Seminar

CHAM

PHOENICS
Burner Example

Burner

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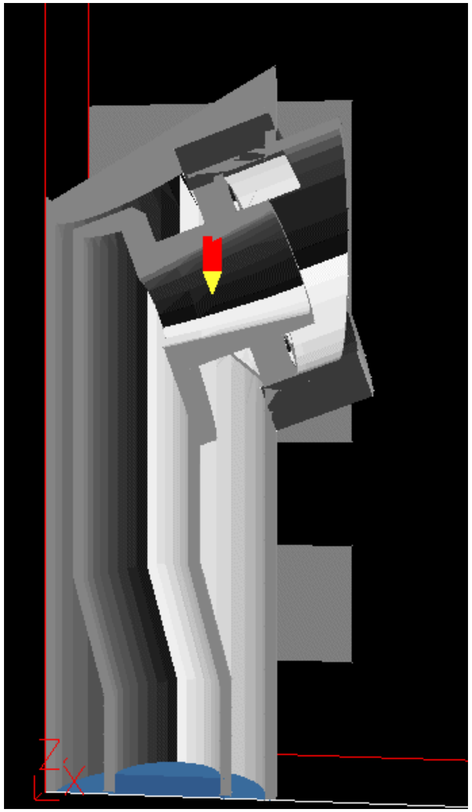
- CHAM was asked to make flow calculations for a particular design of furnace burner.
- This burner had proved troublesome in operation, and had already been the subject of development work aimed at improving its performance.
- The geometry was presented to CHAM as an engineering drawing.
- This was turned into an AUTOCAD solid model, and then exported as an STL file.



Burner - Geometry

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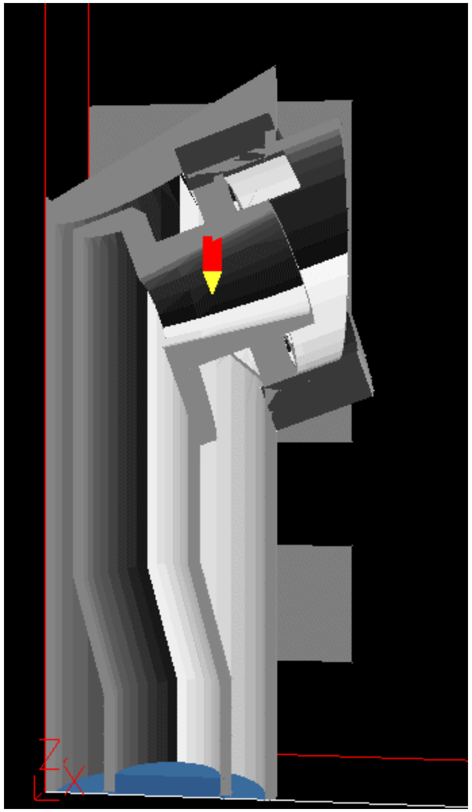
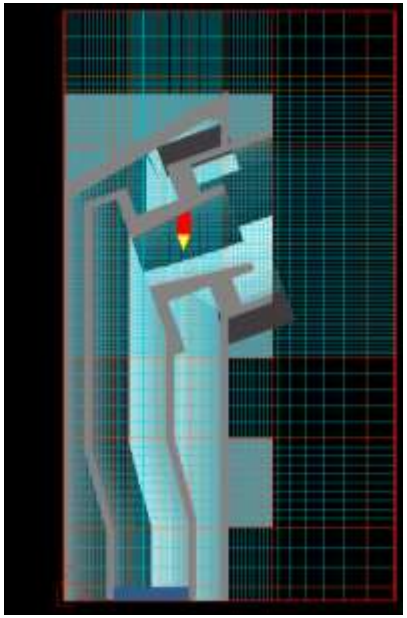
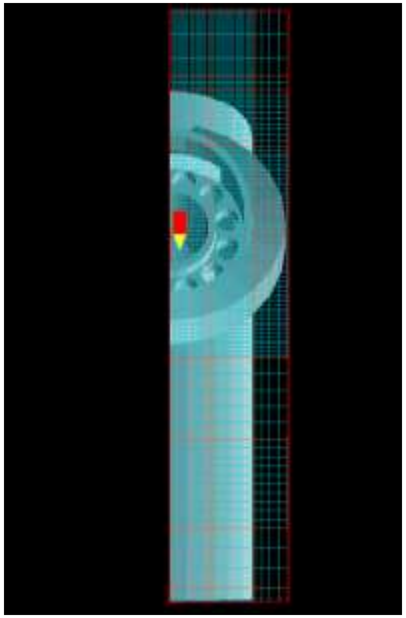
- The burner has a concentric inlet pipe, with fuel fed through the inner pipe, and oxygen in the outer annulus.
- The fuel passes through a nozzle, and the oxygen through a series of holes before finally mixing and combusting.



Burner - Geometry

- In order to resolve the details of the geometry, a relatively fine grid of 80 * 43 * 94 cells was used.





- As can be seen, grid has been concentrated in the region of the nozzle and holes, and also where the inner pipe crosses the mesh at an angle.

Burner - Modelling

- Initially isothermal calculations were made.
- The density was calculated from the Ideal Gas Law, with a mixture-dependent molecular weight to represent the effect of fuel and oxygen mixing.
- Later, calculations were also made using the Simple Chemical Reaction Scheme (SCRS) combustion model, with the reaction rate controlled by Eddy-Breakup
- The standard k-e model was used in all calculations.

Burner – Flow field

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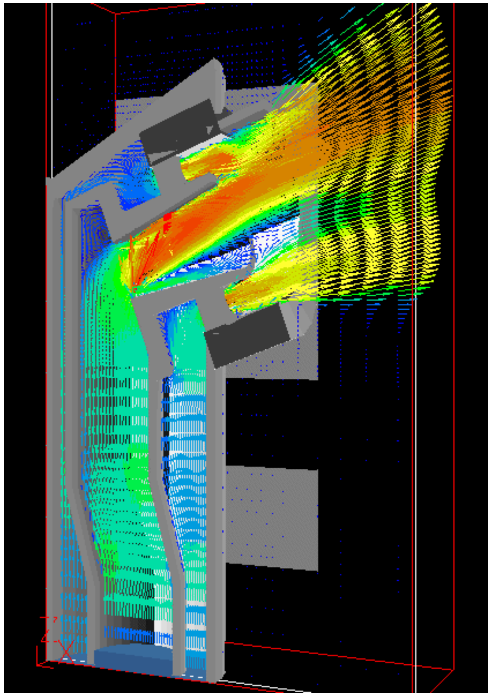
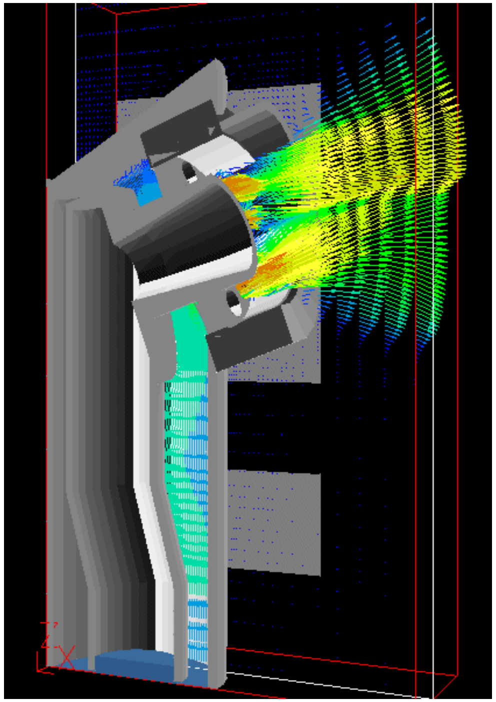
- The flow field shows a strong recirculation zone in the lower part of the fuel nozzle.
- This feature was observed in both isothermal and combusting cases





Burner - Results

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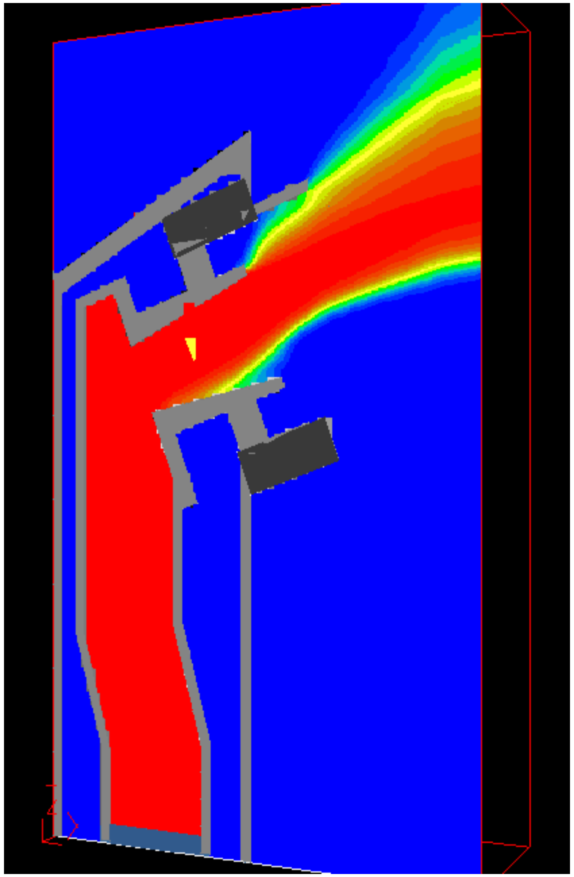
- This slide shows the fuel concentration on the centre-plane.
- The fuel is depleted along the lower inner nozzle surface



Burner - Results

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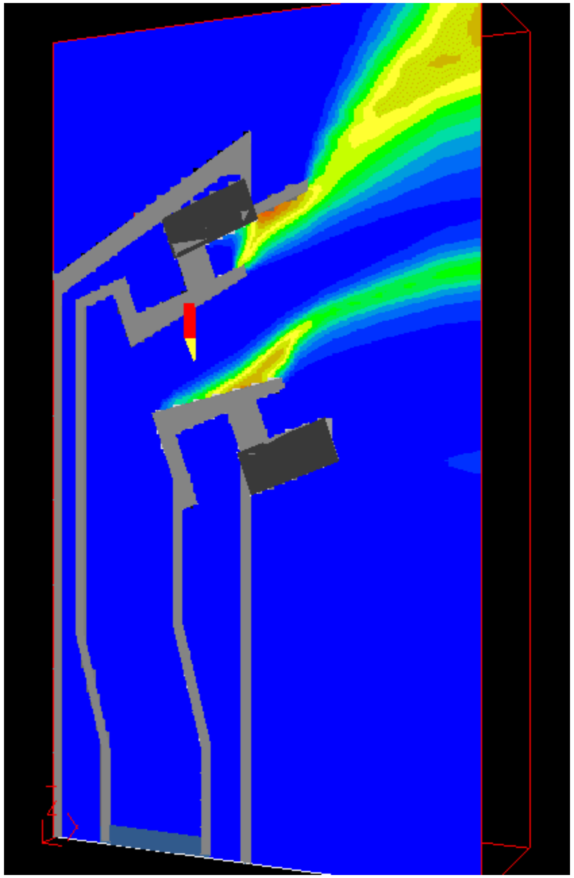
- This slide shows the temperature at the same location - very high temperatures can be seen inside the nozzle.



Burner - Validation

- The original design of this burner, which is modelled here, also exhibited severe recirculation in the lower part of the fuel nozzle.
- This was confirmed by pressure measurements, which showed negative pressure in this area.
- The predictions also show negative pressures here.
- Finally, when the original design burner was 'lit', it melted the lower part of the nozzle and the oxygen holes at the bottom of the inlet ring.
- This confirms that the model is reproducing the effects seen experimentally.