From: [redacted]
Subject: **RE: Mercury**
Date: November 23, 2004 10:42:02 PM PST
To: [redacted]
Cc: [redacted]

[redacted]

[redacted]

The constant chlorine to caustic ratio in large scale operations is about 1:1.125 for diaphragm units and about 1:1.146 for mercury cells.

The anodic reaction proceeds with an efficiency of about 97% in mercury cells and 95% in diaphragm cells according to the equation

$2Cl^- \Rightarrow Cl_2 + 2e^-$

whereas the cathodic reaction is nearly 100% in both cells according to

$2H^+ + 2OH^- + 2e^- \Rightarrow H_2 + 2OH^-$ for the diaphragm unit and

$2Na^+ + (Hg) + 2e^- \Rightarrow 2Na(Hg)$ for the mercury cell,

whereby the Na(Hg) is subsequently reacted in a secondary unit (a decomposer tower packed with graphite) with water, forming NaOH and hydrogen.

$Na(Hg) + H_2O \Rightarrow$ 1 faraday + $NaOH + 1/2H_2 + (Hg)$

Molecular weights: Na=23, O=16, H=1, NaOH=40, which means that hydrogen production is 1/40=2.5% of amount of caustic = 112 tons/40=2.8 tons per day

Since the emissions (see below) in European Euro Chlor members' mercury cell rooms were 26.6 grams Hg/chlorine capacity in 1977, we can assume that G-P plant was not any more efficient since it was built with 10 years older technology.

26.6 grams Hg/chlorine capacity = 2.66% x 100 tons of chlorine/day = 2.66 tons of mercury per day of which most is still in the soil above or under the water in the bay.

[redacted] look from G-P:s permit and calculate how much were they allowed to release in the air and with the effluent from the lagoon to the bay in 30 years. Subtract that amount from 2.66 tons x 365 days x 30 years = 29,127 tons. What was permitted to be released amounts to maybe that 127 tons so there should be 29,000 tons still mercury inside G-P property. Even if the permit allowed 1,127 tons of mercury to be released in 30 years, we still have 28,000 tons left in the soil etc.

I hope the above is of some help to you.

[redacted]

How mercury is used to make chlor-alkali chemicals

Chlorine is produced by electrolysis when an electric current is passed through a solution of brine (common salt dissolved in water). Co-products are caustic soda (sodium hydroxide) and hydrogen. All three are highly reactive, and technology has been developed to separate them and keep them separate. Stringent operating conditions are maintained to protect the health of manufacturing staff and the environment.

About 60% of Western European capacity for chlorine depend on the mercury process. The electrolytic cell has titanium anodes located above a mercury cathode, which flows along the bottom of the cell. Under the action of a direct current on brine, chlorine is released at the anode and sodium dissolves in the mercury cathode to give an amalgam.

Emissions from Euro Chlor members' mercury cell rooms				
Year	**1977**	**1985**	**1990**	**1997**
Amount	26.6	8.1	4.1	1.4
Index	100	30.5	15.4	5.3
(grams Hg/t chlorine capacity)				

The sodium amalgam passes out of the electrolytic cell into a separate reactor, away from the chlorine. Here, it reacts with water to give hydrogen and caustic soda. This regenerates the mercury, which is then returned to the electrolytic cell. Salt is added to the brine leaving the cell and the brine is recirculated. Some 2.26 tonnes of 50% caustic soda and 312 cubic metres of hydrogen result from the production of one tonne of chlorine. The mercury process produces extremely pure, high quality caustic soda, suitable for use in textile applications. Caustic soda from the mercury process is produced at a higher concentration than from alternative processes. This minimises the energy consumption involved in concentrating dilute soda to give a usable product.

The closure or conversion of mercury plants would result in the need to recover some 12,000 tonnes of mercury contained in existing cells. Careful planning and co-operation between industry and the authorities would be essential in ensuring proper storage, use or disposal of this valuable, high-quality mercury.