Gas Treatment Centre - Smart Filter Bags Cleaning With PLC-Based Automation at Sohar Aluminium

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Abstract

Sohar Aluminium has upgraded its Gas Treatment Centre (GTC) by implementing a cutting-edge PLC-based control system, significantly improving the filter bags cleaning process. The traditional vendor-supplied sequencers, installed 35 meters above ground, posed significant safety risks and caused prolonged downtimes. The new in-house developed PLC-based solution replaced these sequencers with a flexible SCADA-integrated system, relocating the controllers to the Motor Control Centre (MCC) for enhanced maintainability, reliability and safety. This innovative system allows operators to monitor and control the process remotely, reducing intervention time and human error. Faults are systematically correlated with specific valves, enabling targeted maintenance and minimizing downtime. The introduction of a pressure regulator with a newly developed PID control optimized the performance and enabled using the system's full potential.

The Smart GTC project has significantly improved efficiency, safety, and cost-effectiveness, positioning the operations at best practices and close to a benchmark level in process operation and industrial automation. By adopting modern automation technologies, Sohar Aluminium has demonstrated its commitment to innovation and operational excellence.

Keywords: PLC-based automation, Filter cleaning, Scada integration, Process optimization, Cost reductions.

1. Introduction

1.1 The Critical Role of Gas Treatment in Aluminium Smelting

Gas Treatment Centers (GTCs) are integral to modern aluminium production, playing a dual role in environmental stewardship and process economy. Their primary function is the capture and treatment of harmful emissions, predominantly gaseous and particulate fluorides, originating from the electrolysis process, thereby ensuring compliance with stringent environmental regulations. Furthermore, efficient GTC operation contributes to economic benefits through the recovery and reinjection of fluorine-rich alumina into the smelting pots, effectively reducing raw material consumption and associated costs.

1.2 Principles of Filter Bag Cleaning in Dry Scrubbing Systems

In dry scrubbing GTCs, fabric filters are employed to capture particulate matter, including alumina and adsorbed fluorides. The sustained efficiency of these filters depends on periodic cleaning to remove the accumulated dust cake. This is commonly achieved by introducing pulses

of compressed air in a reverse-flow manner thereby dislodging particulates from the filter media. Conventional cleaning mechanisms often utilize fixed-timer sequencers located proximally to the filter units. While providing basic functionality, these systems inherently lack adaptability to dynamic process conditions, such as variations in filter bag permeability due to aging, fluctuation in gas flow, or changes in production throughput.

1.3 Challenges with Legacy Filter Bag Cleaning Systems at Sohar Aluminium

Sohar Aluminium's legacy filter bag cleaning system, while having fulfilled the plant's operational needs for many years, presented opportunities for improvement as the system approached the end of its lifecycle. The original design, based on standalone sequencers installed atop the filter structures (baghouses), had inherent limitations in flexibility, adaptability, and integration with modern plant-wide control strategies.

With a focus on enhancing system reliability and ensuring long-term operational excellence, Sohar Aluminium identified the need to modernize the GTC filter bag cleaning system. This initiative aimed to transform the existing setup into a smart, adaptive solution that could meet current operational requirements and support future improvements.

By adopting an in-house engineering approach, the project focused on developing a robust, maintainable, and scalable system architecture. The upgraded design prioritized relocating control hardware to a protected environment, enhancing diagnostic capabilities, integrating with the existing SCADA platform, and ensuring long-term reliability through standardization and futureproofing. This strategic upgrade has modernized the filter bag cleaning process and established a foundation for ongoing performance enhancements, safety improvements, and operational efficiency.

2. System Design and Implementation of the Modernized Control Architecture

2.1 Centralized Control Hardware and Enhanced Environmental Protection

A key design decision was the relocation of all primary control hardware (PLC units) from the exposed top-of-filter environment (see Figure 1) to a climate-controlled Motor Control Center (MCC). This strategic move significantly mitigated the risk of hardware failure due to thermal stress, humidity, and particulate ingress, thereby enhancing overall system longevity and reliability. Standard industrial PLCs were selected for their robustness, processing capabilities, and programming flexibility using standard IEC 61 131–3 languages.

Figure 1. Legacy system.