General
Ideally, chemical treatment of water at municipal and industrial plants should be done within the minimum possible time and chemical use needed for complete disinfection/dechlorination. Energy consumption should be minimized. To fully satisfy this need, chemical induction into and mixing with process water must be rapid and highly efficient. In the past, ejector/diffuser systems have met most needs. However, increases in flow rates at existing plants, increasing energy and chemical costs, and growing public awareness of and concern for the consequences of excessive chemical treatment of water have lead to the search for alternative induction approaches. Most significant of these new approaches is the use of the CHLOR-A-VAC® chemical induction unit.

Ejector/Diffuser Systems
Ejector/diffuser systems combine optional booster pumps or external fresh water sources with ejectors to create a solution of chemical and water. The chemical solution is transported through a pressure line to the point of application where diffusers disperse the solution into the process water. Static or motorized mixers may also be used together with the diffuser to disperse the solution (Figure 1). Weaknesses of ejector/diffuser systems are well known and include:
1. The need to provide a water source for the ejector.
2. Booster pump maintenance and energy costs.
3. Safety issues associated with having a chemical solution line under pressure.
4. The potential for water and solution lines to freeze in cold climates.
5. The possible need to install multiple diffusers to minimize chemical breakout.
6. The possible need to install one or more static or motorized mixers to assure adequate mixing.
7. Motorized mixer maintenance and energy costs.
8. The need to design for a minimum contact time of 30 minutes in disinfection applications to assure complete disinfection at peak flows without producing excessive chemical residuals.

CHLOR-A-VAC Chemical Induction Unit
CHLOR-A-VAC chemical induction units eliminate weaknesses associated with ejector/diffuser systems. CHLOR-A-VAC combines the functions of a booster pump, ejector, diffuser, and mixer in one compact unit. This unique design provides for rapid, effective, highly efficient induction and mass transfer of chemicals to process water. This results in better chemical dispersion, better chemical dissolution, no breakout, reduction of chemical consumption while maintaining effective disinfection, and lower energy costs (Figure 2).

Benefits
CHLOR-A-VAC chemical induction units have several major advantages over ejectors/diffusers:
1. There is no need for a separate water source since CHLOR-A-VAC is submerged in and depends on process water for vacuum creation.
2. The high velocity discharge of solution into the contact tank provides uniform chemical transfer not possible with diffusers and eliminates the need for providing separate mixers.
3. The chemical induction unit design and its all-vacuum operation completely eliminate the pressurized chemical solution line, which is prone to freezing, and significantly enhances operational safety.
4. CHLOR-A-VAC eliminates chemical breakout by the downward force of the unit’s propeller that drives the entrained chemical to the bottom of the contact tank. This action produces small bubbles that accelerate transfer of chemical to the process water.
5. The potential reduction in energy consumption through the use of a single, low horsepower motor in systems when a booster pump or mixer would be required.
Figure 1 - Ejector/ Diffuser System

Figure 2 - CHLOR-A-VAC Chemical Induction System
6. Rapid, efficient mixing of chemical with process water increases the kill rate, reduces the need for 30 minute contact time and significantly decreases chemical consumption. Plants that installed CHLOR-A-VAC® report up to 40% savings in the quantity of chemicals used.

7. Since CHLOR-A-VAC has dual chemical inlets allowing the simultaneous induction of two chemicals, it can be used to both dechlorinate and add oxygen at the same time at plants where dissolved oxygen levels are low. This feature also often eliminates the need and cost of a post-aerator.

Chemical Induction Unit Applications
CHLOR-A-VAC chemical induction units are ideally suited to applications requiring rapid, effective, highly efficient mixing of a wide range of gas or liquid chemicals with process water. CHLOR-A-VAC applications for new or existing plant installations include but are not limited to:

1. Wastewater Disinfection with chlorine gas or liquid hypochlorite Dechlorination with sulfur dioxide gas or liquid bisulfite Coagulation with aluminum sulfate (alum)
2. Drinking Water Disinfection with chlorine gas, liquid hypochlorite, chlorine dioxide, or ozone Coagulation with aluminum sulfate (alum)
3. Cooling Towers Control of algae and slime growth with chlorine gas or liquid hypochlorite

   CHLOR-A-VAC units may be placed in one or more of several locations at water or waste water plants including:
   - Contact basins
   - Headworks
   - Return sludge processes
   - Clarifier inlets
   - Collection boxes
   - Equalization tanks
   - Lagoons
   - Clear wells

In dechlorination applications, CHLOR-A-VAC can be used to replace the diffuser and mixer if used, to meet plant discharge permit requirements. In these applications, the distance between the contact tank and outfall to the receiving stream is too short for sufficient limitation of chlorine residual necessitating more rapid mixing only obtained with CHLOR-A-VAC.

Reduced Contact Time
Plants approaching design capacity due to increasing flows can consider chemical induction units to reduce contact time and avoid expansion programs. Some locations have recognized the efficiencies of chemical induction units and allow contact time to be cut in chlorine contact chambers. This allows plants to increase throughput without the need for physical plant expansion. In the future, contact time requirements may be reduced further as this process gains wider acceptance.