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Optimizing Fire Tube Boiler Design for Efficient Saturated Steam Production: A Cost-Minimization Approach

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Abstract : This report unveils a meticulous project focused on the design intricacies of a Fire Tube Boiler tailored for the efficient generation of saturated steam. The overarching objective is to produce 2000kg/h of saturated steam at 12-bar design pressure, achieved through the development of an advanced fire tube boiler. This design is meticulously crafted to harmonize cost-effectiveness and parameter refinement, with a keen emphasis on material selection for component parts, construction materials, and production methods throughout the analytical phases. The analytical process involves iterative calculations, utilizing pertinent formulas to optimize design parameters, including the selection of tube diameters and overall heat transfer coefficients. The boiler configuration incorporates two passes, a strategic choice influenced by tube and shell size considerations. The utilization of heavy oil fuel no. 6, with a higher heating value of 44000kJ/kg and a lower heating value of 41300kJ/kg, results in a fuel consumption of 140.37kg/hr. The boiler achieves an impressive heat output of 1610kW with an efficiency rating of 85.25%. The fluid flow pattern within the boiler adopts a cross-flow arrangement strategically chosen for inherent advantages. Internally, the welding of the tube sheet to the shell, secured by gaskets and welds, ensures structural integrity. The shell design adheres to European Standard code sections for pressure vessels, encompassing considerations for weight, supplementary accessories (lifting lugs, openings, ends, manhole), and detailed assembly drawings. This research represents a significant stride in optimizing fire tube boiler technology, balancing efficiency and safety considerations in the pursuit of enhanced saturated steam production.

Keywords : fire tube, saturated steam, material selection, efficiency
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