ISSN (Online): 2455-7838
SJIF Impact Factor (2015): 3.476

EPRA International Journal of

Research & Development (IJRD)

Volume:1, Issue:7, September 2016

Published By :
EPRA Journals

SJIF Impact Factor: 3.476 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 1 | Issue : 7 | September | 2016

DRAG FORCE: A REVIEW ON RESEARCH AND STUDIES

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ABSTRACT

Chemical engineering deals with mass transfer, fluid mechanics, reaction engineering, mechanical operation, process control and process engineering. In fluid mechanics flow past immersed solids is one of the most important study areas. The drag force plays important role in flow past immersed bodies. The aero plane has to flow past wind. This is example of flow past bodies for compressible fluids. The drag force is a function of Reynolds number. Various investigators have carried out experimentation on drag force and affecting parameters. Current review summarizes research and studies on drag force and its affecting parameter.

KEYWORDS: *Drag coefficient, roughness, pressure, parameters*

1. INTRODUCTION

Chemical engineering deals with mass, momentum and heat transfer. Also fluid mechanics is an integral part of fluid mechanics. The studies on various aspects such as hydrodynamics of packed and fluidized beds are important study areas of fluid mechanics [1,2,3,4].

The studies on viscosity of fluids and hydrotropy forms important research area [5,6,7,8]. Fluid mechanics is interdisciplinary subject with strong connection and application in civil and mechanical engineering. Also friction and friction factors are important for pressure loss across the pipes and other rotating equipments. Research has also been reported on the effect of friction and friction factors on equipments and their outputs [9,10,11,12]. The current review summarizes research and studies on drag coefficient, drag force and affecting parameters.

2. DRAG FORCE: A REVIEW ON RESEARCH AND STUDIES

Butt and Egbers carried out investigations on flow over circular cylinders with patterned surfaces [13]. They performed experiments in subsonic wind tunnel. They observed the effect of hexagonal patterns on the flow of air. In their investigation they observed that a patterned cylinder with patterns pressed outwards (can be referred as hexagonal bumps) has a drag coefficient equal to 65% of the smooth one. They used cylinders with hexagonal patterns in their investigation. They ensured that these patterns were pressed on steel sheets having a smoothed surface. The purpose behind this was to avoid any effects of surface roughness on the flow. They wanted to study the effects of above mentioned hexagonal structures on the flow of air. Also they wanted to study their contribution in affecting the drag of the body. They performed experiments in a subsonic closed wind tunnel. According to study of velocity profile, the wake of patterned cylinders was smaller than the wake of smooth cylinder. This causes reduction in drag coefficient.

Bruneau et.al. investigated effect of vortex dynamics on drag coefficient [14]. They carried out these studies on a square back Ahmed body. According to them, in such situations a significant part of the drag is formed by a pressure force induced by a vortex generated behind a simplified vehicle. According to them, two factors affecting this pressure force are the distance of the vortex to the wall and its amplitude or its circulation. The drag coefficient, according to these studies can be reduced by pushing the vortices away from the wall and changing their amplitude or their dynamics. Use of porous layer on the roof also changes the size and the dynamics of the top vortices and drag forces. Use of Ahemad body can reduce the drag coefficient with its use after proper study of vortex pattern and geometry of surfaces.

Shakin and Habib carried out an investigation on effect of aspect ratio on drag coefficient of a cylinder[15]. According to them, biggest problem in collecting data for such experiments is eliminating the vibration of the cylinder. They used mechanical filter to resolve this problem. They observed that as Reynolds number approaches 100000, the value of the drag coefficient begins to decrease. Boundary layer separation is obvious reason for this. Patel et.al. carried out an investigation on analysis of lift and drag forces of NACA airfoils using python[16]. According to them, aerodynamic efficiency of wind turbine is largely affected by the aerodynamic airfoils of wind turbine blades. Also in a wind turbine system, lift and drag forces and angle of attack are the important parameters. Mallick and Kumar studied drag coefficient for the flow past a cylinder[17]. According to them, the accurate assessment of drag results in economic design of automobiles, chimneys, towers, buildings, hydraulic structures etc. They carried out extensive experimentation on cylindrical bodies with varying cylinder diameters and air velocity. According to them, the co-efficient of drag obtained by weighing method is more accurate than those obtained from pressure distribution. They observed that, with increase in diameter of the cylinder, drag force increases.

Maroto et.al. carried out experimental evaluation of the drag coefficient[18]. These experiments were encouraged by the fact that the tubular shape of the shafts provides excellent transmission of sound. They evaluated the drag coefficient for the movement of smooth spheres through the air in the laminar regime. Paargaren studied hydrodynamic properties of benthic Marine Crustacea[19]. First part of their research included the studies on two important properties namely specific gravity and drag forces. They determined the specific gravity of various species of marine, benthic crustaceans. They observed that drag coefficients were larger than those predicted by Stokes' law. Peng et.al. used an adjoint technique for the Wind Stress Drag Coefficient adjustment in Storm Surge Forecasting[20]. They used a three-dimensional ocean model and its adjoint model to adjust the drag coefficient in the calculation of wind stress for storm surge forecasting. They found that the drag coefficient is adjusted to an optimal value to compensate for the wind errors, when the errors come from the wind speed. According o them, data assimilation can help to reduce storm surge forecasting errors regardless of the error sources.

Prinsenberg and Peterson investigated effect of ice surface roughness on variations in air-ice drag coefficient[21]. They used helicopter-borne laser altimeter with satellite-tracked ice beacons and ice surface roughness data for wind profiles. They observed that, with ice roughness and atmospheric stability, ice pressure against shore and offshore structures due to wind forcing varies substantially. Koike et.al. carried out an investigation on use of vortex generators for reducing aerodynamic drag[22]. They tested bump-shaped vortex generators for use at roof end of a sedan. By this they facilitated delay in flow separation. In their investigation they observed that the optimum height of the vortex generators was equivalent to the height of boundary layers.

3. CONCLUSION

The drag force is an important part in aerodynamics, flow past immerged bodies, marine transport, and other fluid related applications where fluid and solid are in relative motion. The drag force is a function of velocity, particle or solid diameter, viscosity of fluid and the density. The drag force can be reduced by streamlining the solid. It is important to ensure that there is no sudden change in velocity in order to avoid the frictional loss due to vortex formation.

REFERENCES

1. *Sunil J. Kulkarni(2015), "Fluidized bed contactors: a review on studies and research", Int. J Res. Rev., 2(12),754-757.*
2. *Sunil J. Kulkarni(2014), "Removal of phenol from Effluent in Fixed Bed: A Review", International Journal of Engineering Research and General Science, 2(5), 35-38.*
3. *Sunil Jayant Kulkarni, Dr. Jayant Prabhakarrao Kaware(2015), "Hydrodynamics of Adsorption Beds: A Review", International Journal of Research (IJR), 2(1), 59-62.*
4. *Sunil J. Kulkarni, Ajaygiri K. Goswami(2013), "Adsorption Studies for Organic Matter Removal from Wastewater by Using Bagasse Fly ash in Batch and Column Operations", International Journal of Science and Research, 2(11), 180-183.*
5. *Sunil Jayant Kulkarni(2016), "Studies and Research on Effect of Temperature on Viscosity of Fluids: A Review", International Journal of Engineering Management and Life Sciences (IJEMLS), 1(2), 33-36.*
6. *Nur S, Dody N, Rejeki HS (2005), "Laboratory Study of High Temperature Additive to Rheology Properties of Drilling Mud under Dynamic Conditions", Proceedings World Geothermal Congress, Antalya, Turkey, 24-29 April 2005, 1-7.*
7. *Keshvadi A, Endan JB, Harun H et al. (2011), "The Effect of High Temperature on Viscosity of Palm Oil During the Ripening Process of Fresh Fruits", Int. J Sci. & Eng Res, 26, 1-7.*
8. *Sunil J Kulkarni, Ajay K. Goswami(2014), "Research on Application of Hydrotropy: A Review", Int. J Sci. Eng Tech Res., 3(10), 2617-2619.*

9. Sunil J. Kulkarni, Ajaygiri K. Goswami(2014), "Studies and Research on Friction, Friction Factor and Affecting Factors : A Review", International Journal Of Engineering Sciences & Research Technology, 3(10), 355-359.
10. S. S. Pawar, Dr. D. A. Hindolia, Dr. J. L.Bhagoria(2013), "Experimental Study Of Nusselt Number And Friction Factor In Solar Air Heater Duct With Diamond Shaped Rib Roughness On Absorber Plate", American Journal Of Engineering Research, 2(6), 60-68.
11. Manoochehr Fathi-Moghadam, Khosro Drikvandi, Babak Lashkarara And Kazem Hammadi(2011), "Determination Of Friction Factor For Rivers With Non-Submerged Vegetation In Banks And Floodplains", Scientific Research And Essays, 6(22), 4714-4719.
12. M Hashemi-Dehkordi, A R Abu-Bakar And M Mailah(2012), "Reducing Friction-Induced Vibration Using Intelligent Active Force Control (AFC) With Piezoelectric Actuators", Sadhana, 37(6), 637–655.
13. U. Butt And C. Egbers(2013), "Aerodynamic Characteristics Of Flow Over Circular Cylinders With Patterned Surface", International Journal Of Materials, Mechanics And Manufacturing, 1(2), 121-125.
14. Charles-Henri Bruneaua, Emmanuel Creusé B, Patrick Gilliéron C, Iraj Mortazavi(2014), "Effect Of The Vortex Dynamics On The Drag Coefficient Of A Square Back Ahmed Body: Application To The Flow Control", European Journal Of Mechanics B/Fluids, 45, 1–11.
15. Aaron Shakin, Syed Habib(2011), "Aspect Ratio Effects On The Drag Coefficient Of A Cylinder", Me 241- Professor Gans.
16. Tarun B Patel, Sandip T Patel, Divyesh T Patel, Maulik Bhensdadiya(2015), "An Analysis Of Lift And Drag Forces Of NACA Airfoils Using Python", International Journal Of Application Or Innovation In Engineering & Management, 4(4), 198-207.
17. Monalisa Mallick And A. Kumar(2014), "Study On Drag Coefficient For The Flow Past A Cylinder", International Journal Of Civil Engineering Research, 5(4), 301-306.
18. J A Maroto, J Dueñas-Molina And J De Dios(2005), "Experimental Evaluation Of The Drag Coefficient", European Journal Of Physics, 26(3).
19. D. H. Spaargaren(1979), "Hydrodynamic Properties Of Benthic Marine Crustacea.I. Specific Gravity And Drag Coefficients", Marine Ecology - Progress Series Mar. Ecol. Prog. Ser., 1, 351-359.
20. Shiqiu Peng, Yineng Li, Lian Xie(2013), "Adjusting The Wind Stress Drag Coefficient In Storm Surge Forecasting Using An Adjoint Technique", Journal Of Atmospheric And Oceanic Technology, 30, 590-608.
21. S. Prinsenberg And I. K. Peterson(2002), "Variations In Air-Ice Drag Coefficient Due To Ice Surface Roughness", International Journal Of Offshore And Polar Engineering, 12(2), 1-5.
22. Masaru Koike Tsunehisa Nagayoshi Naoki Hamamoto(2004), "Research On Aerodynamic Drag Reduction By Vortex Generators, Mitsubhishi Motors", Technical Review, 16, 2004, 11-16.