from experience

As You Leak It: Estimating Pipe Leak Losses

Whether caused by corrosion, impact damage, water hammer, or the general wear and tear of everyday use, leaks are a common and problematic occurrence in piping and tubing. It may be necessary to calculate the flowrate from these leaks for a variety of reasons. For non-hazardous materials (e.g., water), a calculated leak rate allows personnel to prioritize which leaks should be fixed first or which can be left unfixed until they worsen. If the material is hazardous, a calculation could be used to determine how much product was lost without actually coming into contact with the hazard. When techniques for calculating leaks such as using a "bucket and stopwatch" are unsafe or impractical, the flow through a leak (Q) can be determined using the fluid velocity leaving the leak (v) and the cross sectional area (A) of the leak as seen in the formula below:

$$Q=v*A$$

Since it is impractical to measure the velocity of the leaking fluid, the American Water Works Association (AWWA) presents Greeley's Formula, a method that uses the pressure (P) inside the pipe to achieve a convenient and reasonably accurate estimate of the flow rate of water leaks. With Greeley's Formula, the flow rate of a leak can be estimated using just the cross-sectional area of the leak, the pressure of the fluid in the pipe, and an empirically derived orifice coefficient.

The flow (Q) can be calculated using the following variations of Greeley's Formula:

$Q = 30.394 * A * P^{0.5}$ for pin holes and circular openings in pipes, and
$Q = 22.796 * A * P^{0.5}$ for joints or cracks in pipes,

Where...

Q = Flow, gallons per minute
A = Cross-sectional area of the leak, inches^2
P = Pressure in the pipe, psig

Note that Greeley's Formula was created using water as a basis, so it provides a good estimation for compounds with similar physical properties. Using the same formula for compounds with other properties (e.g., significantly higher or lower SG or viscosity) will affect the accuracy of the calculation, and is beyond the scope of this article.

Source: 2009 AWWA "Water Audits and Loss Control Programs, 3rd Edition"

experience in brief

Hole diameter to area conversions:

Hole Width (inches)	Hole Area (in^2)
1/32	0.00077
1/16	0.00307
1/8	0.01227
1/4	0.04909
1/2	0.19635

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