Study for Constant and Time Varying Transient flow Analysis of Forward and Backward Flow through Tesla Valve in 2D using Ramping and Pulsating Inlet Flow.

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ABSTRACT

This case study aims to highlight the differences in nature of flow between constant and varying inlet flow rates and attempts to discern the reasons behind these differences.

First, the flow analysis for constant flow velocities of 2m/sec and 6 m/s is performed to confirm diodic nature of fluid flow through Tesla Valve. In the next step of the case study, Inlet Flow Rate Ramp function and oscillating sinusoidal function are introduced as time dependent inlet boundary conditions for forward and reverse flow cases. Pressure, velocity and passive scalar profiles are assessed for both cases.

PisoFoam has been used as the solver for the Transient Flow analysis. The geometry and mesh has been created using Salome Meca. Passive scalar has been introduced at different points of time in the inlet to trace fluid flow in all the cases.

Details regarding geometry and flow have been highlighted below:

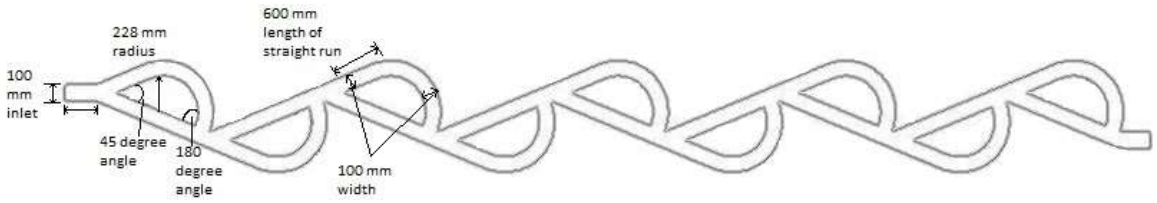

Figure 1: Tesla Valve with n diodic separation branches. There is no geometric difference in dimensions between the diodic separations. The only difference is in orientation and position.

This Case Study focusses on the following inlet flow conditions for the forward and reverse flow case:

1) Constant Inlet Flow Velocity of 2 m/s and 6 m/s from 0 to 5 sec
2) Pulsating Inlet Flow Velocity of 5+sin (40 π*t) m/s where t is the time in seconds from 0 to 6 sec
3) Ramped Inlet Flow Velocity, ramped as follows:
   a) From 0 to 2.5 secs, the inlet velocity is held constant at 2 m/s (Simulation begins)
   b) From 2.5 secs to 5 secs, the inlet velocity was ramped from 2 m/s to 4 m/s
   c) From 5 secs to 7.5 secs, the inlet velocity was kept constant at 4 m/s
   d) From 7.5 secs to 8.75 secs, the inlet velocity was ramped from at 4 m/s to 6 m/s.
   e) From 8.75 sec to 12.5 sec, the fluid flow rate was kept constant at 6 m/s. (End of Simulation)

The viscosity of the working fluid (water) is 4.6×10^{-4} Pa s with a density of 1000 kg/m^3. For the lowest inlet velocity of 2 m/s and an inlet width of 100 mm the Reynold's number is 4.35×10^5. Hence the flow is in turbulent regime for all the above cases.