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Making a Reactive Chemical System Inherently Safer at a Small Company: Case Study of the CDG *Gas:Solid*™ Chlorine Dioxide Generator

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Abstract

It is perceived that management of reactive chemical hazards is especially challenging to small companies due to their limited resources relative to large chemical manufacturers. However, many small companies a very innovative and can quickly find and implement solutions to reactive chemical challenges that threaten the success of their business. In this paper we describe an innovative solution to a reactive chemical challenge faced by a small company, CDG Technology, Inc. in 2000 and 2001. At the time, CDG was a small company with about 10 employees, just emerging from the startup phase.

CDG produces systems for the on-site production of chlorine dioxide (ClO_2) gas, ranging from laboratory scale to plant scale applications for disinfection of municipal drinking water. In the CDG systems dilute Cl_2 gas reacts with solid sodium chlorite ($NaClO_2$) to produce dilute ClO_2 gas. Because of the high reactivity of Cl_2, ClO_2, and $NaClO_2$, significant effort went into the design of the system safety, operating instructions, and warnings. As the number of commercial installations grew over more than five years of incident operation, a series of fires occurred at some customer facilities and at a manufacturing facility of subcontractor that assembled the company's sodium chlorite cartridges. Individual fires appeared to be caused by a variety of external factors that initiated exothermic decomposition of cartridges of $NaClO_2$. While some of these fires can be prevented in the future by adding additional layers of protection to th systems, CDG realized that commercially available technical grade $NaClO_2$ might always be susceptible to exothermic excursions and runaway thermal decomposition when abused. To create an inherently safer system, CDG developed a new formulation of solid $NaClO_2$, *Saf-T-Chlor*™, which also contains hydrated salts. When the material is heated, endothermic dehydration of the salts counters the exothermic decomposition of the $NaClO_2$. The formulation has significantly higher thermal stability than commer available solid $NaClO_2$ and can withstand substantial heating without undergoing runaway thermal decomposition. The developme and testing of the *Saf-T-Chlor* are discussed in detail in the paper. Since the introduction of *Saf-T-Chlor*, no fires have occurred in more than four years of operation and CDG has been able to expand the use of it systems into a variety of new industries.