Sheet E5 · Experimental validation · CALIBRATED

Resonating surge wells: USBR laboratory rig (1952)

Source : USBR, Hydraulic Laboratory Report HYD-324, "Surging in the Coachella irrigation distribution system — causes and control", Denver, 1952, fig. 37

1. The question

A low-pressure network broken by baffled wells resonates when excited at its natural period. Does CBELIER reproduce the measured resonance curves, with one or two covered wells?

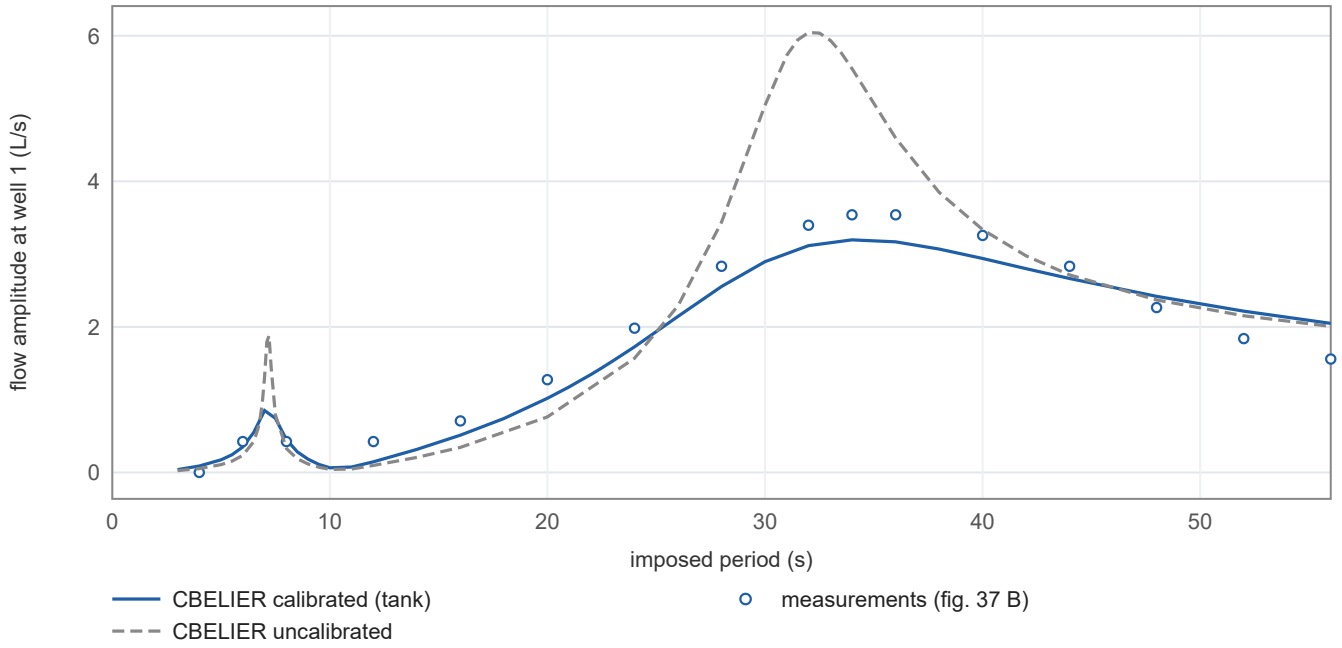
2. The case

Small-scale rig: three vertical wells joined by 8 in, 125 ft steel pipes. A mechanism imposes an inflow oscillation of chosen period; the flow amplitude is measured at the entrance of the wells. Three arrangements: no covered well (A), well 1 covered (B), wells 1 and 2 covered (C). The cover traps air that stiffens the well.

3. Data and status

Data	Value	Status
Wells: area; pipes: D, L	0.101 m²; 203 mm; 38.1 m	PUBLISHED
Baffle and pipe elevations, air volumes under the covers	report	PUBLISHED
Mean flow	7.08 L/s	PUBLISHED
Imposed flow amplitude (asymptote of fig. 37 A)	1.42 L/s	DERIVED
Baffle discharge coefficient; roughness	0.40; 0.045 mm	ASSUMED
Supply tank: active volume Vs	0.0195 m³	CALIBRATED
Cover passage loss Kcouv	30	CALIBRATED
Measured resonance curves (fig. 37, ± 0.02 cfs)	3 panels	READ FROM FIGURE

4. Results



Arrangement B (well 1 covered): resonance curve at well 1, CBELIER with the modelled, calibrated supply tank (line), without calibration (grey dashes), and digitised measurements (circles).

5. Differences

Indicator	CBELIER	Reference	Difference
A: RMS difference, uncalibrated	1.35 L/s	—	12 % of peak
A: RMS difference, calibrated tank	0.65 L/s	—	6 % of peak
B: RMS difference, uncalibrated	1.10 L/s	—	31 % of peak
B: RMS difference, calibrated tank	0.29 L/s	—	8 % of peak
C: RMS difference, uncalibrated	1.40 L/s	—	47 % of peak
C: RMS difference, calibrated tank	0.46 L/s	—	16 % of peak

Without calibration, CBELIER departs strongly as soon as a well is covered (31 to 47 % of the peak). Modelling the supply tank, with two calibrated parameters, brings the difference down to 6 to 16 % of the peak. The case is published as a calibrated case, with the uncalibrated result alongside.

6. Limitations and assumptions

- CALIBRATED case: the tank active volume and the cover loss are fitted to the measurements.
- Without calibration, the 10 % target is met on no panel.
- Measurements read from a 1952 figure (± 0.02 cfs); baffle coefficient and roughness assumed.
- Small-scale rig and forced oscillations: this case concerns mass oscillation, not water hammer.

Computation: CBELIER engine 3c.26, 2026-11-06. Resonance curves computed on 3c.23 (docs/11_Validation_HYD324); differences recomputed on 3c.24.1, identical. Re-run with every release by the verification suite (verification/qv1). Alfa Wamane engineering consultancy — cbelier.alfawamane.ma