Discussion on chlorite conversion for 2-chemical chlorine dioxide generators

1 Acid-Chlorite 2-Chemical Generators

$5NaClO_2 + 4HCl \rightarrow 4ClO_2 + 5NaCl + 2H_2O$

Molecular mass

$NaClO_2$: 90.5
ClO_2: 67.5
HCl: 36.5

Let's look at production of 1 kg of ClO_2.

1kg of ClO_2 = 1000/67.5 = 14.815 moles
This requires 5/4 x 14.815 = 18.519 moles of $NaClO_2$ = 1675.97 g of $NaClO_2$

1.1 Concentrated Acid-Chlorite Generators

1.1.1 Chlorite Conversion

Let's assume we are using 25% NaClO2, this is 250 g/kg with s.g of1.24 = 310 g/L.
So, we need 1675.97/310 = 5.4 L.
This is an interesting result as we know from the typical commercial generator literature for the that 5L of 25% $NaClO_2$ is required for 750g. So, for 1000g they need 6.67 L.

We have already worked out that stoichiometrically, for 100% chlorite efficiency, we need 5.4L.
So, 1.27L is wasted and the real efficiency is 5.4/6.67 = 0.81 = 81%.
If we look at the overall mass balance on the ClO_2 molecule, we can start with the chlorite.
We start with 6.67L of 25% $NaClO_2$. This is 1675.97 x 6.67/5.4 = 2,070 g of $NaClO_2$ or 67.5/90.5 x 2070 = 1544 g of ClO_2^-
This amount of ClO_2^- produces 1 kg of ClO_2. Therefore, the conversion is 1000/1544 = 0.6477 = 64.77%.

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1.1.2 Acid Conversion

For 1kg ClO_2, 14.815 moles of HCl are required = 540.75 g
HCl is 33% = 330 g/kg and sg of 1.16 = 382.8 g/L
So, need 540.75/382.8 = 1.41 L.

However, we know that 5.26L is required for the typical acid-chlorite generator. So, excess acid required is 3.85L which is 2.73 times or 273% molar excess. This lines up with published literature that HCl excess is used to drive the reaction.

Consumption of 31% chlorite and 33% acid is 5.26 L per kg ClO_2 or 0.63 gal per lb ClO_2
Consumption of 25% chlorite and 33% acid is 6.67 L per kg ClO_2 or 0.80 gal per lb ClO_2

1.2 Dilute Acid-Chlorite Generators

1.2.1 Chlorite Conversion

25L of 7.5% NaClO2 and 9% HCl required per kg of ClO_2.
7.5% $NaClO_2$ has s.g of 1.07
9% HCl has s.g of 1.04
1kg of ClO_2 = 1000/67.5 = 14.815 moles
This requires 5/4 x 14.815 = 18.519 moles of $NaClO_2$ = 1675.97 g of $NaClO_2$

Let's assume we are using 7.5% $NaClO_2$, this is 75 g/kg with s.g of1.07 = 80.25 g/L.
So, we need 1675.97/80.25 = 20.88 L.

This is an interesting result as we know from the typical generator literature that 25L of 7.5% $NaClO_2$ is required for 1kg ClO_2

We have already worked out that stoichiometrically, for 100% chlorite efficiency, we need 20.88L.
So, 4.12L is wasted and the real efficiency is 20.88/25 = 0.8355 = 83.55%.
If we look at the overall mass balance on the ClO_2 molecule, we can start with the chlorite.
We start with 25L of 7.5% $NaClO_2$. This is 1675.97 x 25/20.88 = 2,006.25 g of $NaClO_2$ or 67.5/90.5 x 2006.25 = 1496 g of ClO_2^-
This amount of ClO_2^- produces 1 kg of ClO_2. Therefore, the conversion is 1000/1496 = 0.6688 = 66.88%.

Low concentration acid-chlorite requires 3 Gal of each chemical per lb ClO_2

Yours Sincerely,

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