NEW MEXICO

BUREAU OF MINES AND MINERAL RESOURCES

A Department of the School of Mines

E. C. ANDERSON

Director

CIRCULAR 9

CARBON DIOXIDE IN NEW MEXICO

By

Sterling B. Talmage

and

A. Andreas

Reprinted from New Mexico Bureau of Mines Bulletin 18, Oil and Gas Resources of New Mexico, Second Edition, compiled by Robert L. Bates.

Socorro

1942

CARBON DIOXIDE IN NEW MEXICO

By

Sterling B. Talmage 1/

and

A. Andreas 2/

GENERAL FEATURES

Carbon dioxide, at atmospheric temperatures and pressures, is an inert non-inflammable colorless gas, tasteless when dry and not capable of supporting combustion or life. It exists in the air in quantity approximating one-thirtieth of one percent at sea level. This gas is known to the coal miner as "black damp"; it is not actively poisonous in a true physiological sense, but it tends to accumulate in low places on account of being somewhat heavier than air, and a man breathing carbon dioxide will suddenly lose consciousness without warning and will die quickly from lack of oxygen. Such fatalities are caused by smothering, not by poisoning.

The critical temperature for carbon dioxide is 31.1° C. (88° F.), at which temperature the gas can be liquified under a pressure of 73 atmospheres; less than half of that pressure will liquefy carbon dioxide at the temperature of freezing water. Carbon dioxide freezes to a white solid at -56° C. (-69° F.) under a pressure of 5.1 atmospheres. Cold liquid carbon dioxide under pressure, expanding rapidly into the air, will precipitate directly as a solid resembling snow, having a temperature of -78.3° C. (-109° F.). Such carbon dioxide snow, compressed into blocks, is now manufactured and marketed under the commonly used term "dry ice."

ORIGIN AND OCCURRENCE

Carbon dioxide is abundant in many volcanic gases, 3/ and appears to be the normal product accompanying the dying-out of volcanic activity, as in the Yellowstone park region, at Soda Springs, Idaho, and elsewhere. In a region showing as much evidence of recent vulcanism as New Mexico, it seems probable that such a source would be more than adequate; accumulations of carbon dioxide underground would, of course, be formed only where there were favorable structural traps.

It has been suggested that carbon dioxide deposits may have been formed by the action of igneous rocks at great depth coming in contact with limestones, and driving off the carbon dioxide as is done in a lime kiln.

1/ Professor of Geology and Mineralogy, New Mexico School of Mines.
2/ Geologist, New Mexico State Oil Conservation Commission.
3/ Clarke, F. W., Data of geochemistry, 5th ed., U. S. Geol. Survey Bull. 770, pp. 262-271, 1924.

Many cases are known where limestone has been altered to metamorphic silicates with obvious loss of carbon dioxide, but there is no proof of such process in connection with known carbon dioxide accumulations. Still another suggestion, that carbon dioxide has been liberated by the action of acid waters on limestones, is entirely plausible and chemically sound, but there is no geological evidence that such a process has occurred on a large scale.

Carbon dioxide accumulations in New Mexico, of commercial grade or promise, have been found only in porous sediments, where either structure or variation in porosity has provided a trap. Determination of the exact age of the formations carrying carbon dioxide has not been made, but the rocks are all of late Paleozoic or early Mesozoic ages. Except for the one occurrence in Estancia Valley, all carbon dioxide wells in the State are within a few miles of geologically recent igneous rocks.

PREPARATION AND USES

Recovery. -- At all of the wells now producing, recovery of the gas is made by means of natural pressure. Gas from the wells is piped directly to the processing plants, through pipe lines ranging in length from a few rods to nearly 20 miles.

Purification. -- All of the carbon dioxide now being used commercially in New Mexico is more than 99 percent pure. It carries a fraction of one percent of nitrogen, which is negligible. No purification of the gas is required; at some wells a little water seeps in, necessitating drying of the gas to avoid trouble with freezing in the pipes at a late stage of processing. Not all of the plants have driers installed at the same stage.

Compression. -- The gas as it comes from the wells is compressed, with consequent heating. The compressed gas then passes through water-cooled coils, and is brought down to ordinary atmospheric temperature.

Refrigeration. -- The compressed gas, after drying if necessary, is chilled in refrigerating coils to a liquid. Some plants use ammonia as a refrigerant; one plant uses carbon dioxide. Liquefaction completes the process at one plant.

Sublimation. -- From an insulated storage supply tank, the chilled liquid carbon dioxide is blown into the snow chamber, which is 20 inches square and 30 inches high. Here about half of the carbon dioxide precipitates as a snow, filling the chamber loosely. The top of the chamber is the plunger of a hydraulic press, which is forced down under approximately 200 tons pressure, and compresses the carbon dioxide snow to a dense block of dry ice about 10 inches thick. The portion of the carbon dioxide that formed as gas instead of as snow is returned to the circuit, either mixing with incoming gas or passing through the refrigerating coils, depending on the plant process.

Packing and shipping. -- Blocks from the press are sawed across twice; the sawed blocks, approximating cubes 10 inches square of nearly 60 pounds weight, are wrapped in specially designed double sacks of heavy paper.

The wrapped blocks are placed in insulated storage *bins*, or loaded directly for shipment.

From the plants on the railroad, shipment is in standard refrigerator cars, with insulation reinforced on all sides by the addition of an extra layer of kapok 12 inches thick. By this means the loss in transit, from factory to warehouse, has been reduced to below one percent per day of travel. One plant ships by specially insulated trucks; by strewing a layer of loose dry ice on top of the blocks and under the kapok mattress, it is said that the losses maybe confined to the loose material, bringing the pay-load loss down to about one percent per day. Liquid carbon dioxide is shipped in specially constructed tank trucks, in sizes carrying from 3 1/2 to 8 tons of the liquid. The tanks are described as being made of 1 1/4-inch rifle steel, competent to withstand internal pressures exceeding 300 pounds per square inch, and covered throughout with kapok one foot thick,

Uses. -- The principal use of solid carbon dioxide, commonly known as dry ice, is as a refrigerant for long-distance shipments; for this purpose it is said to be from ten to fifteen times as effective, pound for pound, as water ice. It is also used for some purposes for which water ice would not serve, as in quick freezing of fresh fruits and vegetables, which requires temperatures far below "ice-cold." Liquid carbon dioxide has long been used in fire extinguishers, where it serves the double purpose of smothering the flame and lowering the temperature; for carbonated water and beverages; as a preservative for foods, preventing oxidation; and for a variety of minor purposes. Recently liquid carbon dioxide has replaced explosives for some purposes. In coal mining it is used extensively, expanding more slowly than dynamite and consequently breaking the coal more cleanly, and with a greatly decreased proportion of fines. Success is reported in some experiments utilizing liquid carbon dioxide in rifles. It is reported that experiments utilizing dry ice in a newly developed synthetic rubber process are distinctly promising. For some of the purposes for which liquid carbon dioxide has been used, solid carbon dioxide is proving more effective.

PROCESSING PLANTS

Four plants preparing carbon dioxide for market were operating in New Mexico in July, 1942, with a total productive capacity approximating 75 tons daily. Three plants are making solid carbon dioxide, and one is shipping carbon dioxide as a liquid. Summer demand, especially for dry ice, exceeds the total capacity of these plants, but winter demand is only from a third to a half of the summer maximum.

Carbonic Chemicals Corp. -- This plant is the largest one in the State, and the only one using a high-pressure process. It draws its gas from the deeper stratum in the Bueyeros field. The plant is at the station of Dioxice, on the Southern Pacific railway about a mile southeast of the village of Solano. The gas is piped 18 miles from the Bueyeros field to the Dioxice plant. In July, 1942, this plant was operating at full capacity, with three eight-hour shifts, and the newly pressed and wrapped dry ice blocks were being conveyed directly into special refrigerator cars for shipment, without intermediate storage.

Available data, some of it contradictory or not confirmed, on all of the carbon dioxide wells in New Mexico is presented in the accompanying table.

FUTURE PROSPECTS

All of the plants now operating in New Mexico can market all that they can produce during summer seasons. Present plans for expansion are in abeyance, inasmuch as priorities and national defense demands make it difficult to get new machinery, and even replacement and repair material.

Prospects seem favorable for further development by more drilling in the Estancia Valley, and deeper drilling in the Bueyeros field. The neglected area near Wagon Mound, the Sierra Grande uplift, and the demonstrated occurrence of carbon dioxide east of Maxwell seem to warrant further critical attention when conditions make it possible to consider the building of new plants.

CARBON DIOXIDE WELLS IN NEW MEXICO

Well	Location ¼, Sec., T.-N., R.-E.	Year Completed	Depth to CO^2 Zone (Feet)	Percent CO^2	Reported Productive Rock	Reported Potential (Thousands Cu. Ft.)	Reported Pressure (Lbs. per Sq. In.)	Present Status
Bueyeros Field, Harding County								
Carbonic Chemicals Corp. No. 2 Mitchell	SW-20-19-30	1938	2086	99.8	Granite wash (Upper Pennsylvanian)	2300	568	Dry ice, Carbonic Chemicals Corp.
Carbonic Chemicals Corp. No. 3 Mitchell	SE-18-19-30	1939	2100	99.8	Granite wash (Upper Pennsylvanian)	4051	568	Dry ice, Carbonic Chemicals Corp.
Adams No. 1 State	SW-27-21-30	1937	960	99.6	Santa Rosa sandstone (Triassic)	889	38	Dry ice, Ute Carbonic Co.
Neill No. 1 Gonzales	SW-28-21-30	1937	853	99.6	Santa Rosa sandstone (Triassic)	1447	36	Dry ice, Ute Carbonic Co.
Neill No. 1 Gallagher	SW- 9-21-30	1937	814	99.6	Santa Rosa sandstone (Triassic)	1500	36	Dry ice, Ute Carbonic Co.
Kummbaca Oil and Gas Co. No. 1 Kerlin	NW-34-21-30	1931	940	99.9	Santa Rosa sandstone (Triassic)	3000	38	Liquid CO_2, Timmons Carbonic Co.
American Prod. Corp. No. 1 Bueyeros	NW-32-20-31	1916	2000			25000		Plugged and abandoned.1/
Waddell and McFann No. 1 DeBaca	NW-19-20-31	1936	1706	99.4	Probably Permian	132	388	Plugged and abandoned.
Colo-Mex Gas Co. No. 2 DeBaca	NE-31-20-31	1937	2041		"Sand 100 feet thick"	25000	578	Plugged and abandoned.2/
Carbonic Chemicals Corp. No. 1 Mitchell	NW- 9-18-30	1939	1576			"Poor"		Plugged and abandoned.
Danube Oil Co. No. 1 Beller	SE- 1-20-30	1937	650		Santa Rosa sandstone (Triassic)	308	34	Shut in. Chemical Corp.

1/Discovery well. Blow wide open for one year, then bridged; later plugged.

2/Described as offset to discovery well. Ice plant reported under construction in 1937, but never completed.

Estancia Field, Torrance County								
Witt Oil and Gas Co. No. 1 DeHart	NW-12- 7- 7		1245	99.0	"Lower Magdalena"	100	415	Dry ice, Witt Ice and Gas Co.
Witt Oil and Gas Co. No. 2 Dehart	SE-12- 7- 7	1934	1200	99.0	"Lower Magdalena"	2250	415	Dry ice, Witt Ice and Gas Co.
Orville Lee No. 1 Pace	SW-12- 6- 7	1937	1704			1000		Dry ice, Witt Ice and Gas Co.
Orville Lee No. 1-A Pace	12- 6- 7	1939	2017	99.0	Pennsylvanian	60		Dry ice, Witt Ice and Gas Co.
Orville Lee No. 1 Milburn	SW-36- 7- 7	1941	1860		Conglomerate	50		Dry ice, Witt Ice and Gas Co.
Estancia Valley Development Co. No. 1 Crawford	NE-32- 7- 7	1939						Plugged and abandoned.
Estancia Valley Development Co. No. 1 Roland	SE-12- 7- 7	1934	1359					Plugged and abandoned.
Estancia Valley Development Co. No. 1 Strong	SW- 5- 6- 7	1926	1030		"Lower Magdalena"	"Small amounts"		Plugged and abandoned.
Wilson et al. No. 1 Pace	SW-12- 6- 7	1928	1760					Plugged and abandoned.
Drice Co. No.1 Garland	NE-32- 7- 7	1940	1965		Sand			Plugged and abandoned.
Jaritas Dome, Colfax County								
California No. 1 Floersheim State	SW-15-23-24	1925	1509	67.0	Upper Permian	500		Plugged and abandoned.
Near Maxwell, Colfax County								
York Denton No. 1 State	NW- 2-26-24	1940	1515	99.8	Porous sand	153	128	Shut in. 3/
Wagon Mound Anticline, Mora County								
Arkansas Fuel Co. No. 1 Kruse	NE-11-19-21	1926	1420-2225	90.0	"Permian arkose"	26000 "Flowed"		Plugged and abandoned. 4/
Quaker State Oil Co. No. 1 Apodaca	NE-14-19-21	1935	1316					Plugged and abandoned.
Sierra Grande Uplift, Union County								
Sierra Grande Oil Co. No. 1 Rogers	SW- 4-29-29	1935	2300	98.6	Permian	6000		Plugged and abandoned. 5/

3/Reported ready for plant construction (personal communication from Mr. York Denton, Maxwell, N.M., 1942).

4/Well allowed to run wild for one month. Figure represents sum of flows reported from four horizons.

5/Three horizons reported productive.

#