Bleaching Chemicals and Their Properties

Bleaching Chemicals

Name	Formula	Symbol
Chlorine	Cl_2	C
Chlorine Dioxide	ClO_2	D
Oxygen	O_2	O
Hydrogen Peroxide	H_2O_2	P
Sodium Hypochlorite	NaOCl	H
Hypochlorous Acid	HOCl	M
Ozone	O_3	Z
Sodium Hydroxide	NaOH	E

Bleaching Chemical Properties

- Equivalent Weight
- Efficiency
- Reactivity
- Selectivity
- Particle Bleaching Ability
- Environmental Implications

Equivalent Weight

- Bleaching is an oxidation process
- Bleaching chemicals are oxidizing agents
- One equivalent weight of a bleaching chemical is the weight of that chemical that is required to do a specified amount of oxidation.
- Equivalent weight is therefore an inverse measure of oxidizing power

Equivalent Chlorine

- Equivalent chlorine is another way of expressing a bleaching chemical's oxidizing power
- It is defined as the number of pounds (or kg) of chlorine that has the same oxidizing power as one pound (or kg) of the bleaching agent in question
- Equivalent chlorine is therefore a direct measure of oxidizing power

Bleaching Efficiency

- Some of the oxidizing power of a bleaching agent is always wasted in side reactions
- Some bleaching agents are more prone than others to undergo wasteful reactions; conversely, some use their oxidizing power more efficiently than others
- Efficiency is a measure of the degree to which a bleaching agent's oxidizing power is used in desirable, lignin-degrading reactions

Equivalent Wt. and Efficiency

Chemical	Equiv. Weight	Equiv. Chlorine	Efficiency
Cl_2	35.5	1.00	H
ClO_2	13.5	2.63	H
O_2	8	4.44	L
H_2O_2	17	2.09	L
NaOCl	37.2	0.93	M
O_3	8	4.44	H

L=Low M=Med. H=High

Equivalent Chlorine Charge

- The charge of chlorine or chlorine dioxide in the first bleaching stage that employs either is often expressed as **kappa factor**, sometimes also called **active chlorine multiple**

$$Kappa\ Factor = \frac{Percent\ Eq.Cl_2}{Kappa\ No.}$$

Reactivity and Selectivity

- Reactivity may be defined in terms of the fraction of the residual lignin that the bleaching agent is practically capable of removing
- Selectivity is the degree to which the bleaching agent can remove lignin without dissolving or damaging the other components of the fiber, cellulose and hemicellulose

Reactivity and Selectivity

Chemical	Reactivity	Selectivity
Cl_2	H	H
ClO_2	M	H
O_2	L	M
H_2O_2	L	M-H
NaOCl	M	M
O_3	H	M

L=Low M=Med. H=High

Particle-Dirt Removing Ability and Environmental Implications

- Different bleaching agents differ in their ability to remove dirt particles, a very important characteristic
- For good dirt removal, chemical reaction with lignin must be slow enough to allow time for diffusion of chemical into particles
- Different bleaching agents engender different levels of concern for the environment; whether the concern is justified may be irrelevant

Dirt and Environmental

Chemical	Dirt Removal	Environmental Implications
Cl_2	H	H
ClO_2	H	M
O_2	M	L
H_2O_2	L	L
NaOCl	H	H
O_3	L	L

L=Low M=Med. H=High