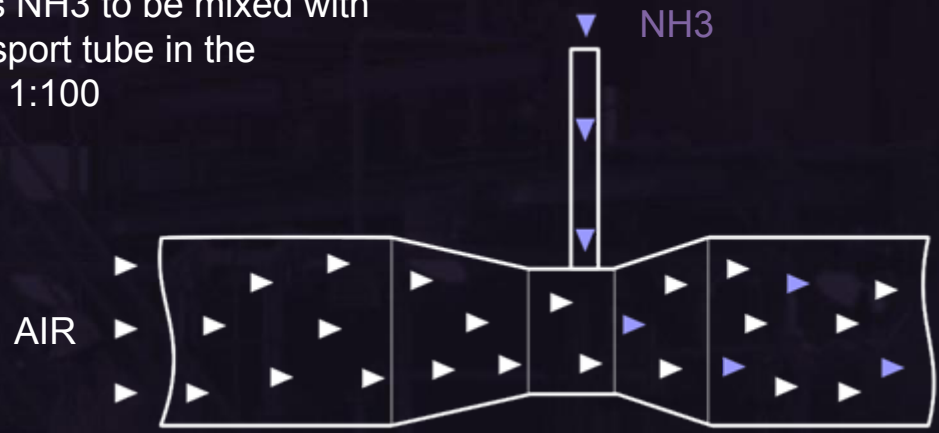
NH3 Utilization

Problem statement

Waste products utilization for Oil Processing Industry

Waste gas NH3 to be mixed with Air in transport tube in the proportion 1:100



It is required to achieve uniform mix

NH3 Utilization

3D task statement

CFD + mix model (Air and NH3 are ideal gases)

2 objectives (minimization of maximal NH3 concentration at the outlet of the static mixer and minimization of pressure loss on the mixer)

15 independent variables – geometrical parameters of the static mixer

NH3 Utilization

Software being used

Geometry parameterization

CATIA V5

Mesh building

ANSYS
ICEM CFD

CFD Solver

StarCD

Optimization software

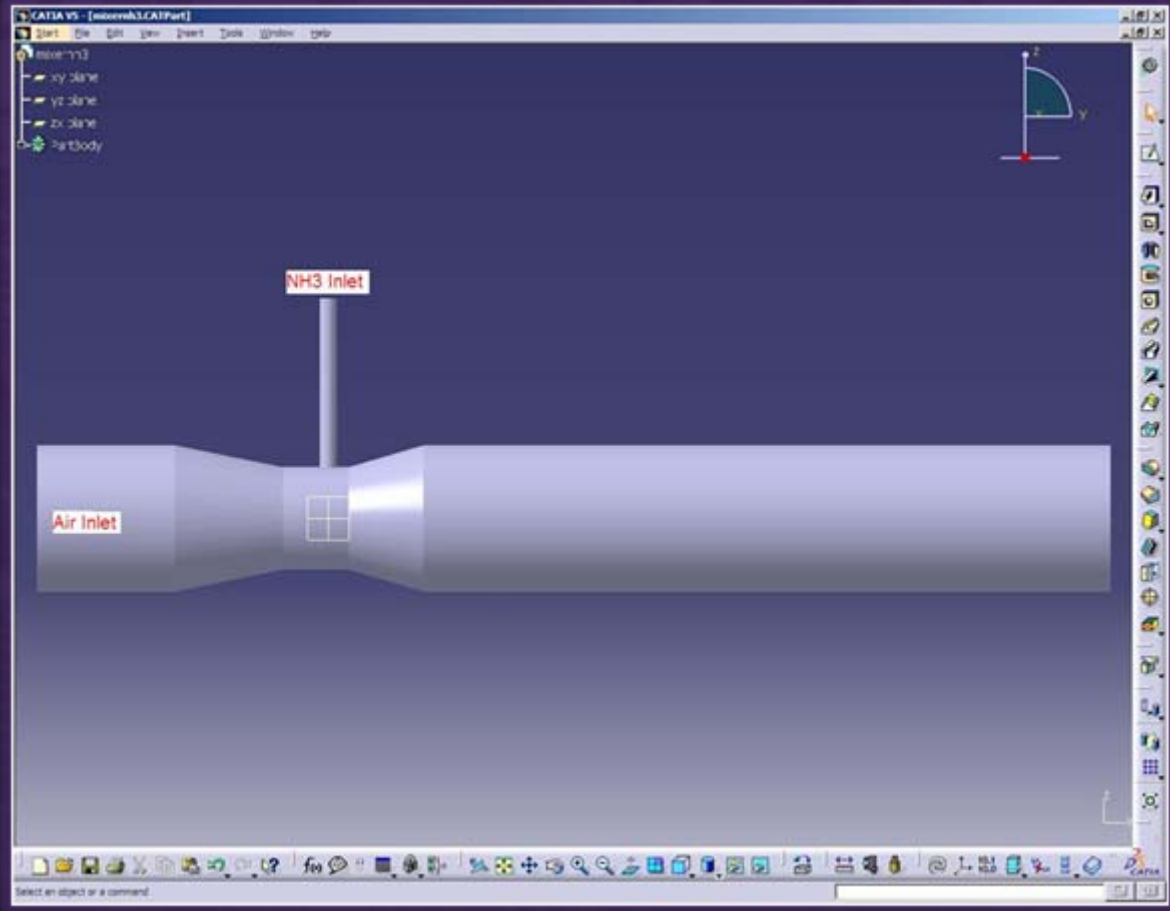
IOSO NM

NH3 Utilization

Software being used

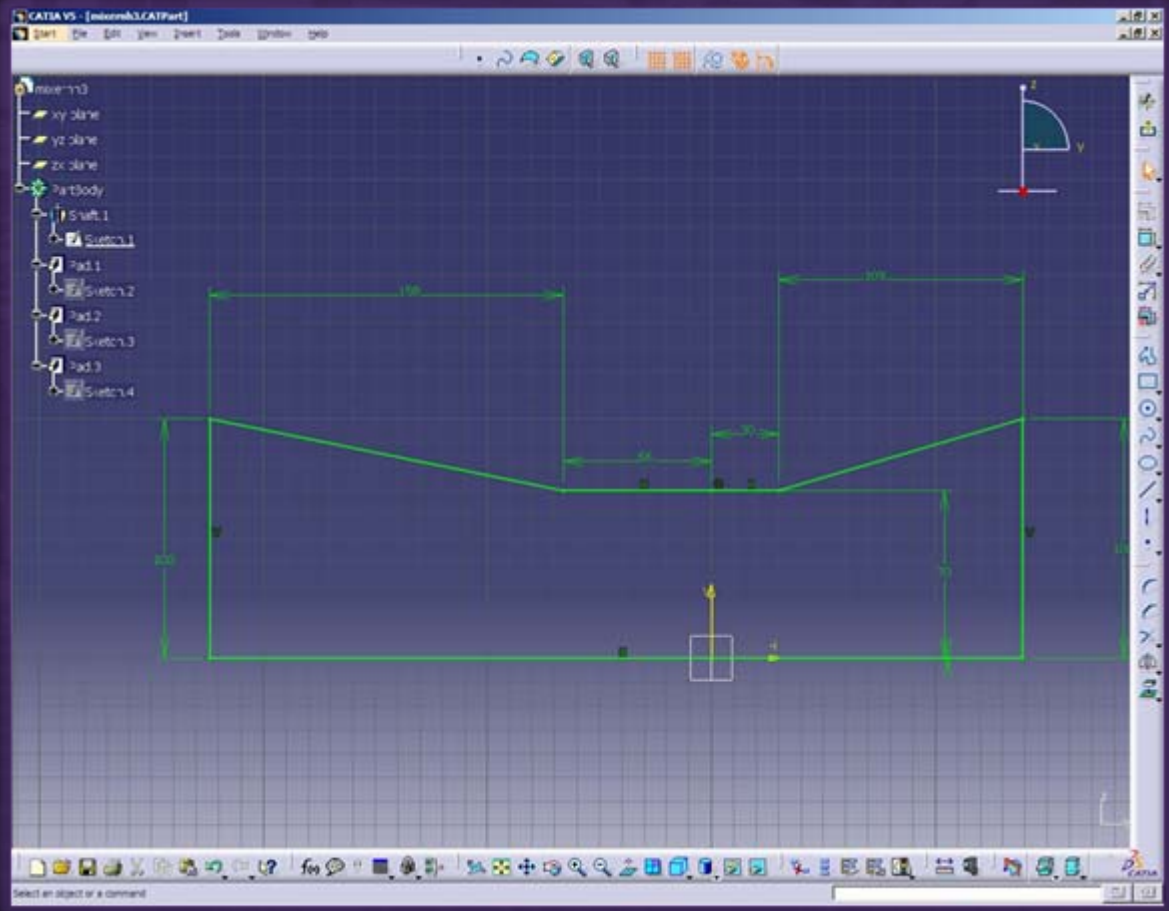
NH3 Utilization

CAD Geometry

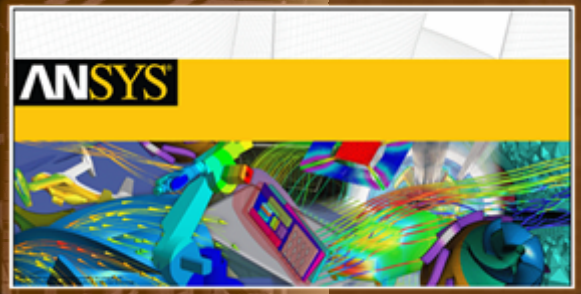


NH3 Utilization

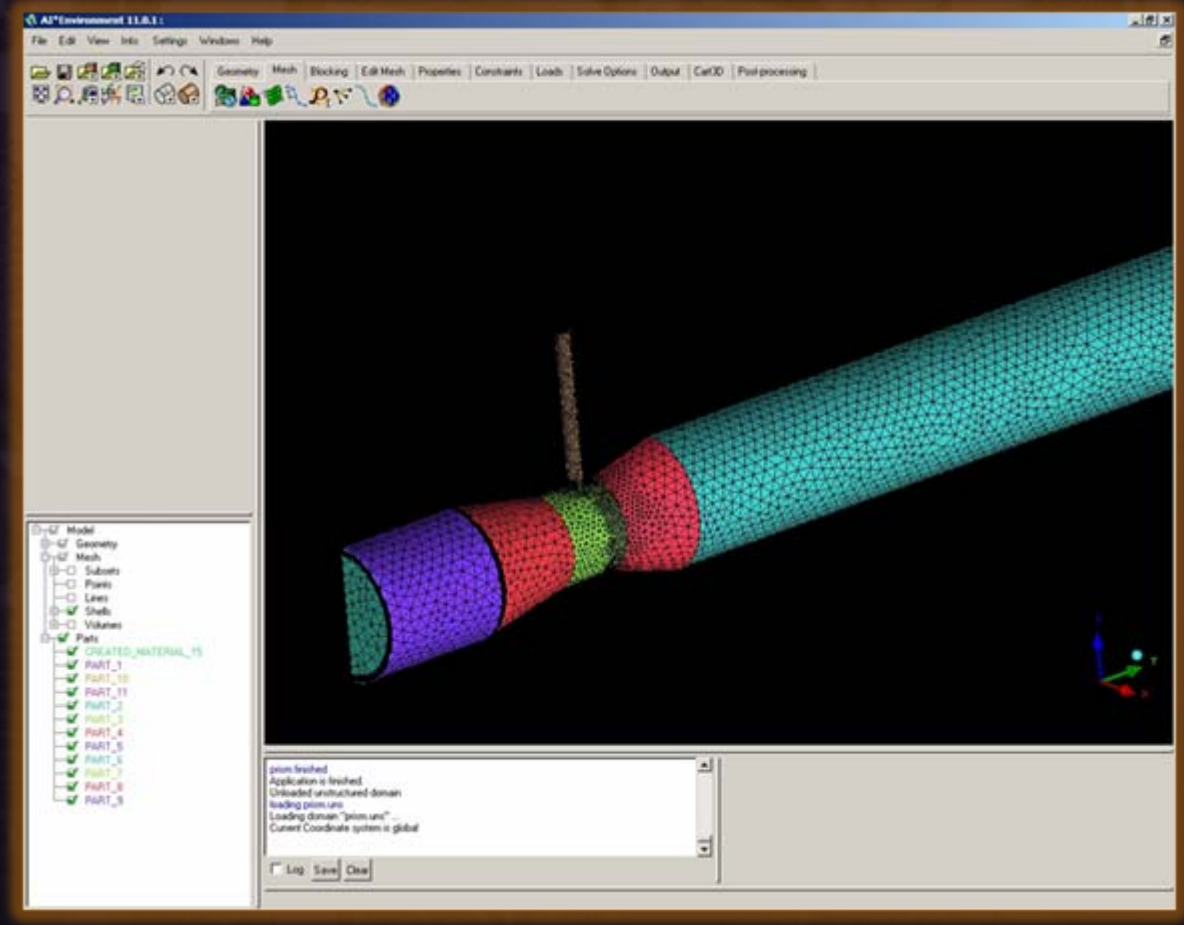
CAD Parameterization



NH3 Utilization



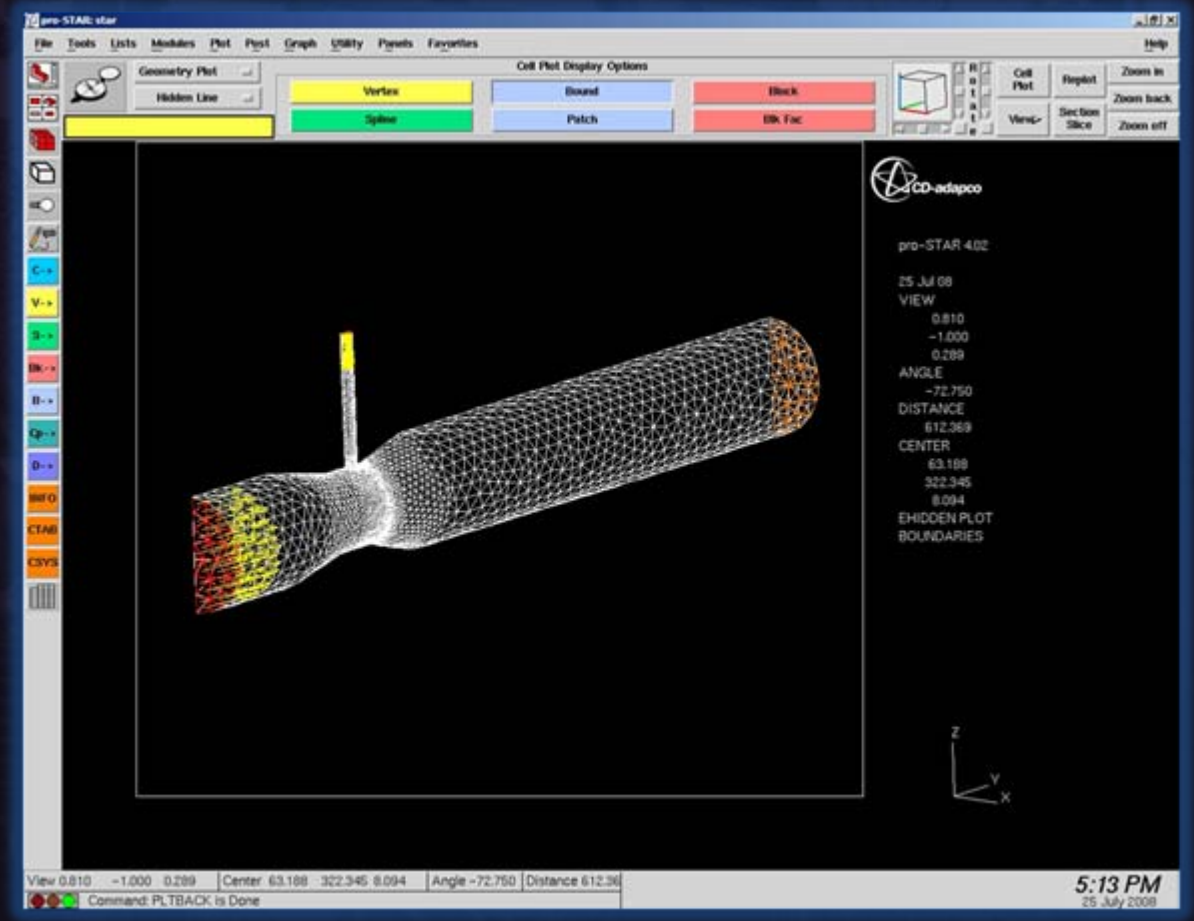
Mesh construction



NH3 Utilization

pro-STAR

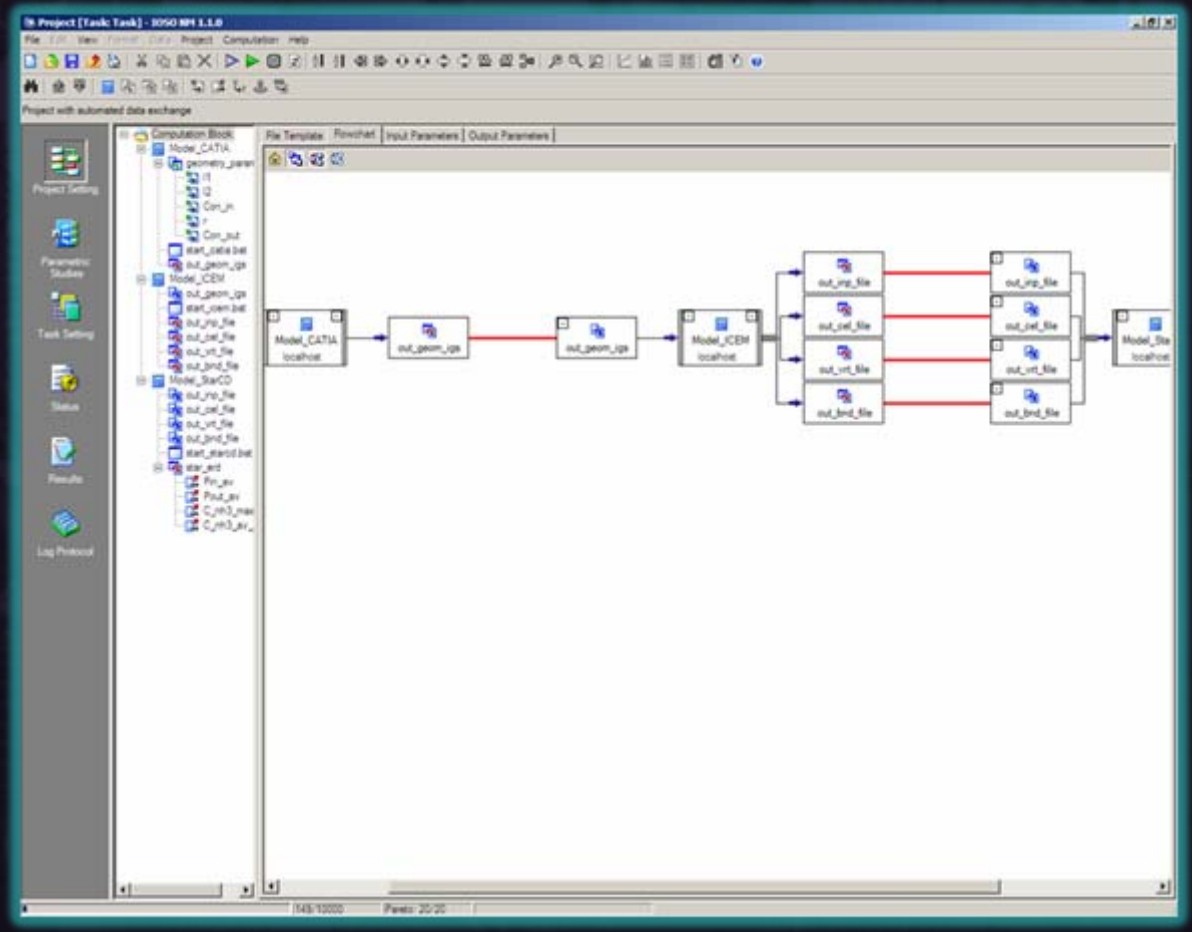
CFD Task Statement



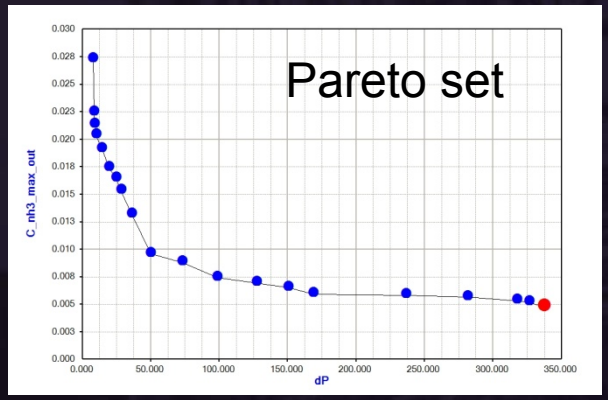
SIGMA technology

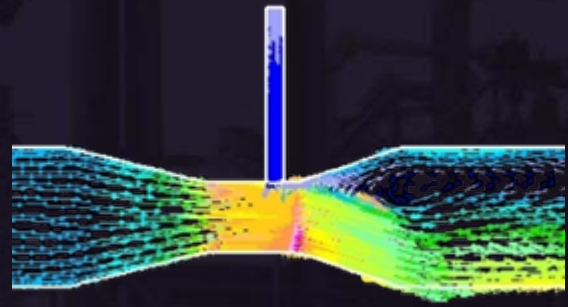
NH3 Utilization

Optimization Project

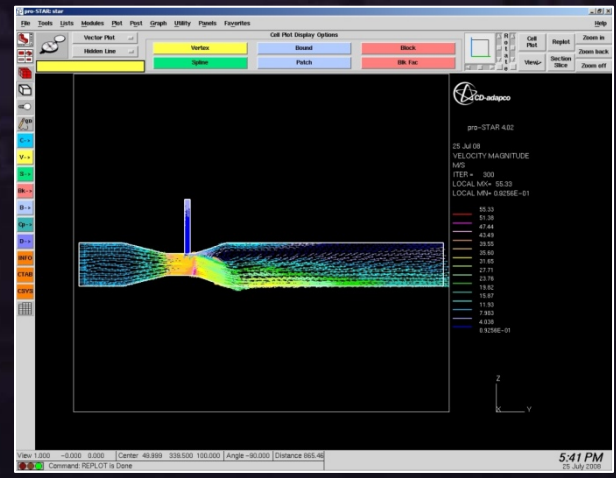


NH3 Utilization





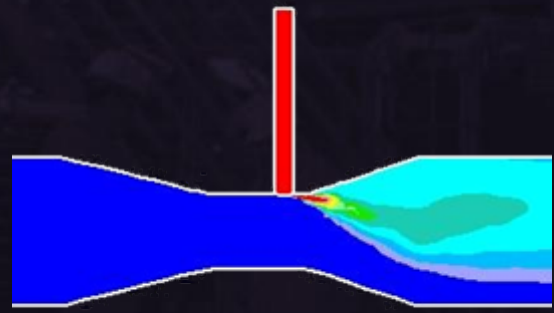
Velocity Vector Plot



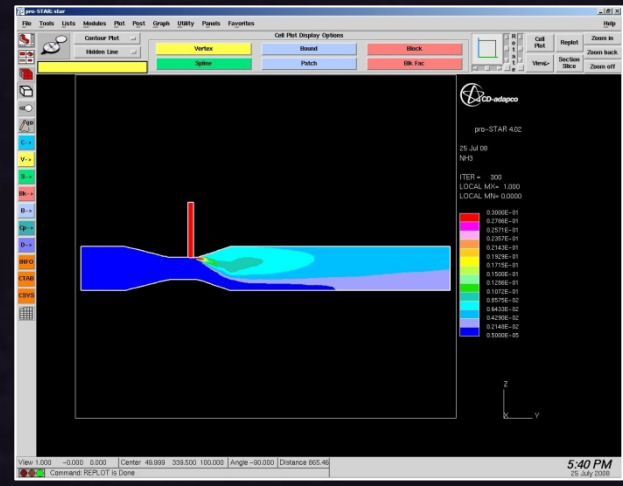
Point 1

Maximal NH3 Concentration at Outlet ~ 0.005

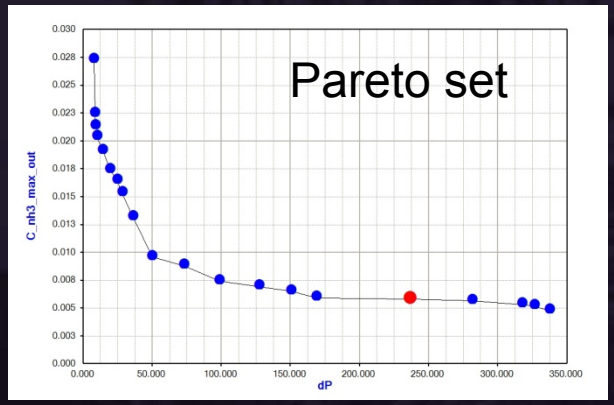
Pressure loss ~ 340

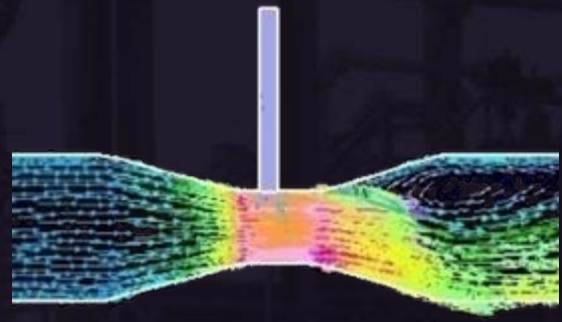


NH3 Concentration Distribution

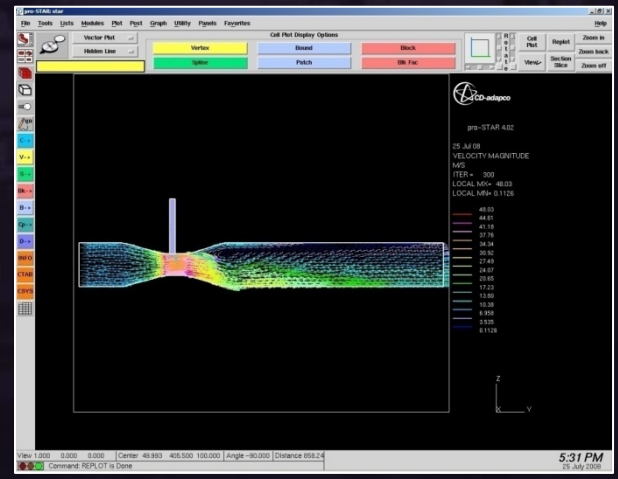


NH3 Utilization





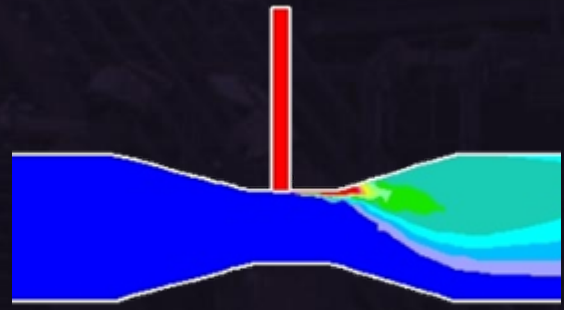
Velocity Vector Plot



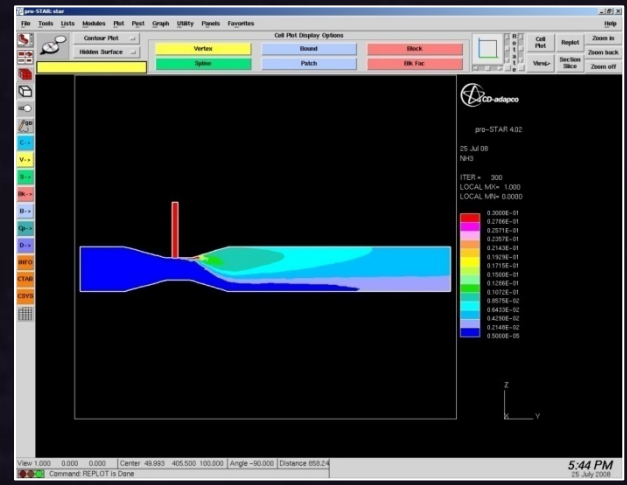
Point 5

Maximal NH3 Concentration at Outlet ~ 0.006

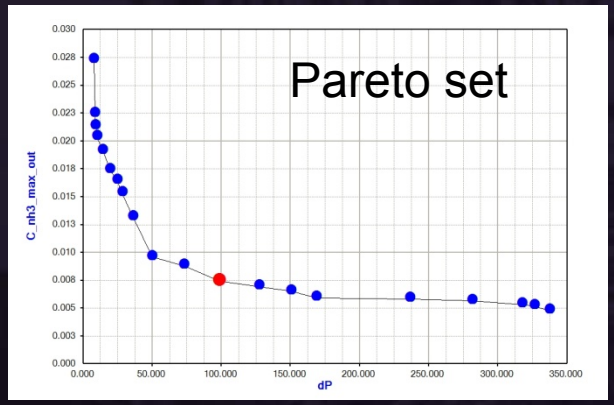
Pressure loss ~ 240

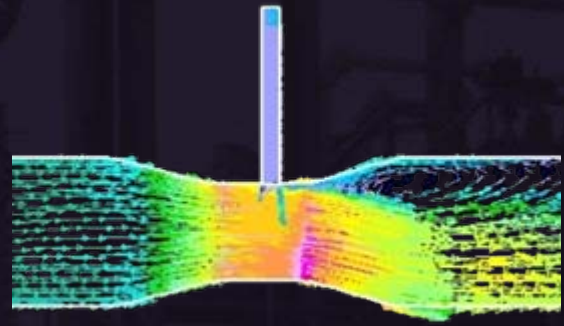


NH3 Concentration Distribution

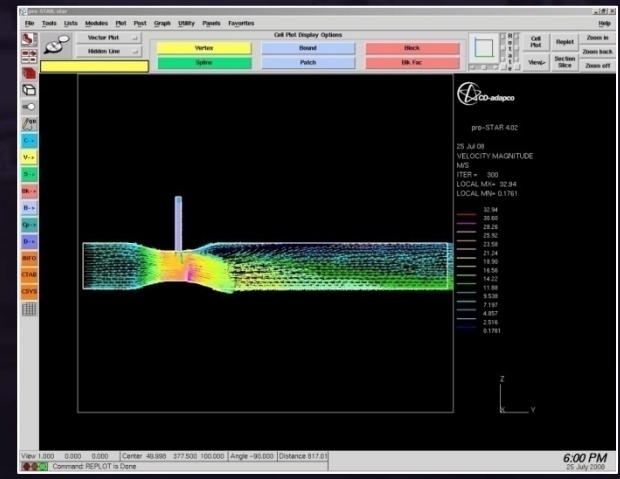


NH3 Utilization





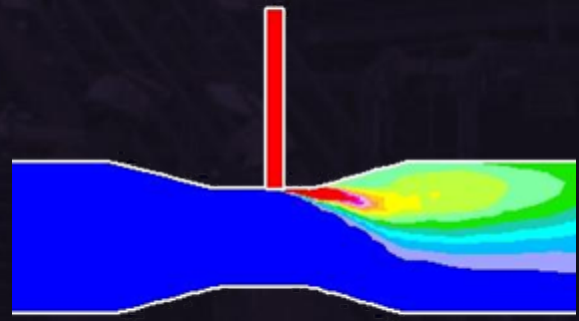
Velocity Vector Plot



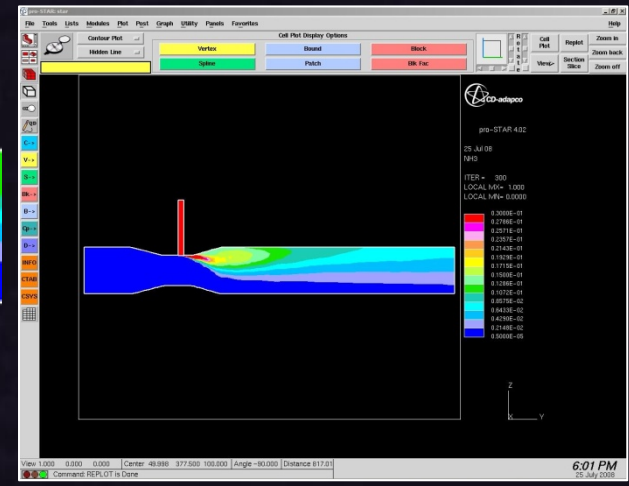
Point 9

Maximal NH3 Concentration at Outlet ~ 0.008

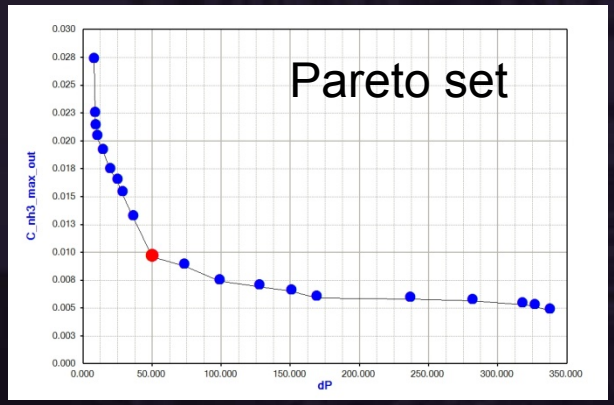
Pressure loss ~ 100

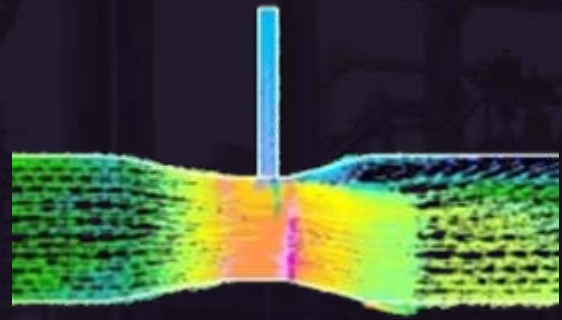


NH3 Concentration Distribution

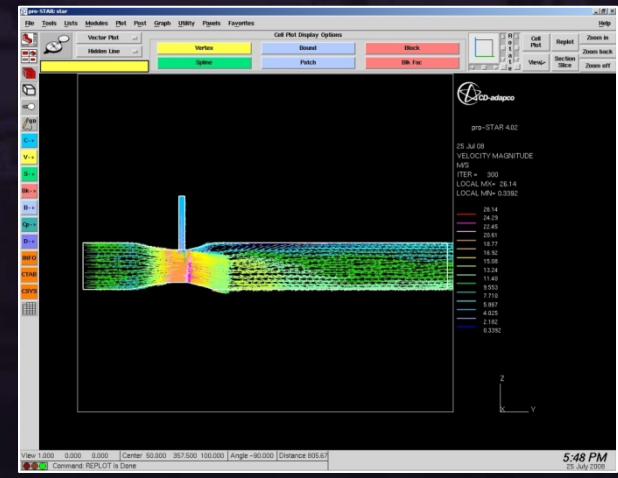


NH3 Utilization





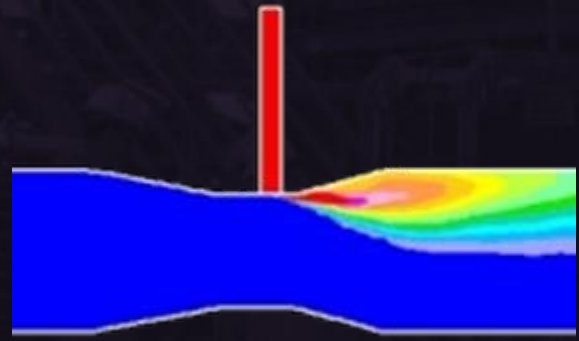
Velocity Vector Plot



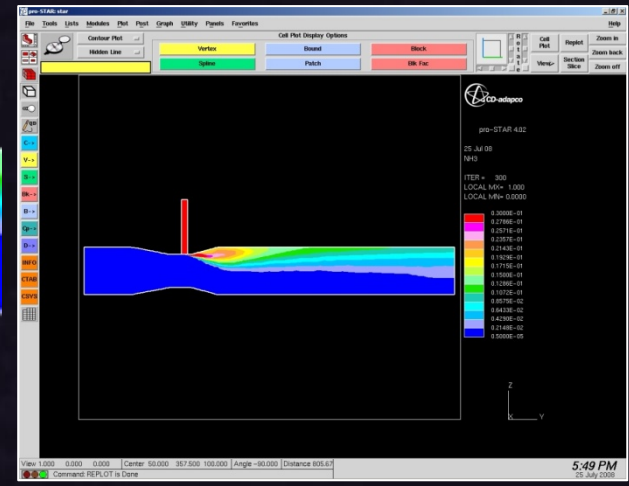
Point 11

Maximal NH3 Concentration at Outlet ~ 0.0095

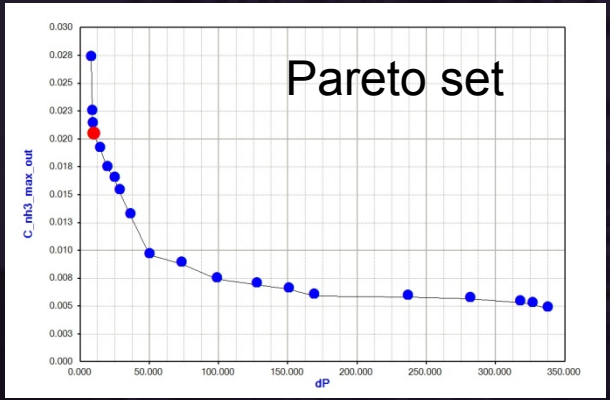
Pressure loss ~ 50

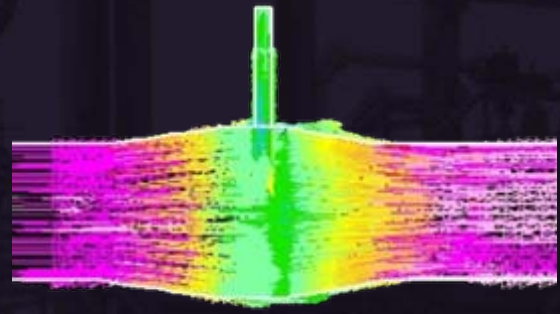


NH3 Concentration Distribution

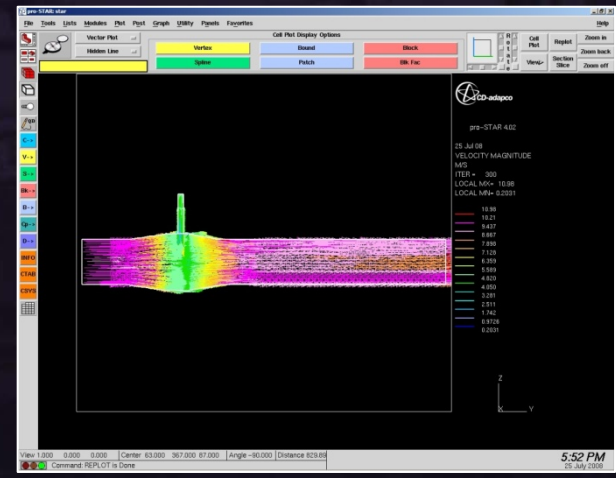


NH3 Utilization





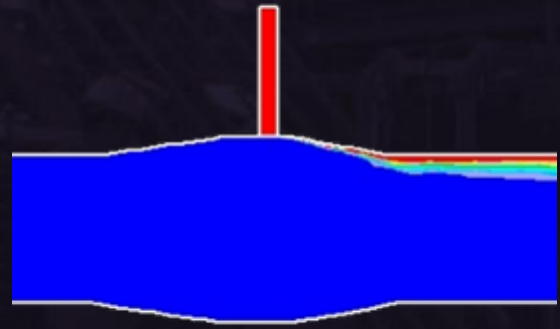
Velocity Vector Plot



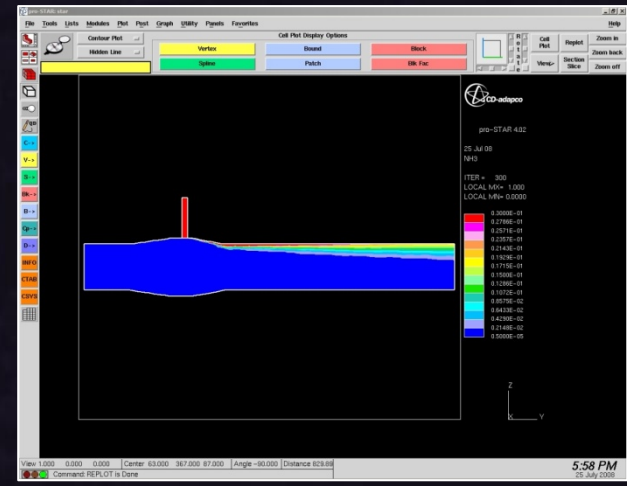
Point 17

Maximal NH3 Concentration at Outlet ~ 0.021

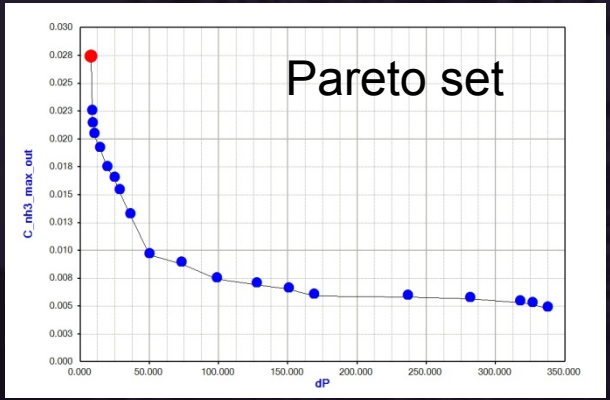
Pressure loss ~ 10

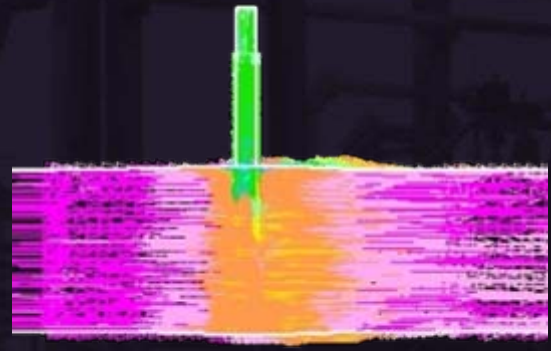


NH3 Concentration Distribution

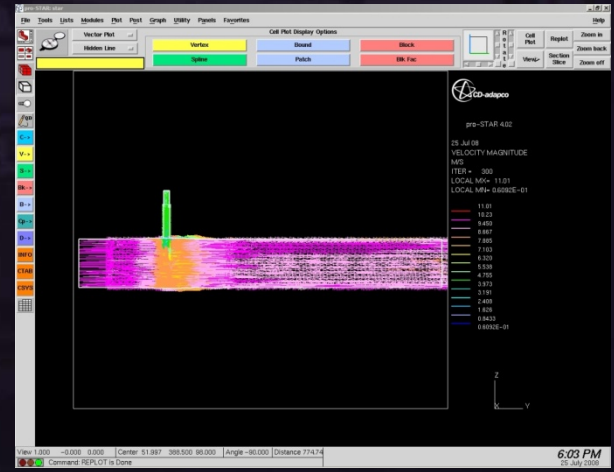


NH3 Utilization





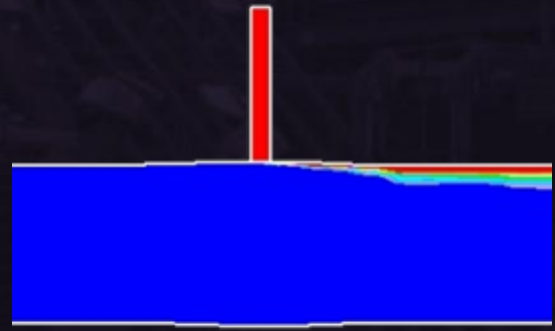
Velocity Vector Plot



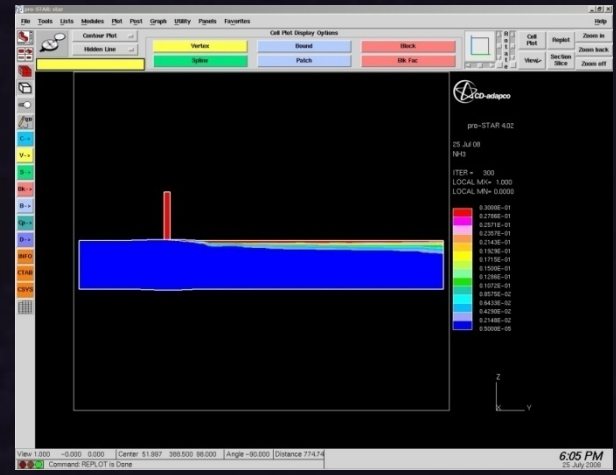
Point 20

Maximal NH3 Concentration at Outlet ~ 0.028

Pressure loss ~ 5



NH3 Concentration Distribution



NH3 Utilization

Conclusion

Geometrical parameters of static mixer Optimization task has been solved

Mathematical model calls - 250

Objective maximal NH3 concentration at the outlet of static mixer changes inside Pareto set in the bounds from 0.005 to 0.028

Objective Pressure Loss on static mixer changes inside Pareto set in the bounds from от 5 to 340