

CHEMICAL RECOVERY AS ALTERNATIVE OF ENVIRONMENTAL SOLUTION BY GEOTHERMAL BRINES IN CERRO PRIETO

Mercado, J. A. López, R. Angulo

Instituto de Investigaciones Eléctricas
Apdo. Postal 475, Cuernavaca, México

ABSTRACT

The Cerro Prieto Geothermal Field is a large area of hidrothermal alteration. In order to use the geothermal energy 55 wells have been drilled. Some of them are in continuous operation, discharging a high pressure steam-brine mixtures. After the process of separation have taken place, the steam (1,500 T/hr) is sent to a generating plants, and the brine (3,500 T/hr) to a setting pond. The brine has a high content of salts and some of them like KCl and LiCl can be recovered economically. It has been a solution to dispose the brine and prevent environmental problems.

INTRODUCTION

The first geothermoelectric plant of 75,000 KW has been in operation in Cerro Prieto since 1973, a second one of the same capacity started its operation this year. The first unit is fed with steam taken from fifteen wells, which have an average depth of 1,500 meters and produce a mixture of water and steam. The steam (approximately 750 T/hr) is sent to the generating plant, and the water (approximately 1,800 T/hr) to the evaporation pond (Fig. 1) where part of it is flashed, part evaporated and a small portion is been discharged into the Hardy River, with the operation of the second unit the waste water has increased twice.

The evaporation pond has an extention of eight square kilometers and enough capacity to handle the water from the first plant, by carrying out partial extractions. The second plant that started its operation this year, is part of the plans to increase ten fold the generating capacity, therefore it is necessary to find out alternative solutions on how to get rid of the disposable brine.

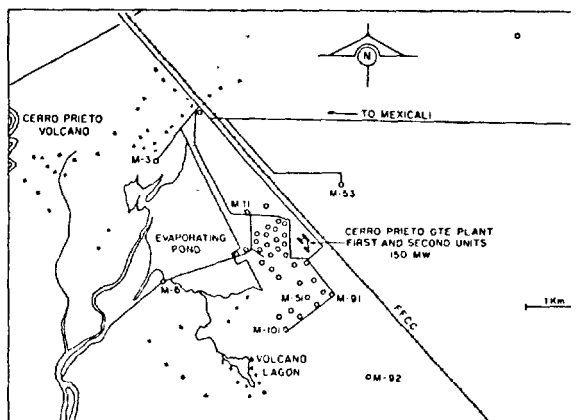


Fig. 1 Cerro Prieto Geothermal Field.

Table 1 Typical Brine Composition of Cerro Prieto.

(Separated water at atmospheric pressure well M5).

Chemicals	ppm	Chemicals	ppm
Na	9,062	F	2
K	2,287	SO ₄	6
Li	38	H ₂ CO ₃	2
Ca	520	Fe	0.3
Mg	1	Salinity	26,442
B	14	pH	7.7
Si	1,250	Conductivity	-32,200
Cl 02	16,045		
Br	31		

BRINE DISPOSAL PROBLEMS

Hot Brine Problems

The hot water discharged from the principal separators has a typical composition that is showed in the Table 1, its chemical composition arise scaling problems in the separator silencers, water discharge lines and drainage (Table 2) imposing difficulty on the handling and the generating cost is increased due to

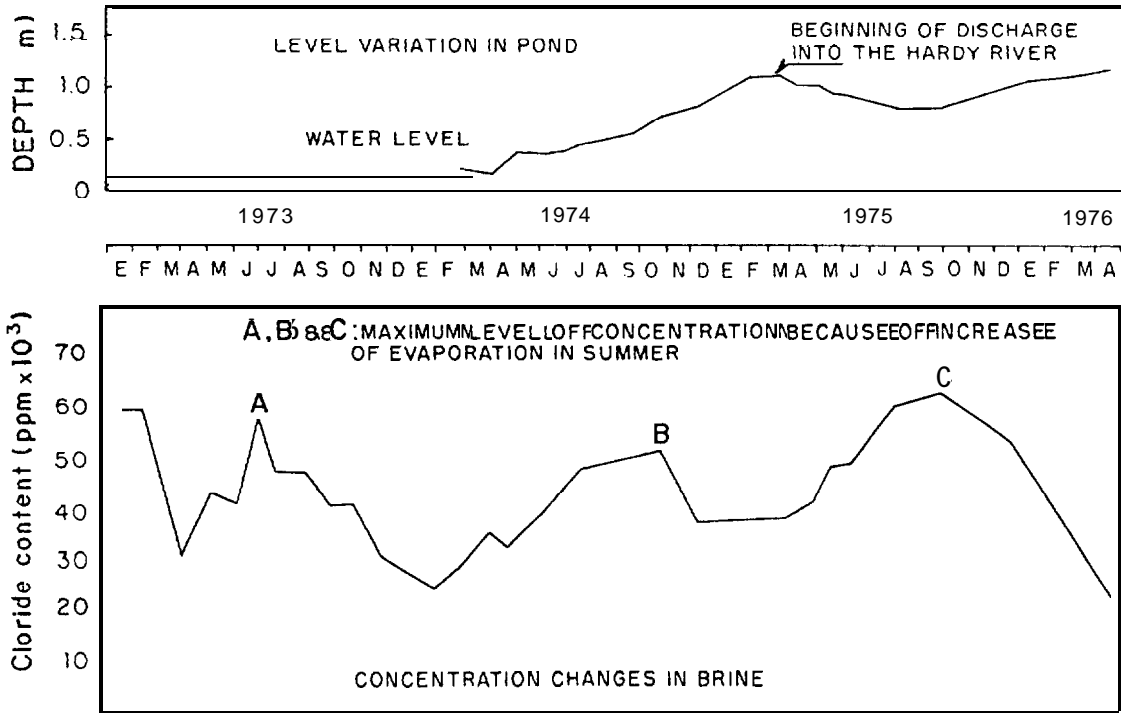


Fig. 2 Salinity Concentration and Level Changes in the Evaporation Pond.

heavier maintenance on the equipment.

doing this one runs the risk of contaminating the river, this one carries sewage from irrigation district of Mexicali Valley, although it is not used for irrigation it is important to control the amount of dumping which takes place because the river has different kinds of fauna that are of interest for the tourists.

Table 2 Scale Composition

A. Waste water pipe scale of well M34.
 B. Silencer scale of well M8.

Chemical	% (w)	
	A	B
CaCO ₃	6.5	0
SiO ₂		93.2
Fe ₂ O ₃	854.3	.8
MnO ₃	.04	.05
co	.003	.02
CU	.003	.008
Au	.0001	.0001
Ag	.002	.002

Cold Brine Problems

Usually, all the brine (separated water) is dumped into the evaporation pond, where starts the condensation, the level of condensation changes according to the season of the year and the rainfall in the area (Fig. 2).

When the concentration level is high and the pond is full it is necessary to discharge some into the Hardy River. By

Another problem which could arise is the contamination of the land surrounding the evaporation pond, because some areas are at a lower level than the maximum level of the pond, therefore it is necessary to maintain the level of the evaporation pond down, to avoid such contamination and of course the capacity of the pond is reduced.

Problems with the hot brine, when increasing the generating capacity ten fold.

The problems of getting rid of the brine will be the same as the present ones. But increased in proportion to the increase of capacity. On the other hand it is planned to install low pressure plants which would make use of the steam taken from the hot brine, flashing it. from 7 kg/cm² to 1 kg/cm² in a secondary separator. Similar scaling problems are foreseen in these secondary separators and in the water discharge pipes.

Problem which will arise from the disposal of the cold brine, when the generating capacity is increased ten fold or more.

With the increase of the waste brine, the problem of its disposal arises, the present pond is insufficient, and it is impossible to discharge it into the Hardy River, because the salinity of the river will increase to an excessive extent. Another option would be to build a concrete lining canal to transport the brine to the Sea of Cortes or to Laguna Salada (Dry salt lake). This lining of the canal would be necessary to avoid the contamination of the crops lands where it would pass through. Another possibility is solar evaporation, for which would be necessary to build large ponds from which the dissolved chemical products would be extracted. A third possibility, which is the most viable but very costly, is reinjection.

The answer to the problem of the disposal of the brine may involve using all three of the above alternatives to a greater or lesser extent: that is some of the water could be processed to obtain salts, some could be injected, and the rest could be sent to the sea or to Laguna Salada. In Laguna Salada, one has a large area with no potential use, and because of this, one could store the brine in the lake and then proceed to construct lakes to be used for solar evaporation and salt extraction. Laguna Salada has sufficient capacity to store and evaporate ten or twenty times more brine than which is at present being dumped.

POSSIBLE BENEFITS WHICH COULD BE OBTAINED FROM REINJECTION THE BRINE OR EXTRACTING SALTS DISSOLVED.

The advantages of reinjecting the waste brine.

Although the process of reinjection implies a high expense it has the advantage of recharging the water reservoir in use. If one considers the reinjection of hot brine, it recharges not only the water reservoir but also increases the life of the reservoir.

Salt extraction

The extraction of chemical products from waste brine is feasible, technically and economically, KCl, LiCl, SiO₂ and other salts can be extracted. All the KCl now used in Mexico mainly as fertilizer is imported. For example it is planned to have in the near future (1984) a generation capacity of 400 MW and with the waste brine would be possible to extract 200,000 tons

of KCl in a year (table 3 and figure 3), which would be sufficient for the whole national consumption and would be a big saving for the country because actually all potassium is imported.

Table 3. KCl Extraction in Cerro Prieto

Year	MW*	KCl ton/year	\$ (1) million us dls
1973-78	75	45,000	3
1979	150	90,000	6
1984	400	200,000	14

(1) Estimated with actual importation price.

(*) Installed capacity)

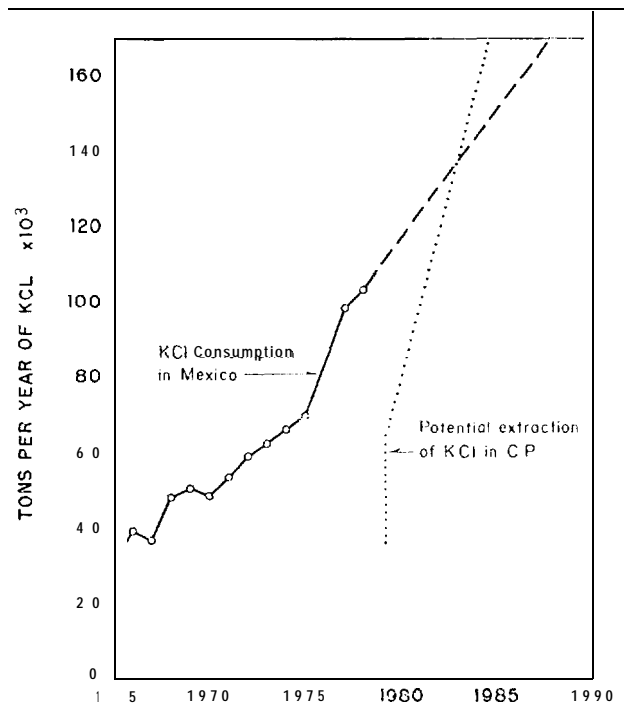


Fig. 3 Consumption of KCl in México and Potential Extraction in Cerro Prieto.

The extraction of lithium and potassium salts is in study actually: there is a pilot plant in Cerro Prieto for the extraction of KCl (see figure 4) in this pilot plant is used the flotation method to process the NaCl-KCl salts which are obtained from a series of crystallization and evaporation solar pilot ponds. The capacity of this plant is of one ton by day, the product (KCl) actually has 96% of purity and it is recuperation efficiently is 80%. With all the information obtained until now, technically and economically it is possible to state that the salts extraction is the most accessible

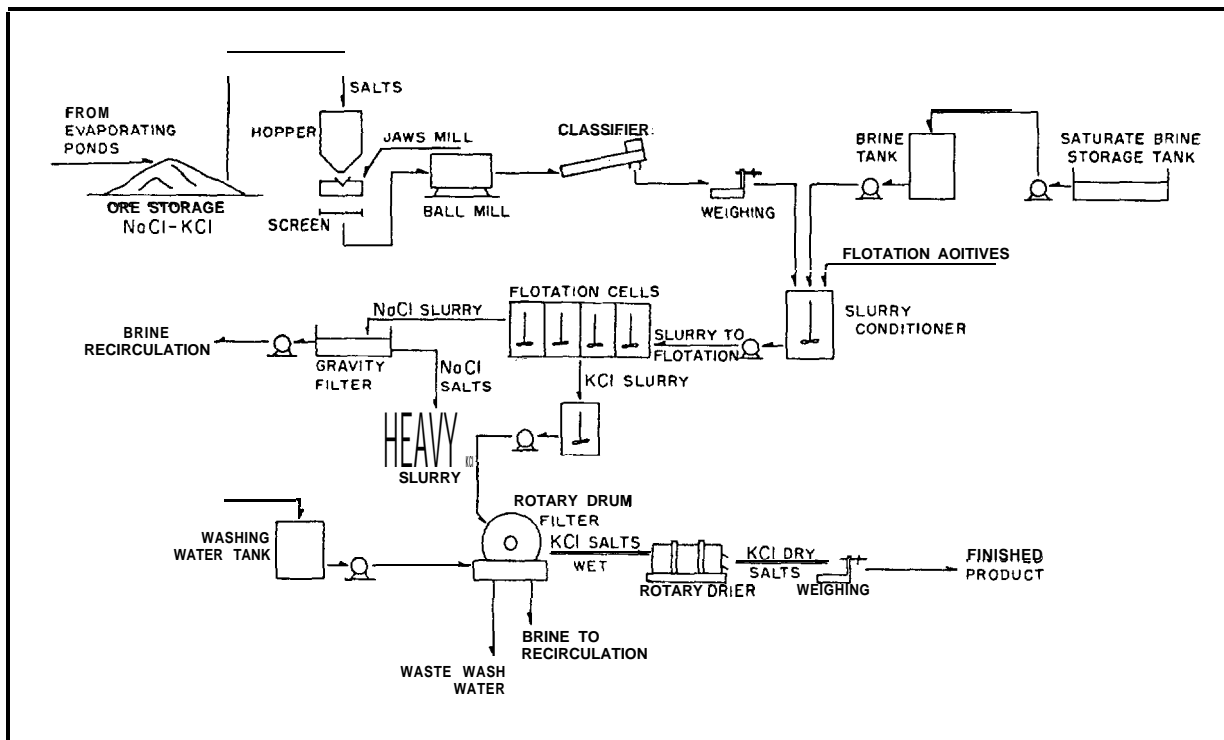


Fig. 4 Potash Extraction Pilot Plant

way to dispose the waste brine in order to control the contamination.

CONCLUSION

The problem which arise on the waste brine in Cerro Prieto, the options on how to get rid of it, and also the advantages of extracting the salts or reinjection of the brine need to be studied and carry further the field practice actually both of them are in fact now taking place or they are on a planing stage in order to improve the use of geothermal energy and to take advantage and profit from it.

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