DESIGN AND OPERATION OF A HIGH PRESSURE CO_2 DEHYDRATION FACILITY

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ABSTRACT

A carbon dioxide (CO_2) supply well was drilled and completed by Conoco Inc. in the Elsinore Field, Pecos County, Texas in September, 1983. The well was drilled to provide CO_2 for the Ford Geraldine (Delaware Sand) Unit, Reeves and Culberson Counties, Texas. The well tested flowing 11.5 MMCFPD of saturated CO_2 at a pressure above the critical.

The corrosive nature of the saturated CO_2 at a pressure above the critical necessitated a careful study of pipelining and dehydration options. Ultimately, the CO_2 would have to be dehydrated, since it would be moved to the Ford Geraldine Unit through an existing unprotected steel pipeline.

This paper details the design and operation of the Elsinore "73" No. 1 CO_2 dehydration facility. Specific topics that will be discussed are pipelining and dehydration alternatives, molecular sieve (mol sieve) bed design, equipment and piping, metallurgy, fuel options, automation, startup and operation.

INTRODUCTION

Full scale carbon dioxide injection began in February, 1981 in the Ford Geraldine (Delaware Sand) Unit located in Reeves and Culberson Counties, Texas (Figure 1). This is one of the first fieldwide tertiary recovery applications of carbon dixoide flooding.

The carbon dioxide source for the Ford Geraldine Unit CO_2 Project is the vent gas off Lone Star's Pikes Peak Plant, Pecos County, Texas. The CO_2 concentration of the vent gas varies between 93-98% depending on the volumes being processed through the plant. Water content is less than 8 pounds per MMCF of CO_2 and the H_2S content is about 125 ppm. The CO_2 is compressed to 1250 psi at the plant and moved through a 112-mile bare steel pipeline to the Ford Geraldine Unit.

Carbon dioxide deliverability has been a major concern. During the first two years of CO_2 injection, the available CO_2 volumes have been half of the expected 20 MMCFPD desired rate. The supply has also been very erratic with many zero delivery days.

The unreliable daily supply rate and questionable reserves from the Lone Star Pikes Peak Plant lead to the search for additional CO_2 supplies. Numerous CO_2 sources along the pipeline route were investigated as possible supplemental supplies. The investigation revealed a well drilled by Hunt Oil Company in 1961 on Elsinore Cattle Company acreage. The Elsinore Royalty Company No. 57, located in Section 72, drill stem tested 18.9 MMCFPD of 97.5% CO_2 at a flowing surface pressure of 1200 psig. There was no demand for the CO_2 at that time so the well was not completed. Conoco obtained the CO_2 rights for four sections offsetting this well. The favorable location, 9 miles from the Lone Star Pikes Peak Plant, and the excellent DST made this area promising for the development of CO_2 for the Ford Geraldine Unit. (Figure 2).

PRODUCTION DATA

The Elsinore "73" No. 1 was drilled and completed in September, 1983. The well flowed 11.5 MMCFPD of 96.5% CO_2 from the Ellenburger formation at a depth of 15,217'. The H_2S content was 42 ppm and the density of the CO_2 at the wellhead conditions was 35 lb/ft^3. Table 1 shows a typical gas composition during testing. The well flowed at 1500 psig with a wellhead temperature of 110°F. Water production was 150 barrels per day. Table 2 shows a typical water composition after the well had been on production.

A key consideration in designing the facilities was the water content of the CO_2. Experimental water content data for CO_2 is incomplete; therefore, a dew point analysis was performed on a sample of gas from the well. A dew point curve was developed for the saturated CO_2 stream. The curve (Figure 3) indicated that a minimum temperature of 100°F would be required to remain above the dew point throughout the system.

SYSTEM REQUIREMENTS

Three design considerations were analyzed prior to selecting the CO_2 processing method for the Elsinore "73" No. 1. The first concern was free water separation at the wellhead. The water would need to be removed as early as possible in the system to avoid excessive corrosion from the CO_2 and water at the high partial pressures.

The second concern was whether the CO_2 would require dehydration. Several different methods of operation could eliminate the need for dehydration.

Finally, pipeline and compression requirements had to be considered. A nine mile pipeline would be required to move the CO_2 from the wellsite to the plant. At that point the CO_2 would enter the existing pipeline and be transported to the Unit.

PIPELINE OPTIONS

Various options for pipeline materials and construction were evaluated. An above ground, bare steel pipeline was chosen as the most economical. The area around the Elsinore acreage is in the Sierra Madera Mountain range. It is extremely rocky and burying the pipeline would require extensive blasting. The cost of blasting the rock was more than five times that of installing it above ground. Since there were no safety restrictions, the pipeline was laid above ground.

The ultimate decision on the material selection for the pipeline was based on the method of dehydration. If the system were operated without dehydration or if the dehydration facility had been located at the Pikes Peak Plant, corrosion protection would be required. Internal coating or corrosion inhibition were considered to protect the pipeline.

Locating the facilities at the Pikes Peak Plant would facilitate fuel gas and electrical power hookups and internal coating would adequately protect the pipeline, but there were operational problems. The main problem would be moving two phase CO_2 through the pipeline late in the life of the well. Pipeline hydraulics are more favorable for dense phase CO_2 (i.e. above critical pressure); therefore, it would be more economical to compress at the wellsite as the well pressure declined.

Chemical protection of the pipeline with a corrosion inhibitor or glycol had been considered if the CO_2 were not dehydrated. Not only is corrosion inhibition unreliable for a gaseous, wet pipeline system, but when compression becomes necessary the wet CO_2 would require special compressor metallurgy.

DEHYDRATION OPTIONS

A thorough study of the various drying options was conducted to determine the system that was best suited for drying CO_2 above the critical pressure.

One option considered was operating without a dehydration facility. Water content data indicated that if the temperature was 60°F at the time of separation and never dropped below that temperature through the system no additional water would separate from the CO_2, until the pressure dropped below 800 psig at the injection wellhead. At that point all of the equipment is corrosion resistant. There were two methods of cooling the CO_2, refrigeration or dropping the pressure and recompressing. Both methods would expend tremendous amounts of energy and would not insure a water free system.

An evaluation of operating the system without dehydration and using corrosion inhibitors revealed that the success of corrosion inhibition was questionable. The inhibitor would have to be carried in the gas phase; therefore, free water in the pipeline low points would not be inhibited.

Glycol absorption was considered for both low and high pressure applications. Glycol absorption is unaccepatable at high pressures. At the higher pressures there are extreme glycol losses and degradation of the adsorbent. At the lower pressure the glycol absorption system would be acceptable; however, recompression of the CO_2 would be required. Heat would also be required to keep the CO_2 in the gaseous phase. Since the wellhead pressure was adequate to enter the pipeline without compression, other systems needed to be evaluated.

A study of solid adsorption systems revealed that they are best suited for high pressure CO_2 application. The dry dessicant adsorbents considered were activated alumina, mol sieve and silica gel; of these three the mol sieve was considered the best for this system. It met dew point requirements and the CO_2 did not have any adverse effects on the dessicant. Since there was always a possibility of free water in our system, activated alumina and silica gel were not considered acceptable. There was concern that the activated alumina dessicant would be degraded by the formation of carbonic acid, while silica gel would decompose in the presence of free water.

FLOW SCHEMES

The raw, wet effluent stream enters the dehydration unit at flowing well conditions (Figure 4). The 12 MMCFPD of CO_2 enters an inlet separator where the free water is separated from the CO_2. The saturated stream then enters a cartridge filter separator where contaminents and any remaining free water droplets are removed. A flow control valve is located on the outlet of the cartridge separator to control the amount of CO_2 used for regeneration. The CO_2 not used for regeneration enters one of two dehydration towers, where it is dried and put into the pipeline.

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The CO_2 used for regeneration goes to a direct fired heater where it is heated to 550°F. The hot gas enters the tower that is not in the drying cycle and regenerates the bed. During the regeneration, the gas becomes saturated with water that is desorbed from the mol sieve. The saturated gas then goes to a fan cooler where the water is condensed out of the CO_2. A separator downstream of the cooler separates the free water from the CO_2. The heating cycle continues until all the water is desorbed from the bed. The beds are then cooled to 150°F in preparation for the drying cycle. All exiting CO_2, during heating and cooling, is recombined with the incoming stream to the drying tower where it is dried and put in the pipeline.

EQUIPMENT

The dehydration unit contains two different two-phase horizontal separators for separating free water and CO_2. The inlet separator is used for removing free water from the produced CO_2, while the regeneration separator removes the water that is desorbed from the mol sieve during regeneration.

The inlet separator is 20" OD X 5'0" long, ASME Code stamped for 1650 psig at 150°F. The vessel is designed to separate 12 MMCFPD of CO_2 and 1000 BWPD over a pressure range of 750-1500 psig. The regeneration separator is 12" OD X 5'0" ASME Code stamped for 1650 psig at 150°F. It is designed to separate 3 MMCFPD rate of regeneration gas and the estimated 3 barrels of water that would be desorbed from the mol sieve per cycle. An internal vane mist extractor is used in each separator to aid in separating the two streams. The water level in both separators is controlled by float actuated dump valves. These level controllers are mounted in external bridles due to the small size of both separators. The bridles are wrapped with heat tape to keep the CO_2 in a vapor phase.

A cartridge filter separator is located downstream of the inlet separator. The filter separator is 14" OD X 6'0" long, ASME Code stamped for 1650 psig at 150°F. The cartridge element is designed to keep solids out of the dehydration towers and to remove any water droplets that might be carried out of the inlet separator. The water from this separator accumulates in a "boot" that is manually dumped whenever necessary.

The regeneration heater is a 2.5 MMBTU/hr direct fired fuel gas heater. It is designed to increase the temperature of the regeneration CO_2 stream from 110°F to 550°F. The average fuel consumption is 64 MCF/day at an operating efficiency of 92.8% at full capacity. The operation of the heater is fully automatic. After receiving a signal from the control panel the heater will light the pilot then ignite the main burner or turn itself off. It is also designed to shut-off upon receiving any one of 7 shut-down alarm signals.

The 550°F CO_2 stream is cooled to 110°F by a forced draft air cooled heat exchanger. The 60" fan is driven by a two speed, 7.5 hp, 480 volt electric motor. The fan has a variable pitch for seasonal adjustments and automatic louver doors to control air flow. A heat exchanger using the incoming 110°F gas stream for cooling the hot gas was evaluated. It was not acceptable for this application because of the high pressure drop it generated.

The two vertical dehydration towers are 60" ID X 10', ASME Code stamped for 1650 psig at 590° F. These vessels are constructed of SA 515-70 carbon steel with a 1/8"

304L stainless steel overlay for corrosion protection. Steel thicknesses of the heads and shell are 2.875" and 3.0" respectively. The 1/8" 304L stainless steel overlay was used in lieu of solid stainless steel heads and shell because of the cost. The overlay was much less expensive than solid stainless steel, while it still assured corrosion protection. The smaller diameter connections (less than 4") are all 304L stainless steel but the larger conections (manways and fill connections) are carbon steel with the 1/8" stainless steel overlay. Any connection less than 4" could not be overlayed because of the size of the overlaying machine.

The internals of the towers include bed support grating made of 304L stainless steel size 3, 10, and 14 mesh screening and a swirl ring inlet diverter to ensure good gas distribution throughout the bed.

The two separators, cartridge filter, control panel, and switching valves are mounted on a 10' X 19' skid. A small skid was used to minimize pressure drop through the system. The cooler and heater are located 10 feet off the skid for safety and noise control. The dehydration towers were not mounted on the skid because of their size and weight. They are placed at edge of the skid to minimize pressure drop and piping.

MOL SIEVE BED DESIGN

The mol sieve was designed to adsorb 114 lbs of water per hour. The total amount of water to be adsorbed during the 8 hour drying cycle is 912 lbs of water. A mol sieve adsorption capacity of 10.48 lbs of water per 100 lbs of sieve was used in the design. This adsorption capacity was an average for the equilibrium and mass transfer zones with an estimated bed life of 3 years. A total of 8700 lbs of mol sieve per tower was required to dry the CO_2 at our design conditions. A design with a 5' bed diameter was recommended to keep the dehydration towers small. The 5' diameter bed required a bed height of 9.9' (10' towers seam to seam).

A pressure drop of .02 to .03 psi/ft through the bed was recommended with .01 psi/ft as a minimum. These pressure drops ensure good gas distribution and prevent channeling. The original bed design called for all the sieve to be 4-8 mesh beads. This size sieve in a 5' diameter bed provided unsatisfactory pressure drops of .00994 psi/ft and .00346 psi/ft for the adsorption and regeneration cycles, respectively. The design was re-examined using smaller 8-12 mesh beads. The use of the smaller sieve in a 5' diameter bed provided satisfactory pressure drops of .0203 psi/ft (adsorption) and .0122 psi/ft. (regeneration). Satisfactory pressure drops of .0222 psi/ft (adsorption) and .0104 psi/ft (regeneration) could have been obtained with the 4-8 mesh sieve using a bed diameter of 4'. Rather than reducing the bed diameter and increasing the height of the towers, the 5' diameter bed design was installed using all 8-12 mesh beads.

This bed design should produce a 0°F dewpoint with a 3 year life. The life depends on how effective the upstream separators and filters remove free water and solids (i.e. salt). The probability of plugging the sieve is greater with the smaller mesh beads. To prevent this problem from occuring, the cartridge filter upstream of the towers is checked frequently. If the filter element is cracked or broken it is replaced to prevent any solids from being carried to the beds.

REGENERATION

A countercurrent flow scheme is used during the regeneration cycle. The flow is upward through the beds during the heating cycle and downward during cooling. Concurrent flow (heating and cooling the same direction) was also investigated. This flow scheme was not recommended due to the additional energy it required during desorption. A regeneration rate of 3 MMCFPD is used to desorb the 912 lbs of water per 8 hour cycle. The 8 hour regeneration cycle is comprised of 5.4 hours of heating and 2.6 hours of cooling. The heating cycle is designed to obtain an outlet bed temperature of 500°F. The cooling cycle is designed to cool the mol sieve to a minimum temperature of 150°F. The cooling is accomplished by diverting the produced CO_2 flow from the heater and sending it directly to the hot bed. If the 150°F temperature is not obtained within the 2.6 hours, the cooling cycle is automatically extended until it is obtained.

The regeneration process uses produced wet CO_2. The 3 MMCFPD regeneration rate is controlled by a flow control valve located near the inlet of the unit. Regenerating with the incoming wet gas enables the process to be performed at line pressure. A design using dry processed gas for regeneration was also studied. This design required a compressor to raise the regeneration pressure. The cost of operating and maintaining the compressor made the dry gas regeneration design undesirable.

FUEL OPTIONS

The Elsinore "73" No. 1 was located in a remote area without any accessible power supply at the location. Electrical power was required to operate the main control panel, fan cooler, air compressor and lights. The two options available were to install a 9 mile electric line from the nearest three phase power supply (located at the Lone Star Plant) or install gas operated electric generators. Installing the electric line was chosen because of its reliability and maintenance free operation.

A power supply for the regeneration heater was also required. The options available were propane, unprocessed gas from a supply well, processed gas from the Lone Star Plant, and electricity.

Propane could be trucked from Ft. Stockton located 27 miles away. This was a reliable source of fuel but was too expensive.

Fuel gas could be supplied from a gas well flowline located approximately ½ mile northeast of the location. The gas was unprocessed and would have to be dried. The BTU content of the gas was only 540 BTU/MCF, since the produced gas was 46% CO_2. The gas from this well was an unacceptable option due to the low BTU content, the unreliability of delivery, and erratic well performance.

Fuel gas could also be supplied from Lone Star's main distribution line located at the Pikes Peak Plant. This gas would be processed and dry with a BTU content of 950 BTU/MCF. This was a reliable source of fuel since our supply would not be effected by the plants operation. The disadvantage of this source would be the installation of a 9 mile 2" supply line.

The 1300 KW electric line, installed to supply electrical power to the process control skid, was also capable of supplying enough power to operate an electric heater. Therefore, no additional installation costs would be required.

Quotations were received for both fuel gas and electric regeneration heaters. Economic parameters for fuel gas were the cost to purchase the gas and the supply line investment. The electric line economic parameters included an electrical prepayment and power costs. An economic analysis of the mutually exclusive investments indicated that the fuel gas heater was the most economical over the project life.

METALLURGY

Material selection for the dehydration and pipeline system was based on historical data for CO_2 operations. The CO_2 above 30 psi partial pressure is extremely corrosive in the presence of free water. The well had extremely low sulfide and chloride contents; therefore, stress cracking from these elements was not considered a problem.

Both phenolic coatings and corrosion resistant metals have been used successfully in the presence of CO_2; however, the extreme temperatures encountered in portions of the system made a corrosion resistant metal the better option. A 304L stainless steel was chosen because of its good all-around properties and its excellent corrosion resistance at elevated temperatures in CO_2 service.

Although not all of the system would experience the elevated temperatures, 304L stainless steel was selected for all water wet piping and vessels. The inlet piping and the inlet, filter and regeneration separators were all constructed from 304L stainless steel, as well as, the tube bundles in the fan cooler. The adsorber towers were overlaid with 1/8" 304L stainless steel as previously discussed. All valves, flanges, and level controllers in wet service are stainless steel.

The regeneration heater internal tubes are constructed of SA-106B carbon steel seamless pipe designed at 1650 psig and 800°F. Since there is no free water in the system at the heater, and CO_2 has the ability to hold more water at higher temperatures the tubes were constructed of carbon steel.

AUTOMATION

The dehydration unit is fully automated and designed for unattended operation. The sequencing system is operated by a programmable controller in the main control panel. The controller sends a signal activating air solenoid valves which regulate the position of the switching valves. The controller can be programmed on location to maximize the operating efficicency of the unit.

There are five separate conditions that are programmed to automatically shut the well in. These conditions are high-low flowline pressure, regeneration heater shut-down, high level in the cartidge filter, excess water in the gas, and excess vibration on the cooler.

The high-low flowline pressure shutdown is monitored by a pressure gauge pilot located on the inlet separator. The amount of cooler vibration is detected by a vibration switch located on the fan motor. These shutdowns are incorporated for personnel and equipment safety.

The high level in the cartridge filter is detected by a level probe mounted in a external bridle. This alarm is designed to shut the well in before any free water is carried to the dehydration towers. The excess water in the gas is monitored by a dewpoint analyzer. This analyzer is designed to shut the well in before any corrosive water and CO_2 enter the unprotected pipeline.

The regeneration heater has a separate control panel with 7 different shut-down conditions. If any one of these conditions occur a signal is sent to the process control panel to shut in the well. The shutdowns on the heater are: main flame fail, pilot fail, high process temperature, high stack temperature, high fuel pressure, low fuel pressure, and fan fail.

The process skid also has three conditions that are alarmed, but do not shut-in the well. These conditions are low temperature regeneration gas, high level in the inlet separator, and high level in the regeneration separator. These alarms are to indicate a condition that should be cleared, but are not critical enough to shut-in the well.

All of these conditions, shut-downs and alarms, are tied in to a remote terminal unit (RTU) located at the location. The RTU sends a radiolink to a tower in Ft. Stockton which in turn sends a data circuit to the Ford Geraldine Unit field office and the Midland Division office. The condition is printed out in the field office, the Division office, and at an answering service. The answering service calls out the alarms to operating personnel 24 hours a day to minimize downtime of the well. The well remains shut-in until the shut-down condition is cleared by the operator.

START-UP

The unit was brought on line with an initial gas rate of 2 MMCFPD. The wellhead pressure and temperature were 1200 psig and 75°F, respectively. The unit ran for two hours before it shut down due to a high dewpoint. Both of the towers were regenerated but the dewpoint remainded high. The mol sieve was analyzed at which time it appeared that the beds had been contaminated with free water that was not being separated in the wellhead separator. It appeared that at flowing conditions, 1200 psi and 75°F, the density of the CO_2 was too high for effective separation. A rental line heater was hooked up to raise the CO_2 temperature to the design condition of 110°F. It was also recommended by the mol sieve manufacturer to heat the beds at the regeneration temperature for extended cycles to "cook-off" the contaminents. After two days of "cook-off" cycles below 0°F dewpoints were obtained in both dehydration towers at a rate of 6 MMCFPD. Two weeks after start-up a tube in the regeneration heater ruptured. Conoco inspection and failure analysis personnel inspected the heater and determined the failure was caused by excessive temperatures created by a no flow condition. All the tubes in the heater were replaced and an additional alarm was installed that would turn the heater off during a no flow condition. The unit was turned back into at a rate of 10.3 MMCFPD with a FTP of 1550 psig. Below 0°F dewpoint were obtained in both towers.

Although the towers were effectively drying the CO_2, mechanical problems were hampering the operation. Water was not being dumped out of the regeneration separator, and a level was not indicated in the gauge glass. It was determined the desorbed water was not being dumped in the regeneratjon separator but was being carried on to the mol sieve beds. The dump and drain lines were taken off and both were plugged with mol sieve beads. The sieve beads were being carried out of the towers by the upward flow during the heating cycle. The unit was shut-in and the regeneration separator cleaned out. Top hold down screens and a 6" layer of ceramic balls were installed on each tower to keep the sieve in place. The unit was put back on and water was now being dumped out of the separator automatically with no carryover to the beds.

Attempts were made to operate the unit at 10 MMCFPD rate with the compressors at the Lone Star Plant running. The unit would shut down every afternoon due to high pressure. The high pressure was caused by the expansion of the gas in the pipeline from the hot sun. The pressure would decrease by late afternoon and the unit would return to operation until the next day. The well was shut-in and provisions were made to bury the pipeline. The burying of the pipeline would eliminate the problems of expansion and enable the unit to operate all day without shutting-in because of high pressure.

A dump valve and level control were installed on the filter separator. The automatic dumping of water out of the filter separator was necessary due to the frequent number of times the well shut-in due to a high level.

The operation of the moisture analyzer was very erratic and unreliable. The probes became contaminated easily and would not operate. The original probe was in service only a few days before it became contaminated and gave false readings. A second probe was installed and it also lasted only a few days before it became contaminated. An additional moisture analyzer was installed in parallel as a backup due to the erratic operation. A divert system was also installed for the moisture analyzers. When the towers are switched at the end of a cycle the flow is diverted to a vent line for ten minutes before going through the analyzer.

The rental line heaters were replaced with a permanent 3.82 MMBTU/hr indirect gas fired heater. The heater is complete with 304L stainless steel coils and is designed to heat 8.5 MMCFPD of CO_2 and 1000 BPWD from 70°F to 110°F. This heater will be used until the flowing wellhead temperature reaches an acceptable temperature for CO_2 and water separation, and on all start-ups after the well has been shut-in for extended periods of time.

OPERATIONS

The pipeline was buried in early June, 1984 to eliminate the pressure fluctations. The well was brought on-line at 10.4 MMCFPD with a flowing tubing pressure of 1500 psig and a water rate of 50 BWPD. Operation of the facility was extremely erratic throughout 1984; however, problems are attributed to poor well performance rather than facility design inadequacies (Figure 5).

The well experienced a dramatic rise in water production that reduced gas production and resulted in a decline in the flowing tubing pressure. As the tubing pressure declined, it became necessary to utilize the inlet heater on a continuous basis to keep the gas at the design temperature of 110°F.

Eventually the tubing pressure declined below the required pipeline pressure. A 430 HP reciprocating compressor was installed to raise the pressure from 700 psig to 1250 psig. The compressor was designed for a flow rate of 6 MMCFPD.

Even at the higher water production rates and lower gas flow rates, the dehydration facility has operated in an effective manner. The only problem has been plugging of the regeneration separator. The regeneration separator has plugged with an unidentifiable hydrocarbon base substance resulting in free water carryover to the beds. The regeneration separator has been removed from the skid and cleaned with touluene, alcohol and warm water then returned to operation. At this time the origin of this hydrocarbon base substance is being investigated.

RECOMMENDATIONS

In addition to the changes noted, other modifications to the original design should be evaluated prior to construction of new facilities.

A more efficient inlet filter system to keep all solids and liquids off beds.

A building to minimize temperature effects on the CO_2.

A bypass/vent line to permit operation of the skid without flowing through the towers.

Several additional sample points for the measurement of free water carryover.

CONCLUSIONS

Dehydration of CO_2 above the critical pressure can be successfully achieved with a molecular sieve dehydration system. A key consideration in the design of the system is the free water separation that is critically controlled by the wellhead temperatures. Adequate water removal and solid filtration is essential for maintaining bed quality and meeting dew point requirements. The installation of an above ground CO_2 pipeline is not recommended for systems that cannot be operated with variances in pressure.

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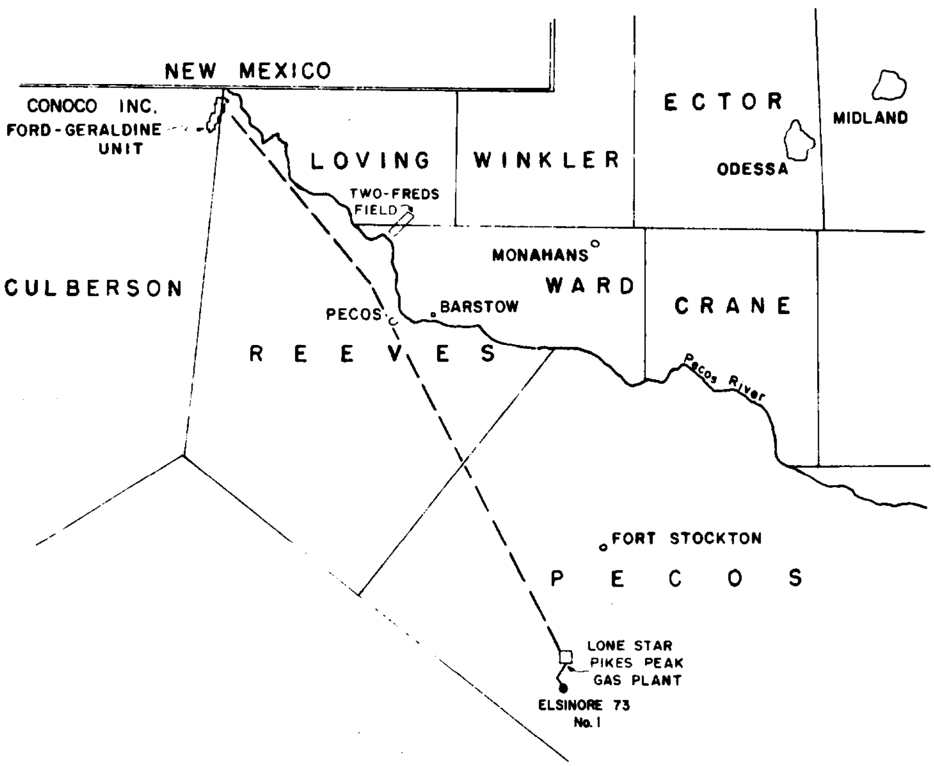

Figure 1 - CO_2 pipeline route

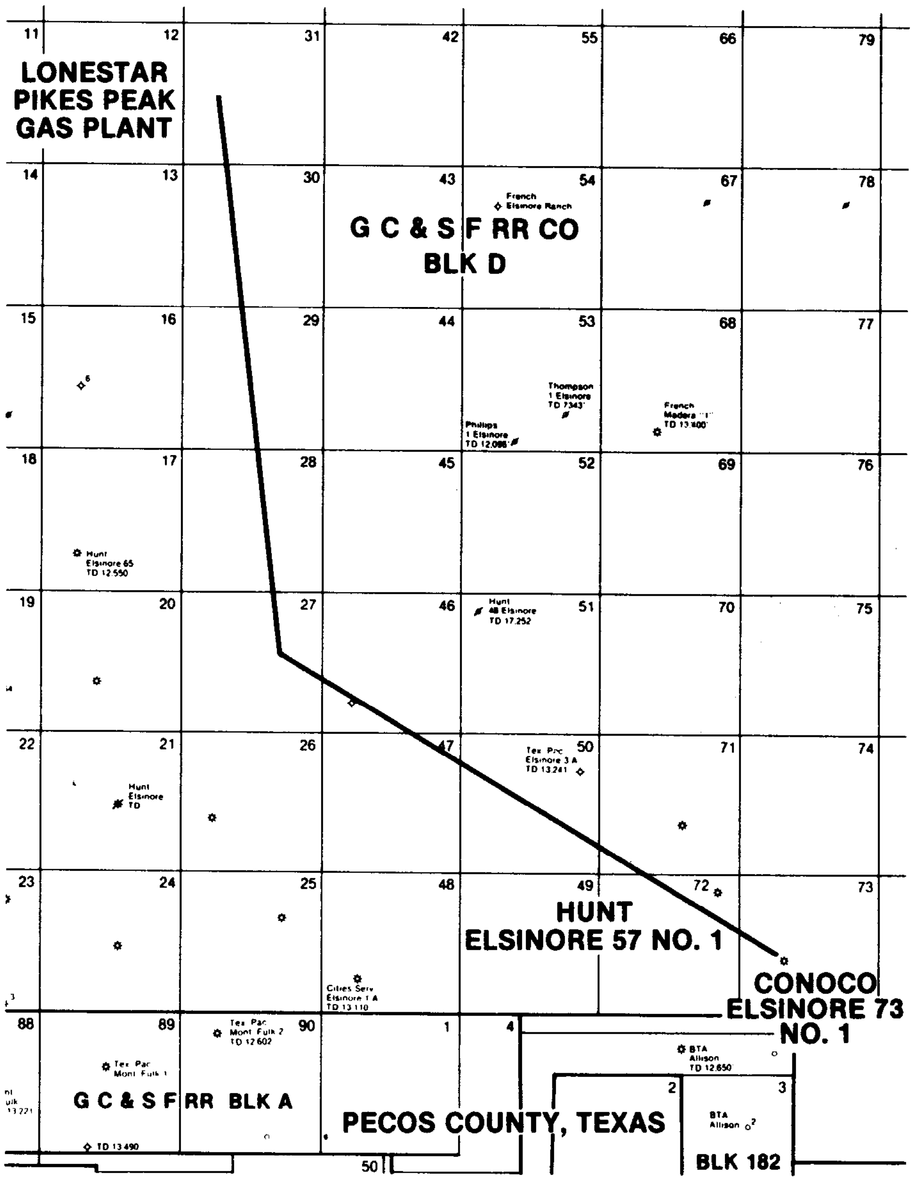

Figure 2 - Elsinore "73" No. 1 pipeline route

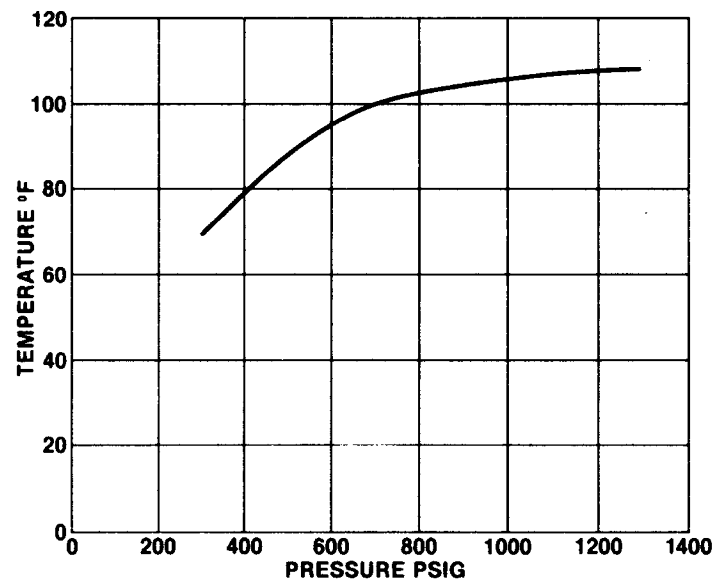

Figure 3 - Elsinore "73" No. 1 dew point curve

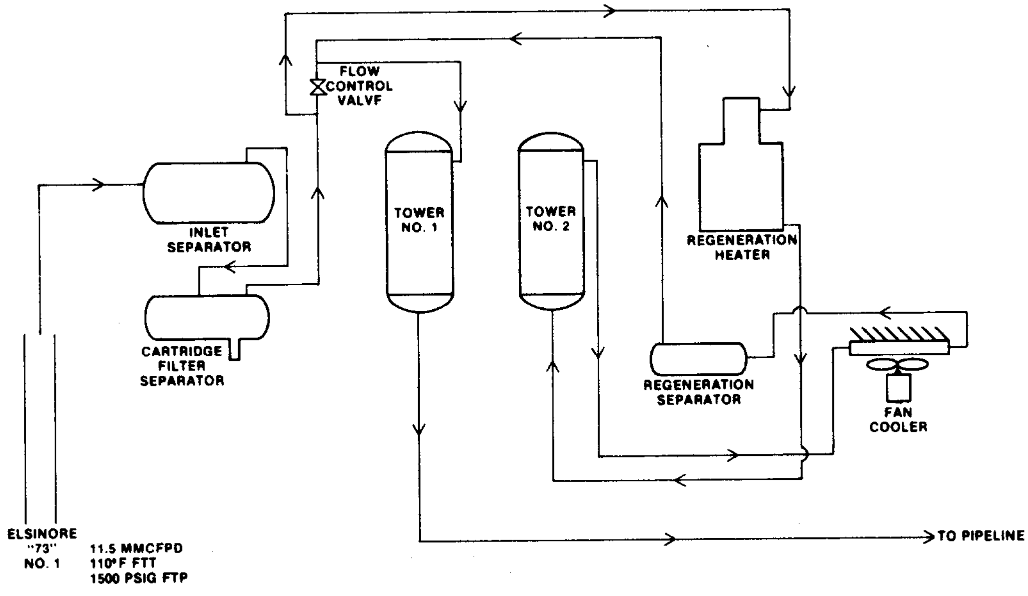

Figure 4 - Flow scheme of CO_2 dehydration facility

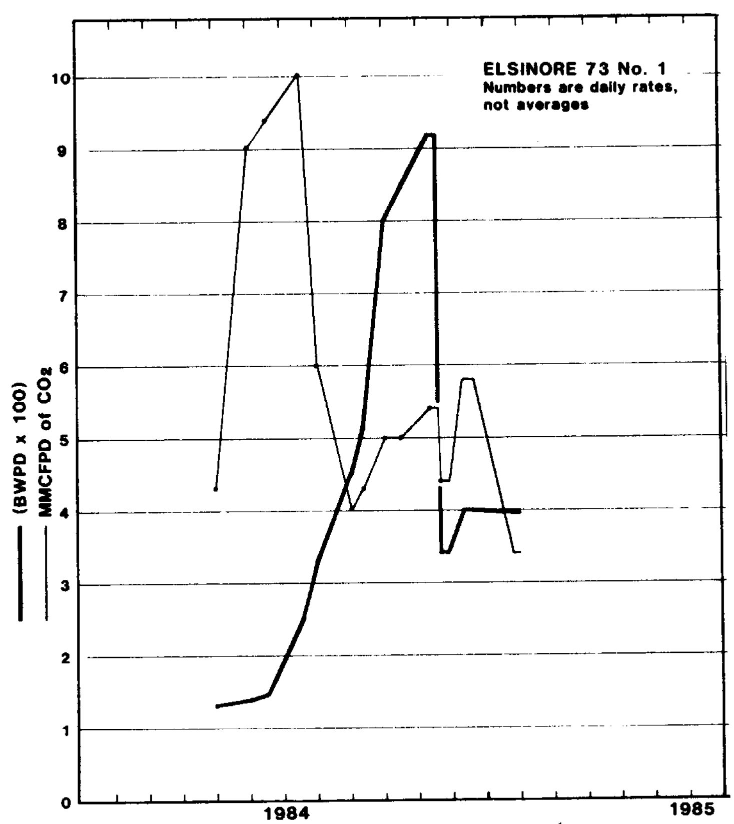

Figure 5 - Elsinore "73" No. 1 production curve