Effect of blade parameters on separation efficiency of screw separator.

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Abstract

the separation efficiency of spiral separator is closely related to spiral parameters. In this paper, the influence of spiral blade parameters on the separation efficiency of spiral separator is studied through CFD numerical simulation. The relationship between the winding number and the separation efficiency is obtained by calculating the internal flow field of the spiral separator in eight different helices.The results show that the separation efficiency increases with the increase of the number of spirals, and the separation efficiency is 92 percent when the number of spirals is 12.

Keywords

Separation efficiency, CFD , spirals , numerical simulation.

1. Introduction

The performance of the underground helical gas-liquid separator mainly depends on the change of the screw pitch, diameter and length. In order to improve the efficiency of the separator, people do a lot of research, especially in recent years, with the development of computer technology, using computer simulation, doing a lot of work, but as a result of gas liquid two phase in spiral separator movement is more complex, the study of the flow field has certain difficulty, the separation efficiency of downhole spiral gas-liquid separator is not a quantitative calculation formula. Therefore, in order to understand the effects of structural parameters of spiral separator separation performance, and then forecasts reasonable downhole spiral gas-liquid separator separation efficiency and better design a high performance downhole spiral gas-liquid separator, it is necessary to know exactly the internal flow distribution. In this paper, based on the study of internal flow field, the effects of spiral structure parameters and operation parameters on the separation performance are studied by computational fluid dynamics (CFD) method.

2. Numerical simulation of gas-liquid two-phase flow field in spiral separator.

For the numerical simulation of gas-liquid two-phase flow field, the corresponding geometrical model is established firstly, then the mathematical model of gas-liquid two-phase flow is established. The complete gas-liquid two-phase flow field calculation includes the modeling of the motion equation, the processing of boundary conditions, the numerical calculation method and the visualization of calculation results.

2.1 Geometric model and finite element model.

In order to the accuracy of the simulation results, geometric model for fluid flow in the downhole gas-liquid separator area and the import and export to take over as the calculating model.The Geometric model and finite element model is shown in Fig.1, Fig.2.

Fig.1 The geometric model

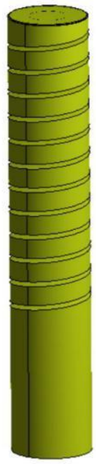


Fig. 2 the finite element model

2.2 Mesh

This paper adopted the tetrahedral unstructured grid and the flow field is very complex. Adopting gradually thin mesh density on the radial, save computation time and space, the smallest unit size 0.005 m, due to flow more complex spiral flow channel, the encryption processing, grid size defined as 0.003 m. As is shown in Fig .3

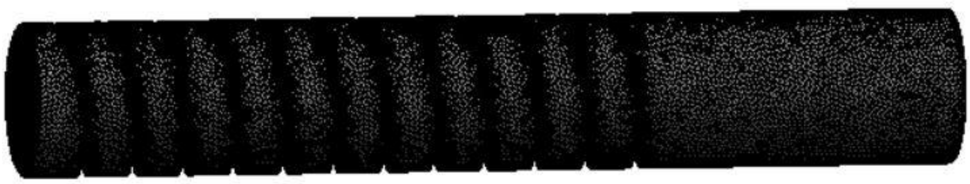


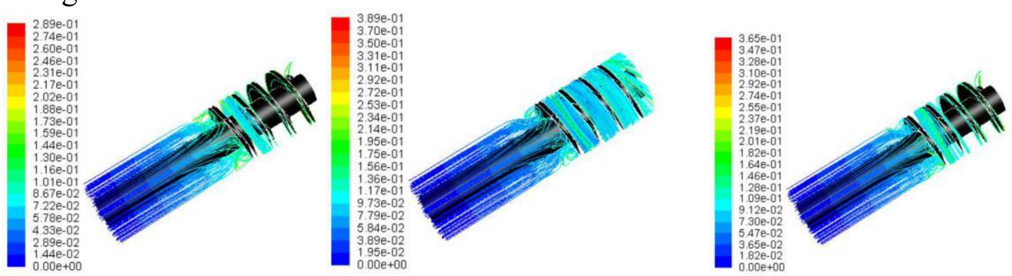
Fig .3 mesh

2.3 Setting of boundary conditions.

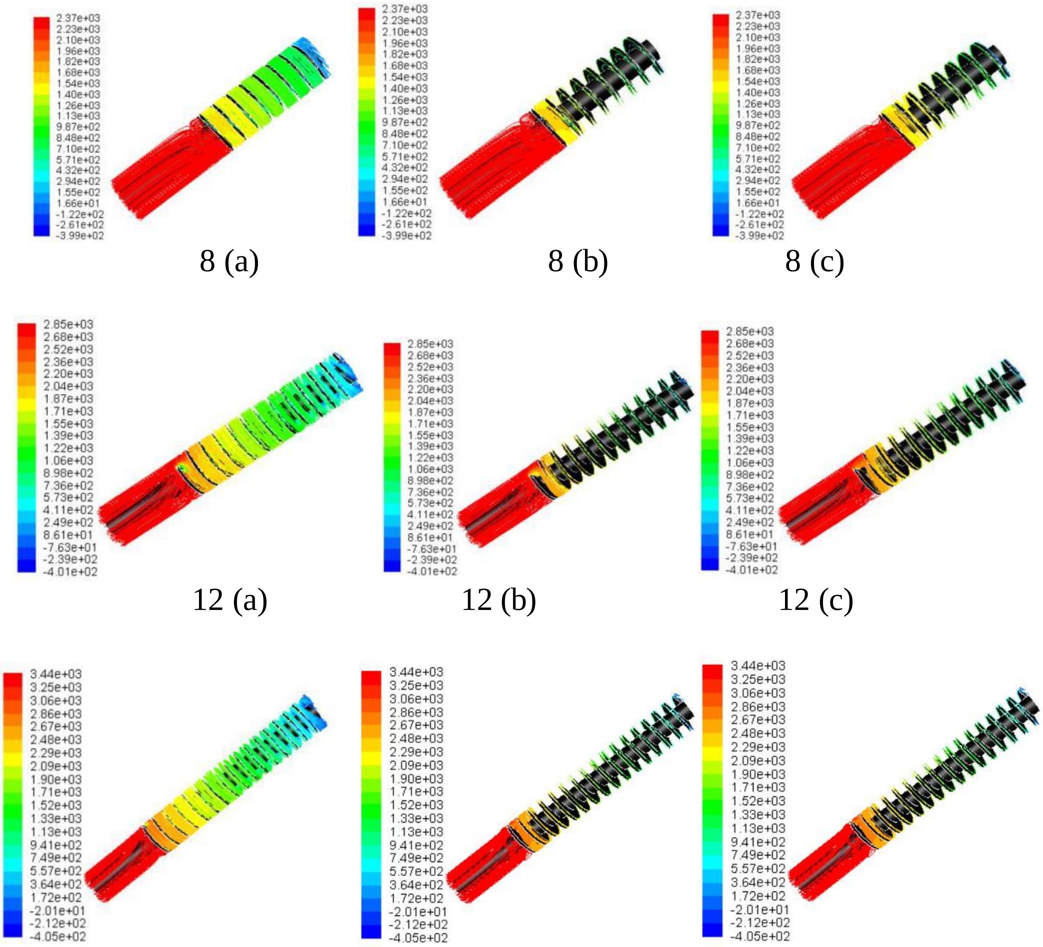
The inlet adopts the velocity boundary, the speed is 4m/s, the outlet adopts the pressure boundary, and the pressure is 0. In this paper, DPM discrete phase model is used for numerical simulation, and the liquid exit boundary is set as trap, wall is set to reflect, and the fluid inlet and gas outlet are set to escape. By counting the number of liquid particles flowing from the liquid outlet boundary and the number of liquid particles flowing in from the fluid inlet, the separation performance of the helical gas-liquid separator is calculated.

2.4 The results of Numerical simulation

The gas inlet velocity is constant speed, the pitch is 50 mm, reserch the relationship between separation efficiency and the coil number. After calculation, in the structure model of the spiral flow channel, the separation trajectories of the different spiral winding number and different particle size are shown in Fig. 4



4(a) 4(b) 4(c)



8 (a) 8 (b) 8 (c)

12 (a) 12 (b) 12 (c)

16 (a) 16 (b) 16 (c)

Fig .4 Separation track

The separation efficiency is shown in table 1. when the droplets of different particle sizes are separated in the helical structure of different helical winding number.

Table .1

Number of turns	4	8	12	16
1um	0.441	0.463	0.493	0.501
10um	0.774	0.848	0.908	0.911
50um	1	1	1	1

The simulation results show that: under the same pitch, , the more separator coil number the better separation efficiency, it also accords with the basic common sense, when the coil number increases, the fluid the distance from the separator inlet to export increase, then the separation interval and separation time also will increase, so the separation efficiency increased with the increase of number of coil. By Fig.4, when the spiral gas-liquid separator coil number more than 12, the separation efficiency increased with the increase of number of coil up slowly, and considering the comprehensive energy loss, separation efficiency and production cost, we conclude that the optimal spiral winding number is 12.

3. Conclusion

The numerical simulation of two phase flow field of gas-liquid separator in eight different helical structures was carried out using CFD and FLUENT, and the simulation results were compared with the analysis.

The results show that the more spiral winding, the easier the separation.But it can't increase blindly, otherwise the processing cost and energy consumption will increase, and the optimal spiral winding number is 12.

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