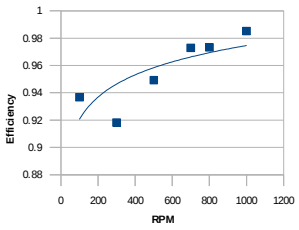
CFD ANALYSIS OF GEAR PUMP

Objective

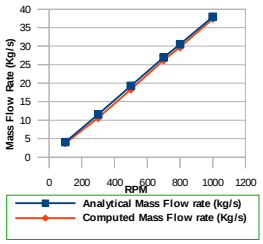
To study the Gear Pump using Overset Mesh Technique

Challenges

- To produce the gap in the size of microns between the gear and casing
- Troubleshooting the overset regions
- Ensuring fine meshing at critical regions to capture the flow physics accurately



Graph 2: Volumetric Efficiency VS RPM



Graph 3: Comparison of Analytical and Computed Mass Flow Rate with RPM

CFD Model

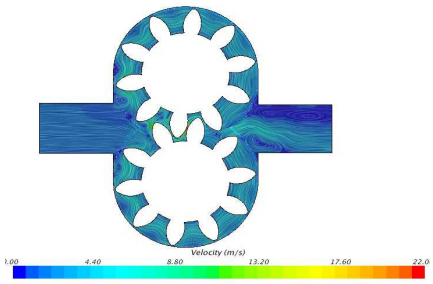


Fig.1: Velocity Vectors

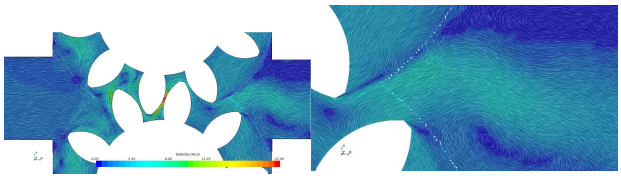
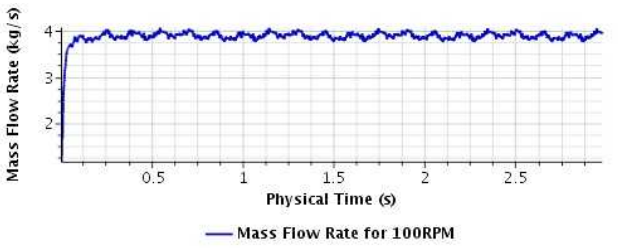


Fig.2: Velocity Vectors Close-Up View



Graph 1: Mass Flow for 100rpm

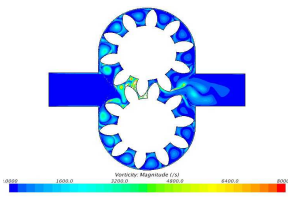


Fig.3: Vorticity

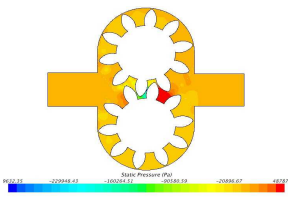


Fig.4: Static Pressure

Approach

The physical model chosen for this analysis represents an external gear pump manufactured in industry. The investigation produced significant information on flow patterns, velocity and pressure fields and flow rates. The mass flow rate at outlet which is found to be function of time is sinusoidal and steady as shown in the **Graph 1**. The **Table 1** shows that if the RPM increased, the efficiency of the pump increases. The mass flow rates are less than the theoretical flow rates for all the cases, which is due to the slip through the gaps.

RPM	Analytical Mass Flow rate (Kg/s)	Computed Mass Flow rate (Kg/s)	Volumetric Efficiency
1000	37.9628	37.4	0.9852
800	30.5132	29.7	0.9733
700	26.9580	26.23	0.9730
500	19.3197	18.34	0.9493
300	11.5875	10.64	0.9182
100	4.0889	3.83	0.9367

Table 1: Comparison of Analytical Calculation with CFD

Conclusion

The Theoretical or Analytical calculation cannot reveal all the flow features correctly. One can capture such complex flows by employing CFD. The CFD has been successfully used here to compute the flow features like flow pattern and high pressure region and their critical values between the gears.

The use of CFD in Gear Pump shows that it is quite possible to understand how a Gear Pump “works” and it has shown that useful calculations can be made to the point where an engineer can make a good start at designing a pump. However it makes sound sense to look at the Gear pump in use to see what constraints the engineering imposes on the physics.

Benefits

- High speed can be tested without prototype
- Study of high pressure
- New gear module with their casing
- Gap adjustment study according to the requirement
- Design accommodates wide variety of materials

Applications

- Various fuel oils and lube oils
- Chemical additive and polymer metering
- Chemical mixing and blending (double pump)
- Industrial and mobile hydraulic applications (log splitters, lifts, etc.)
- Acids and caustic (stainless steel or composite construction)
- Low volume transfer or similar applications

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