The objective is now to numerically recover these results. A description of the code may be found in Refs. 5 and 6. The numeric is based on a time-splitting procedure. Each phase is first integrated using a finite volume explicit MacCormack scheme. Then, a third-order total variation diminishing Runge–Kutta time discretization is applied to update interphase exchange terms. In fact, because the medium is at rest, this test case is particularly selective only for the integration schemes for the source terms.

Characteristics of the test case described in Ref. 11 are retained. A sinusoidal pressure signal at 1000 Hz is imposed at the head end. The relative amplitude is chosen sufficiently small, namely 0.1%, to remain in the Stokes regime. The length of the domain corresponds to 20 wavelengths. Because the dispersion can be negative, computations are performed, at most, for only 15 periods to avoid spurious reflexions at the outlet. The solutions are computed with 50 points per wavelength on a uniform grid. Computations are run for several droplet diameters included between 5 and 75 $\mu$m to cover a large range of Stokes numbers. Gas and droplet properties are listed in Table 1.

Circles in Fig. 1 correspond to simulations performed for $\varepsilon = 0$ and 1. Figure 2 gives an example of pressure amplification for 6-$\mu$m vaporizing droplets. As shown in Fig. 1, the third-order explicit scheme is not robust enough to recover theoretical results below a Stokes number of 0.15, whereas, without mass transfer ($\varepsilon = 0$), the scheme gives good results down to a Stokes number of 0.06. In fact, an implicit method seems to be required when the source terms become stiff. Except for these small diameters, numerical results are close to the theoretical attenuation and dispersion, thereby validating the code. Simulations with different $\lambda$ and $\kappa$ were not judged necessary. Note that the droplet diameter and loading remain constant during the computation (to the fourth digit), so that all of the computations are relevant.

**Table 1 Gas and droplet properties**

| Property | Value | Property | Value |
|---|---|---|---|
| $p_0$ | 5 MPa | $\kappa$ | 0.396 |
| $\rho_0$ | 3.78 kg/m$^3$ | $\rho_l$ | 1766 kg/m$^3$ |
| $C_p$ | 2021.8 J/kg/K | $C_l$ | 0.68 $C_p$ |
| $\gamma$ | 1.23 | $\lambda$ | 0.2 |
| $\mu$ | 8.855 $10^{-5}$ kg/m/s | $Pr$ | 0.8 |

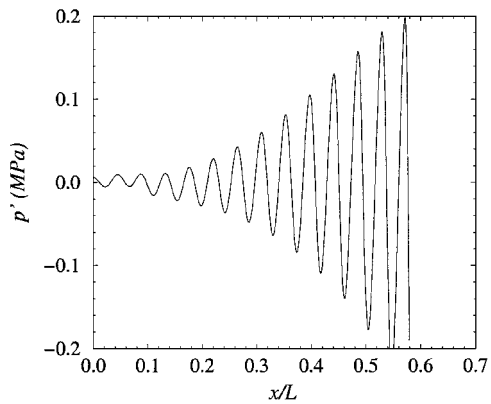


**Fig. 2 Amplification effect for 6-$\mu$m vaporizing droplets ($\lambda = 0.2$ and $\omega\tau_u = 0.25$).**

## Conclusions

In spite of its simplicity, this test case seems to be valuable to obtain a first validation of an unsteady reactive two-phase flow code. Beyond this numerical aspect, this study highlights the driving effect for acoustic-related oscillations of a thermal conductivity-controlled vaporization process and incidentally gives an estimation of the critical frequency–diameter pairs in a straightforward way. The next step in the validation of numerical codes is to consider a diffusion-controlled vaporization process to address multi-species aspects.

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# Erratum

THE November–December 2001 issue of the *Journal of Propulsion and Power* contained two errors. In the editorial preface on page 1137, we misspelled Woody Waesche. On the spine, we misspelled Hypersonics.
AIAA regrets both errors.