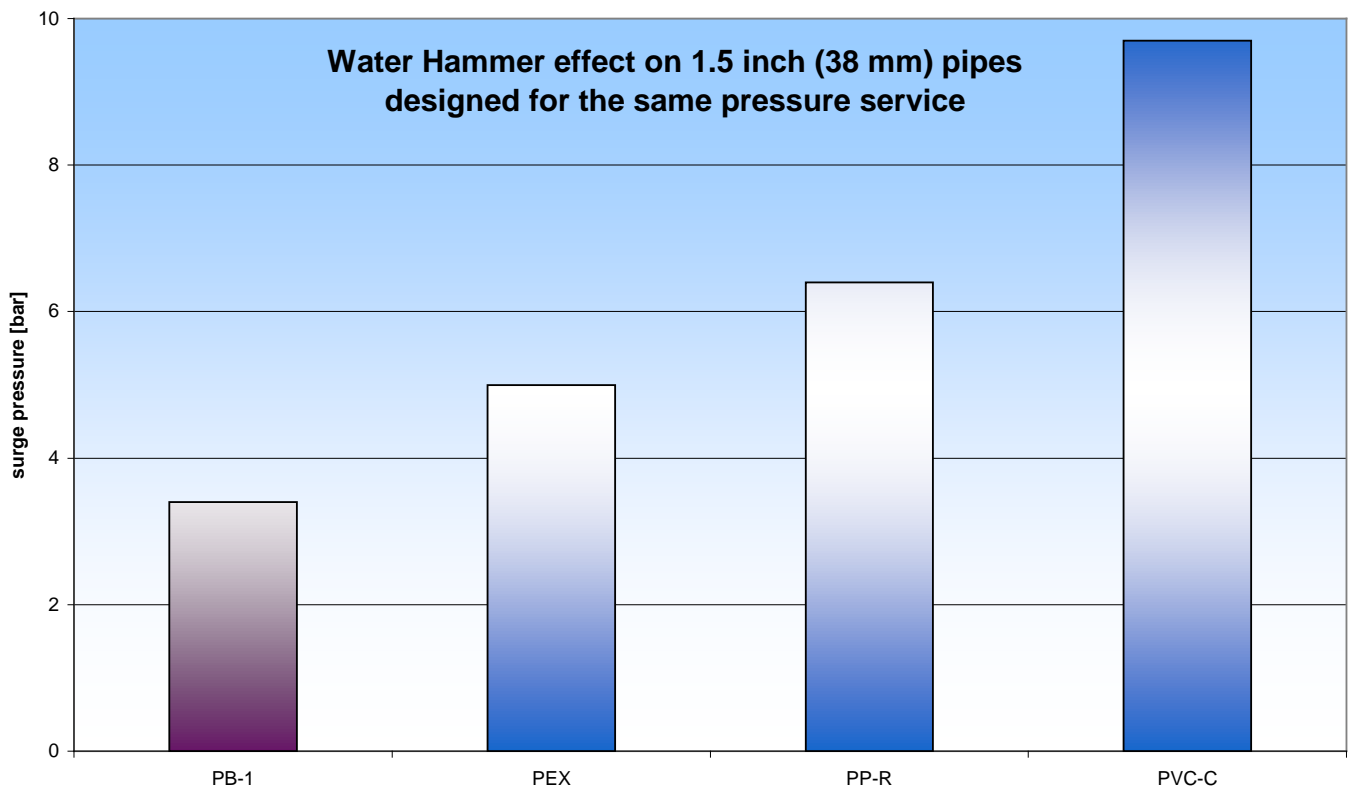


1) Basic Information

A column of moving water within a pipeline contains stored kinetic energy arising from its mass and velocity. Since water is essentially incompressible, this energy cannot be absorbed when a valve is suddenly closed. The result is a high instantaneous pressure surge normally referred to as 'Water Hammer'.

2) Grafic overview



3) Results

Five factors determine the severity of water hammer:

1. Velocity
2. Modulus of elasticity of the pipe material
3. Inside diameter of the pipe
4. Wall thickness of the pipe
5. Valve closing time

PB-1 gives the **lowest** Water Hammer effect mainly due the low modulus of elasticity. The Water Hammer is partly absorbed and the installation is left with much lower effects, as the follwing calculation is showing.



Water Hammer resistance

Calculation:

The maximum surge pressures caused by water hammer can be calculated using the following equation taken from the 'Handbook of Thermoplastic Piping System Design', Thomas Sixsmith and Reinhard Hanselka, Marcel Dekker Inc., pp 65-69

$$P_s = V((3960 E t)/(E t + 3 \times 10^5 D_i))^{1/2}$$

where:

- P_s = surge pressure (psi)
- V = water velocity (ft/sec)
- D_i = inside diameter of the pipe (in)
- E = modulus of elasticity of the pipe material (psi)
- t = pipe wall thickness (in)

The low elastic modulus of Polybutene-1, combined with reduced wall thickness gives rise to a low surge pressure for a given pipe OD and pressure rating. The table below compares maximum surge pressure for 1½" (38.1 mm) OD pipes of different plastic materials, designed for the same pressure service.

	E	D_i	t	V	P_s [psi]	P_s [bar]
PB-1	65000 *	1.28	0.15	5.0	49,5	3,4
PEX	87000 **	1.14	0.22	5.0	72.4	5.0
PP	116000 ***	1.05	0.26	5.0	93,0	6,4
CPVC	507000****	1.22	0.18	5.0	140,6	9,7

- * for 450 MPa
- ** for 600 MPa
- *** for 800 MPa
- **** for 3500 MPa

4) References/Standards

PB-1 pipes and fittings can withstand more than 100.000 pressure changes (2bar to 25bar to 2bar).

This is 10 times the requirements of pulsation test according to Plumbing standards (require 10.000 pulsations only).

Technical data are subject to alteration.

