PERFORMANCE ASSESSMENT AND COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF SUBMERSIBLE SUMP PUMP IN A POWER PLANT COOLING SYSTEM

[1]CHONG SOON YONG, [2]SALMI SAMSUDDIN

Kapar Energy Venture Sdn Bhd, Malaysia
E-mail: [1]chong.soonyoong@kaparenergy.com.my, [2]salmis@tnb.com.my

Abstract - In cooling water systems of thermal power plants, sump pumps are often affected by undesirable hydraulic phenomena such as surface and subsurface vortex formation, flow separation, and non-uniform velocity distribution, all of which compromise pump performance and reliability. This study investigates practical vortex mitigation strategies through both physical modeling and computational fluid dynamics (CFD) simulation. A 1:10 geometrically scaled sump pump model was constructed and tested under three water levels water low (LWL), medium water level(MWL), and high water level (HWL) with and without mitigation devices. Two key design modifications were evaluated: a rear-wall splitter, positioned at the back of the sump bay to interrupt recirculating boundary flows, and a conical vortex breaker with baffles installed beneath the bell mouth to dissipate rotational energy. Experimental velocity profile measurements and streamline visualizations were complemented by validated CFD simulations. Results show that the rear-wall splitter effectively suppresses free-surface vortex formation at LWL, while the conical vortex breaker ensures a uniform velocity distribution across intake elevations, eliminating low-velocity regions prone to vortex initiation. Both physical and numerical findings demonstrate that these structural interventions significantly improve sump hydraulics, providing reliable strategies for minimizing vortex formation and enhancing pump intake performance.

Keywords - CFD, Submersible Sump Pump, Vortices, Vortex Breaker