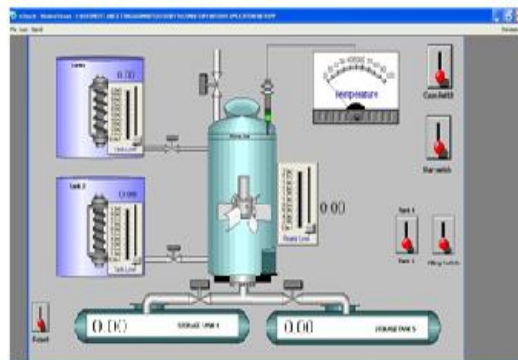
Port3and5 → Exhaust Port
 Port1 → InputPort
 Port4and2 → OutputPort

Industrial agitators are machines used in industries that process products in the chemical, food, pharmaceutical and cosmetic industries, in a view of mixing liquids together. Promote the reactions of chemical substances. Keeping homogeneous liquid bulk during storage. Increase heat transfer (heating or cooling).

AGITATOR

An agitator is a device or mechanism to put something into motion by shaking or stirring.

DYE PREPARATION SIMULATION



CONCLUSION

The energy and water conservation is the main problem in the industry. In this project, we developed a system to reduce the conservation. In this project it also reduces the man power in the

preparation of dye. The existing system carries a large amount of water, energy and man power. But in this project, it overcomes all the drawbacks that exists in the old system.

REFERENCE

- [1]. C. M. Zhu, "Photo catalytic degradation of AZO dyes by supported TiO₂+UV in aqueous solution," Chemosphere, 41, 2000, 303-309,
- [2]. C.M. Zhu, "Photocatalytic degradation of AZO dyes by supported TiO₂+UV in aqueous solution," Chemosphere, 41, 2000, 303-309,.

- [3]. F. Kiriakidou. "The effect of operational parameters and TiO₂-doping on the photocatalytic degradation of azo-dyes," *Catalysis Today*, 54, 1999, 119-130.
- [4]. M. A. Rauf, S. B. Bukallah, A. Hamadi, A. Sulaiman, F. Hammadi, "The effect of operational parameters on the photoinduced decoloration of dyes using a hybrid catalyst V₂O₅/TiO₂," *Chemical Engineering Journal*, 129, 2007, 167-172,.
- [5]. Y. Yang, A. P. Chen, H. C. Gu, Z. M. Dai, Z. R. Gu, and Y. Tao, "Photocatalytic degradation of oil film floating on water by TiO₂ immobilized on expanded perlite," *Chinese J. of Catalysis*. 22. 2001, 177-180,
- [6]. Y.Z. Wang, "Solar photocatalytic degradation of eight commercial dyes in TiO₂ suspension," *Wat. Res.* 34, 2002, 990-994,.
- [7]. F. Kiriakidou. "The effect of operational parameters and TiO₂-doping on the photocatalytic degradation of azo-dyes," *Catalysis Today*, 54, 1999, 119-130.
- [8]. C.M. Zhu, "Photocatalytic degradation of AZO dyes by supported TiO₂+UV in aqueous solution," *Chemosphere*,. 41, 2000, 303-309.
- [9]. K. Tanaka, "Photocatalytic degradation of commercial AZO dyes," *Wat. Res.* 34, 2001, 327-333.
- [10]. M.M. Kumari and D. Philip, "Degradation of environment pollutant dyes using phytosynthesized metal nanocatalysts," *Spectrochim. Acta Part A: Mol. Biomol. Spectr.*, 135, , 2015, 632-638