Due to the low heat rejection capacity or huge water consumption of traditional cooling methods, many power plants are looking for a way that is eco-friendly and high efficient but low-cost to retrofit their current cooling system. This study aims to explore innovative solutions to enhance heat transfer efficiency based on current dry cooling systems. Several metamaterial-based agitators were assembled with a commercial extruded heat sink where experimental testing was conducted to investigate the validity of the modified configuration. Vortex-induced vibrations (VIV) of structures have attracted much attention these years due to its application in many engineering disciplines. Taking advantage of this phenomena, these agitators are expected to mimic the motion of fish swimming and agitate the flow in channels of the heat sink, which will mix the cool air and hot air. Instead of the cylinder widely used in VIV study, the wing of the agitator has a streamlined cross-section to reduce air drag while shedding vortices. The heat transfer efficiency is expected to increase with a low-pressure penalty utilizing this method. This study compared the heat rejection and the incurred pressure loss of agitators with different shapes, sizes, and numbers of wings. The study presented several types of heat sink/agitator configuration that exhibit a significant increase in heat transfer performance compared to the unmodified commercial heat sink. Hence, the metamaterial-based agitator proves to be an effective solution for increasing heat rejection capability of a heat sink.