The Chaplin Lake processing plant and sodium sulphate stockpiles.

ALKALINE LAKES IN SOUTHERN SASKATCHEWAN AND THE SODIUM SULPHATE INDUSTRY

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Extensive deposits of naturally occurring sodium sulphate exist in the widespread alkaline lakes of southern Saskatchewan. The sulphates form permanent or intermittent crystal beds on mud flats along the margins of the lakes and are concentrated in the covering brines. The hot, dry summer months have evaporated most of the water from these closed basins and, over thousands of years, millions of tons of salts have accumulated.

The salts in several of these lakes are commercially harvested for sodium sulphate. It ranks second only to potash in Saskatchewan's industrial mineral enterprises. Large quantities of the recovered sodium sulphate are used in the manufacture of kraft paper, the familiar brown paper of cardboard and paper bags.

Sodium sulphate associated with southern Saskatchewan alkaline lakes occurs naturally as mirabilite ($Na_2SO_4 .10H_2O$) or Glauber's salt, which deposits from saturated brines or goes

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The Chaplin Lake alkaline flats from which the brine is removed. Note the remains of a old wooden bridge in the foreground. Wood does not decay very easily in such a harsh environment.

back into solution depending upon climatic conditions. When kiln dried, hydrous sodium sulphate is converted to the mineral, thenardite (Na_2SO_4), a white, dry, free flowing crystalline material with the general appearance of fine table salt.

Many lakes have a more or less permanent salt bed, varying in composition and thickness, and usually covered by a thin layer of mud. Contaminants by other salts are usually magnesium sulphate, sodium chloride and calcium sulphate, which may have been present in the original brine. A permanent bed may or may not be present in a commercial deposit lake.

There are 10 lakes in southern Saskatchewan, each with calculated reserves of over two million tons of anhydrous sodium sulphate: Alsask Lake, Big Quill Lake, Chaplin Lake, Frederick Lake, Horseshoe Lake, Ingebright Lake, East Coteau, Muskiki Lake, East Sybouts Lake, and Whiteshore Lake. Five of the lakes are currently in commercial production some, like at Chaplin, on a year round basis. The most satisfactory method of commercial production is recovery from the brine, rather than actual mining of an existing permanent salt bed. This permits greater control over impurities, particularly clay, mud and unwanted salts.

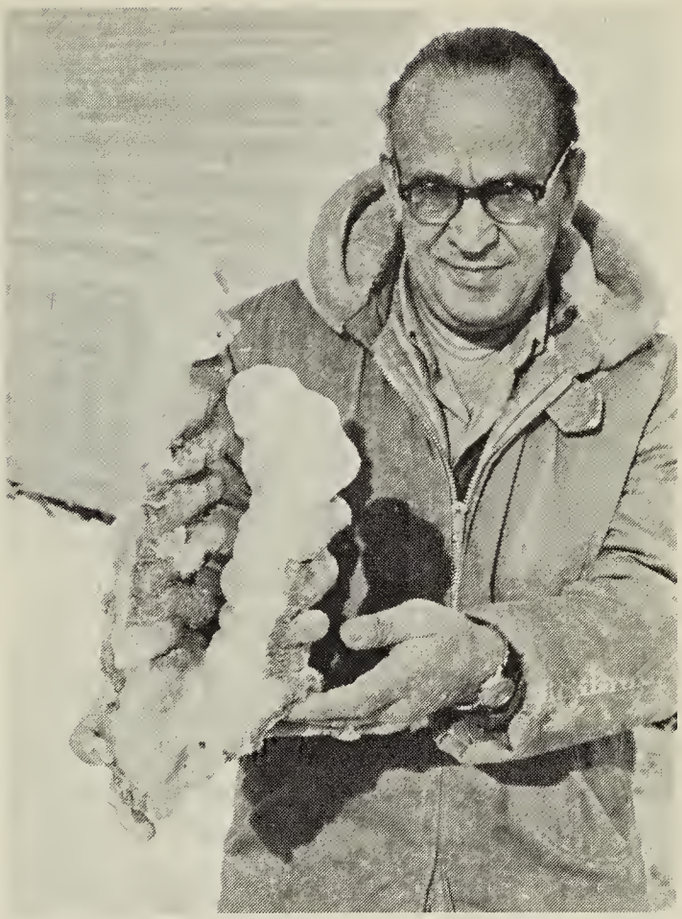
If you have an interest in mineral recovery from alkaline lakes, you visit would be welcomed at many of the commercial plants. Most visitors tend to stop at the Saskatchewan Minerals Corporation plant at Chaplin Lake. Undoubtedly, one of the most accessible of the alkaline lake operations, it is located 100 miles west of Regina on the Trans-Canada Highway. Driving on the Trans-Canada through the small town of Chaplin, one can readily see the stockpiled mounds of sodium sulphate.

Commercial production from the Chaplin Lake deposit started in 1947, though the existence of this and other deposits were known earlier in the century. During the first World War, efforts expanded to find a new supply for the halted German potash imports. An erroneous report of potash in the southern Saskatchewan lakes led to a 1918 claim-staking rush. Failure to find this potassium mineral, however, resulted in the lapse of the claims and most interest in the area. Nevertheless, the lakes were found to contain large quantities of Epsom and Glauber's salts, the hydrated forms of magnesium and sodium sulphates. A geological survey in 1944 indicated that Lake Chaplin would indeed support a viable commercial sulphate production. The growing demand for this salt in the manufacture of kraft brown paper at this time provided the needed incentive to transform this wasteland.

Chaplin Lake is roughly 18 square miles with a brine depth of approximately 2 feet.

The Chaplin plant uses the brine pumping methods for recovery of the salts, rather than direct mining of the salt bed. The brine from the lake is diverted by ditches and pumping stations into small but deep storage reservoirs. Saskatchewan's arid summer is conducive to the formation of high density brines, particularly when the temperatures approach the 90-100 degree range. In the fall, freezing weather causes the sodium sulphate crystals to precipitate from the supersaturated brines without the formation of an ice layer over the reservoir. Periodic removal of the weak brine solution and its subsequent return to the lake leaves most of the available salt precipitated on the floor of the evaporating basin. In the winter months tractor-pulled scrapers stockpile the sodium sulphate near the processing plant.

The brine pumping method reduces the chemical impurities to a minimum. In the brines where carbonates, chlorides and magnesium sulphates are formed, the sodium sulphate is one of the first salts to precipitate out in cold weather. Careful control over the brine chemistry at this point permits most of the unwanted salts to be carried away in the dilute brine and returned to the lake.



A prize specimen of sodium sulphate taken from the plant.

From the stockpiles, the raw salt, $Na_2SO_4.10H_2O$, is transported by conveyor belt to the processing plant. The Glauber's salt is fed into one of several Holland evaporators. Since the crystals contain about 60 per cent water by weight, they melt almost immediately to form a semi-liquid slurry of sodium sulphate crystals in a 35 per cent sodium sulphate solution. As the slurry passes through the gas-fired, 2000°F. evaporators, more and more of the water is evaporated, until a salt cake remains. The dry salt cake, Na_2SO_4, contains 97.5 to 99 per cent

Stockpiling the sodium sulphate.

sodium sulphate. None of the soluble impurities have been removed as yet, though there is a ready market for salt cake of only this purity. By recycling and recrystallizing the mother liquid in the above slurry, the impurities can be quickly eliminated.

Each time I visit the Chaplin Lake plant I am fascinated by the formation of sodium sulphate stalactites and stalagmites from the ceiling, the rafters and the floor. Apparently, the water liberated to the atmosphere during the dehydration of the mirabilite condenses at various points in the building and maintains a steady drip flow. Absorbing sodium sulphate from the fine dust that coats the plant, it precipitates it as beautifully formed mirabilite stalactites and stalagmites. One notable stalagmite rises more than 5 feet from the plant floor. Smaller foot-long formations can be readily collected at numerous points about the plant. The management freely permits you to take whatever specimen you want. But, alas, their beauty is only transitory; the sulphate slowly dehydrates into an opaque white powder and the stalactites are barely able to support their own weight without crumbling.

The largest percentage of southern Saskatchewan saltcake is consumed in the kraft paper industry for the manufacture of coarser brown papers, as in paper bags and cardboard although it is now finding widespread use in the manufacture of newsprint. An important part of the production goes to glass manufacture, where it is added to the glass melt to prevent scumming and, since it reacts with silica only at the very highest temperatures, it ensures that there will be no free silica in the melted glass. Another popular use for sodium sulphate is as an inert filler in cleansing detergents, some containing as much as 70 per cent. Other uses in the North American chemical industry include tanning leather, manufacture of blue pigments, in fertilizers, textile dyes, pharmaceuticals and non-ferrous smelting.

Canadian production of sodium sulphate is roughly 500,000 tons per year, most of which comes from southern Saskatchewan. About 400,000 tons are used domestically, with most of the balance exported to the United States. About 90 per cent of the market is for the paper industry. The southern Saskatchewan deposits have future reserves estimated between 30 and 50 million tons and perhaps, double this in presently uneconomical deposits. It should be a viable industry for many decades to come, well into the next century.