Automation of ROTOMOULDING PLANT (RP) Using PLC


*1Dept: of Computer Systems Engineering, Mehran UET, Jamshoro Pakistan.
*2Dept: of Computer Systems Engineering, Mehran UET, Jamshoro Pakistan.

bushra.naz@faculty.muet.edu.pk,
naveed.jaffari@faculty.muet.edu.pk,
faisi.kk@gmail.com

Abstract: This paper is mainly focus to answer the question “can you make a cell phone, change the world?”. Mobile autonomous Systems received considerable interest in research and development communities. As the Technology future belongs to the Mobile Devices. More efforts will be employed on Mobile Application development. Most of the desktop and laptop computers will be replaced by intelligent mobile devices, iPhones and iPads. The development of low cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC). PLCs have been gaining popularity on the factory floor and will probably remain predominant for some time to come. Simplification of engineering and precise control of manufacturing process can result in significant cost savings [1]. This paper presents a automated control system which offers safety, security mobility, and precautions in the alarming situations for the industrial plant as well as it will decrease the machine downtime, labor cost and increase the productivity of the industrial plant.

Keywords: Rotational Moulding, Wireless and mobile networks, mobile applications, Industry Automation, security, PLC (Programmable Logic Control).

1. Introduction

Since the dawn of civilization, man has endeavored to innovate and create projects that make their life on this planet as friendly as possible. Industries are one such platform through which man achieved the pinnacle of civilization. Control engineering has evolved over time. In the past, humans were the main method for controlling a system. More recently electricity has been used for control and early electrical control was based on relays. With the advantages of PLC’s and wireless raise industries are stepping up to new imaginary automatic control systems.

The most cost-effective way, which can pay big dividends in the long run, is flexible automation a planned approach towards integrated control systems [1]. It requires a conscious effort on the part of plant managers to identify areas where automation can result in better deployment/utilization of human resources and savings in man-hours, down time. Automation need not be high ended and too sophisticated, it is the phased, step-by-step effort to automate, employing control systems tailored to one’s specific requirements that achieves the most attractive results. That is where Industrial electronics has been a breakthrough in the field of automation and control techniques. A constant demand for better and more efficient manufacturing and process machinery has led to the requirement for higher quality and reliability in control techniques. With the availability of intelligent, compact solid state electronic devices, it has been possible to provide control systems that can reduce maintenance, down time and improve productivity to a great extent. By installing efficient and user friendly industrial electronics systems for manufacturing machinery or processors, one can obtain a precise, reliable and prolific means for generating quality products.

2. Brief Introduction of Rotational Moulding

Rotational moulding is a recent technology in plastic process, which has received worldwide acceptance. With advantages certain to attract both manufacturers and users, rotomoulding has useful applications in conventional and imaginative products lines. Rotational moulding or rotomoulding is a cost-effective way to produce large parts. The main purpose of rotational moulding was to create consistency in wall thickness and density.

Current rotomoulding machines and processes in most of the rotomoulding industry of PAKISTAN are relatively labor-intensive. Manual intervention is
typically required to open and close the mould and to place the powder in the mould. Moving the mould into and out of the oven and into a cooling station may also be performed manually.

Rotomoulding is a four-phase process, which comprises loading, heating, cooling, and unloading the mould. There are generally four processes from which raw material have to pass to give a resultant required mould by a rotational moulding process;

![Figure 1: Rotomoulding four phase process](image1)

1) Extruder
2) Palletizer
3) Pulveriser
4) Rotomould Oven (with biaxial arm)

Mobile and wireless information [2] systems for industrial plant can be described as systems involving:

- Mobile Devices,
- Programmable controllers,
- Wireless and Mobile Networks,
- Mobile Applications,
- Databases, and
- Middleware.

Automation of any industrial plant increases the productivity up to 20%, unfortunately most of the industrial plants working in Pakistan are not fully atomized, and auto controlling of industry will improve the economy growth of industry.

3. Need for the Automate Control System

Technology has driven fundamental changes in the way industrial and manufacturing companies manage their businesses [2]. With the addition of sophisticated solutions, like warehouse management and ERP (Enterprise Resource Planning) systems, as well as advanced data capture and wireless networking tools, companies are squeezing more efficiency out of their operations every day. These solutions deliver significant improvements for the specific areas they’re designed to manage, but do nothing to unite the entire supply chain. It’s rare for companies to have reached that level of automation or, in some cases, even understand the value of doing so. But the rapidly changing marketplace is creating a greater demand for manufacturers to be more agile and flexible in order to meet their needs, and that, in turn, is placing more pressure on managing supply chains.

![Figure 2: Typical Rotational Moulding Machine](image2)

It’s not uncommon for companies to gain 20 percent more productivity in areas they’ve automated [3]. Now imagine those same gains across every function. Or the dramatic increase in manufacturing flexibility gained by having total visibility into your upstream supply chain as well as changes in demand downstream. That’s what total automation can do for an industrial/manufacturing enterprise. It can dramatically improve operations by providing real-time data to all the interdependent parts of the supply chain.

The proposed product is meant a lot to humanity, common masses and for nature as well. It can reduce the probability of accidents, which may cost life. It will facilitate to avoid human-made errors causing heavy accidents in developing countries due to non-standard implementation of industrial security.

4. Implementation

Considering the varied demand and increasing competition, One of the latest techniques in solid state controls that offers flexible and efficient operation to the user is “PROGRAMMABLE CONTROLLERS”. The basic idea behind these programmable controllers was to provide means to eliminate high cost associated with inflexible, conventional relay controlled systems.
We implemented this system to automate the rotomoulding plant located in industrial area. From the beginning it is to accomplish the completed design with a prospect to provide a control of rotomoulding apparatus and method of process in which a rotomoulded product can be produced with minimal or no manual intervention. The centralized monitoring & controlling system incorporates all the machineries analysis with the aim of determining the presence or absence of a set of conditions.

**Figure 3: FATEK PLC Configuration**

The main requirements in this particular plant system were:

1) Synchronization between machineries.
2) Control the cost of a product.
3) Control the flow of a raw material to produce a good quality product.

The automated RP is not dependent upon a network of gears for its functionality instead based upon electronic modules which will be responsible for handling each type of operations. The electronic modules connected to a central brain (PLC). The PLC proceeds as a decision maker and a monitoring station.

Programmable controllers offer a system with computer flexibility:

1) Suited to withstand the industrial environment
2) Has simplicity of operation
3) Maintenance by plant technicians and
4) Reduce machine down time and provide expandability for future.
5) PLC constantly and simultaneously scrutinizes the operations of the plant.

## 5. Novelty & versatility of the Automate RP

Current industrial machines and processes in most of the industry of PAKISTAN are relatively labor-intensive [4]. Automation has become a necessity because of the huge Power requirements and labor cost. Manual work has been replaced by electronic devices (Computers) to provide a reliable means of power management.

The work done manually increases the risk of errors and also increases the cost of labors. It has ability to produce effectively manage rotational moulding in the least time whether by using single or multiple station machines that will enable you to optimize heating, cooling and de-moulding cycle times for any machine configuration.

The real time output from the system allows the machine operators and quality control personnel to identify the machine at any process to identify which valve is working at the moment & what is flow rate, which container is full or empty or time at which all the powder is melted, the maximum internal air temperature within the mould, the time at which the product has solidified and the heating/cooling rates during the rotomoulding process.

## 6. Conclusion

This paper mainly focused on the concept of industrial automation using PLC and computer flexibility, both in the broad and specific domains. For the overall features like level sensors, flow controllable valves & temperature control and most importantly Windows® based Alarms Monitor interface were implemented as SCADA software, and ran on selected records. The following traits were observed.

- Early fault detection and correction.
- No more rejects from over or under curing or sticking in mould due to shrinkage.
- Control end product shrinkage for better quality product.
- Less down time from moulds off machine due to problems.
- Product recipes include alarm settings, material requirements and machine allocation.
- Analyze man, machine and product performance.
- Control machine operation with interface options.
7. Future Work

The primary possibilities for increasing the functionality and practicality of use of the system are being the implementation of wireless connectivity between the field instruments and the PC server. This would allow patient mobility during monitoring. Additionally this would allow the possibility of further project expansion, into areas of long-distance remote monitoring like GPRS or another IP – based method. Further exploration of the rotomoulding plant monitoring procedure could yield an analysis more detailed than at present.

Reference

[1] Jackson M. H, INDUSTRIAL AUTOMATION.