

NOTE ON CONVERGENCE CRITERIA FOR ENERGY AND MASS IN CFD MODEL OF FIXED-BED COMBUSTION

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CFD models are based on physical laws of conservation and a system of governing equations is solved by conservative numerical schemes to ensure the conservation over the entire computational domain. Due to complexity of equations, however, an iterative procedure must be employed. Iterations are continued until convergence criteria are met.

The effect of convergence criteria on mass and energy balances is studied through a series of CFD simulations of heat-up and pyrolysis as essential stages of combustion of dry wheat straw in an experimental fixed-bed reactor. Since combustible volatiles are released during pyrolysis, even a small mass imbalance in the system can lead to large errors in the energy conservation. The equations (adopted from [1]) are discretised by the finite volume method and implemented in an in-house computer program GRATECAL. Convergence is judged by scaled (non-dimensional) residuals of transport equations as defined in [2]. The effect of the convergence criterion for energy transport equations on the energy imbalance during heat-up of wheat straw by primary air (398 K) and over-bed radiation is shown on figure 1. The convergence criterion for gas species transport equations is fixed to 10^{-3} . However, this value seems to be too low to obtain sufficiently low energy imbalance after volatile matter (approximately 1.1 kg, 79.28 wt% on dry basis) is completely pyrolysed as shown on figure 2. The convergence criterion for energy transport equations is fixed to 10^{-6} in this case.

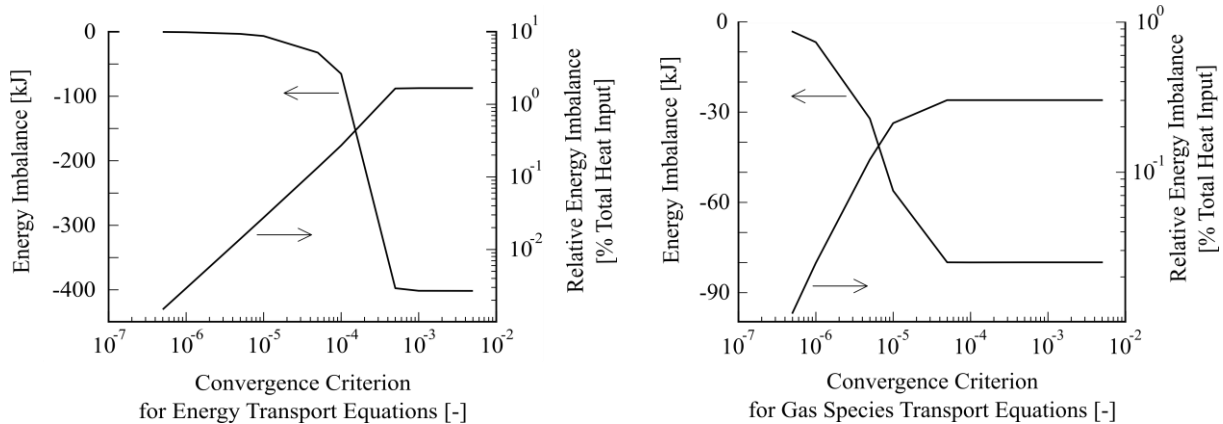


Figure 1. Total and relative energy imbalances **Figure 2.** Energy imbal. due to mass imbal.

References

- [1] Zhou H., Jensen A.D., Glarborg P., Jensen P.A., Kavaliauskas A., "Numerical modeling of straw combustion in a fixed bed", *Fuel* 84: 389-403 (2005)
- [2] Fluent 6.3.26., *User's Guide*, Fluent Inc., Lebanon, USA, 2006