CONTAMINATION BY MERCURY

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In 1987, in São Paulo, Brazil, we began a study - using the action research methodology – [on the use of mercury] in the chlor-soda, electric bulb, battery, and precision instruments industries. The study showed that most companies did not perform any kind of effluent treatment, and drained their contaminated wastewaters into the public sewage system or nearby rivers. The amount of mercury that has already been released into the environment by companies operating in all industrial sectors is incalculable. In order to prevent mercury intoxication in the workplace, the companies were asked to adopt the following measures: eliminate the use of Hg either by replacing it or by adopting a different process; isolate the production process and adopt measures for collective protection, such as the installation of a local diluting and exhausting ventilation system including mercury collection. As a result, in 1994, the number of exposed employees declined from 1,551 to 893, and the number of companies using mercury dropped from 22 to 10. In the beginning, we found that 32% of the exposed employees showed mercury levels above biologic tolerance limits. This figure is extremely high and demonstrates that many companies have treated the issue in a very negligent way.

We examined 448 workers from a number of industrial sectors who had been exposed to mercury. Of these, 172 (38%) showed signs of mercury intoxication. Of those intoxicated, 14 are now dead. The workers were diagnosed through a specific questionnaire, detailed clinical and neurological exams, supplementary exams, and neuro-psychological tests aimed at evaluating short-term memory; motor functions, tremor, attention and cognitive efficiency.

A later study evaluated the effects of low-level exposures on the workers' health, and revealed that exposed workers showed a number of intoxication signs and symptoms that were significantly higher in comparison with those in the control group.

There are no mercury mines are found in Brazil. Therefore, all the mercury that is used in the country is imported. CACEX – Brazil's foreign trade department - regulated the import of 151 tons of Hg from January to June of 1989. Half of that amount was destined for use in the following industrial segments: metal, batteries, paints/varnish, chlor-soda, dentistry, and precision instruments. Resellers purchased the remaining 50%, and there is no available information on its use. In the gold digging areas mercury is easily found for sale at different places. Anyone can buy it. No information is available on the amount of mercury that has been brought into country since 1990, the year in which the opening of the economy to foreign imports occurred.

The policy for implantation and expansion of the Brazilian industrial park has allowed for the installation and existence of all kinds of production technologies and different work situations. Thus, workers have been exposed to a number of hazards in their workplaces, and the population in general has exposed to pollution in the environment.

The use of obsolete technologies, together with bad work conditions, a perverse labor organization and unemployment has contributed to an increase in the number of occupational diseases and accidents. Subject to the hazards deriving from the encounter of the obsolete and the latest – both in terms of technologies and work relations – the working population also suffers from the combined effects of a number of health-harming agents.

There are three main methods of producing chlorine and caustic soda: the mercury cell process, the asbestos diaphragm cell process, and the ionic exchange membrane cell process.

Early chlor-soda industries worked on mercury cells. After the tragedy in Minamata, Japan, there was a global mobilization aimed at dropping the mercury process. Companies producing chlorine and sodium hydroxide agreed not to install plants that used mercury cells. A number of companies adopted the asbestos diaphragm technology. In the 70s, as information on the hazards posed by asbestos to human health circulated, the membrane cell technology began to be implanted. This membrane is an ionic exchange resin that has been used all over the world to replace the other processes.

Some of the chlor-soda industries that have stopped production processes including mercury cells are Fluminense, Lutcher, Nitroquímica, Refinaria Paulista, Klabin, Champion, and Hoescht.

Table I shows some information on the chlor-soda companies still operating in Brazil.

TABLE 1 – Chlor-soda companies in Brazil: location, production process and year of process installation.

Brazil, 2001

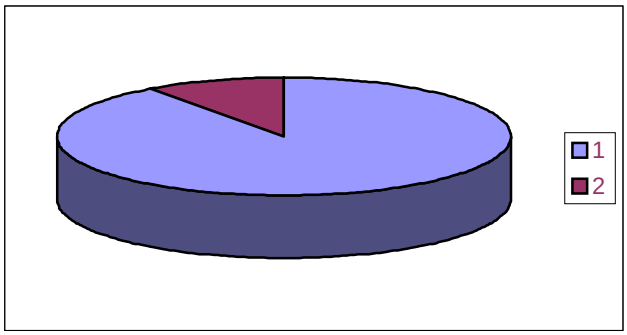
COMPANY NAME	STATE	PROCESS	YEAR IN WHICH THE PROCESS WAS INSTALLED
Solvay	SP	Mercury	1948
Igarassu	PE	Mercury	1963
Pan-americana	RJ	Mercury	1951
Carbocloro	SP	Mercury and Diaphragm	1964
Trikem	BA and AL	Mercury and Diaphragm	1975
Dow Química	BA	Diaphragm	1977
Anhembi	SP	Diaphragm	1965

Cenibra	MG	Diaphragm	1965
Aracruz (CXY)	ES	Membrane	1979
Riocell	RS	Membrane	1992

Source: Zavariz, C., São Paulo, 2001.

Graphs 1, 2, and 3 show the percentage of companies existing in different decades, by technology employed.

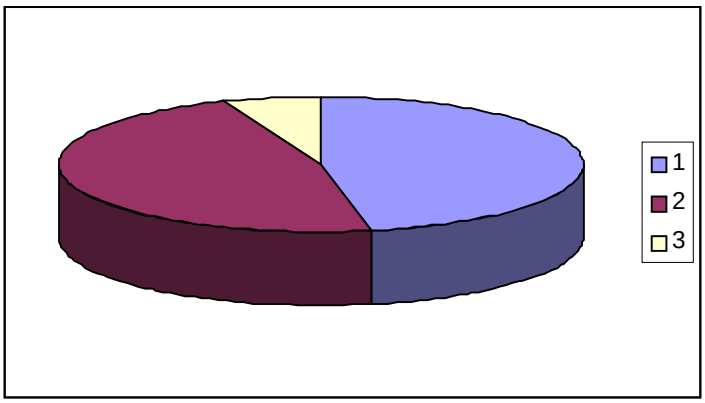
Graph 1. Percentage distribution of the chlor-soda industries, by production process, Brazil, 1976.



Source: Caio, 1976.

1 - Mercury (90%) 2 - Diaphragm (10%)

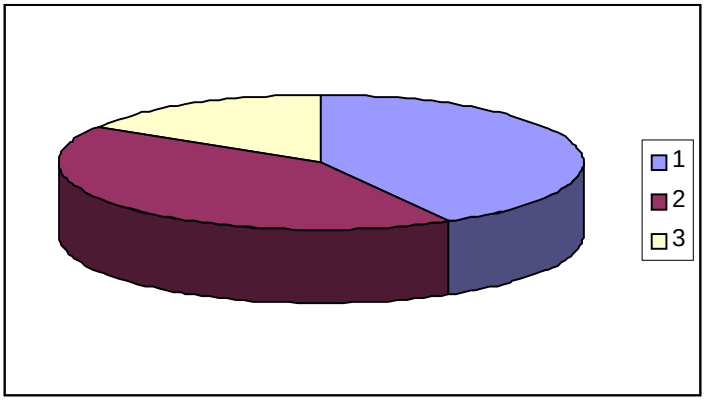
Graph 2 Percentage distribution of the chlor-soda industries, by production process, Brazil, 1989.



Source: ABICLOR, 1999 Elaboration: Zavariz, C., 2001

1 - Mercury (47%) 2 - Diaphragm (47%) 3 - Membrane (6%)

Graph 3 Percentage distribution of the chlor-soda industries, by production process, Brazil, 2001.



Source: Zavariz, C., 2001

1 - Mercury (42%) 2 - Diaphragm (42%) 3 - Membrane (16%)

Mercury consumed by the chlor-soda industry does not remain in the end product. A part of it is recovered, and the other part is lost during the process and contaminates the environment. One of the companies located in the Cubatão area used up to 440 grams of mercury per ton of chlorine produced in 1975.

Considering that - as far as we know - the ionic exchange membrane cell technology is not a polluting process, whereas the other processes pose hazards to human health, all companies using polluting processes should be required to replace such processes.

Mercury is also used in the making of fluorescent and Hg vapor lights. The amount of mercury placed in each bulb varies from 12 to 120 mg per Hg, depending on the type of bulb, bulb length and diameter.

One of the big problems we face is the loss of mercury into the environment after bulbs are discarded. Owing to our energy crisis, fluorescent light consumption is on the rise. Fluorescent light users throw used bulbs in regular garbage cans, thus contributing to increase the amount of mercury in the environment, an issue may assume serious dimension. In order to prevent environmental contamination, fluorescent light bulb manufacturers and importers should be responsible for the collection of used bulbs. As to the effects of mercury in the workplace, there is evidence that encapsulating mercury in the light bulb may reduce employee exposure to mercury.

Mercury was also used in the manufacturing of alkaline batteries. Alkaline battery manufacturers are now using a substitutive process. In the early 90s, battery factories in São Paulo discontinued their alkaline battery productions. However, a pertinent question remains unanswered: what was/has been done about the residues and contaminated environments?

The precision instrument industry uses mercury - mainly because of element's capability to expand uniformly - in the making of thermometers, barometers, manometers, valves, and switches. The production process in this industry is very crafty and depends on the manual skills of the employees. Production training is given in the workplace where older employees pass their experience down to the newly hired ones. This situation favors the existence of illegal companies and terrible work conditions. Mercury that is lost during the manufacturing process goes into the sewage system. Here, too, mercury could be replaced with nitrogen, colored alcohol or other products.

Paint manufacturers use compounds for anti-bacterial and anti-incrusting functions. The most significant pollutants in the paint industry are metals such as chromium, copper, lead, mercury, nickel, and zinc, plus some solvents like benzene, tetra chlor ethylene, toluene, naphthalene, and carbon tetrachloride. Mercury is used in its basic organic form (mercury phenyl).

The use of mercury-based fungicides in agriculture was banned in Brazil by Resolution Number 2, of January 6, 1975 - which was revoked and replaced by Resolution Number 6, of April 29, 1980, which prohibits registration of new mercury fungicides, and regulates trade and use of existing stocks. That was not enough to prevent soil contamination in an area near the city of Campinas, where a mercury-based fungicide was used on a potato crop.

In the 1990s the gold mining areas covered approximately 17 million hectares, mainly in the Pará State. The situation in the mining areas is critical when it comes to the use of mercury. In those areas gold is found in the form of small particles (gold powder), and the amount of mercury used in gold amalgamation is considerable. Mercury is used in all gold mines, and practically all of it is lost into the environment during the process. It remains in the environment and contaminates the flora and fauna, particularly the fish. It is estimated that 1.3 kg of mercury is released into the environment for each kg of gold produced. Gold-mercury amalgam is later submitted to heating for purification. The mercury in the amalgam then evaporates and pollutes the environment. High mercury concentrations were found in different fish species in the Madeira River (Rondônia), the Tapajós River (Pará) and in the Carajás region. The lethal level in the fish is high and occurs when their tissues reach 10-20 PPM concentrations. Because of that many fish survive and contaminate those who eat them. Little is known about the mercury' s toxic effects on the living water species.

The complex interactions between the physical, biological, and social spheres make the environment vulnerable. The transformation of metallic mercury into organic mercury depends on favorable conditions, namely: the presence of organic matter, specific bacteria, acidic pH (pH<6), and high temperatures. If these conditions occur in the mining region the fish affected by organomercurials will be eaten both by the populations that live along the

rivers and by people living in distant areas, thus generating an unprecedented catastrophe. Death is not the only result deriving from the ingestion of contaminated fish. Blindness, deafness, and extremely serious neurological alterations such as those that were observed in Japan may also occur.

We are extremely concerned about the contamination which affects workers and the whole population through the industrial garbage which has been dumped over the years by unscrupulous companies which – during the whole industrialization process - have released contaminants into the environment, many times with the connivance and omission of government officials, while the population remains in complete ignorance of such facts.

It is necessary that the organs of environmental control perform the functions for which they were created, without interference or interruption in their activities, by adopting concrete and adequate measures to prevent all kinds of contamination.

The government's carelessness in dealing with environmental issues has left the population to the mercies of ignorant workers, corrupted government officials and businessmen interested in immediate profit only.

The existence of linked laws imposing harsh punishments on infringers and allowing integrated actions on the part of the different authorities - thus preventing vigilance discontinuity – is necessary. Companies must be held accountable by public organs and the population. Information on existing situations and actions undertaken by companies and public organs should be permanently available to the whole society. Openness is an imperative.

The courts have not punished environment polluters with prison, depollution and indemnification penalties. Impunity generates the devastation we hear of every day in the news – not to mention the many cases that are not publicized. In the end, it is the population that suffers. If the companies are not punished for their predatory actions, then they will certainly come to a conclusion: in Brazil, crime really pays.

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