Fig. 6 also shows the GVT efficiency curve. This efficiency can be defined as the ratio of the energy output to the energy input. In the current study, it was determined experimentally by measuring the power output and the flow rate of the fluid. By varying the angular velocity of the turbine and measuring the corresponding power output and flow rate, the efficiency curve can be generated. Typically, the GVT efficiency is highest at a specific angular velocity, known as the optimum point. Beyond this point, the turbine efficiency decreases due to increased friction and energy losses. By analysing the efficiency curve of the target GVT, the optimum point allowing an efficiency of 0.495 was identified at 140.25 rpm.

4. Conclusion

The development of experimental facilities is crucial for advancing in the field of GVT. Modular GVT with interchangeable parts can greatly facilitate the testing and development process. A strong vortex in the discharge chamber of a gravitational vortex turbine is crucial for achieving optimal performance. The vortex helps to create a low-pressure zone at the center of the turbine, which results in increased rotational speed and higher energy conversion efficiency. The wider vortex generated at low inlet velocities presents an opportunity for maximizing the energy output of the turbine. During experimental tests on the designed bench, it was observed that a narrower vortex was generated when the inlet velocity was high, as the fluid flow had less time to expand in the discharge chamber. Conversely, a wider vortex was generated when the inlet velocity was low, as the fluid flow had more time to expand in the discharge chamber. It should be noted that factors such as the geometry of the discharge chamber, the shape of the runner, and the viscosity of the fluid, in addition to the inlet velocity, can also influence the width of the vortex in a GVT.

By analysing the efficiency curve of the turbine, the optimal operating point can be identified so that the maximum efficiency is achieved. In the GVT experimental testing, an efficiency of 0.495 was achieved at 140.25 rpm. In this regard, the continued research and development of these turbines have the potential to contribute to the production of clean and sustainable energy.

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