SOME PROBLEMS OF FLOW INSTABILITY IN COMPRESSIBLE FLOWS

Michail Lipatov

Moscow Institute of Physics and Technology

Gagarin str.16, Zhukovsky, Moscow region, Russia

E-mail mlipatov@inbox.ru

Abstract. Considered are two problems associated with centrifugal instability arising in compressible viscous gas flows.

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1 Introduction

Investigated is the Couette-Taylor flow between two concentrate cylinders. Investigated is the flow instability under action of unsteady disturbances. Different instability regimes were found for different Reynolds numbers.

Linear equations are deduced to describe unsteady instability processes for large Reynolds numbers. Presented are numerical results of linear problems solution. This part of the work is the continuation of previous investigations [1].

Nonlinear problems solutions have been obtained with the help of ANSYS CFX programmes and computers in MIPT.

2 Numerical results

As a result of numerical analysis new results have been obtained for the flow parameters as functions of the walls temperatures along with the characteristic Reynolds and Mach numbers.

Some results are depicted on the next figure where velocity vertical component is presented in the plane between cylinders for one variant of calculations. These results along with the results for other velocity components show that there are vertical structures originations in the space between cylinders these vortices lead to the mass and energy transfer intensification.
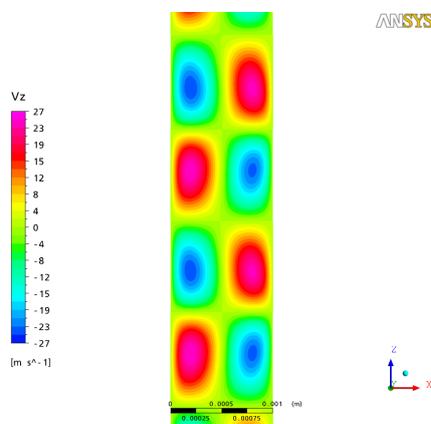

Figure 1. Lines of constant vertical velocity in the flow between two concentrate cylinders

Second problem investigated is associated with the linear instability arising near the critical point of circular cylinder in supersonic flow. For incompressible flow original analysis has been done by Goertler [2], who investigated linear instability of the flow described by exact Navier-Stokes equations. In supersonic flow exact solution near the critical point may be found at least for the case where specific heat ratio tends to unity.

In this case numerical solution of the linear equations is obtained describing disturbed flow between cylinder and shock wave.

3 Conclusion

Two problems associated with the compressible Couette Taylor instability have been analyzed. Analytical and numerical results are presented.

References

1. Lipatov I.I. Stability of compressible Taylor-Couette flow. Asymptotical analysis. J. of Physics. Conf. Ser. 2005. V. 14. pp. 113-117.
2. Görtler H. Dreidimensionale Instabilität der ebenen Staupunktströmung gegenüber wirbelartigen Störungen. Fünfzig Jahre Grenzschichtforschung. Braunschweig.1955. pp. 303-314.