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Investigation of k-ε Turbulent Models and Their Effects on Offset Jet Flow Simulation

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Abstract

In the case in which relatively low thickness and high-velocity flow enter into the lower velocity fluid, the resulting interference field of these two flows is called the jet. This phenomenon is the dominant output of power plants and some of the dams. The jets can be divided into two categories of free jets and confined jets, caused by the distance from the discharge to limited boundaries points. The offset jet is a type of confined jet in which both free surface and wall boundaries are near the diffusion location. The jet flow due to the extreme curvature in the main flow path and the proximal portion of this flow with solid boundaries have characteristics that make it difficult to solve with simple turbulence models.

In this research, the offset jet phenomenon and related issues have been investigated. For this purpose, the offset jet flow pattern and probable factors in the complexity of this model have been simulated using Fluent software which analyses fluid flow in a two dimensional and three dimensional finite volume method. The simulation of offset jet flow pattern has been performed with a focus on investigating different models of turbulence k-ε, also boundary conditions, various wall functions and other effective coefficients in the numerical model and the model results compared with test case data findings and validating results, the necessary approaches in numerical simulation of this phenomenon for using in the next stages had been taken.

Keywords: k-ε; Turbulence; Offset Jet; Numerical Simulation.

1. Introduction

In the case of flow inlet with a relatively low thickness and high velocity in the lower velocity, the resulting field is called the jet. The jets are divided into two main categories including free jets and confined jets, by the distance of the discharge point to the limited boundaries [1]. The confined jets can be classified into three categories: impact jets that tend to the boundary direction, wall jets in which the flow is discharged to the boundary and offset jet.

The offset jet is a confined jet in which both of the free surface boundary and the horizontal wall parallel to the jet axis are located near the diffusion place and, depending on the boundaries distance to the gap, the jet extends toward the other boundary. In Figure 1, the characteristics of offset jets and its development stages are described [2].

The jet through a gap with the width w and the distance h from the wall, enters into the static fluid that surrounds it. Continuing the fluid flow, between the jet and the lower surface causes pressure decrease and jet extend to the wall until at the impingement point, finally the jet hits the wall and forms the converging zone. A portion of the inner shear layer of the fluid has been extended from the impingement point to the vortex zone influencing by pressure gradient and the flow is developed as wall jet at the distance far from the downstream of the gap. According to the above, the offset jet behavior in different areas after releasing is that in the orifice adjacent and at very short distance from the discharge

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