Sheet E3 · Experimental validation · CALIBRATED

Looped HDPE network, 4 sensors (University of Perugia)

Source : Meniconi, Brunone, Maietta, Zenodo 10.5281/zenodo.5535442 (CC BY 4.0); layout from Maietta's thesis

1. The question

In a real looped network, the wave splits and reflects at every node. Does CBELIER reproduce the pressures measured at several points of a laboratory network with 800 m of pipes?

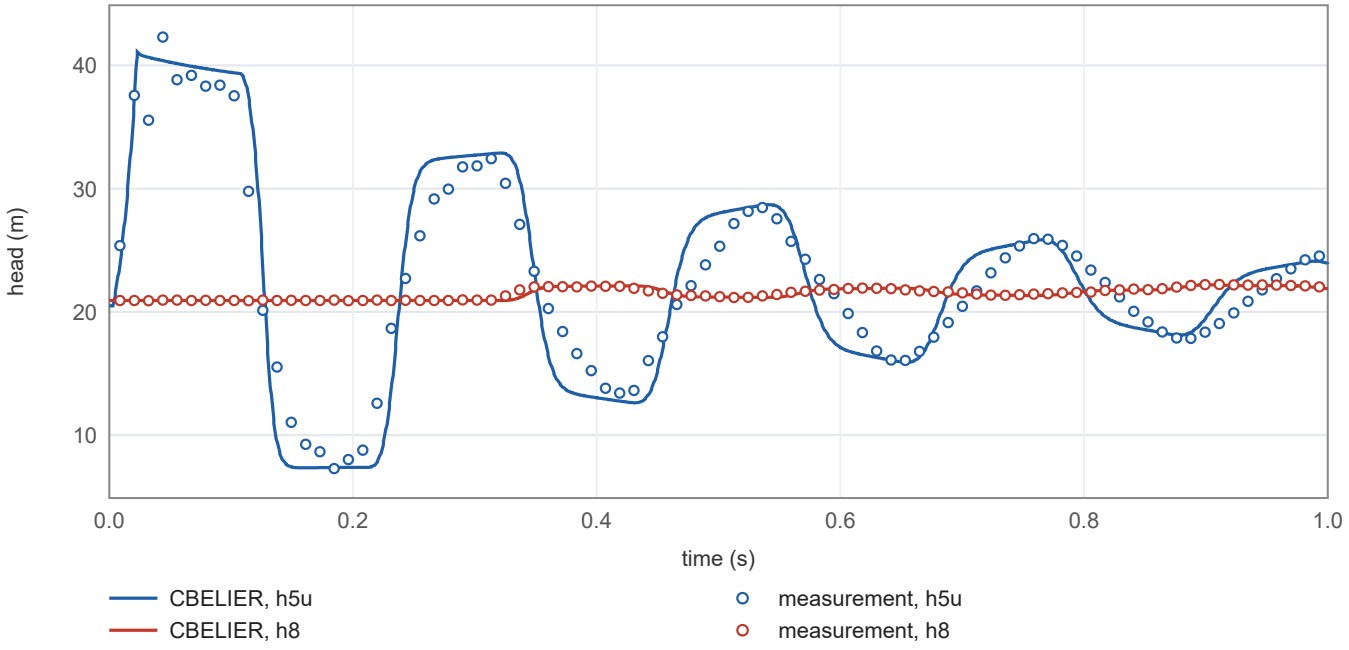
2. The case

The network includes a DN 110 supply pipe (42 m), two loops in DN 75 and DN 50 (700 m in total) and a DN 25 service branch, closed quickly at its end. Head is measured at the valve (h5u) and at three network nodes (h5, h8, h4).

3. Data and status

Data	Value	Status
Measurements at the 4 sensors	512 Hz	PUBLISHED
Layout: lengths, diameters, nodes	thesis, table 7.2	PUBLISHED
HDPE Kelvin-Voigt parameters	thesis	PUBLISHED
Initial flow (test 5u_q015)	0.15 L/s	ASSUMED
Closure duration and smoothing	19.6 ms; 3.1 ms	CALIBRATED
Reservoir level; valve area	—	CALIBRATED

4. Results



Head at the valve (h5u) and at node h8 over the first second: CBELIER (lines) and measurements (circles, one in six).

5. Differences

Indicator	CBELIER	Reference	Difference
Maximum pressure rise at the valve (h5u)	20.61 m	22.28 m	−7.5 %
Maximum pressure drop at the valve (h5u)	−13.14 m	−13.42 m	2.0 %
RMS difference, h5u (2 s)	1.98 m	—	—
RMS difference, h5 (2 s)	0.13 m	—	—
RMS difference, h8 (2 s)	0.17 m	—	—
RMS difference, h4 (2 s)	0.09 m	—	—

The extremes at the valve and at the network nodes are reproduced after adjusting only the closure law. Without the viscoelastic model the difference would be about five times larger: this case mainly validates the treatment of the HDPE wall in a looped network.

6. Limitations and assumptions

- CALIBRATED case: closure law, reservoir level and valve area are fitted to this test.
- The initial flow (0.15 L/s) is still to be confirmed with the authors.
- Small-diameter laboratory network: the orders of magnitude differ from a water-supply network.