

Process Control in Chemical Industry

Matthew N. O. Sadiku¹, Sarhan M. Musa¹, and Osama M. Musa²

¹Roy G. Perry College of Engineering Prairie View A&M University
Prairie View, TX 77446

²Ashland Inc. Bridgewater, NJ 08807

ABSTRACT: *The present era of fierce competition has compelled the chemical industry to improve their performance for survival. Automatic process control systems are now an integral part of modern chemical plants. Consequently, process control has become a fundamental topic for chemical engineering students. The paper provides a short discussion on chemical process control systems.*

KEY WORDS: *process control, chemical industry*

I. INTRODUCTION

Process control refers to the collective methods employed in controlling process variables (such as temperature, pressure, humidity, conductivity, fluid level, etc.) when manufacturing a product. The production process is controlled for three reasons: reduce product variability, increase operating efficiency, and ensure safety [1]. Process control combines statistics, engineering, and algorithms for controlling a process. It deals with any aspect that requires continuous monitoring within an operation. Due to their complexities, large dimensionality, and nonlinearity, chemical processes are not straightforward to understand and available theories often cannot be applied directly. It is time-consuming and expensive to develop advanced control methods for these processes [2].

Many new chemical control systems are being designed with a digital computer included as an integral part of system. Engineers can improve the operation of old process control units by replacing them with computerized process control units, which exploit are new and more effective digital control schemes. Manual adjustment of process conditions has been replaced by automated controllers. A computerized unit can be programmed to implement the complex sequences of interdependent operations needed to run a large manufacturing plant. A plant may retrofit with new control units in order to increase production, to cut costs, or sometimes just to stay in operation. It is estimated that computerized process control systems have increased efficiencies and productivity [3]. Computerized process control systems have emerged as a realistic solution and a number of benefits can be listed. The most important of these is flexibility, which mainly facilitates production through increased control of production flows and settings. Another benefit is significant improvements in production performance and economies of scale in the chemical industry [4]. Safety of workers and the community around the plant is another benefit. The industry-wide deployment of large automatic process control systems has enabled the design of complex high-volume processes.

II. OVERVIEW OF CONTROL PROCESS

Process control systems can take one of the following forms [5]:

- **Batch** – Some applications require that specific quantities of raw materials be combined in specific ways to produce an intermediate or end result.
- **Continuous** – Often, a physical system is represented through variables that are smooth and uninterrupted in time. Continuous processes in manufacturing are used to produce very large quantities of product per year.
- **Hybrid** - Applications having elements of batch and continuous process control applications.

Process technology has shifted from batch to continuous operations and control procedures have evolved. New developments for control strategies have led to advanced strategies such as artificial neural networks, model-based controllers, and fuzzy-based controllers.

III. APPLICATIONS

Automatic process control is implemented widely in industries such as oil refining, pulp and paper manufacturing, chemical processing, and power generating plants. Since the last decades, process control has become important for the food industry due to its capability of increasing yield, minimizing production cost, and improving food consistency and quality. Process control is extremely important today in pharmaceutical chemical manufacturing due to tight product specifications and increasing governmental requirements for good process documentation.

IV. CHALLENGES

The chemical industry has been a focal point for both public and private organizations due to its enormous consumption of energy and resources in production, its pollution potential and safety risks. As global demand for chemical products increases, the chemical industry faces new business challenges. The competing factor in process control is that products must meet certain specifications in order to be satisfactory. Standardization and training are essential for efficient utilization of such systems. Efforts have been made towards standardizing software packages. Recent threats to our national critical infrastructures have prompted taking some security measures across many different industry sectors. Reducing the vulnerabilities of process control system against physical and cyber attacks is necessary to ensure the safety, reliability, integrity, and availability of these systems. The chemical industry has traditionally focused on safety and productivity. While the US Homeland Security has developed a strategy to secure these vulnerabilities, the Control Systems Security and Test Center (CSSTC) promotes a proactive, collaborative approach to increase industry's awareness of standards and products that can enhance the security of process control systems [6].

V. CONCLUSION

Computer systems are now being employed in several chemical firms, allowing communication with each other and boosting productivity. Justification for these computer and automatic process control systems is found in labor savings, greater productivity, lower raw material and utility costs, and improved quality control [7]. For further discussion on this topic, consulting the book by Luyben [8] is recommended.

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AUTHORS

Matthew N.O. Sadiku is a professor in the Department of Electrical and Computer Engineering at Prairie View A&M University, Prairie View, Texas. He is the author of several books and papers. His areas of research interest include computational electromagnetics and computer networks. He is a fellow of IEEE.

Sarhan M. Musa is a professor in the Department of Engineering Technology at Prairie View A&M University, Texas. He has been the director of Prairie View Networking Academy, Texas, since 2004. He is an LTD Sprint and Boeing Welliver Fellow.

Osama M. Musa is currently Vice President and Chief Technology Officer for Ashland Inc. Dr. Musa also serves as a member of the Advisory Board at Manhattan College's Department of Electrical and Computer Engineering as well as a member of the Board of Trustees at Chemists' Club of NYC. Additionally, he sits on the Advisory Board of the International Journal of Humanitarian Technology (IJHT).