

# CHLORINATION EQUIPMENT SELECTION GUIDELINES

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# Background

In the past, design practice was based primarily on population and little emphasis was placed on other related factors such as water quality, chlorine demand, flow variance, training requirements, cost, etc.



# Goal

to recommend design criteria to be considered by designers and municipalities in choosing the most appropriate form of disinfection equipment for their water supply system



# **Gas Chlorination**

- Gas chlorination is usually used in communities where chlorine demand is in excess of 0.68 kg or 1.5 lb per day
- Gas chlorination provides higher doses of available chlorine to the water





### CL<sub>2</sub> Gas System

### Sodium or Calcium Hypochlorite System









# In this province

501 water supply systems 138 gas - 300 liquid 11 powder - 52 other or no cl





### **Dosage vs Flow**



Area below the curve would be hypochlorination and areas above would be either gas chlorination or hypochlorination



# **Education and Training**

Selection of either gas or hypochlorination equipment would have little bearing on operator education and training requirements. Training requirements vary between the two types of equipment, but it is not significant.



# Hazard/Safety

- Both chlorine gas and hypochlorite are classed as hazardous materials and should be treated as such.
- Chlorine gas can be considered a higher hazard/safety risk as compared to hypochlorite.



### Definition

 The cost of purchasing, operating and maintaining your treatment related equipment over 10 year period.



### Information used to create life cycle tables

- Annual Inflation Rate
- Rate of Return
- Annual Interest Rate
- Consumption Growth Rate
- Flow Rate
- Dosage Rate
- Capital Cost
- Chlorine Cost
- Maintenance Cost



Town of : Any Town

#### Hypochlorite Liquid

Commencement Year:	2005		
Annual Inflation Rate:	1.0%		
Rate of return	5.0%		
Annual Interest Rate:	10.0%		
Annual Consumption Growth Rate:	1.5%		
Average Flow Rate:	2.50 L/S		
Dosage:	5.0 mg/l		
Capital Cost:	\$104,000		
Cost of Chlorine per litre	\$1.24		
Concentration of Liquid Chlorine	10.50%		
Maintenance Cost 1st Year	2,340		

	Capital					Cost per	
	Year	Cost	Chlorine	Maintenance	Total	СМ	СМ
	2005	16.026	4 047	2 340	22 212	78 750	0.206
	2005	16,920	4,047	2,340	23,313	70,750	0.290
	2000	16,926	4.375	2,387	23.687	81.130	0.292
	2008	16,926	4,440	2,411	23,777	82,347	0.289
	2009	16,926	4,507	2,435	23,867	83,582	0.286
	2010	16,926	4,575	2,459	23,959	84,836	0.282
	2011	16,926	4,643	2,484	24,053	86,109	0.279
	2012	16,926	4,713	2,509	24,147	87,400	0.276
	2013	16,926	4,783	2,534	24,243	88,711	0.273
	2014	16,926	4,855	2,559	24,340	90,042	0.270
	PW	\$130,694	\$34,694	\$18,829	\$184,217	842,839	
	Total PW			\$184,217			
62	Equivalent Annual Cost			\$23,857			
Nowfoundland	Ave Cost Per	Cubic Meter		0.283			
	Ave Cost per	1000 Imp Gal		1.287			
Laprador							14

Town of :

Labrador

**Any Town** 

#### **Chlorine Gas**

Annual Inflation Rate:	1.0%			
Rate of return	5.0%			
Annual Interest Rate:	10.0%			
Annual Consumption Growth Rate:	1.5%			
Average Flow Rate:	2.50 L/S			
Dosage:	5.0 mg/l			
Capital Cost:	\$216,000			
Cost of Chlorine per lb	\$1.00			
Maintenance Cost 1st Year	1,740			

Consumption Capital Cost per Year Cost Chlorine Maintenance Total СМ СМ 2005 35,153 78,750 866 1,740 37,759 0.479 2006 35,153 923 1,757 37,833 79,931 0.473 2007 35,153 936 1,775 37,864 81,130 0.467 2008 0.460 35,153 950 1,793 82,347 37,896 2009 0.454 35,153 965 1,811 37,928 83,582 2010 35,153 979 1,829 37,961 84,836 0.447 2011 35,153 994 1,847 37,994 86,109 0.441 2012 1,009 0.435 35,153 1,866 38,027 87,400 2013 35,153 1,024 1,884 88,711 0.429 38,061 2014 35,153 1,039 1,903 38,095 90,042 0.423 PW \$271,442 \$7,426 \$14,001 \$292,869 842,839 Total PW \$292,869 Equivalent Annual Cost \$37,928 Ave Cost Per Cubic Meter 0.450 NewToundland Ave Cost per 1000 Imp Gal 2.046

# Conclusion

 flow rate and dosage demand have the greatest affect on the disinfection equipment selection process.

- population alone can not be used as a sole selection criteria
- Gas chlorination equipment has limited dosage control at or below 0.68 kg or 1.5 lb per day
- Capital cost of gas chlorination equipment is approximately double that of hypochlorination equipment



# Conclusion

- The purchase cost per person for sodium hypochlorite is approximately 3.8 times that for chlorine gas.
- Calcium hypo-chlorination or HTH powder is more suited and recommended for remote areas based on transportation and hypochlorite storage or shelf life limitations.
- Operator education and training is not a distinguishing factor in selecting type of equipment.



# Conclusion

- certification training as recommended by ABC is equivalent for both types of equipment, however, familiarity and proficiency of the operator is considered greater for the gas equipment due to more complex components.
- Both hypochlorite solution and chlorine gas are hazardous materials, however, gas equipment requires greater safety awareness, housing, and process control provisions.
- Chlorine gas will lower the pH of water and may require review for possible corrosion concerns





