CALCIUM HYPOCHLORITE IN MUNICIPAL AND EFFLUENT WATER TREATMENT

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ABSTRACT

Calcium Hypochlorite (CH) is a strong oxidizer and an effective anti-microbial compound. It serves as a multi-functional sanitizer in drinking water, wastewater treatment, irrigation, swimming pools and spas, fruit washing, beverage plants, cooling towers and abattoirs.

In municipal and wastewater treatment CH is used at all stages from Surface Raw Water, Finished Water, Booster Stations, Reservoirs, Remote Well Sites, Reclaimed Water and Overflows. It is used as backup chlorination on chlorine gas treatment plants and in emergency potable and wastewater treatment situations across the world.

This paper reviews the properties of CH with a focus on evolving practical application through a range of Case Studies.

KEY WORDS

Calcium Hypochlorite (CH), Chlorine, available Chlorine (avCl), oxidation, canister, feeder, dosing

1.0 INTRODUCTION

1.1 Calcium Hypochlorite / $Ca(OCl)_2$ – Industry Approval, Physical and Chemical Properties, Available Forms

CH has been an approved chemical for disinfection and oxidation of drinking water in Australia since 1983 (NHMRC). CH is part of the chlorine based oxidising family sodium hypochlorite, chlorine gas, and related chlorine dioxide and chloramines (NHMRC). CH is stable during storage with shelf life typically two years.

CH is manufactured at 65-70% available Chlorine (avCl) by content and typically supplied in 10 - 45kg sealed and 'drop tested' buckets.

Table 1: ***Physical forms and chemistry of common chlorine sources***

Type	Form	avCl in use	pH
Chlorine	gas	100	1.0
Sodium hypochlorite	liquid	7.5 – 15	13.0
Calcium hypochlorite	solid	65 – 70	8.0 - 11.0

CH is classed as a 5.1 oxidising agent for transport and storage purposes. Quantities up to *1000kg are classed as 'minor storage' under Australian Standard® (2008) and require lowest tier safety requirements and no secondary containment when stored.

*1000kg of CH at 68% will raise Chlorine levels by 1ppm in approx. 700ML

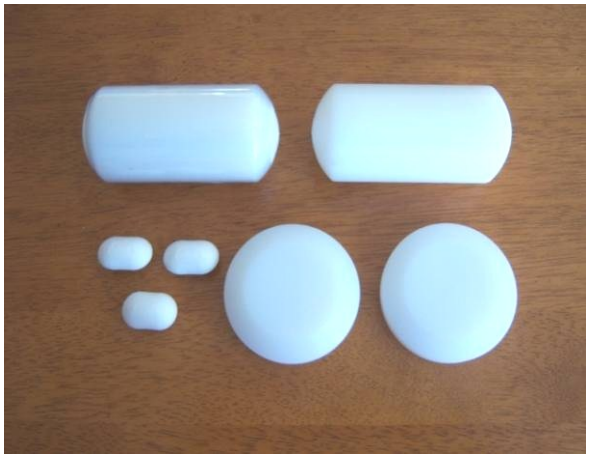

Figure 1: ***Calcium Hypochlorite in typical moulded forms***

The first stage granular form can be moulded into a range of tablet and briquette forms. Typical weights range from 7g to 300g (Figure 1) to suit application methods and ease manual handling through the use of scoops for filling erosion/spray systems and hopper feeder systems

2.0 DISCUSSION OF CH DOSING METHODS, INNOVATION & CASE STUDIES

2.1 Direct Dosing

CH dissolves readily in water and this property remains a valuable feature for all applications. Manual addition in granular or tablet form can be a fast and effective method for boosting or 'shock' oxidation. Innovations in manufacturing have led to slower dissolving rates and release of chlorine through high density tablet presses and encapsulation in plastic sleeves. CH filled floating and submersible canisters dissolve over a period of days to weeks depending on the reservoir size and chlorine demand. Typically canisters are 1m length of 100mm diameter PVC pipe, perforated and capped at one end, filled and suspended.

Whilst the principle of dissolving CH in water is simple there are an increasing number of ways to deliver a controlled chlorine dose into the target water supply.

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2.2 Controlling Water Quality via In-line, Erosion/Vortex and Spray Technology

Accurate control of the rate of chlorine dissolution and dosing 'on demand' is possible with modern CH feeder methods and vital in most modern municipal water supply networks.

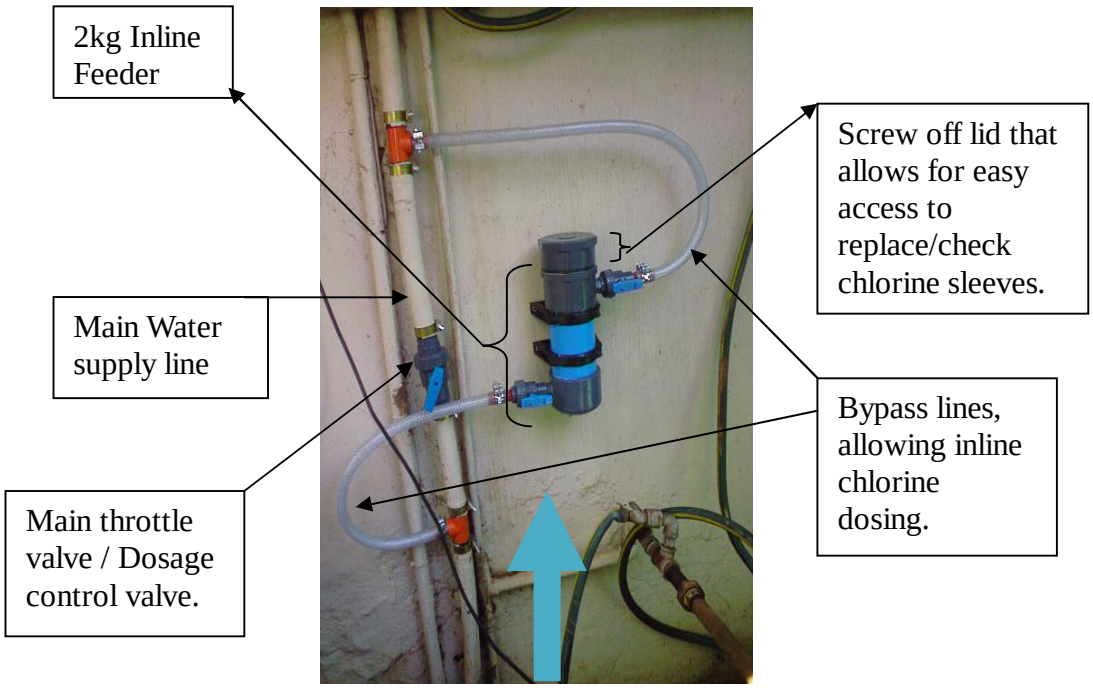

Figure 2: ***2 kg CH capacity in line feeder method***

- Ideal for small settlements or boreholes –
- Mainline water flow: 2600 l /hr with flow through inline feeder: 600lt/hr.
- Chlorine Dosage: 1.6ppm. Consumption: average 3½ weeks between fills, 1.82kg CH tablet capacity when full.

In line feeder size can be modified to suit demand, for example holding 20kg of CH.

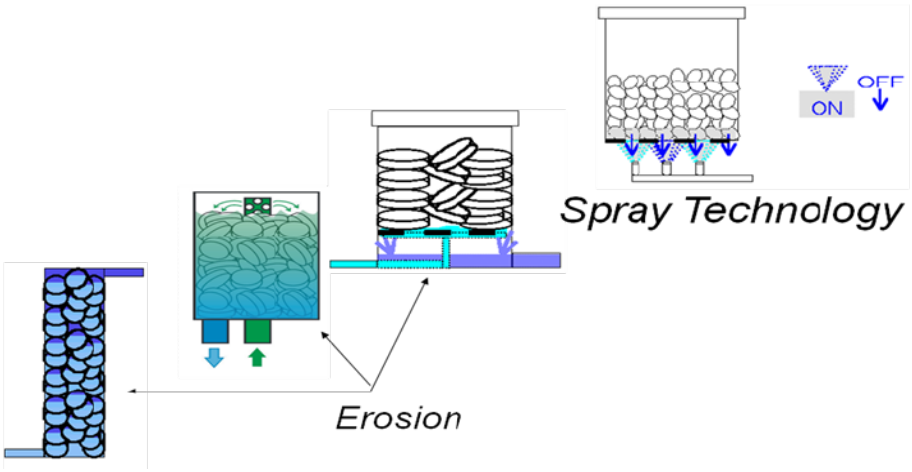

Figure 3: ***Erosion, Vortex and Spray Technology producing CH solution on site, on demand***

Spray and Erosion Technology create a fresh and readily available chlorine solution which suits applications with variable flow or chlorine demand.

Spray Technology uses a mesh grid to support the CH tablets or briquettes, which are sprayed from below with a stream of water which dissolves the CH. In both cases a consistent solution is created in the holding or reservoir tank below at up to 17,000ppm chlorine ready for use.

2.3 Case studies

Siza Sewage Water Treatment: Ballito, South Africa treats about 5 ML of sewage water per day. A CH erosion feeder was linked to a continuous pH and Redox (Oxidation Reduction Potential) analyzer to control the feeder and meet required residual Chlorine levels in the final water and compliance with discharge requirements set by Department of Water Affairs (DWA). A dedicated re-circulating line was installed on the contact chlorine tank to circulate the water continuously at a rate of 16 m^3 per hour to ensure proper mixing of chemicals and final effluent water.

Figure 4: ***Feeder, pH /Redox controller adjacent to the chlorine contact tank***

CH used as a means of backup chlorination to gas chlorine: Zuikerbosch plant site, Rand Water Board (RWB) – Johannesburg, South Africa. One of the largest water utilities in the world, RWB is the sole bulk supplier of potable water to Johannesburg and Pretoria in Gauteng, South Africa, supplying more than 10 million people across an area of 18,000 km^2.

Here, during phases of planned and occasionally unplanned chlorine gas plant shutdown 9 x 180 kg capacity feeder units dissolve more than 30 kg CH each per hour without the help of electricity, solution is gravity fed to the 128 ML storage tanks below.

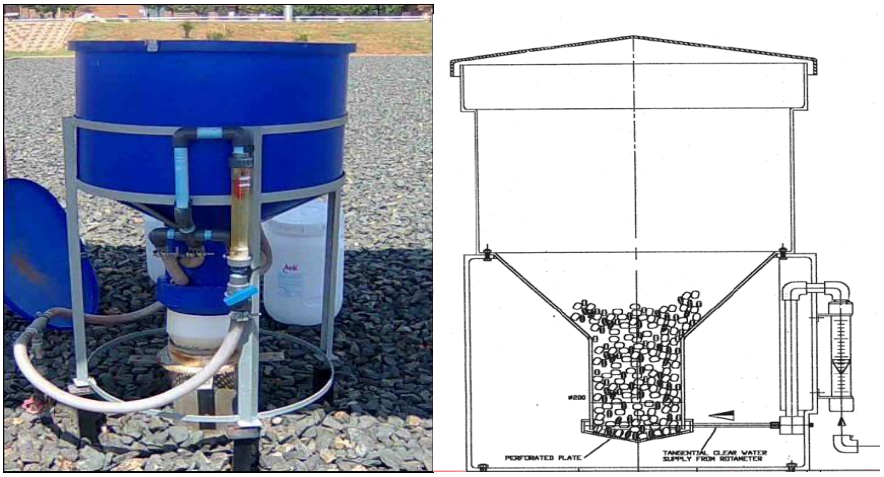

Figure 5: ***180kg capacity feeder situated above a 30ML storage tank at RWB Zuikerbosch Station with a cross sectional view of a typical erosion feeder on the right.***

Potable water supply at Waterberg District Municipality: Bela Bela, South Africa. CH dosing system replaced gas chlorine on the Potable Water Plant to serve the needs of 615,000 people in the Limpopo province of South Africa This newly built 6.5 ML/day plant abstracts its raw water from the Platriver ex the Warmbad New Dam.

Figure 6: ***Feeder with reservoir using a partial vacuum or venturi system to draw the CH solution from the reservoir below the feeder into the main water supply.***

2.4 Combining CH dosing with water quality monitoring

A range of water quality parameters can be monitored e.g. avCl, pH and redox. Feedback of these values controls the CH feeder unit maintaining chlorine levels at predetermined set levels.

Figure 7: ***Dosing CH at a small reservoir – feeder, pumps and analyzer housed in a skid unit***

3.0 CONCLUSIONS

- Calcium hypochlorite is a versatile source of chlorine suitable for a range of dosing methods, many of which are simple, low maintenance, do not require power and can cope with variable demand
- Suitable for all sizes of municipal and wastewater treatment
- Compact systems with small footprint for storage and dosing equipment
- Simple, robust dosing systems help to reduce breakdowns and maintenance
- Consistent strength of chlorine solution gives consistent chlorine residual
- Linking with water quality monitoring, dosing pumps and remote communication technologies to meet the demands of evolving water standards.

4.0 ACKNOWLEDGEMENTS

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5.0 REFERENCES

NHMRC Australian Drinking Water Guidelines, Chapter 8 Drinking water treatment chemicals www.nhmrc.gov.au/_files_nhmrc/file/publications/synopses/adwg_11_06_chapter_8.pdf

Australian Standard® 2008 - The storage and handling of oxidizing agents, AS4326-2008