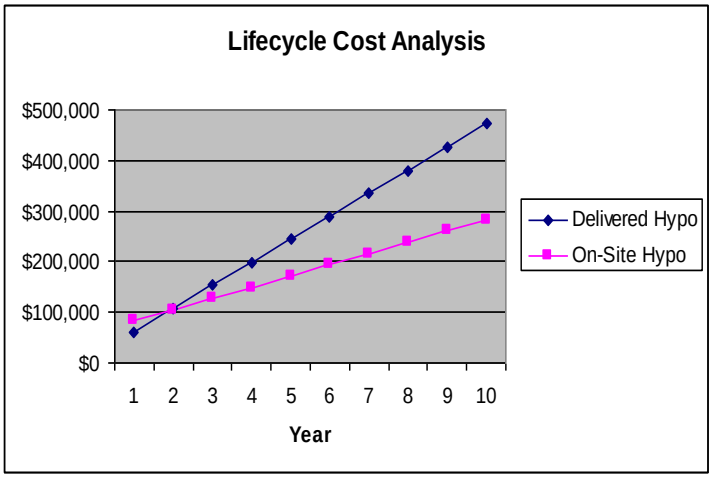
Switching from Chlorine Gas
Evaluating Bulk Hypochlorite versus On-Site Generated Hypochlorite

Chlorine gas is the historical disinfection choice for municipal potable water and wastewater systems due to its low cost and ease of maintenance. However, the hazardous status of chlorine gas and its potential as a terrorist target are driving many facilities to consider alternative disinfection methods. The decision frequently comes down to a choice between commercial sodium hypochlorite delivered in bulk and on-site generated sodium hypochlorite. The primary decision factors are cost, ease of maintenance, safety, and environmental impact.

COST:

When making an evaluation, the full lifecycle cost of operations, transport, maintenance, and capital outlay should be considered. Although the capital cost of an on-site generation system is typically higher than delivered hypochlorite, the operating costs (determined by the cost of salt and power) are often around half that of delivered hypochlorite. System payback for an on-site generation often occurs in less than three years, as shown by the graph at right for a 100 pound per day system. Assumptions include a cost of $1 per gallon for 12.5% hypochlorite, $0.10 per pound for salt, $0.07 per kW-hr for power, and industry standard conversion efficiencies of 3.5 pounds of salt and 2.5 kW-hours of power per pound of free available chlorine (FAC) generated. Vendors should be able to provide a similar cost analysis based on appropriate regional costs.



The raw materials costs for both delivered hypochlorite and chlorine gas have been climbing drastically over the past several years while the cost of salt and power has remained relatively constant.

These figures do not include transportation costs, which further exaggerate the difference between on-site generation and bulk hypochlorite.

OPERATION & MAINTENANCE:

The main maintenance concern associated with on-site generation (OSG) is cleaning the electrolytic cell due to calcium build-up. Since the solution is generated on site and on demand at a low concentration, there is no concern with degradation or off-gassing. Operators and plant managers state that time invested in OSG system maintenance is similar to that required with chlorine gas.

In contrast, solution stability of concentrated hypochlorite is greatly affected by concentration and temperature. The hotter the temperature and the more concentrated the solution, the more rapid the degradation to chlorate and oxygen gas. A 15% concentration at 80°F showed 28% degradation in 1 month's time.[i] Sites using bulk hypochlorite must adjust for degradation, dilute their solution upon receipt, plan for more frequent deliveries, or cool the storage room.

Concentrated hypochlorite also causes a much greater impact to the pH of the treated water, due to the fact that the pH of the bulk solution is adjusted to around 12-13 to control degradation. The pH of an on-site generated hypochlorite is only 9, meaning that it is 1,000 to 10,000 times less caustic. OSG can often significantly reduce the use of pH adjustment chemicals.

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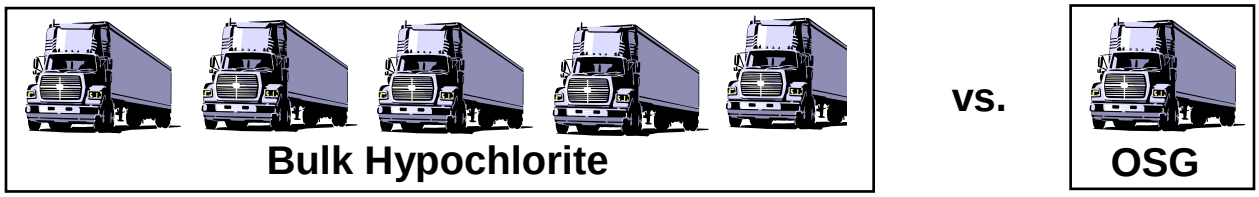
Concentrated hypochlorite is also significantly more corrosive and is more prone to off-gassing than OSG, causing subsidiary maintenance requirements due to facility corrosion.

ENVIRONMENTAL IMPACT:
OSG drastically reduces the addition of carbon to the environment, due to reduced transportation requirements. The volume of 12.5% bulk hypochlorite is nearly five times more than the volume of salt required to generate an equivalent amount of hypochlorite on site. Shipping requirements are reduced by up to 5 times with OSG.



SAFETY:
Safety concerns with OSG include hydrogen safety and electrical safety, both of which can be controlled through proper system design and installation, as evidenced by the more than 4,000 installed units in the U.S. alone from a variety of manufacturers.

In contrast, bulk hypochlorite is a concentrated chemical with the potential for an accidental chlorine release during transport to the site, transfer to storage tanks, and storage of the chemical. Although the results of an accident are usually less severe than with chlorine gas, the occurrence is more frequent, causing disruptions to facility operations and communities.

CONCLUSION:
The data indicates that on-site generation of hypochlorite presents a more favorable solution than delivered hypo, with a better safety record, more favorable lifecycle costs, ease of operation and maintenance, and an improved carbon footprint.

[i] Gordon, G. et al., "Predicting Liquid Bleach Decomposition" Vol. 84, Issue 4, pp.142-149, 1997.