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Stress Simulation Analysis of Horizontal Well Water Jet Salvaging Rock Block

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Abstract

Horizontal well drilling technology is a commonly used technology in oil exploitation. It can be used for oil exploitation in thin layers and oil exploitation in cracks. Using this technology to exploit can increase the area of the underground oil and the ground building, and improve the efficiency of oil exploitation. Due to the instability of the rock and the complex underground working conditions, the rock block fell. If the collapse of the rock can not be cleaned in time, it will cause serious consequences such as tripping and drilling obstruction and sticking. In this paper, we propose to wash the rock block into the fishing bag by water jet, and analyze the force analysis of the rock block under different jet angles and different distances from the nozzle.

Keywords

Rock, jetting, Angle, orce, analysis.

1. Introduction

The most important characteristic of horizontal well is that it can greatly increase the length of borehole in the producing zone and the drainage area of the producing zone, and the production of a vertical well can be achieved at a cost slightly higher than that of a vertical well. For a long time, because of the special well structure, horizontal well fishing operation has been regarded as the hard bone in underground operation construction. There are many impurities in the horizontal wellbore, to solve the problem of residue within the wellbore, must take all kinds of salvage plan including process or fishing tool to remove impurities, selected the salvage plan is reasonable determines the efficiency of the subsequent operations, before the downhole salvage operations, often according to the actual working condition to set up the reasonable and effective salvage plan.

2. Finite element model establishment of fishing tools

2.1. Computational model construction

The block fishing tool is designed for blocks up to 30mm in height in horizontal Wells over 5". In this paper, the block is simplified to a 30mm cube block. Detailed parameters of nozzle are shown in Table 1.

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Table 1 Nozzle details

name of parameter	Parameter values
Outer diameter of nozzle/mm	30
Inner diameter of nozzle/mm	24
nozzle diameter/mm	7
nozzle numbers	6
nozzle angle	variable time constant

The three-dimensional modeling software SolidWorks is used to build the three-dimensional structure of the nozzle in the horizontal well section, and the internal drainage basin through which the water flows is extracted. The final simplified drainage basin structure of the nozzle is shown in Figure 1 and Figure 2.

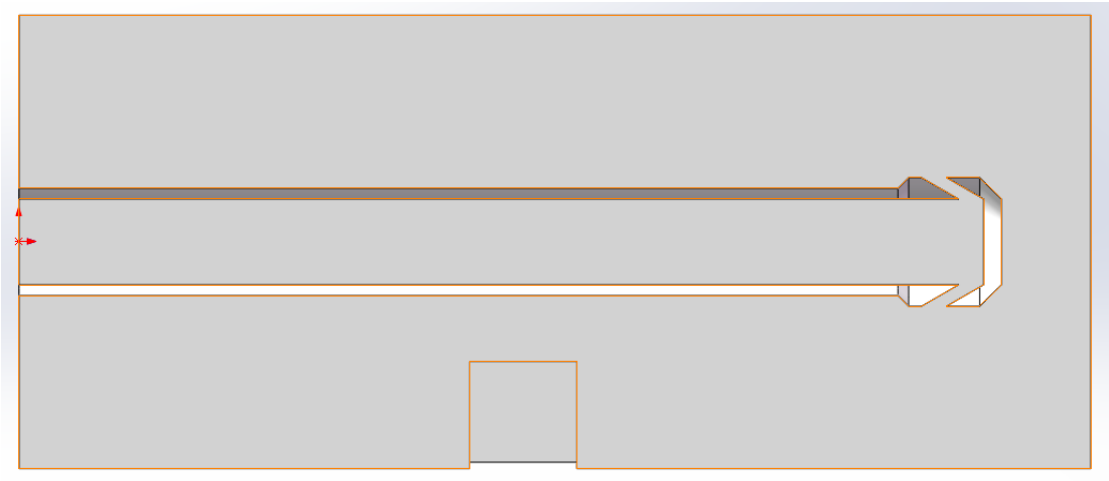

Fig. 1 Semi-section diagram of nozzle structure

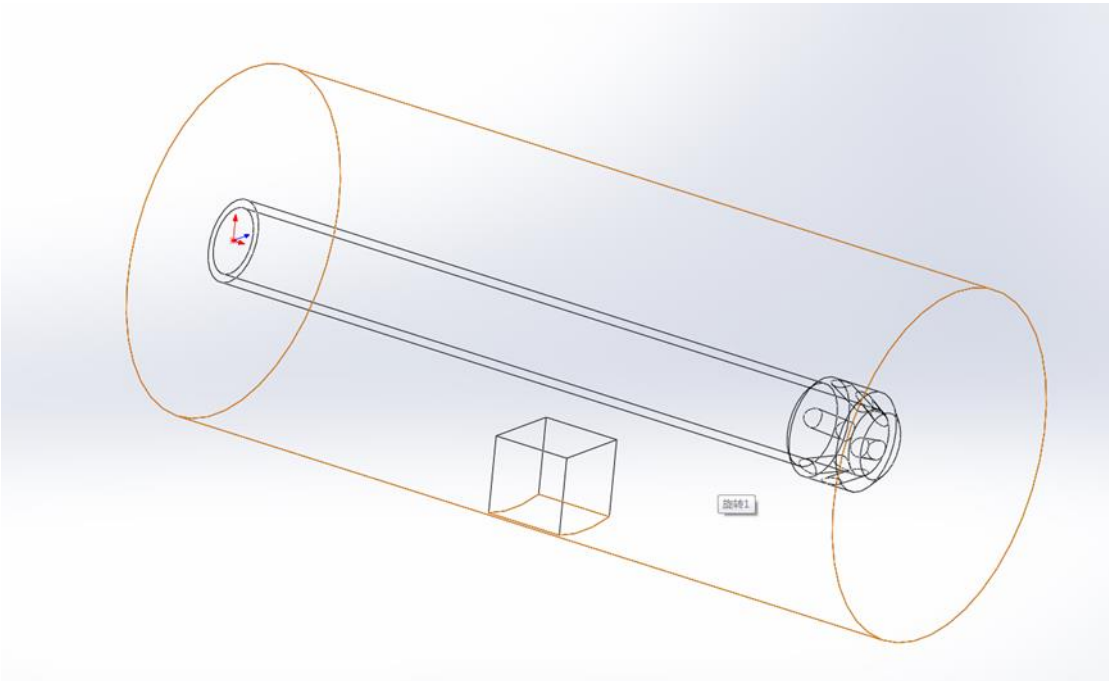

Fig. 2 nozzle structure diagram

2.2. Grid division

Finite volume division of the computational domain is carried out by cutting volume grid division. The minimum mesh size is 0.05mm, the maximum mesh size is 3mm, the overall mesh

number is 393333, the number of nodes is 75699. The meshing results of the fluid domain in the pipe are shown in Figure 3.

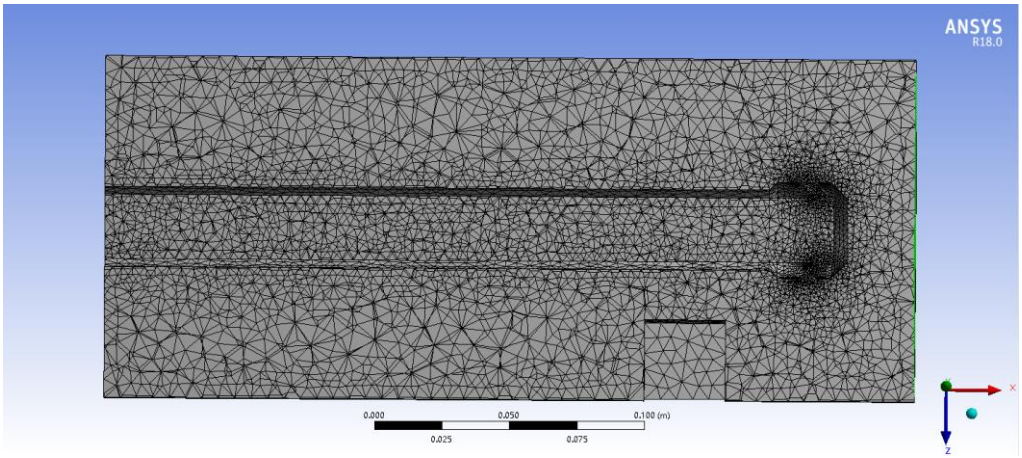

Fig. 3 Partition results of fluid and mesh inside the tube

2.3. Simulation analysis of flow field in inner runner of nozzle

In order to obtain the force fraction of the rock block at different nozzle angles and different distance from the nozzle, the fluid analysis software Fluent was used to simulate the force analysis of the rock block on various occasions. Verify the pressure nephogram, velocity vector diagram of internal flow field and horizontal force of rock block under different occasions. Boundary-condition setting: the inlet of the nozzle is set as 12m/s, the circulating medium is set as water-liquid (H20 <1), the environmental pressure at the outlet is set as 0MPa, the number of iterations is set as 1000, and the convergence accuracy of continuous iteration is 10-5. When the nozzle Angle is 30° and the distance between the rock block and the nozzle is 30mm, the simulation results of the pressure cloud diagram and velocity vector diagram of the flow field are shown in Figure 4.1 (a) and 4.1 (b) respectively. At this point, the rock block is subjected to 2.016N horizontal force.

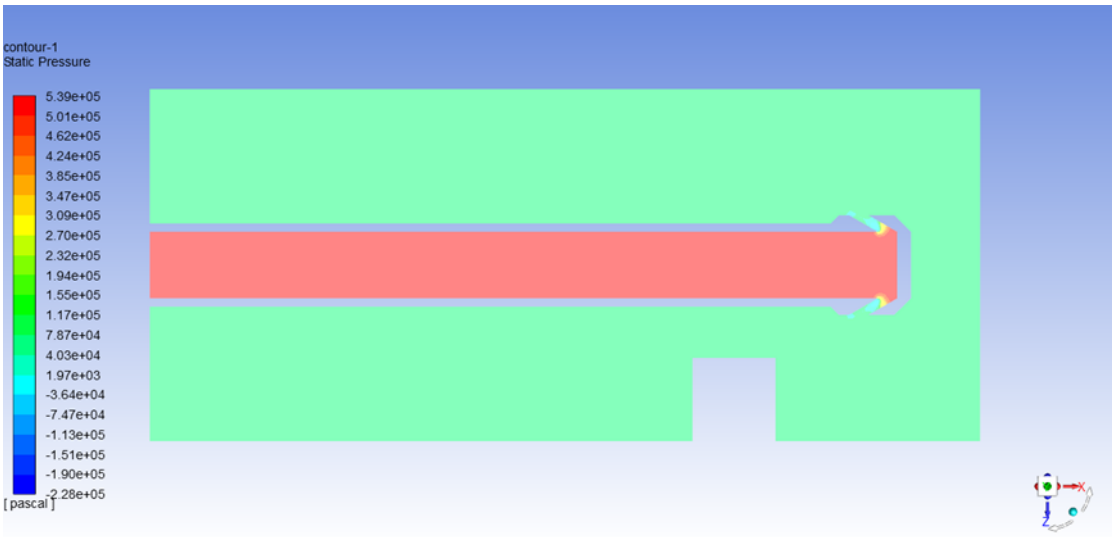

Fig. 4.1 (a) Pressure cloud diagram when the rock block is 30mm away from the nozzle

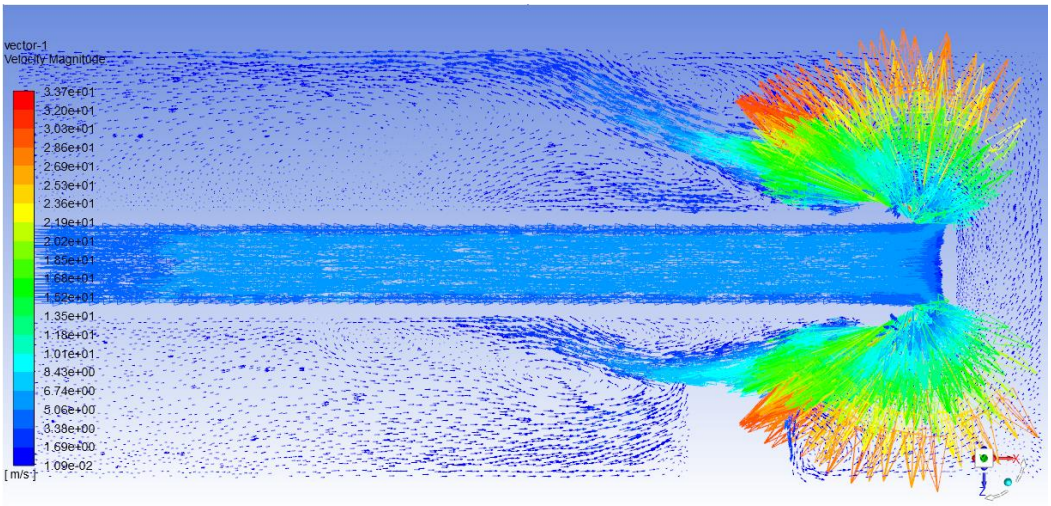

Fig. 4.1 (b) Velocity vector diagram when the rock block is 30mm away from the nozzle

When the nozzle Angle is 30° and the distance between the rock block and the nozzle is 75.61mm, the simulation results of the pressure cloud diagram and velocity vector diagram of the flow field are shown in Fig. 4.2 (a) and 4.2 (b) respectively. At this point, the rock block is subjected to 136.67N horizontal force.

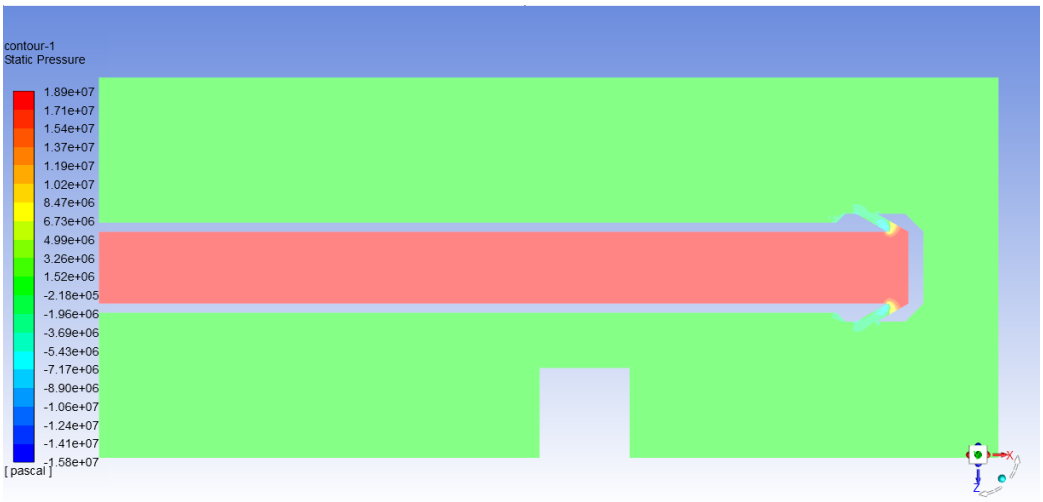

Fig. 4.2 (a) Pressure cloud diagram when the rock block is 75.61mm away from the nozzle

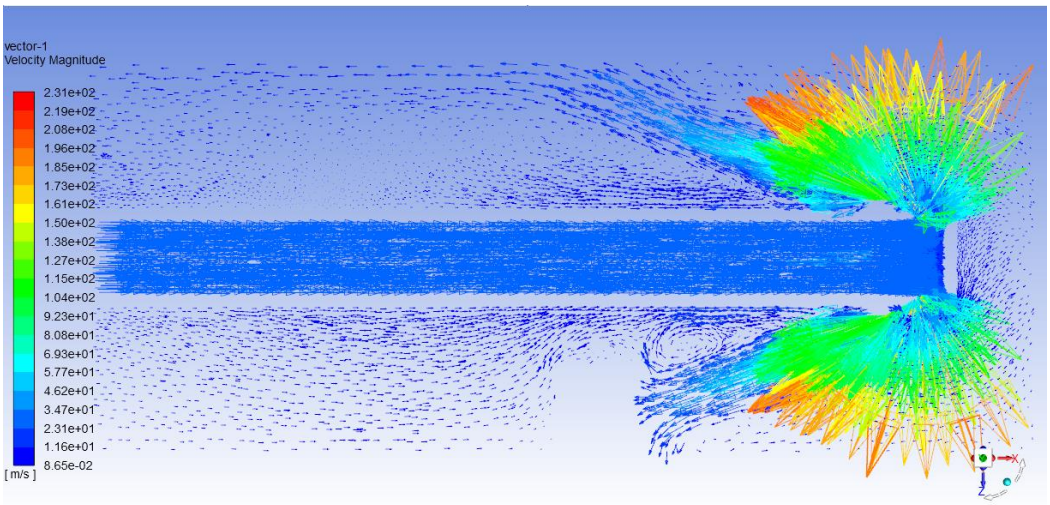

Fig. 4.2 (b) Velocity vector diagram when the rock block is 75.61mm away from the nozzle

When the nozzle Angle is 30° and the rock block is 150mm away from the nozzle, the simulation results of the flow field pressure cloud diagram and velocity vector diagram are shown in Fig.

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4.3 (a) and 4.3 (b) respectively. At this point, the rock block is subjected to a horizontal force of 0.39N.

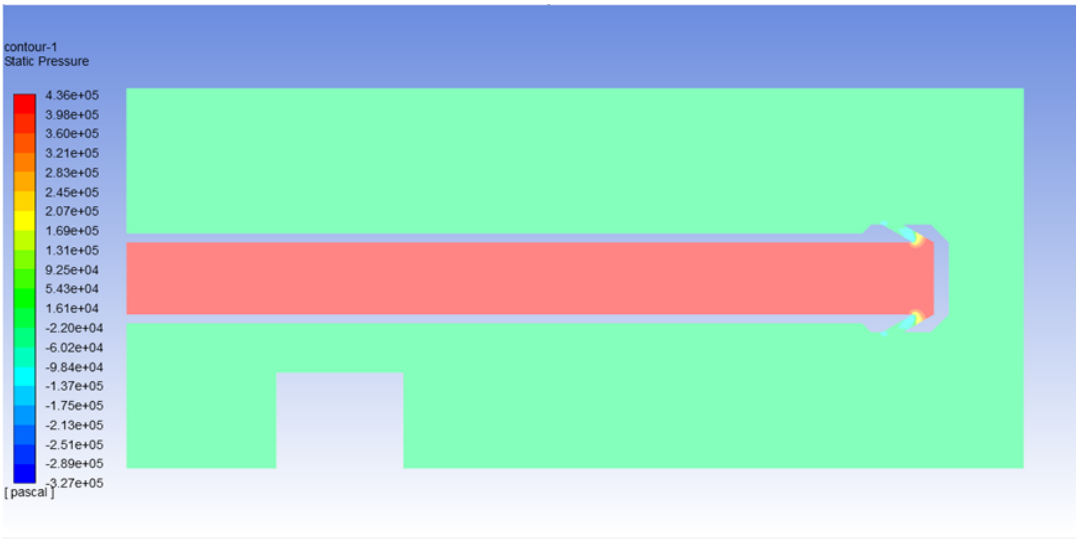

Fig. 4.3 (a) Pressure neogram when the rock block is 150mm away from the nozzle

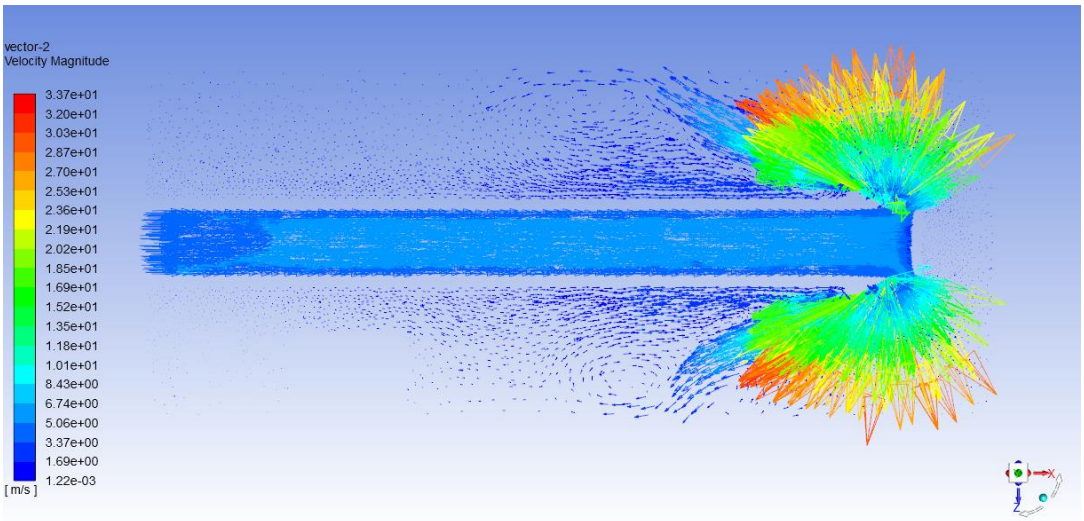

Fig. 4.3 (b) Velocity vector diagram when the rock block is 150mm away from the nozzle

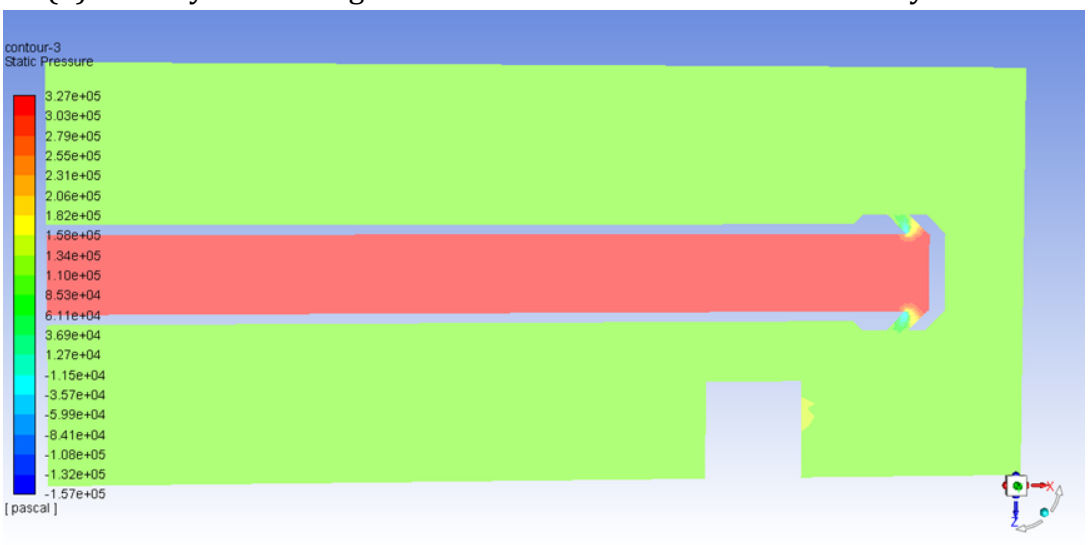

Fig. 4.4 (a) Pressure cloud diagram when the rock block is 30mm away from the nozzle

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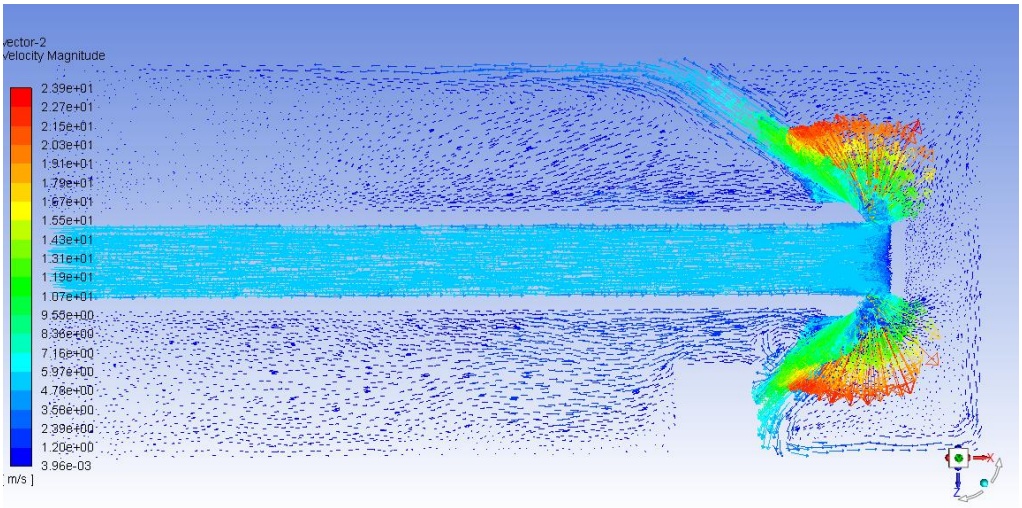

Fig. 4.4 (b) Velocity vector diagram when the rock block is 30mm away from the nozzle

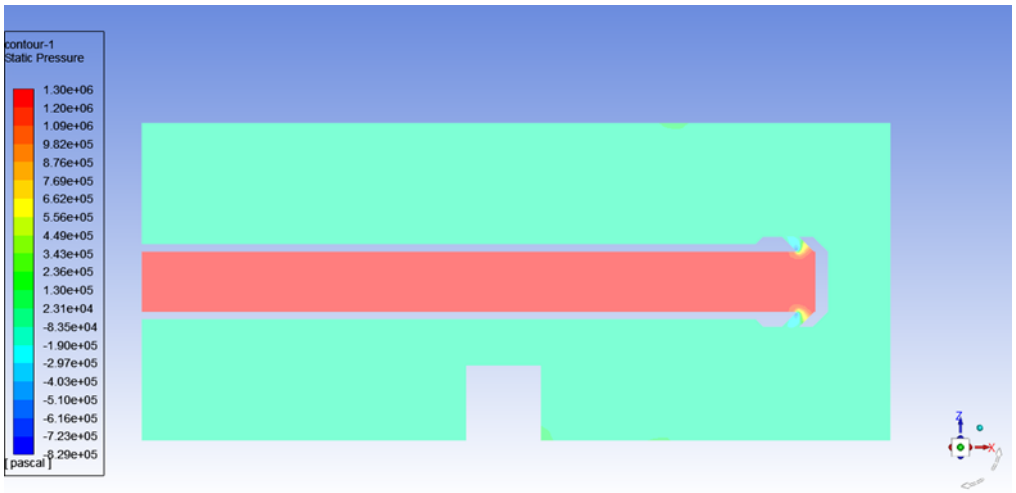

Fig. 4.5 (a) Pressure cloud diagram when the rock block is 100mm away from the nozzle

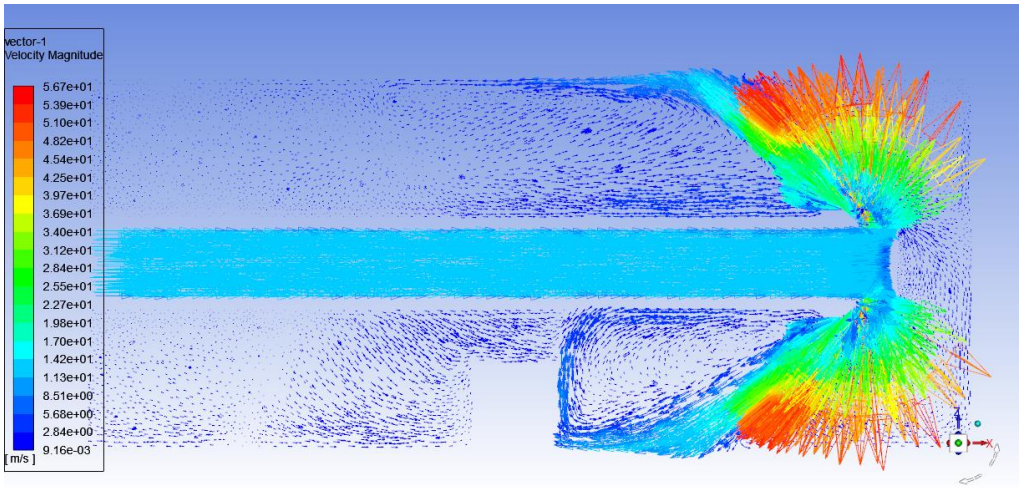

Fig. 4.5 (b) Velocity vector diagram when the rock block is 100mm away from the nozzle

When the nozzle Angle is 45° and the distance between the rock block and the nozzle is 30mm, the simulation results of the flow field pressure cloud diagram and velocity vector diagram are shown in Fig. 4.4 (a) and 4.4 (b) respectively. At this point, the rock block is subjected to a horizontal force of 4.06N.

When the nozzle Angle is 45° and the rock block is 100mm away from the nozzle, the simulation results of the flow field pressure cloud diagram and velocity vector diagram are shown in Fig. 4.5 (a) and 4.5 (b) respectively. At this point, the rock is subjected to a horizontal force of 4.03N.

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3. Conclusion

Under the condition of a certain Angle of the sprinkler head, the force on the rock block is proportional to the distance between the rock block and the sprinkler head. According to the velocity vector diagram analysis, the maximum force on the rock block is at the place where the vortex is generated.

The force exerted by the rock block is related to the Angle of the sprinkler head. The smaller the Angle between the sprinkler head Angle and the axis, the greater the thrust generated under the same distance. But the smaller the Angle, the farther the water jet action distance, and the greater the loss.

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