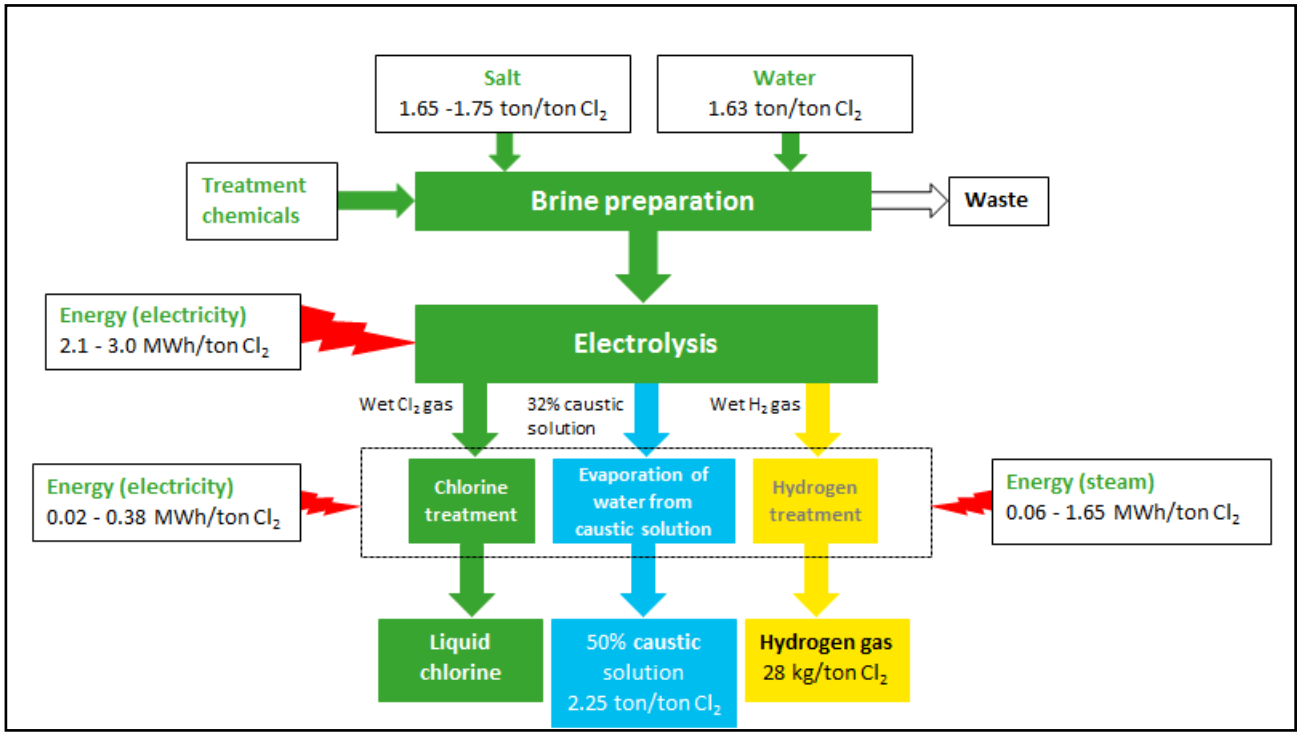
The Electrolysis process and the real costs of production

PUBLIC INFORMATION
July 2018

As explained in our information sheet on its thermodynamics (Information Sheet 11), production of chlorine, caustic soda (KOH or NaOH) and hydrogen by the European chlor-alkali industry requires salt, water and a large amount of energy under the form of electricity and steam. There are real costs associated with this electricity which in turn influence the cost of the end chemicals.

A schematic overview of the membrane production process (one of the main technologies to produce chlor-alkali), including the main material streams, is presented below. The membrane process is of particular interest because, by 2018, around 85% of chlorine produced in Europe will come from this technology.

Based on the amounts of chlor-alkali produced and the current prices for electricity, steam and the required raw materials, it is possible to calculate the production costs of chlorine, caustic and hydrogen.



An overview of the chlor-alkali production process and the main material flows.

Brine is a highly concentrated solution of salt in water.

Component	Use per ton neCl$_2$	Unit cost	Cost range per tonne Cl$_2$	% of total costs
Electricity - electrolysis unit	2.10 - 3.00 MWh	€ 34 - 86	€ 71.4 - 258	50.6 - 51.1
- rest of plant	0.02 - 0.38 MWh	€ 34 - 86	€ 0.70 - 32.7	0.5 - 6.5
Salt	1.65 - 1.75 ton	€ 15 - 50	€ 24.8 - 87.5	17.6 - 17.3
Water	1.63 - 1.70 m³	€ 1 - 2	€ 1.60 - 3.40	1.1 - 0.7
Treatment chemicals			€ 12.0 - 4.0	8.5 - 0.8
Steam	0.06 - 1.65 ton	€ 10 – 30	€ 0.60 - 49.5	0.4 - 9.8
Manufacturing costs			€ 30.0 - 70.0	21.3 - 13.9
Total			**€ 141 - 505**	

Overview of the costs in the membrane process. Unit cost is the cost of each MWh/tonne or m³ of each key component

The table clearly shows the large variations in local costs.

For example, European electricity prices can range from € 34 all the way up to € 86 per MWh for extra-large electricity consumers. This can be shown in 2016 information from the International Energy Agency.

The cost of salt depends on its type (quality) and source (brine/evaporated salt, rock salt/sea salt) and the distance it has to be transported. The purity of the salt, typically varying between 95% and 99.9%, also influences the amount of other treatment chemicals that are needed to achieve the required brine quality level. Whilst lower purity salt may be cheaper, it will require more treatment chemicals.

This is why, in the table above, lower salt prices are linked to higher treatment chemical costs and *vice-versa*. The relative costs of salt, water, treatment chemicals and steam prices per unit are taken from benchmark studies by Townsend.

Finally, there are additional manufacturing costs to be taken into account. These cover maintenance, operation, personnel, machinery updates, etc. The previously mentioned studies estimate these manufacturing costs at being between € 30 and € 70 per ton Cl$_2$.

Overall, the cost range, per tonne Cl$_2$, varies between € 141 and € 505 with the associated electricity costs ranging between € 72 and € 291.

Conclusion:

The cost of electricity accounts for 51-58 % of the total chlor-alkali production cost.

Much more about chlorine at www.eurochlor.org

Chlorine chemistry applications: www.chlorinethings.eu

Euro Chlor Communications
Rue Belliard 40 (box 15)
B—1040 Brussels
Tel. +32.2.436.9502
eurochlor@cefic.be

A Sector Group of cefic