Sodium Hypochlorite: The Unsung Hero In Disinfection

By Angela Yeung, District Sales Manager, Grundfos

For the fortunate few in this world, many of us enjoy fresh cold water from our taps, crisp white linens in hotel rooms, and refreshing and safe water in swimming pools. It all seems very easy and straight forward with all the new technologies available in the industry to ensure safe and clean drinking water. A reliable and effective technology is always needed to ensure peace-of-mind for all water treatment processes. In many cases, it is the centuries old Sodium Hypochlorite (NaClO) chemical, or as known by every household – Bleach.

Need for Different Disinfectants

A single amoeba detected in a swimming pool can close down the entire facility. Even clear mountain water can have giardia protozoan and lead to fatal illness. Each of these organisms is different and requires different methods to kill them. They build immunities, have different structures and live in different environments. Often, more than one disinfectant is needed to ensure eradication.

There is no single, magic disinfectant. There are a large variety of disinfectant technologies available today, mainly categorized as physical disinfection (filtration or heating) or chemical disinfection (chlorine, bleach, or alcohol). It is important to understand the strengths and weaknesses of the disinfectants and how to utilize both physical and chemical technologies for a customized disinfection, balancing cost, effectiveness and safety. While it has become increasingly common to use physical filtration as a main disinfecting step, its popularity should not shadow the importance of the trusted sodium hypochlorite.

Bleach

Sodium hypochlorite, or bleach, was developed in the 19th Century and used increasingly as a disinfectant in the last few decades. It is the most common water disinfectant in the US and the world. Bleach is a stabilized salt solution of sodium hypochlorite, which typically comes out of solution as a vapor. It is available in a variety of strengths from 0.8 % to 12.5%, and can be used in drinking water applications. In order to stabilize it at a high pH (near 13), caustic and metals will remain as part of the solution from the manufacturing process.

Like chlorine, hypochlorous acid (HClO) is the actual disinfectant, with sodium hypochlorite converting to acid and caustic in water. Bleach is relatively inexpensive and is as effective as chlorine. Other than containerized solution form, bleach can also be produced on site using electrochlorination. Onsite Sodium Hypochlorite Generators (OSHG) generate bleach using salt and water with electricity to create a pure but dilute form of bleach.

Most bleach ships in an aqueous solution in containers. However, due to the volatile nature of bleach, the strength of bleach decreases with time, especially in warmer weather. Chemical feed and precise control equipment are required for proper feed of bleach that may vary in strength. It has a long lasting effect in water and is ideal for distribution networks.

Despite the ease of use and simplicity of bleach, it has the same issues as chlorine gas when it comes to pH dependency and disinfection by-products, such as THMs and chlorophenols. There are also feed issues related to the off-gassing tendencies of bleach. Hypochlorite solution is volatile. It decomposes and releases gas leaving salts behind. The gas can get trapped in suction tubing and pump heads. These issues can cause gas locking in diaphragm pumps which can stop the pump from feeding chemical. Even peristaltic pumps can be inaccurate and can cause premature failure with bleach off-gassing.

Tips for Bleach Feed

Proper bleach feed starts with smart system design. Short, straight flooded suction feed lines to pumps, as opposed to suction lift from drums, ensures consistent supply. In certain applications pulsation dampeners, air release valves and other devices are necessary. It is important to eliminate exposure to air – such as in spring-loaded air-release valves – and unnecessary bends and curves in piping. A multifunction-valve or back-pressure and pressure relief valves after the feed pump ensure proper injection.

Smart adaptable pumps such as the Grundfos' SMART Digital Dosing pumps with advancements in accuracy and integration allow a smooth handling of the most troubling issue of bleach off-gassing. The dosing head and valve with 100% suction stroke are designed to allow gas bubbles to escape easily. The pump is equipped with air bubbles detection and auto degassing drive strategy. They even have an auto deaeration feature during pump standby. Its ground-breaking internal stroke speed control with stepper motor technology allows a maximum turn-down ratio of 1:3000. The result is smooth and accurate dosing over the pump's full adjustable range (100% to 1/3000 of full capacity), with no impact due to off-gassing.

Conclusion

Weighing the advantages and disadvantages of bleach, it is easy to see why it remains the most common disinfectant today. It is simple, inexpensive and effective. With all other newer technologies available in the market today, bleach is seeing more competition in the growingly demanding and stringent disinfection market. With the long life cycle and reliable operating history of bleach, it remains a viable solution for the foreseeable future. When you dive into the swimming pool you can still be assured that bleach is working hard to guarantee your access to fresh, clean and safe water.

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About Angela Yeung

Angela is the disinfection technical sales manager from Grundfos, focusing on chlorine dioxide generators. She graduated from University of Michigan with a chemical engineering degree. Angela is the author of several technical papers on membrane filtration best practices for major water treatment plants. She is an active member of AWWA and WEF organizations, and served on the committee of South Central Membrane Association. Prior to her current role at Grundfos, Angela was the lead technical specialist for RO and UF membrane filtration at Dow Water and Process Solutions.