Chemical Injection Technologies

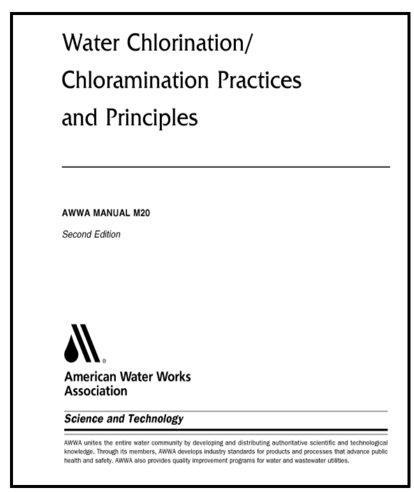
Technical Bulletin

Chlorine gas Flow Regulation In Modern-Day Vacuum Operated Gas Chlorinators.

Virtually every major manufacturer of gas chlorinators in the market today, uses "SONIC" regulation rather than the old differential pressure regulator that was common in the 1950's and 1960's, for gas chlorinators feeding up to 500 PPD (10 KG/HR). Many of these same manufacturers were claiming at that time, and even up into the 1990's in some cases, that Sonic regulation was not a viable method of regulating chlorine flow. However, like most outmoded ways of thinking, they had to give up on that desire to stay linked to old theories and get on with designing equipment better suited to the more modern requirements.

One reason for the reluctance to change is, of course, the cost and time involved in designing and manufacturing new equipment, to say nothing of the talent. The "old guard" finally just didn't have a choice, because the market had matured and users realized that there was a better, simpler, safer, and less expensive way to accomplish things. But consider for a moment how much more complicated those old designs were, with all of the inherent extra parts involved that meant future revenues for the manufacturer as replacement parts were needed. Service and maintenance contracts were the norm because most users were not able to handle routine maintenance, so that was another source of income for distributors and service centers. That is why the change to "sonic" regulators took so long.

However, the end user pressure has not been as great with higher capacity gas chlorinators, because the major manufacturers have all pretty much stuck together in this area, partly to justify the very high prices they charge. The sonic regulation principle, which is well documented (see excerpt, below) and has been known in fluid mechanics for over 70 years, is not limited in any way to a particular maximum rate of flow of the gas. The same principle applies to feed rates of 200 KG/HR (10,000 PPD) as it does to 0.2 KG/HR (10 PPD). It boils down to whether or not the equipment can maintain a constant upstream pressure (vacuum) from the vacuum regulator to the rate valve, and whether the ejector is capable of creating enough gas volume POTENTIAL to maintain the gas stream VELOCITY across the rate valve, at or above the speed of sound in that gas. Our ejectors are capable of doing this, as are those of several other manufacturers who also do not require differential pressure regulators at 40 KG/HR. This has been proven and demonstrated in the field for over 25 years. D/P regulators are definitely the "old" technology and I believe that they will eventually disappear from some of the current brands that still use them in gas chlorinators over 10 KG/HR. Differential pressure regulators are not "rocket science" and those principles and designs are well known by us and other manufacturers. For us to use outdated technology for the sake of making it easier to develop a wider range of capacities, would mean abandoning our commitment to our customers that we will continue to give them the best and most modern equipment on the market. And make no mistake about it . . . we can very easily copy that old technology and just give customers that same old complicated, expensive and maintenance prone equipment, but that's not why SUPERIOR has earned a very enviable reputation for quality and customer preference.



Excerpt from AWWA Manual M20 "Water Chlorination/Chloramination Practices and Principles". *(NOTE: This excerpt is copyrighted material and is intended only for review)*

"The principle components of a chlorine gas feeder are vacuum regulators, flow indicators, flow controllers, and a venturi. The feeder operates by rgeulating th eflow of chlorine gas by controlling and regulating the vacuum conditions upstream and downstream of an orifice or flow-control device. Most chlorine gas feeders use [one of] two methods of controlling and regulating the gas flow: constant differential-pressure or sonic flow. Constant differential pressure requires maintaining a constant vacuum differential across the orifice (rate-control valve) by using a differential pressure (vacuum) regulator or downstream vacuum vacuum regulator. This regulator maintains a constant pressure (vacuum) drop across the orifice for any givensetting of the orifice. When this occurs, the operator can adjust the orifice (the rate control valve) and be assured that the gas flow will be maintained at the desired setting. The use of a differential-pressure regulator or a downstream vacuum regulator corrects for any variation in downstream vacuum that would cause an undesireable variation in gas flow.

Sonic flow requires maintaining a minimum upstream vacuum so that a variation in downstream vacuum will not cause any variation in flow. Sonic flow is so named because the minimum upstream vacuum level required to reach the desired condition is such that the velocity of the gas through the orifice is at the speed of sound, i.e., sonic velocity.

The ratio of the downstream pressure to the upstream, for which the sonic velocity is attained, is called the *critical pressure ratio* (rc). If the upstream vacuum is held at a constant 20 in. (508 mm) water (13.973 psia [96.3 kPa (absolute)]), the downstream vacuum must be 14.6 in (371 mm) mercury vacuum or 7.53 psia (51.9 kPa [absolute]) *or greater*.

The flow of chlorine gas across an orifice increases as this ratio reaches 0.539. When $P_u = P_d$, the ratio is 1 and flow ceases. As the vacuum level increases, the gas flow increases, although not linearly. At some point, any additional increase in vacuum level causes no further increase in gas flow. The point at which this occurs is the sonic flow of the gas. For chlorine, sonic flow occurs at approximately 14 in. (356 mm) of mercury vacuum level downstream of the orifice. Sonic flow is important because it represents a simpler form of flow control, has fewer components than other typical functioning systems, and reduces the costs of maintenance and service."