- It has lower theoretical error than mathematic models when modeling the valve and the flow structure of reciprocating compressor.
- It can realize parametric modeling when simulating theoretical dynamic pressure of different compressor structure and different working condition parameters.

2.1 The simulation object

The simulation and analysis object is a 2D type reciprocating compressor which is single stage and drove by motor. The parameters of the compressor are shown in Table 1 and the compressor is shown in Fig.1. In production process, the compressor has been drilled the indicator holes to install the dynamic pressure transducers which can monitor the pressure of the cylinder. As a result, we can compare the simulation pressure signals with the actual signals.

Table 1 The operation parameters of the reciprocating compressor

Operating parameters	Value	Operating parameters	Value
Working speed	495r/min	Crank radius	0.09m
Connect rod length	0.45m	Cylinder radius	0.125m
Clearance volume	0.001269m^3	Rated discharge volume	12 m3/min
The suction pressure	100KPa	The discharge pressure	200/300KPa
The suction temperature	27℃	The discharge temperature	90℃
The suction valve equivalent stiffness	8000N/m	The discharge valve equivalent stiffness	6000N/m
The spring pre-compression of suction valve	0.004m	The spring pre-compression of discharge valve	0.004m
The displacement of suction valve plate	0.002m	The displacement of discharge valve plate	0.002m
The suction valve number in one side of the cylinder	2	The discharge valve number in one side of the cylinder	2

Fig.1 The reciprocating compressor

2.2 The simulation models

This compressor is comprised with two cylinders which have the same structure and working stage. As a result, we can only build the model of one cylinder and its valves to simulate the dynamic pressure of the compressor. The geometry model of flow structure in the valve and cylinder is shown in Fig.2. Some simplifications are made as follows:

- Leakages in valve are neglected in the model.
- The valve flow channel is simplified with no rounding, which is more convenient for meshing.
- Because of the symmetrical characteristic, the model is half built to reduce the computational effort.

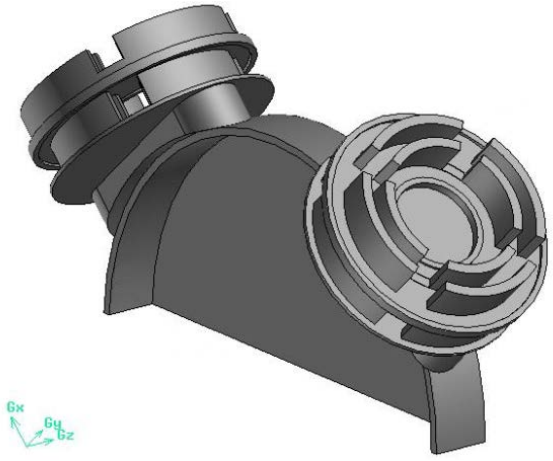

Fig.2 The geometry model of valves and cylinder

In CFD analysis, the mesh quality directly affects the calculation accuracy and convergence rate. The valve model was separated in three parts in order to apply structured hexahedral mesh because the hexahedral mesh has the best effect in all kinds of meshes. As we separated the model, we need to set the contact property of the three parts as INTERFACE to ensure that the parts will communicate with each other. In addition, we apply