The mining and oil sectors make extensive use of centrifugal pumps. In the mining and oil industries, centrifugal pumps are used to move drilling fluid, which is usually a non-Newtonian fluid, This study presents a detailed numerical investigation of centrifugal pump performance using both Newtonian (water) and non-Newtonian fluids, specifically Carboxymethyl Cellulose (CMC) solutions at concentrations of **0.1%, 0.2%, 0.3%, 0.4%, and 0.5%**. Two rheological models: **Bingham Plastic** and **Bird-Carreau -** were applied to simulate the non-Newtonian behavior. The simulations were performed using **ANSYS Fluent**, and three impeller blade numbers (**4, 6, and 8 blades**) were evaluated to determine their impact on hydraulic performance.

The results showed that for water, the maximum head generated was 13.2 meters with the 6-blade impeller, and the corresponding efficiency was 61%. When using CMC at a concentration of 0.1%, the head dropped to 12.5 m according to the Bird–Carreau model and 12.2 m for the Bingham model, while the efficiency decreased to 58% and 56%, respectively. At the highest concentration of 0.5% CMC, the head further decreased to 10.6 m for the Bird–Carreau model and 9.8 m for the Bingham model, with efficiency dropping to 49% and 45%, respectively. Power consumption increased with increasing CMC concentration, rising from 145 W for water to 178 W for the 0.5% CMC solution using the Bird–Carreau model and 190 W for the Bingham model. The 6-blade impeller consistently outperformed the 4- and 8-blade designs, offering the best balance between head, efficiency, and power consumption across all tested fluids.

Furthermore, the Bird–Carreau model provided more realistic results than the Bingham model, especially at lower CMC concentrations, due to its more accurate representation of shear-thinning behavior. These findings indicate that CMC-based non-Newtonian fluids significantly affect the performance of centrifugal pumps, and that careful selection of both the rheological model and impeller design is essential. The results have strong relevance for engineering applications involving bio-fluids, slurries, and polymer solutions