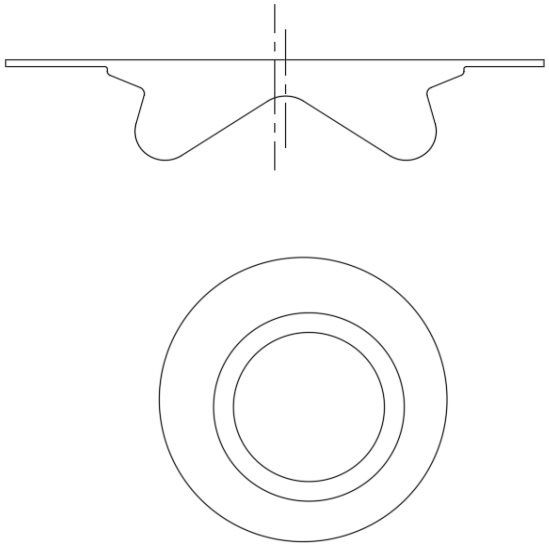
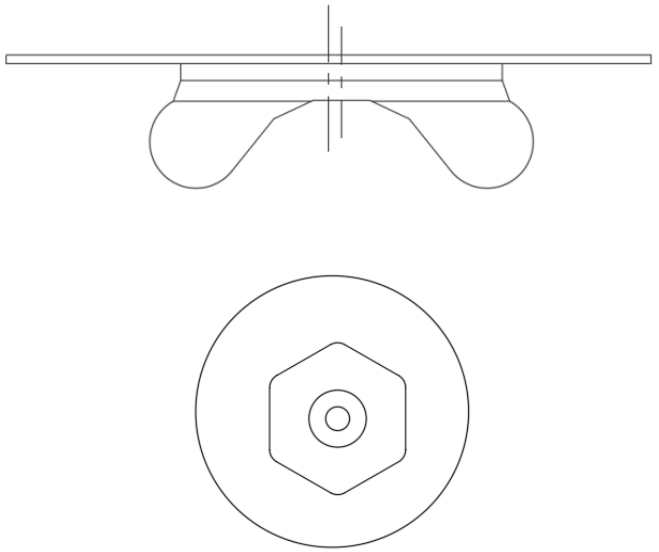
研究内容

研究内容：

分析两形状不同燃烧室对燃烧和排放性能的影响。



圆ω型缩口燃烧室A



六边形直口燃烧室B

研究内容

- 主要工作：
  - 1）建立三维燃烧室模型。在同一压缩比情况下，通过Solidworks三维建模软件对ZS1115柴油机的两种燃烧室模型进行仿真建模。
  - 2）仿真建模。了解理论基础和计算方法，确定计算中紧密联系的数学模型，其中包括湍流模型，喷雾破碎模型，雾滴碰撞和聚合模型，液膜模型，蒸发模型，着火模型，燃烧模型，排放模型；设定合理边界条件和计算初始条件。
  - 3）运用仿真分析软件CONVERGE对圆ω型缩口燃烧室和六边形直口燃烧室两种形状不同的燃烧室进行不同喷雾角度下的仿真计算，获取两种燃烧室的优选喷雾角度。
  - 4）在优选喷雾角度情况下，通过EnSight对结果进行后处理分析缸内流动、燃烧过程和排放物分布。
  - 5）分析对比两种不同燃烧室对燃烧和排放的影响。

计算模型

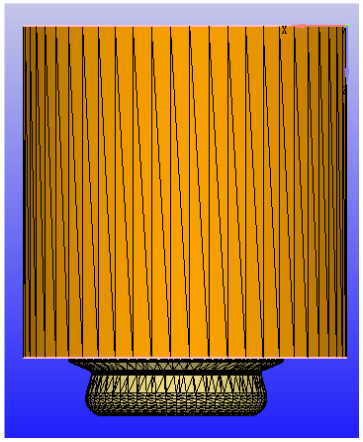
湍流模型：RNG　k-ε模型；
喷雾破碎模型：Kelvin-Helmholtz及Rayleigh-Taylor模型；
雾滴碰撞和聚合模型：NTC模型；
撞壁模型：Rebound/slide模型；
燃烧模型：CTC/Shell模型；
NOx模型：扩充的Zel`dovich模型；
碳烟模型：Hiroyasu Soot模型。

仿真分析建模

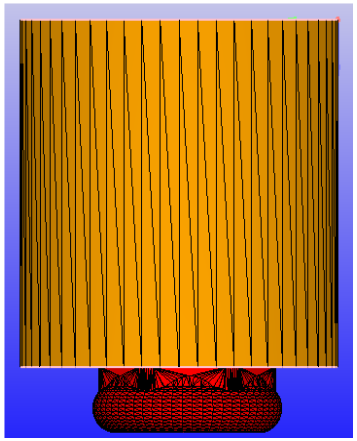
单缸ZS1115柴油机规格参数

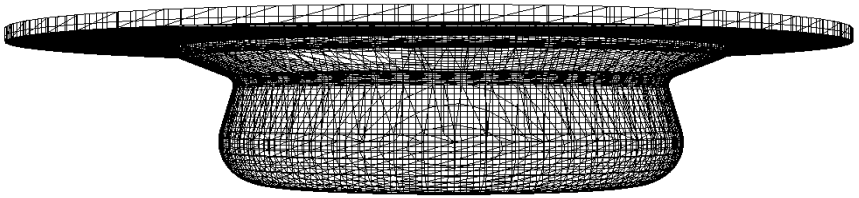
型式	单缸、四冲程、直喷式
气缸直径/mm	114.35
活塞冲程/mm	115
连杆长度/mm	210
初始涡流比	2
压缩比	17
功率/KW	16.2
额定转速/(r/min)	2200
喷孔数/孔径（mm）	6/0.16

仿真建模建立

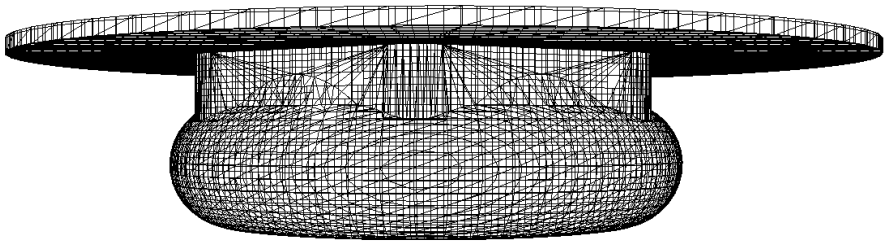


气缸盖底部：523K
气缸壁：433K
活塞顶部：553K
缸内初始温度：320K
初始压力：0.8bar
初始涡流比：2





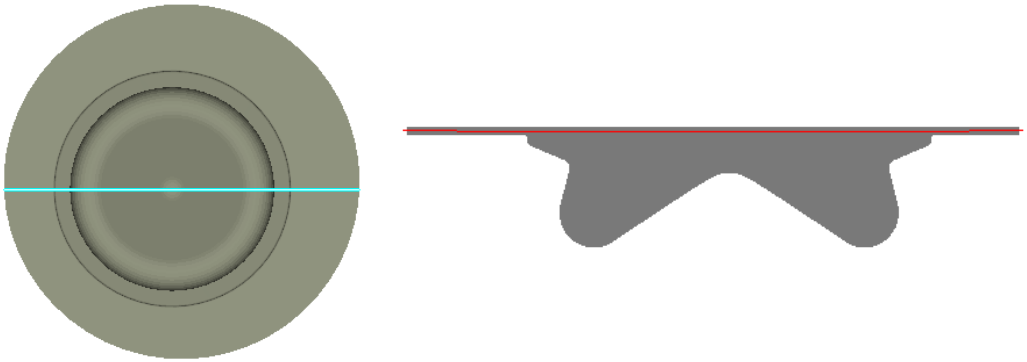
燃烧室A计算模型及网格



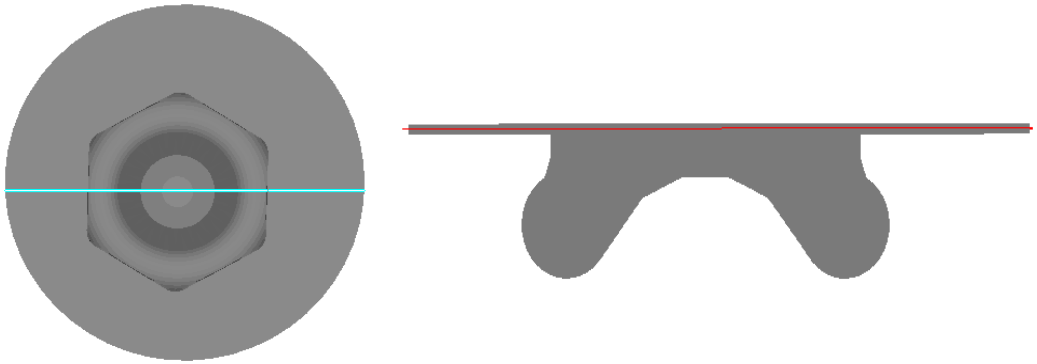
燃烧室B计算模型及网格

分析中各截面位置

Z=-0.0075



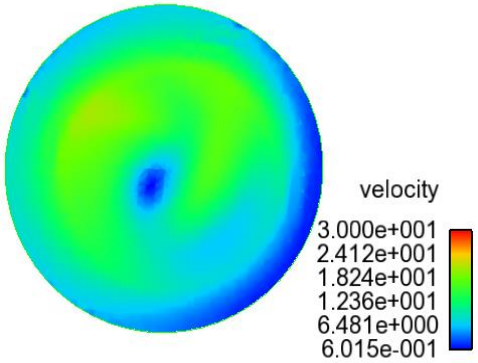
燃烧室A中X、Z截面位置



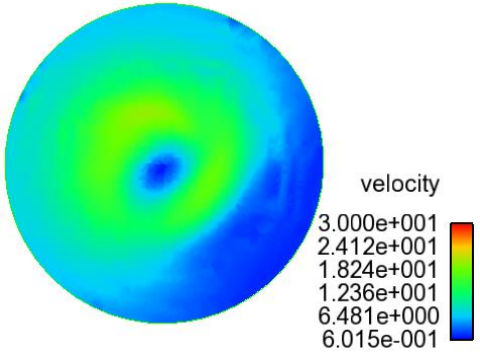
燃烧室B中X、Z截面位置

流场分析

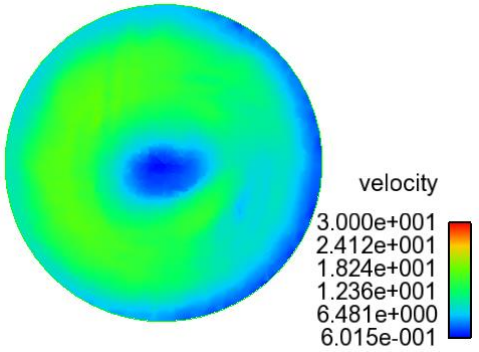
燃烧室A



-16°CA TDC

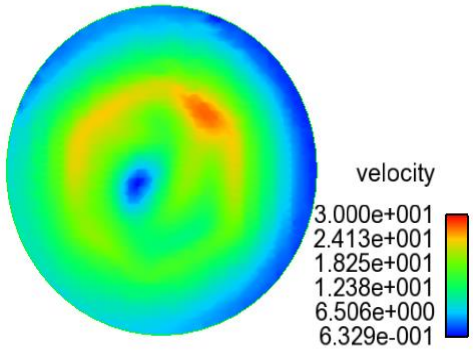


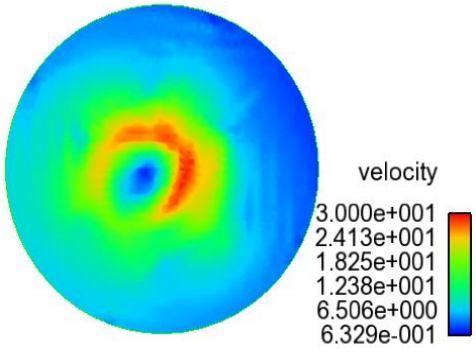
-1°CA TDC

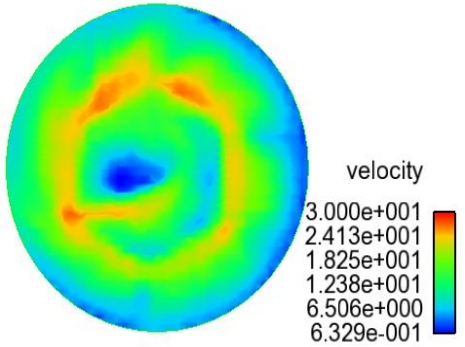


19°CA TDC

燃烧室B



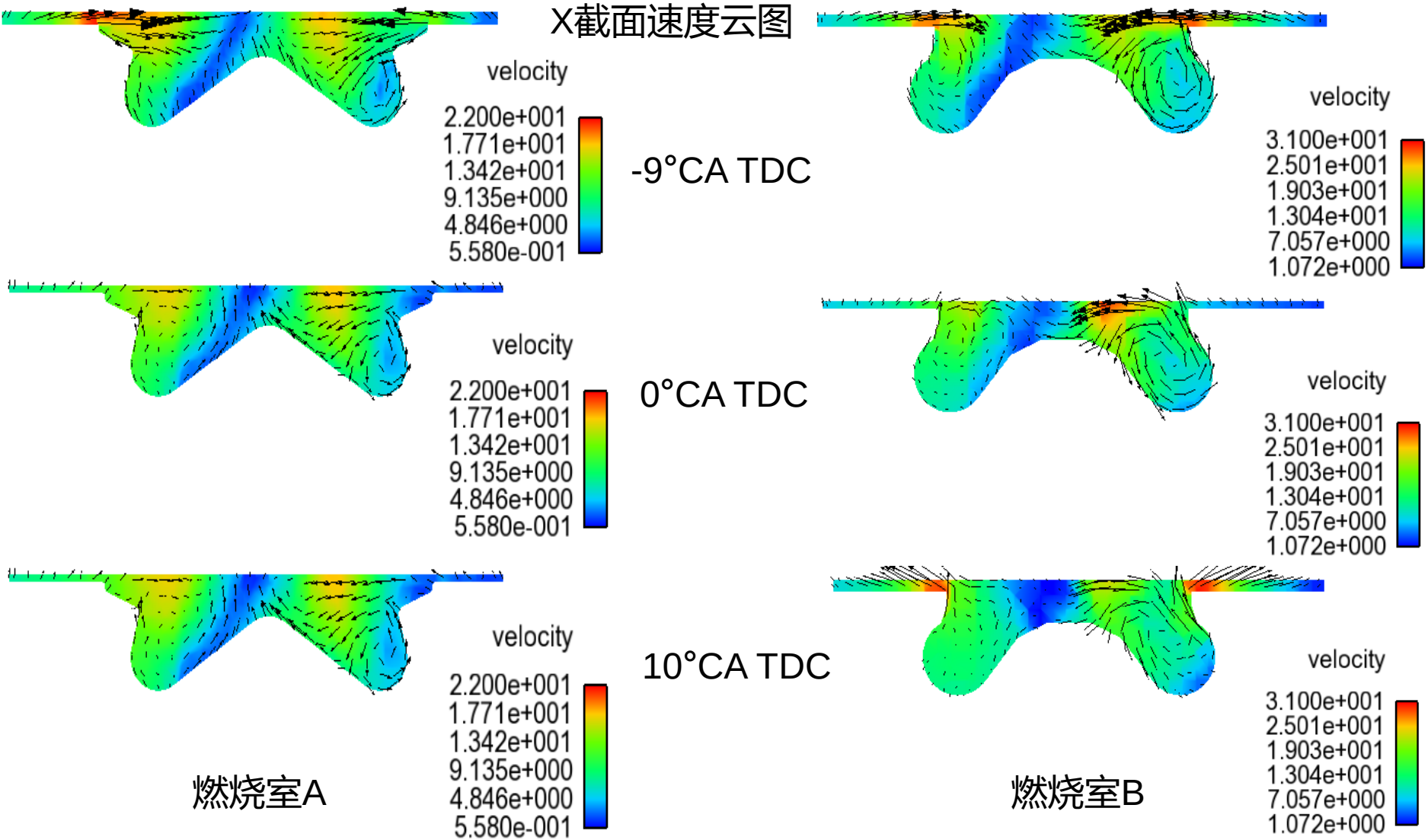




燃烧室A、B在Z截面速度云图

流场分析

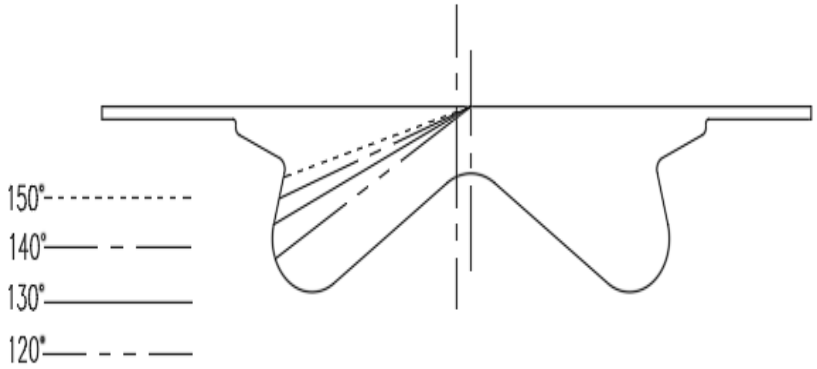
X截面速度云图

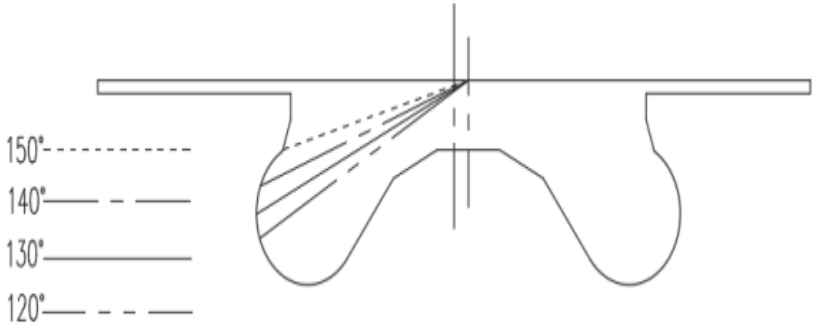


燃烧室A

燃烧室B

不同喷雾角度分析

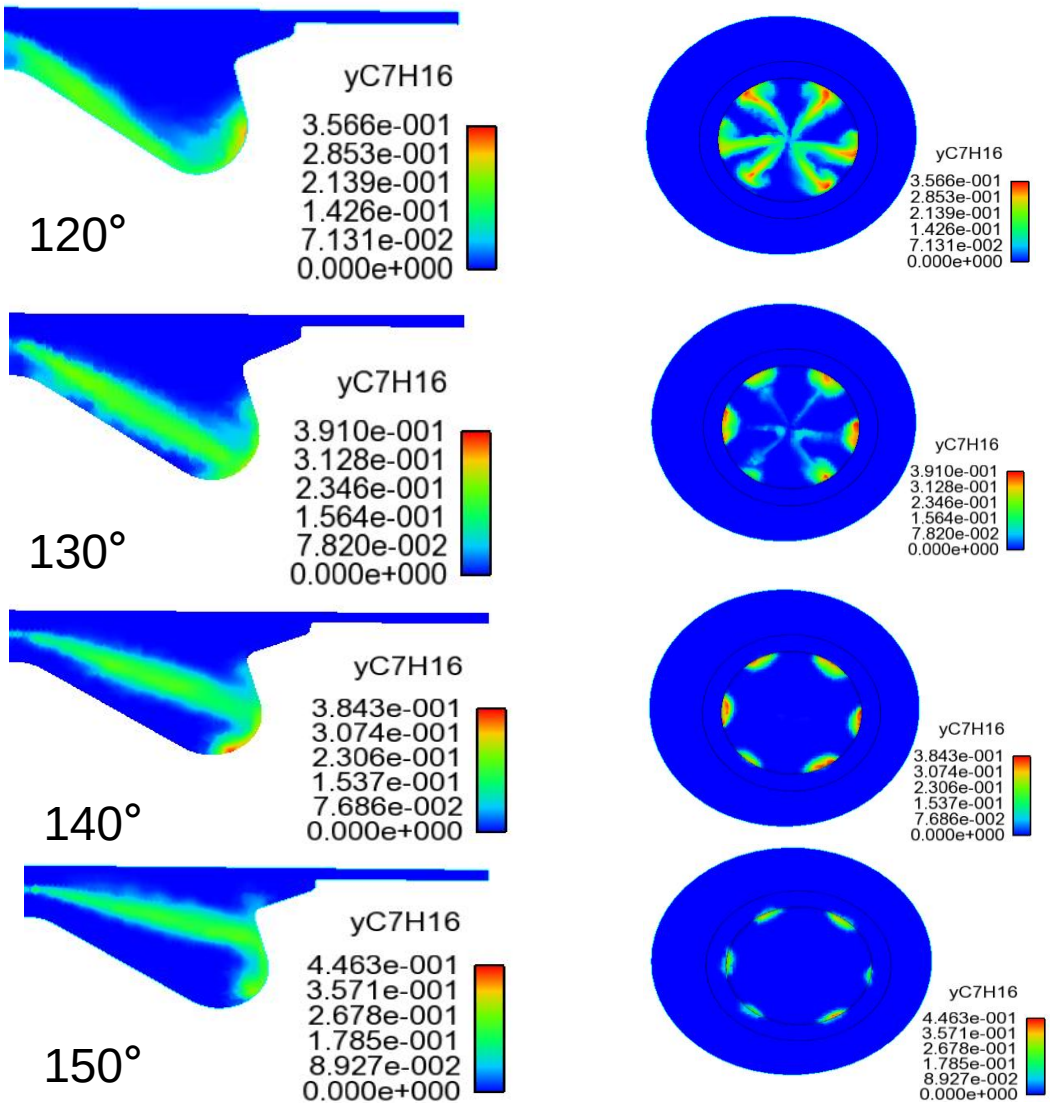




燃烧室A、B不同喷雾角度

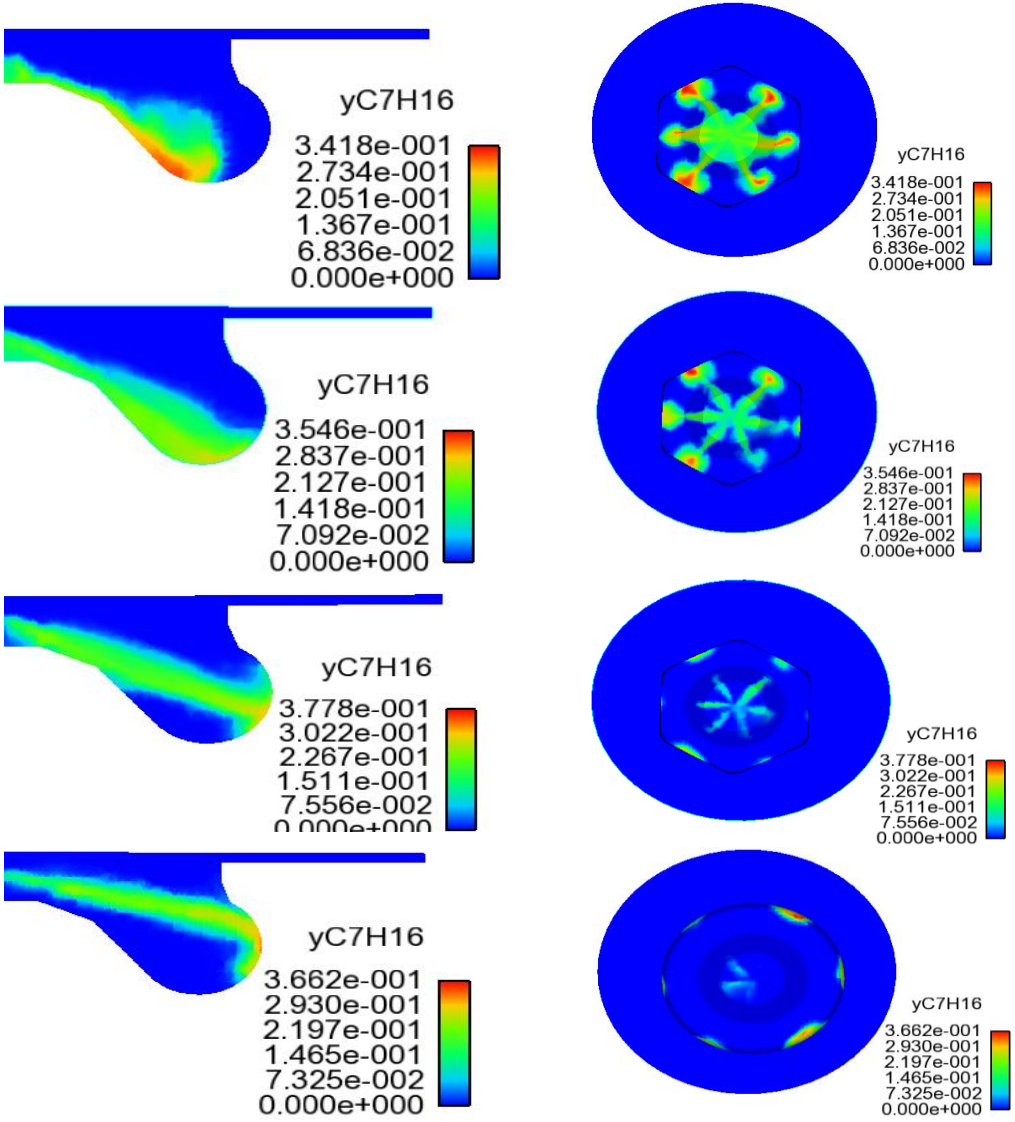
不同喷雾角度分析

燃烧室A不同喷雾角度

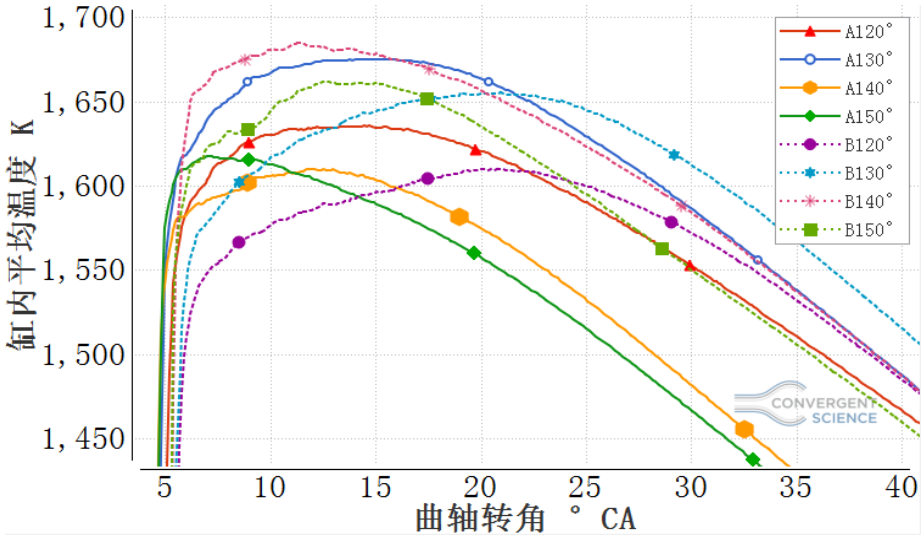


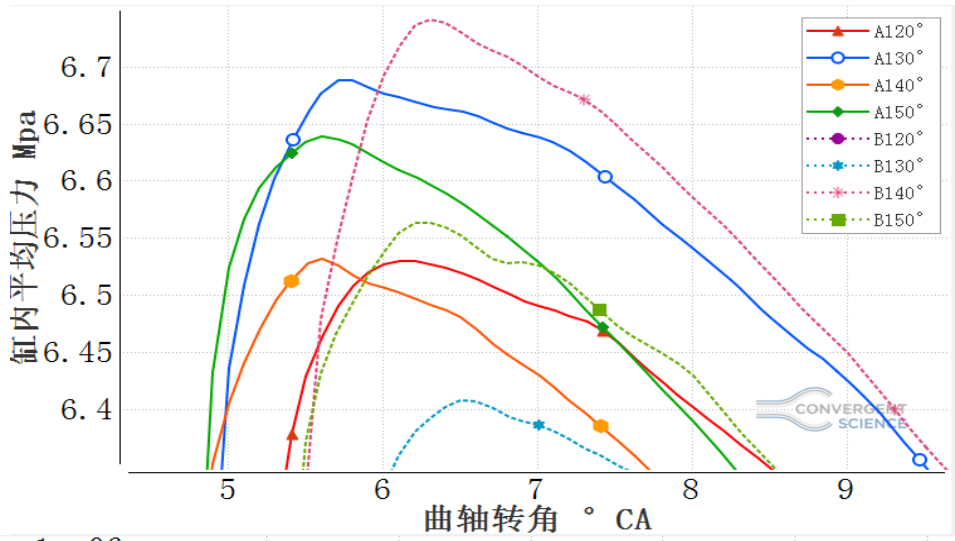
不同喷雾角度分析

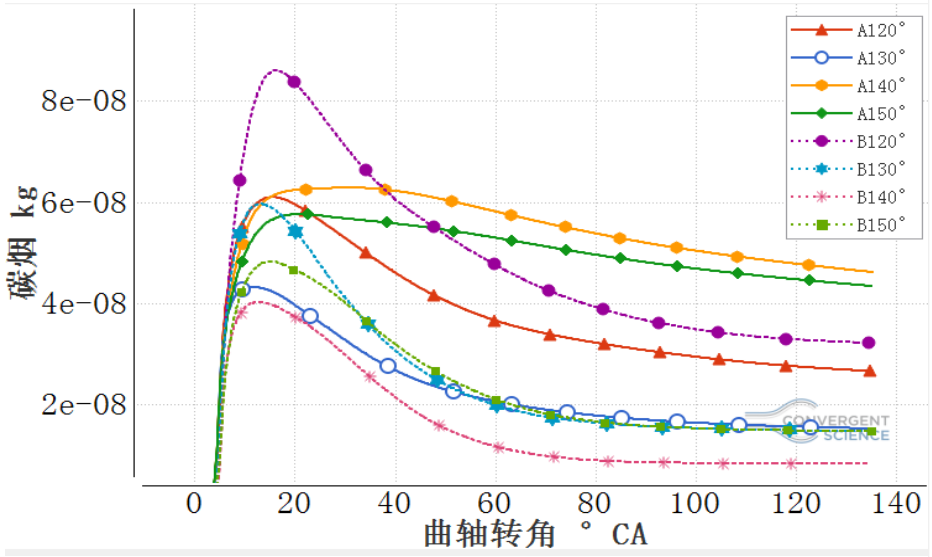
燃烧室B不同喷雾角度

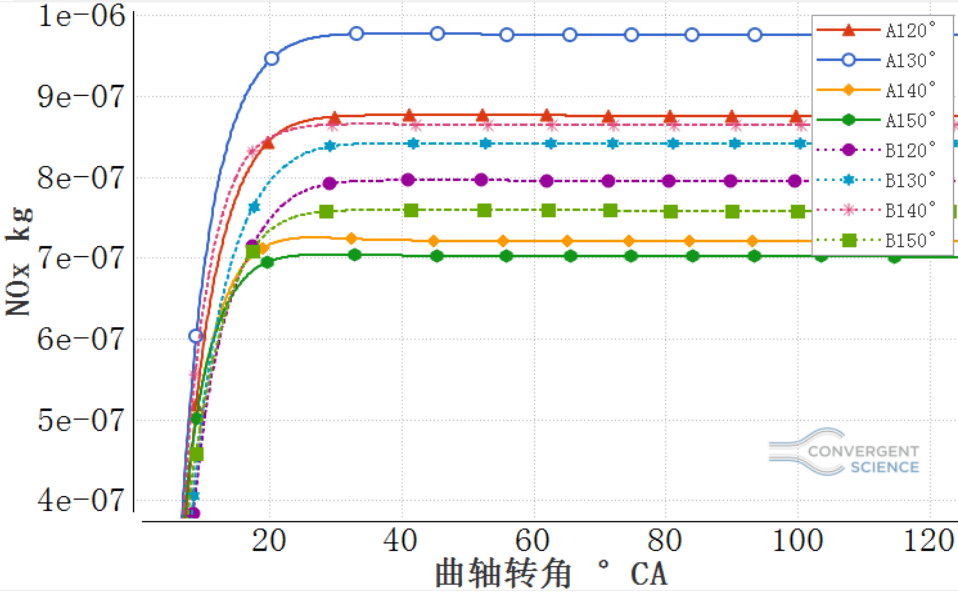


不同喷雾角度分析


缸内平均温度 K
1, 700
1, 650
1, 600
1, 550
1, 500
1, 450
5
10
15
20
25
30
35
40
曲轴转角 ° CA
A120°
A130°
A140°
A150°
B120°
B130°
B140°
B150°
CONVERGENT SCIENCE


缸内平均压力 Mpa
6. 7
6. 65
6. 6
6. 55
6. 5
6. 45
6. 4
5
6
7
8
9
曲轴转角 ° CA
A120°
A130°
A140°
A150°
B120°
B130°
B140°
B150°
CONVERGENT SCIENCE


碳烟 kg
8e-08
6e-08
4e-08
2e-08
0
20
40
60
80
100
120
140
曲轴转角 ° CA
A120°
A130°
A140°
A150°
B120°
B130°
B140°
B150°
CONVERGENT SCIENCE


NOx kg
1e-06
9e-07
8e-07
7e-07
6e-07
5e-07
4e-07
20
40
60
80
100
120
曲轴转角 ° CA
A120°
A130°
A140°
A150°
B120°
B130°
B140°
B150°
CONVERGENT SCIENCE

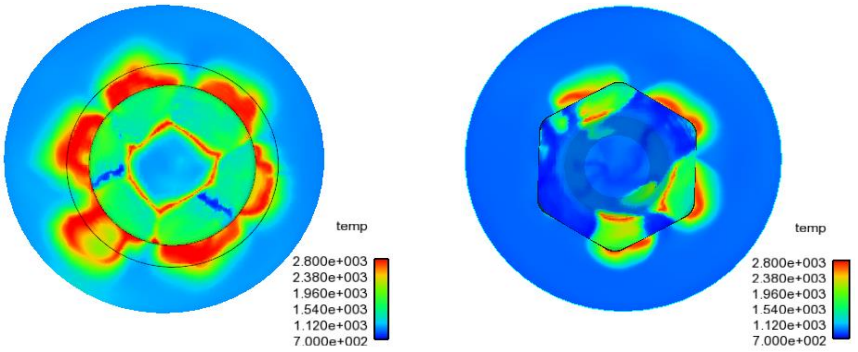
不同喷雾角度分析

燃烧室A、B最高平均温度和最高平均压力

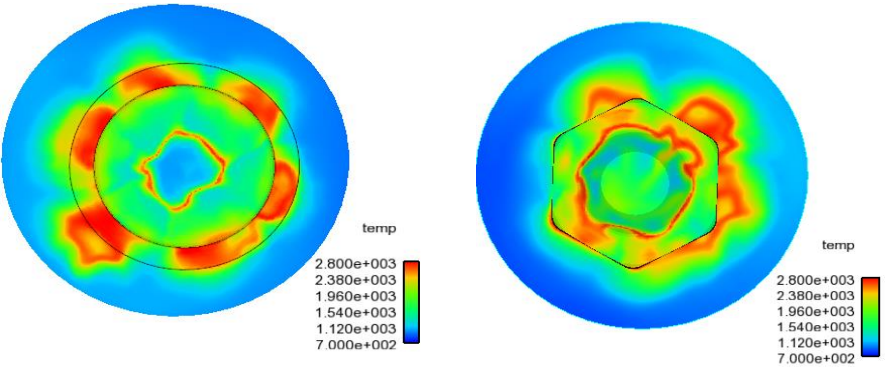
喷雾角度	燃烧室A温度/K	燃烧室B温度/K	燃烧室A压力/MPa	燃烧室B压力/MPa
120°	1635	1610	6.5	6.26
130°	1675	1655	6.69	6.41
140°	1609	1684	6.53	6.74
150°	1617	1661	6.64	6.56

优选喷雾角度分析

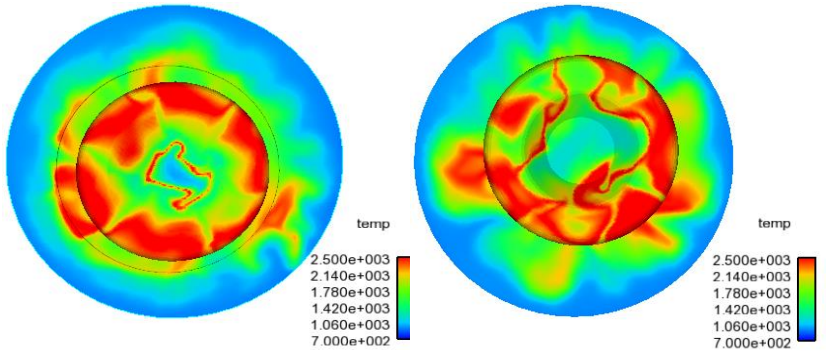
燃烧室A150°、燃烧室B140°温度场



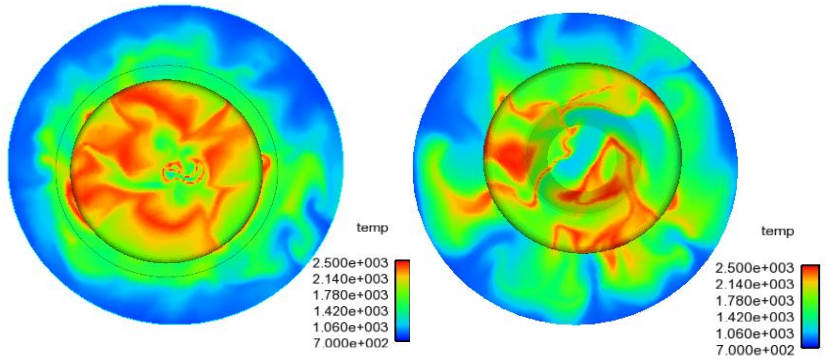
5°CA TDC



9°CA TDC

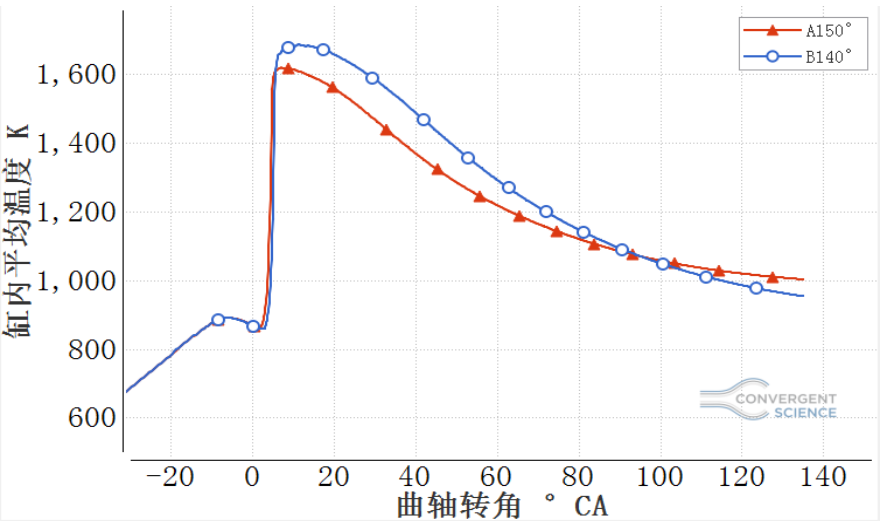


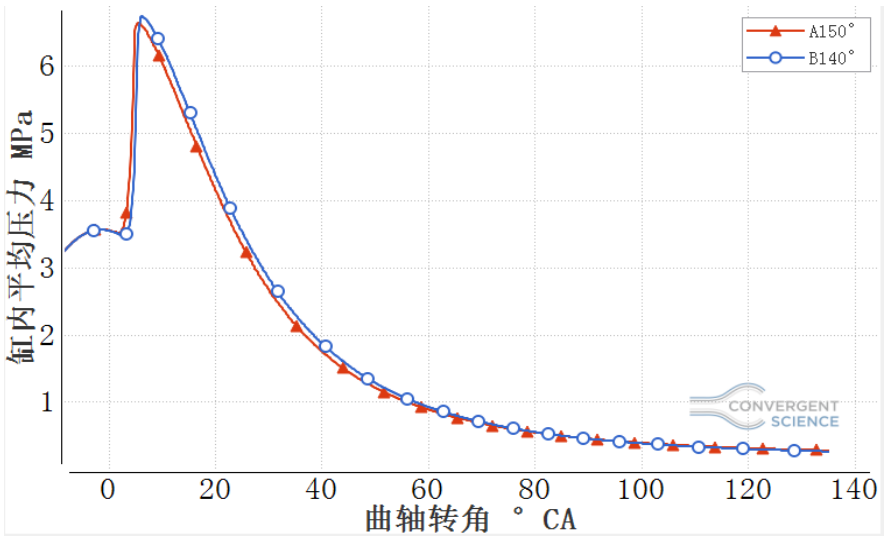
13°CA TDC

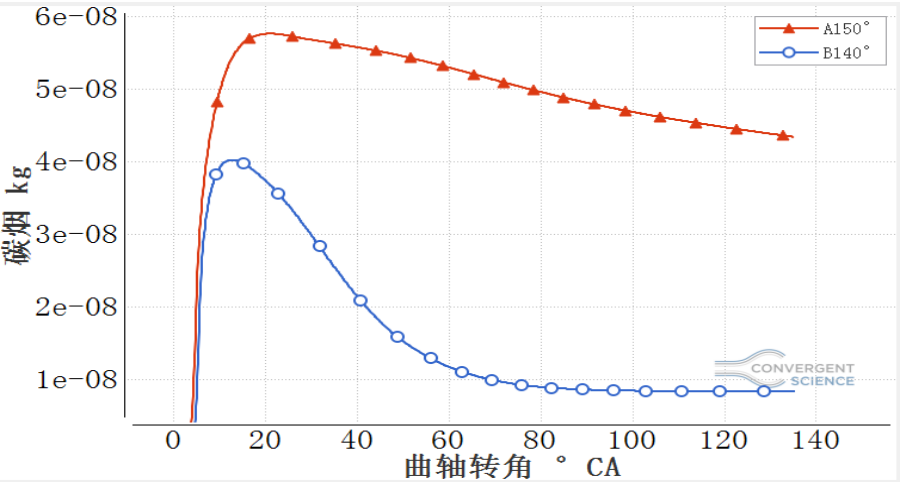


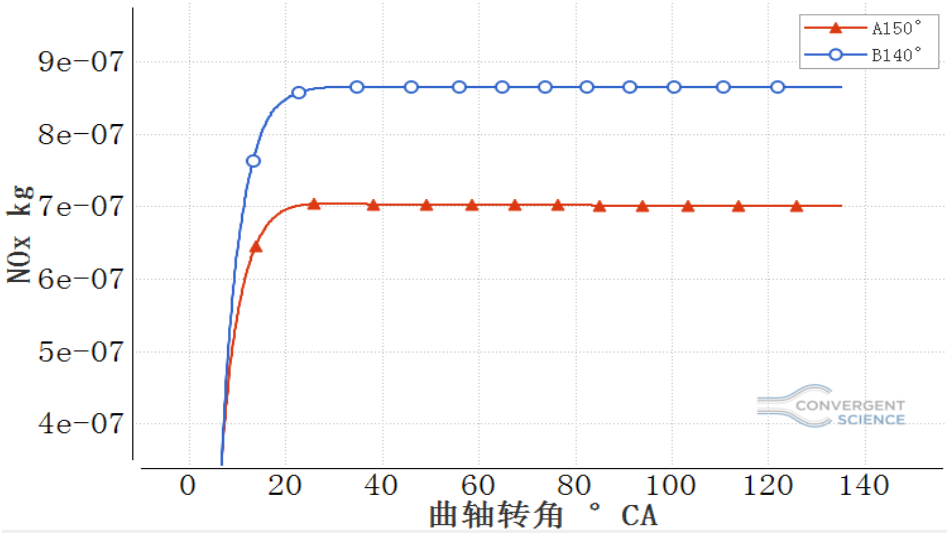
23°CA TDC

优选喷雾角度分析


A150°
B140°
缸内平均温度 K
1, 600
1, 400
1, 200
1, 000
800
600
-20
0
20
40
60
80
100
120
140
曲轴转角 ° CA
CONVERGENT SCIENCE

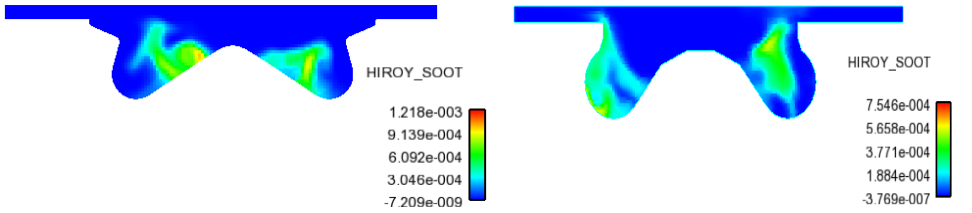

A150°
B140°
缸内平均压力 MPa
6
5
4
3
2
1
0
20
40
60
80
100
120
140
曲轴转角 ° CA
CONVERGENT SCIENCE


A150°
B140°
碳烟 kg
6e-08
5e-08
4e-08
3e-08
2e-08
1e-08
0
20
40
60
80
100
120
140
曲轴转角 ° CA
CONVERGENT SCIENCE

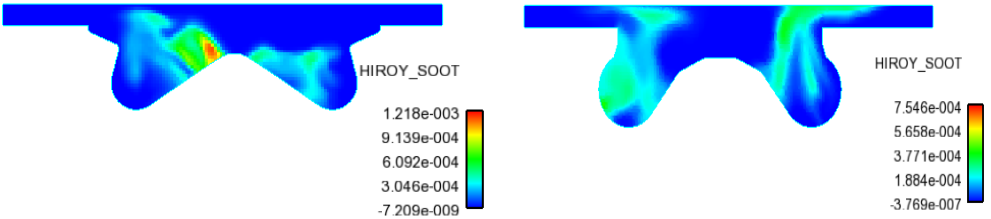

A150°
B140°
NOx kg
9e-07
8e-07
7e-07
6e-07
5e-07
4e-07
0
20
40
60
80
100
120
140
曲轴转角 ° CA
CONVERGENT SCIENCE

优选喷雾角度分析

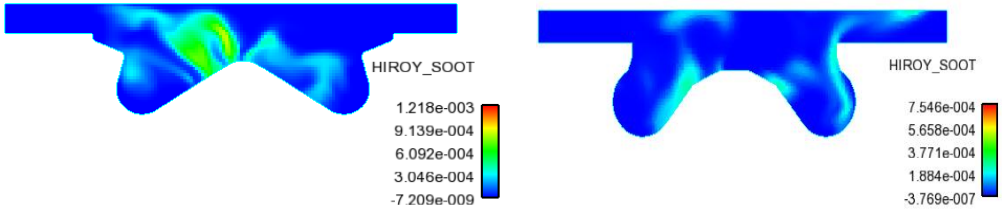
燃烧室A150°、燃烧室B140° 碳烟分布



13°CA TDC

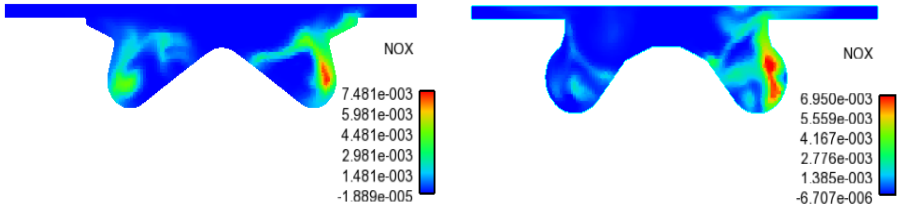


17°CA TDC

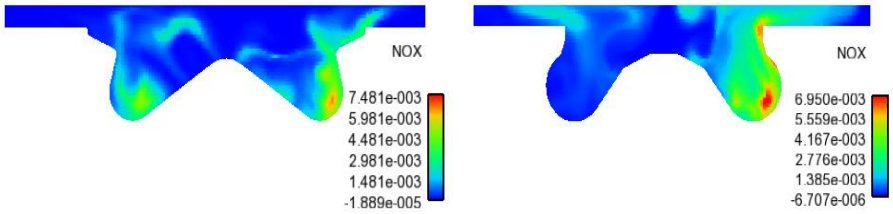


23°CA TDC

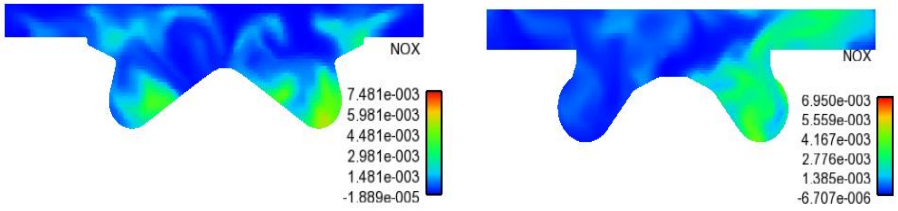
燃烧室A150°、燃烧室B140° NOx分布



11°CA TDC



17°CA TDC



23°CA TDC

总结

- 1、燃烧室A与B对缸内气流有不同程度的影响
- 2、在不同喷雾角度下，不同燃烧室受到不同影响，由底部凸台形状及凹坑深度所引起。
- 3、燃烧室A中NOx含量较低，碳烟较高。燃烧室B中NOx含量较高，碳烟较低。