Sheet V3 · Verification

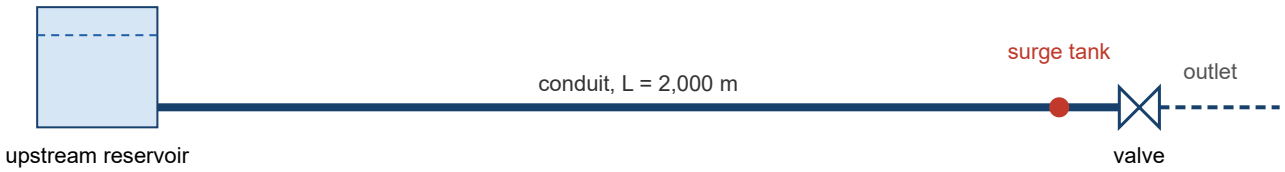
Mass oscillation in a surge tank

Source : Independent rigid-column integration (fourth-order Runge-Kutta), verification/tests/CBELIER_test_verification_methodologie.mjs

1. The question

After a valve closure, the level in a surge tank oscillates slowly. Does CBELIER, which computes the waves, reproduce the extreme levels given by the rigid-column equation?

2. The case

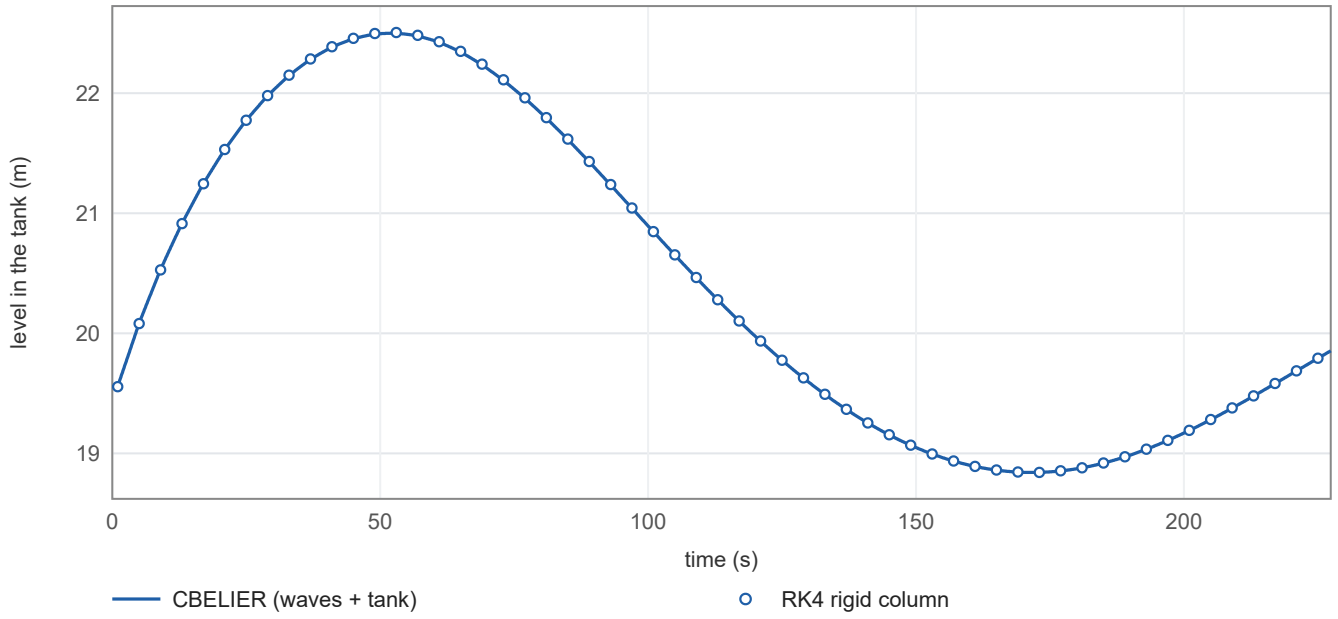


A reservoir feeds a 2,000 m conduit ending at a surge tank, then a valve closed at t = 1 s. CBELIER's full computation (waves and tank) is compared with a separately written rigid-column integration using the same friction and the same tank entry loss. Three geometries are tried.

3. Data and status

Data	Value	Status
Conduit: length, wave speed	2,000 m; 1,000 m/s	DEFINED
Case 1: D, tank area, ζ	2 m; 20 m²; 0	DEFINED
Case 2: D, tank area, ζ	2 m; 20 m²; 1	DEFINED
Case 3: D, tank area, ζ	1.5 m; 30 m²; 0.2	DEFINED
Valve closure	instantaneous at 1 s	DEFINED

4. Results



Case 2 (ζ = 1): level in the tank, CBELIER (line) and rigid column (circles). The rigid column starts at the closure (t = 1 s).

5. Differences

Indicator	CBELIER	Reference	Difference
Case 1: maximum level	22.097 m	22.096 m	0.001 m
Case 1: difference relative to the amplitude	0.04 %	—	tolerance 1 %
Case 2: maximum level	22.500 m	22.506 m	−0.005 m
Case 2: difference relative to the amplitude	0.15 %	—	tolerance 1 %
Case 3: maximum level	22.196 m	22.201 m	−0.005 m
Case 3: difference relative to the amplitude	0.14 %	—	tolerance 1 %

The extreme levels agree within 0.2 % of the amplitude in all three geometries. CBELIER computes both the fast waves and the slow oscillation without losing mass.

6. Limitations and assumptions

- The reference is an independent numerical integration, not a measurement.
- The rigid column ignores waves: a slight difference at the very start of the oscillation is normal.

Computation: CBELIER engine 3c.26, 2026-11-06. Re-run with every release by the verification suite (verification/qv1). Alfa Wamane engineering consultancy — cbelier.alfawamane.ma