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Instrumentation and Automation in Effluent Treatment Plants (ETP): A Technical Review and System Design Approach

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Abstract: *Effluent Treatment Plants (ETPs) are essential systems for minimizing industrial environmental impact by treating wastewater prior to its discharge or reuse. [1], [2]. With increasing regulatory requirements and operational complexity, contemporary ETPs depend extensively on instrumentation and automated control technologies to enhance process efficiency, ensure compliance, lower human dependency, and optimize the consumption of chemicals and energy. [3], [4]. This paper provides an in-depth review of key measurement instruments employed in ETP operations, such as sensors for flow, level, pH, dissolved oxygen, turbidity, oxidation–reduction potential, and pressure. An integrated automation framework incorporating PLCs, SCADA systems, control valves, closed-loop control strategies, and safety interlocks is presented. The study further analyses improvements in operational performance achieved through automation across major treatment stages, including equalization, aeration, clarification, filtration, and sludge handling. Emerging developments such as IoT-enabled water quality sensing, softsensor modelling, and AI-driven predictive treatment optimization are also explored.*

Keywords: Effluent Treatment Plant (ETP), Automation, Instrumentation, pH Control, SCADA, PLC, Dissolved Oxygen Sensor, Wastewater Treatment

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