Numerical Investigation of Swirl Flow in Curved Tube with Various Curvature Ratio

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Introduction: Curved tubes are frequently used in many engineering applications [1]. The influences of curvature effects and swirl intensities for Sodium Carboxymethyl cellulose (0.65% NaCMC) flow in a curved tube have been numerically investigated by using COMSOL Multiphysics®

Computational Methods: The mathematical model is developed taking into account a negligibly small gravity force. The steady three-dimensional Navier-Stokes equations are used as the governing equations. Boundary conditions: in the inlet region of the channel velocity field is fully developed, in the outlet region of the channel normal stress is given (the total stress on the boundary is set equal to a stress vector of magnitude, f0=0, oriented in the opposite normal direction). The no-slip condition is forced on the channel walls. To describe the viscosity behavior is taken the Kutateladze model, which based on the structural theory of viscosity and its parameters have physical meaning. The twisted tape, which are located directly in front of the curved part, are used as swirl flow generators. The tape is twisted until it reaches an angle of 90 degrees and turns right.

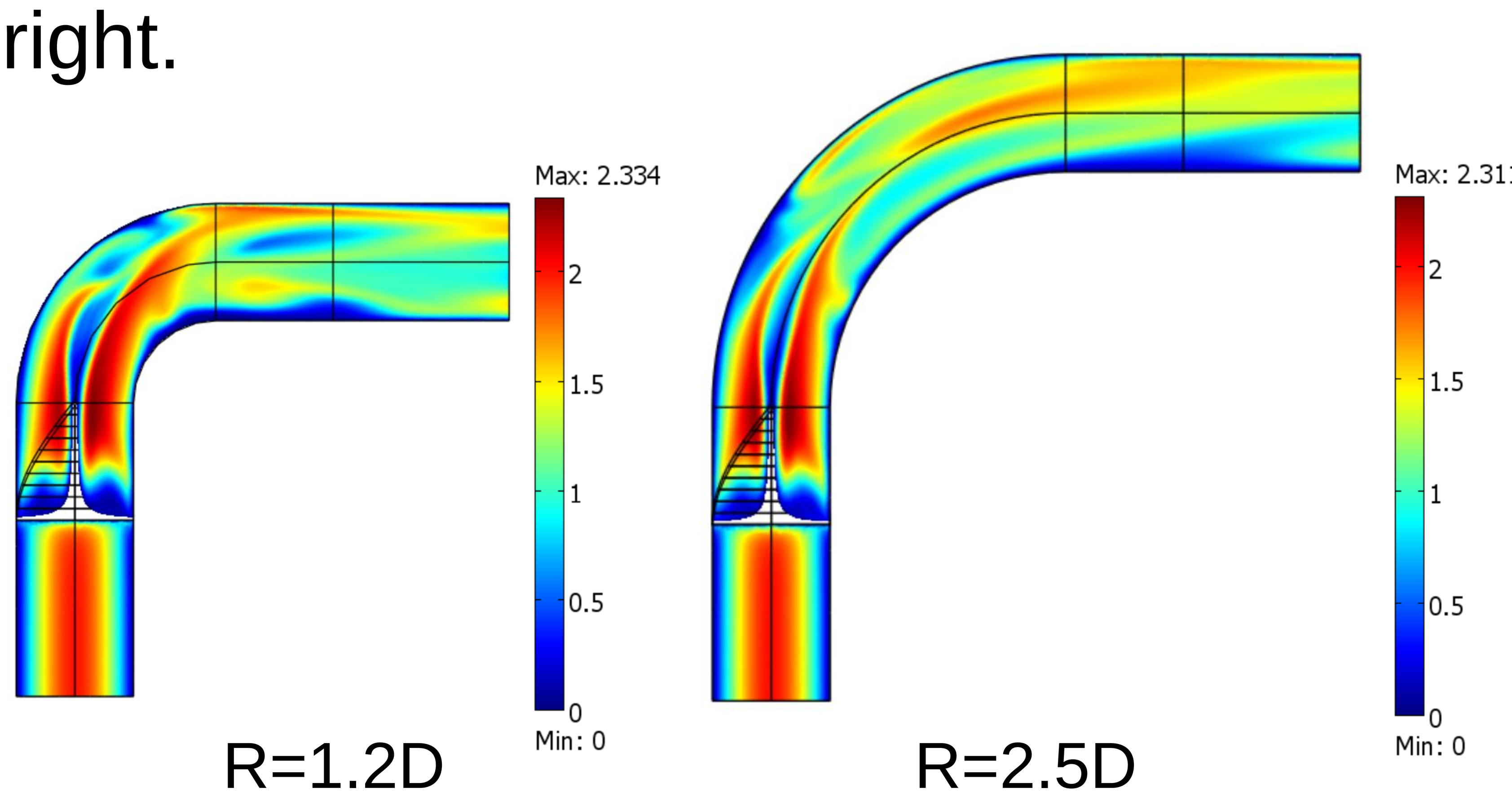

Figure 1. The relative velocity (U_ns/U0) distribution for different curvature ratio (R), Re=640.14, U0 - initial avarege velocity

Results: Present your results and findings based on the simulation work. Address your hypothesis and present your results in the form of simulated graphics of your model, tables and graphs.

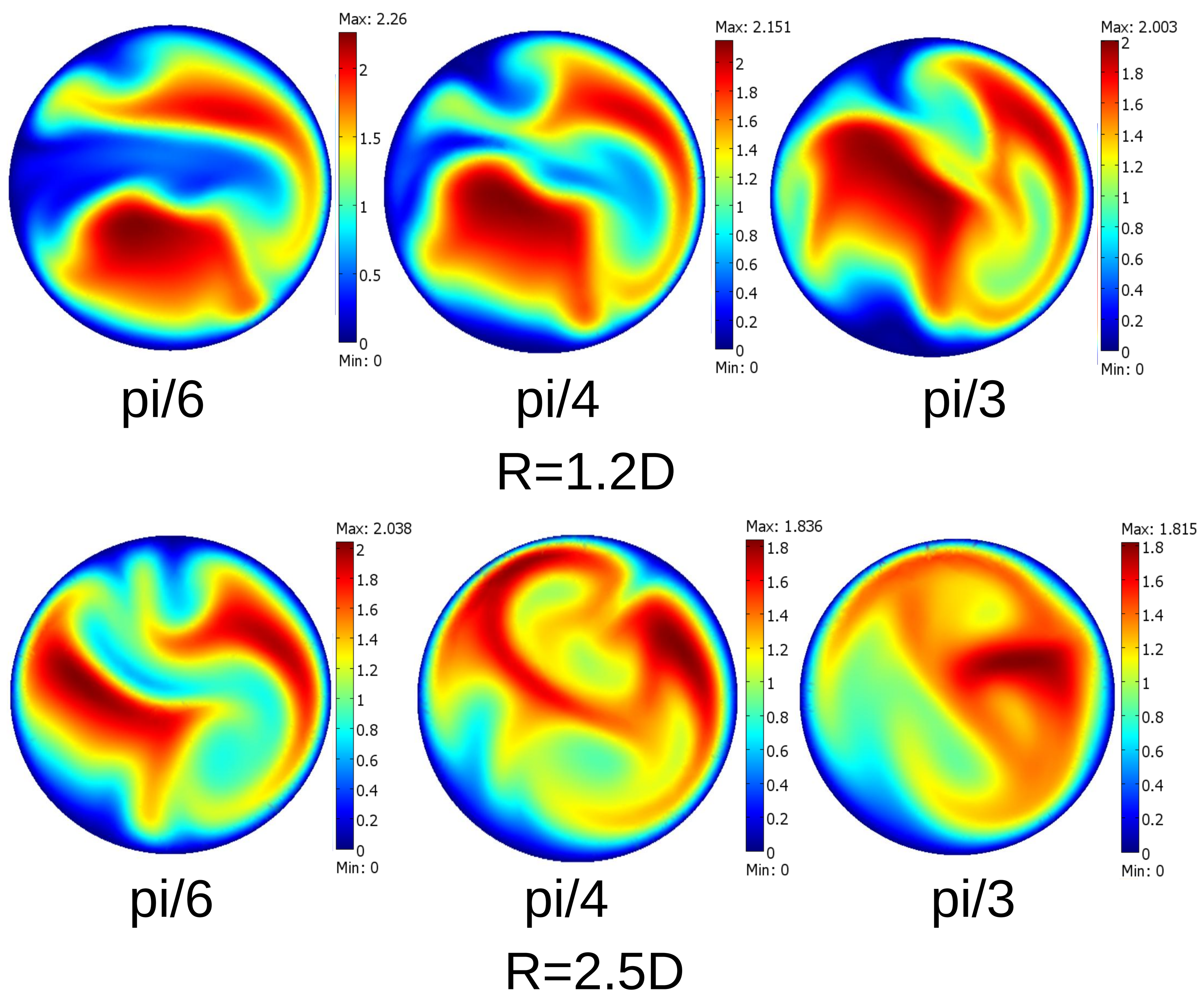

Figure 2. The relative velocity (U_ns/U0) distribution for different cross-section (pi/6, pi/4, pi/3) and curvature ratio (R), Re=640.14, U0 - initial avarege velocity

Conclusions:

Swirling flow, getting into the curved part, forms two vortexes with different sizes: the largest is located on the inside of the curved part. Then, these vortexes shifted to the outside of the curved part due to the inertial forces. Then vortixes are deformed and die out.

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References:

1. Paisarn Naphon, A review of flow and heat transfer characteristics in curved tubes, Renewable&Sustainable energy reviews, 10, 463-490 (2006)