

Other Gases

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A REVIEW OF GAS EXPLOSION MODELS

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Summary

This Discipline Information Note summarises a recent review of gas explosion numerical models carried out by HSL⁽¹⁾.

Background

The prediction of gas explosion over pressures is important when considering safety assessments of plant design and layout. The development of a strategy for improving gas explosion models is, therefore, highly desirable. The review was the first stage in the development of this strategy and the objective was to identify areas where further work is required.

Conclusions

The findings show that:

- explosion models in current use employ crude approximations of the modelled geometry, relying on calibrated sub-grid models;
- the computational fluid dynamics (CFD) codes most commonly used for explosion prediction use simple, old numerical schemes for both the computational grid and the finite differencing, which could lead to substantial numerical errors;
- the combustion models used to predict the reaction rates are also subject to a considerable degree of uncertainty;
- the simple eddy-viscosity concept is widespread amongst the explosion codes for modelling turbulent transport. This model is not strictly applicable in high speed combusting flows and could give rise to further errors.

Recommendations

The main recommendations for future work are:

- numerical schemes used in explosion codes should be enhanced, both in terms of the grid employed to represent the explosion geometry and the numerical finite difference schemes
- model development should be driven by highly detailed, small scale experiments. If possible, large scale experiments should be used for model evaluation only;
- further work is needed to establish the reliability of the combustion models;
- the effect of using alternative turbulence models should be investigated.

References

1 A review of gas explosion models; S J Brookes. HSL Report GE/97/05.