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| **Title:** | Innovative Design and Scalable Manufacturing of a High-Performance Globe Valve with Plug-Type Disc | | |
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| **Abstract:** |  |
| This study presents the design and development of an advanced industrial-grade globe valve for enhanced flow control, excellent sealing performance, and augmented longevity. A key scientific contribution of this research is the implementation of an innovative plug-type disc design that demonstrates a 27% reduction in leakage compared to conventional flat-disc configurations, as validated through computational fluid dynamics (CFD) simulations. The Z-type valve design optimizes seating alignment, reduces pressure drop by 20 %, and extends operational lifespan through strategic material selection (ASTM A48 cast iron body, AISI 304 stainless steel internals) and a three-layered sealing mechanism. The manufacturing process integrates precision sand casting, CNC machining, and rigorous testing (ISO 5208:2015), yielding a 95% casting success rate and a 23.82% cost reduction (26 USD/unit) compared to imported valves (47 USD–63 USD). Validated in Bangladesh’s industrial context, the valve demonstrates superior throttling, bubble-tight shutoff, and flow stability, reducing import dependency and supporting sustainable manufacturing. This scalable framework positions the valve for global applications in power generation, chemical processing, and oil/gas industries. | |