Enhancing Industrial Valve Integrity: Non-destructive Assessment through Acoustic Emission Measurements

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The occurrence of leaks or passing flows, encompassing gases, liquids, or multiphase substances within industrial facilities, imposes significant financial burdens owing to substance losses. Simultaneously, it poses a substantial safety concern due to the potential for explosions and contamination hazards. Additionally, there is an inherent risk of environmental pollution when chemical products are inadvertently released into the environment. To address these critical issues, there is a pressing need to effectively detect, localize, and quantify internal passing flows within pipes and valves. Our approach involves the measurement of acoustic emissions generated by these flows, which subsequently propagate across the surfaces of the valve system under investigation. To achieve this, we use piezoelectric sensors strategically positioned on analysis surfaces, each featuring couplings tailored to the specific application. The specialized test bench, named ETR83NXT, has been developed based on empirical findings and can perform both single measurements and continuous monitoring. An individual acoustic emission measurement has a duration of approximately 0.13 seconds, with the capability to provide an Average Signal Level (ASL) at intervals of 0.2 seconds. Furthermore, our instrumentation enables concurrent measurement of four parameters, comprising two acoustic emission channels and two additional channels for variables such as temperature, pressure, displacement, or force. The inherent significance lies in the correlation between acoustic emissions and these supplementary parameters, facilitating the determination of leak origins, quantification of leaks, or adjustments to valve settings. Notably, our instrumentation is robust enough to analyze valves operating at elevated temperatures, reaching up to 300°C, while maintaining continuous monitoring capabilities spanning several weeks. Rigorous experimentation in both laboratory settings and industrial environments, including nuclear power plants, has provided validation for our measurement devices and data processing methodologies. This comprehensive approach promises to significantly enhance our ability to address and mitigate the adverse effects of passing flows within industrial systems.