A Comparison of Natural Gas Dehydration Methods

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Abstract

The allowable moisture content of transmission natural gas ranges from 4 to 7 pounds per MMSCF (64–112 mg/m^3). Water content may leads to solid hydrate formation, corrosion of pipelines & process plants particularly in the presence of CO_2 or H_2S, slugging and erosion problems in the flowlines. Also, it leads to specific volume increasing, heating value decreasing and freezing in cryogenic and refrigerated absorption plants. Dehydration of natural gas is necessary in order to obtain a water dew point below operating temperature to avoid water condensation and subsequent free water on the system and hydrates formation. A comparison between different widely industry methods of natural gas dehydration is made in order to choose a method for achieving the required water dew point of export gas suitable for North Africa gas project. These methods are adsorption (using solid desiccants), absorption (using liquid desiccants), dehydration (by $CaCl_2$, expansion refrigeration and membrane permeation). The comparison is made according to their energy demand and suitability for use in North African countries. At the central process facilities of North Africa project, flowline arrival pressure and temperature may be in the range 54 to 60 bar and 25 °C to 50 °C (in winter to summer) respectively. In North Africa Gas Project at south Tunisia, the required water dew-point specification of export gas in field is -12°C at any pressure. As a comparison result it was found that it is recommended to use a TEG (Triethylene Glycol) dehydration method due to many advantages.

Keywords: Natural Gas, Dehydration, Dehydration Methods, hydrate formation, absorption plane.

1- Introduction

A main sources of energy in human life is Natural gas. It becomes increasingly important alternative fossil fuel due to the depletion of crude oil. Before consumers use, natural gas must be processed or refined. Gas dehydration is one of the most important operations in gas processing to eliminate water vapor associated with natural gas [1]. The presence of water vapor in natural gas cause problems such as hydrate formation or freezing (which results pipe plugging), Corrosion (especially in the presence of H_2S and CO_2) and reduction of combustion efficiency [2]. Netusil and Ditl. made a comparison between three methods for natural gas dehydration. These methods are absorption by triethylene glycol, adsorption on solid desiccants and condensation. He found that energy consumption under low pressure for the refrigeration method was the most demanding one and the absorption method was less demanding on the whole pressure scale [3]. The North Africa Gas Project field development consists of eight wells, a gathering system and a Central Processing Facility (CPF) at which stream production from the various fields were separated into condensate and dew pointed gas products for export. The condensate will be exported via the existing Trans Saharan Pipeline Company (TRAPSA) oil pipeline to the La Skhira oil terminal near Gabes. The gas will be exported to a tie-in point at the LPG Project facilities from where it will be transported via a 320 km gas pipeline to Gabes and treated in a dedicated Liquefied Petroleum Gas (LPG) extraction facility to commercial specification required for end user consumption. The required water dew point in the export gas of North Africa Gas Project is -12 ^oC at any pressure.

In the present work a comparison of all gas dehydration available methods applied in the industry to choose a suitable gas dehydration method for North Africa Gas Project gas development project in the south of Tunisia to

achieve the export gas specifications. The comparison based on energy costs, market conditions (materials cost, consumables costs), technology evolution with time and company experience with a certain technology.

1-1. Dehydration methods

1-1-1. Absorption Dehydration using Glycol

Glycol possess the criteria for liquids suitable for absorbing water from gas in commercially viable processes. Due to its relatively high volatility, the use of monoethylene glycol (MEG) is limited to injection into a wet gas stream for hydrate suppression rather than water dewpoint depression by contact with gas in an absorber tower [4]. Other hand, diethylene glycol (DEG), triethylene glycol (TEG) and tetraethylene glycol (TREG) possess suitable properties for dewpoint depression i.e. dehydration through gas/liquid contact. However, the vast majority of the glycol dehydrators in service use TEG. DEG may be cheaper to buy in certain markets but when handling and other labour costs are accounted for there is little if any saving. Compared to TEG, DEG exhibits greater losses in carry-over, provides less dewpoint depression and regeneration to high concentrations is more difficult [5]. TREG is more viscous and more expensive than the other processes. It exhibits a lower vapor pressure which reduces absorber carry-over losses. It can be used in high temperature applications where dehydration of gases at temperatures in excess of 60°C is required. Additionally, TREG is not as readily available as TEG [6]. TEG is the most widely used and easily available desiccant for dehydration units. For the reasons outlined above the most suitable liquid desiccant for use at North Africa Gas Project is TEG. Property data for TEG and other glycols are shown in Table (1) and Figure (1) [7].

Table 1: Physical Properties of Glycols

	Mono-ethylene Glycol (MEG)	Diethylene Glycol (DEG)	Tri-ethylene Glycol (TEG)	Tetra-ethylene Glycol (TREG)
Formula	$C_2H_6O_2$	$C_4H_{10}O_3$	$C_6H_{14}O_4$	$C_6H_{18}O_5$
Molecular Weight	62.1	106.1	150.2	194.2
Boiling Point at 760 mmHg - °C	197.3	244.8	285.5	314.0
Vapor Pressure at 25°C - mmHg	0.12	<0.01	<0.01	<0.01
Vapor Pressure at 50°C - mmHg	0.62	0.06	<0.01	<0.01
Density @ 25°C kg/m3	1110	1113	1119	1120
Density @ 60°C kg/m3	1085	1088	1092	1092
Freezing point - °C	-13	-8	-7	-5.5
Pour Point - °C	-	-54	-58	-41
Viscosity @ 25°C - cP	16.5	28.2	37.3	44.6
Viscosity @ 60°C - cP	4.68	6.99	8.77	10.2
Surface Tension (25°C) dyne/cm	47	44	45	45
Refractive Index (25°C)	1.430	1.446	1.454	1.457
Specific Heat (25°C) kJ/(kg. K)	2.43	2.30	2.22	2.18
Flash Point - °C (PMCC)	116	124	177	204

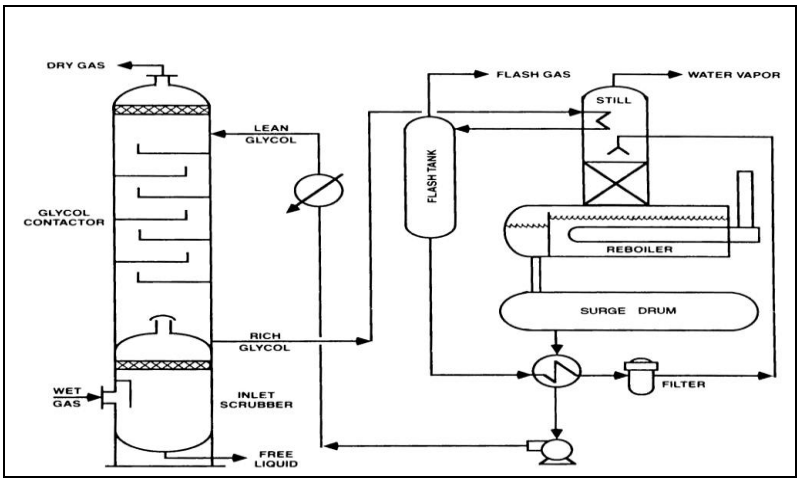


Figure -1 Basic Flow scheme for Glycol Dehydration

M.M. Ghiasi et al. studied the triethylene glycol (TEG) purity in natural gas dehydration units using fuzzy neural network, developed of an intelligent model based on the well-proven standard feed-forward back-propagation neural network for accurate prediction of TEG purity based on operating conditions of reboiler. He found that reducing the pressure in the reboiler at a constant temperature results in higher glycol purity [8]. M. A. Satyro and Schoegglb studied temperature change from isenthalpic expansion of aqueous triethylene glycol mixtures for natural gas dehydration. They found that for typical natural gas dehydration conditions, the depressurization of rich TEG solutions from 7000 kPa to 440 kPa under isenthalpic conditions has a temperature increase in the order of 1.9 K. The isenthalpic expansion across the valve was modeled with a cubic equation of state and classic quadratic mixing rule with interaction parameters determined based only on VLE data. The model predicted a temperature increase in the order of 2.5K for all mixtures studied in this work [9].

1-1-2. Other Glycol Options

Other options to enhance glycol purity to achieve a high degree of water dewpoint depression include operation of the regenerator under vacuum, the proprietary Drizo process and the proprietary Coldfinger process.

1-1-2-1. Stripping gas and Vacuum

At boiling conditions of 1 atm and 204 ºC the maximum lean glycol mass concentration will be 98.6%. If higher concentration, to meet the dewpoint specification is required, two different modifications can be introduced (the introduction of stripping gas to the regenerator or the regenerator operation at vacuum pressure) for lowering the partial pressure of the water in the vapor space of the glycol reboiler and enhance glycol concentration. The uses of stripping gas or the vacuum in the reboiler are the two most common methods for enhancement of the glycol concentration [10]. For stripping gas, any inert gas is suitable and gas can be introduced directly in the reboiler or on the packed unit between the reboiler and the surge tank. A less consume of gas is needed in case the second arrangement is utilized [11]. M.M. Ghiasi et al. studied Rigorous models to optimize stripping gas rate in natural gas dehydration units, found that based on the statistical analysis, an excellent match was noticed between the values obtained from the predictive tools and the real data. The average absolute relative deviation percent (AARD %) was determined to be lower than 0.01% [12].

1-1-2-2. DRIZO

At this process, a solvent (in general, mixture of 70% aromatic, 20% naphthenic and 10% paraffin hydrocarbons) substitutes the stripping gas. This solvent vaporizes at reboiler temperature and is used as a stripping agent. Then, when it leaves the tower from its top, it is condensed and pumped back previously separation on a three phase vessel. The solvent and all BTEX compounds are condensed in this unit before the vapor is discharged to atmosphere [13, 14].

Advantages: One of the more important advantages is that a high purity of TEG is performed (99.999 mass %) with very high stripping flow rates and with little or no venting of hydrocarbons. Other advantage is that all BTEX compounds can be recovered from the vapor flow preventing from being sent to the atmosphere. DRIZO technology can be used to upgrade an existing unit in order to get higher glycol concentrations, or less BTEX and CO_2 emissions.

Disadvantages: A second particular solvent closed circuit is needed. This process has to be operated with some care to obtain a consistency constant operation. In addition, it has taken into account that in case utilizing this technology a license fee has to be paid.

1-1-2-3. Coldfinger

The Coldfinger process involves placing a cooling coil (Coldfinger condenser) in the vapor space above hot glycol in the surge drum, and a collecting tray is placed below the coil to catch condensate. The collected water/condensate from the Coldfinger condenser is collected in an accumulator from where it is periodically pumped back to the regenerator to recover the glycol and drive off the water [15].

The process requires a coolant to condense the water vapor and achieve a claimed 99.9% lean glycol concentration without the need for stripping gas. Also, a small amount of gas is required to be introduced to the surge drum to replace the volume of condensate drained from the Coldfinger to avoid drawing a vacuum; this gas leaves through the regenerator vent and effectively behaves like stripping gas although gas volumes may be less if carefully controlled [16]. Advantages: With these process a TEG purity of 99.96 mass% can be achieved without the use of stripping gas. Disadvantages: A cooling medium is needed and an additional set of pumps is required for the condensed water-TEG mixture. M.R. Rahimpour et al. studied the performance of dehydration unit with Coldfinger technology in gas processing plant; found that Dehydrating by Coldfinger technology represents an effective method for removing water from natural gas [17]. A comparison between the different technologies is presented in Table 2. The maximum TEG concentration and water dew point depression that can be achieved are presented in the table below.

Table 2: TEG Technologies Comparison

Method	[TEG] % m/m (max.)	Water Dew Point depression [°C]
Stripping	99.2 / 99.98	55 / 83
Vacuum	99.2 / 99.98	55 / 83
Drizo	99.99+	100 / 122
Cold finger	99.96	55 / 83

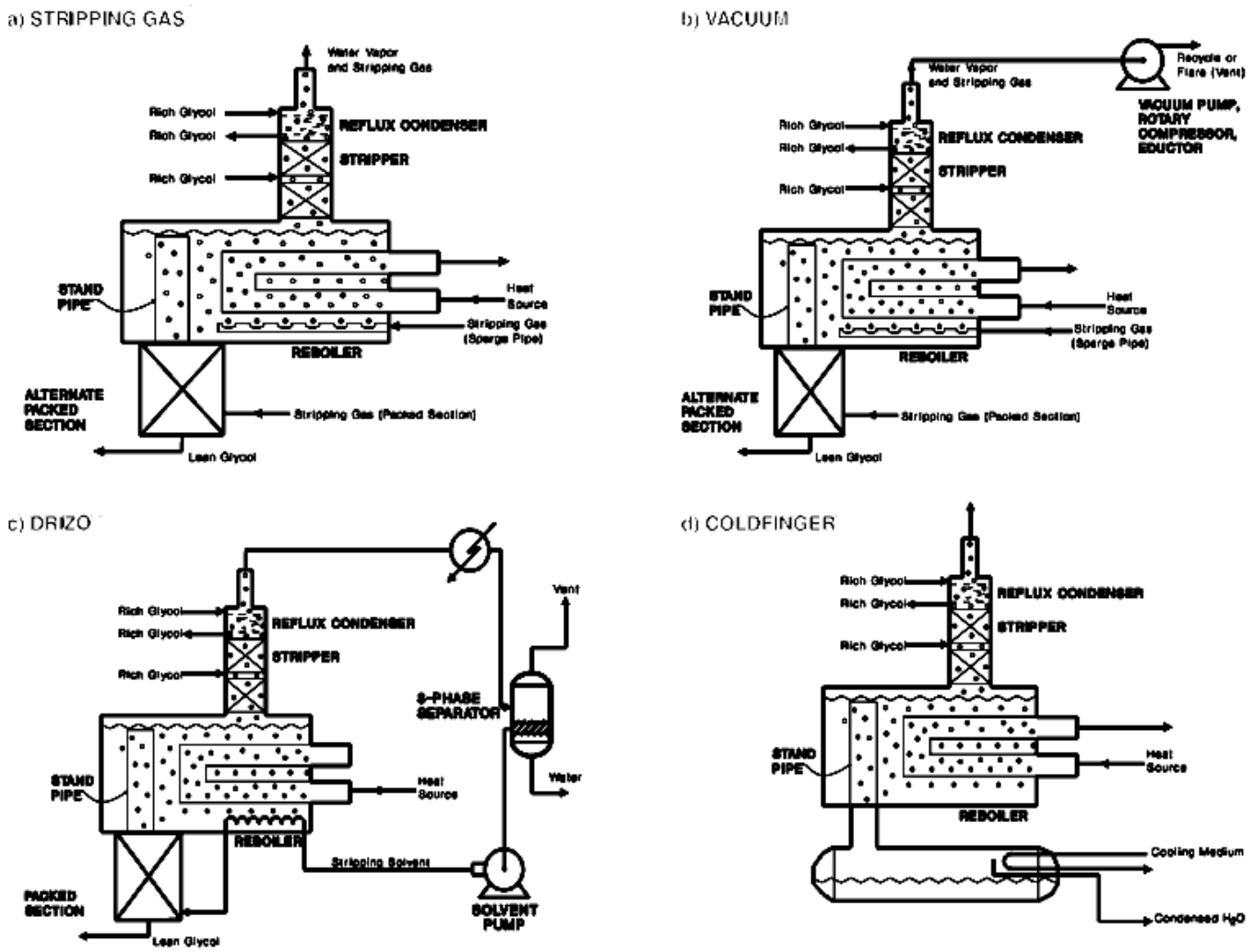


Figure 2 Simplified flow diagram of Enhanced TEG regeneration system

1-1-3. Adsorption Dehydration using solid desiccant

There are several solid desiccants which possess physical characteristic to adsorb water from natural gas. Generally, in a simple two-tower system, the dehydration systems consisting of two or more towers and associated regeneration equipment (Figure 3). One tower is on stream adsorbing water from the gas while the other tower is being regenerated and cooled. Hot gas is used to drive off the adsorbed water from the desiccant, after which the tower is cooled with an unheated gas stream [18]. In general, the use of solids desiccant instead of liquids is associated to very low water dew point requirements, applications with high H_2S gases content, requirements of simultaneous control of hydrocarbon and water dew point. At cryogenic or very low temperature it is usually preferred the use of solid desiccants than inhibition, to avoid hydrate and/or ice formation [19]. The following three types of solids desiccants are usually used:

- **Silica Gel**

Silica Gel basically, is a silicon dioxide, SiO_2 and is used for gas and liquid dehydration. Also, it can be used for hydrocarbon recovery from natural gas. Dew point of approximately -60 ºC can be achieved in hydrocarbon removal units that are commonly called HRUs (Hydrocarbon Recovery Units) or SCUs (Short Cycle Units) [20].

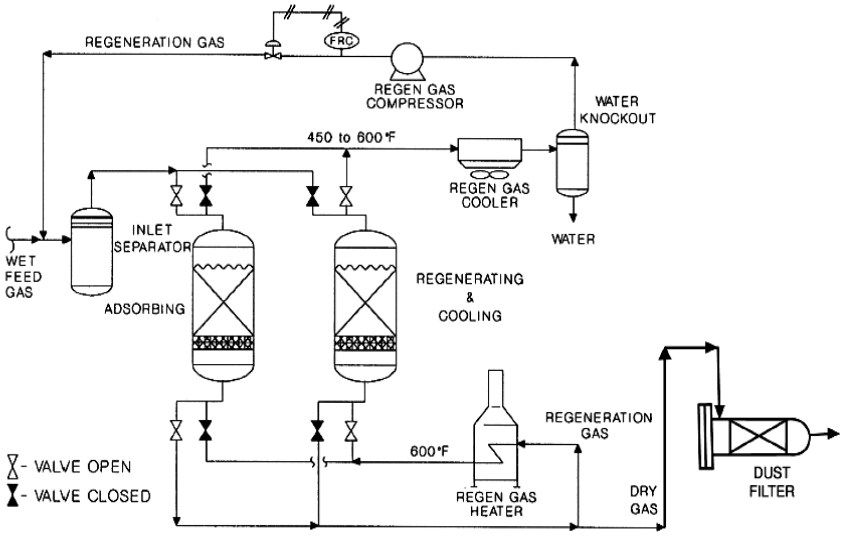


Figure: 3 Basic Flow scheme for solid desiccants

- **Alumina**

Alumina (manufactured or natural) is a hydrated form of alumina oxide, Al_2O_3 which can be used for dehydration of liquid and gases and get water dew points of about -70ºC [21].
Advantages: In comparison with molecular sieves, alumina needs less regeneration heat because its regeneration temperature is lower. Disadvantages: Heavy hydrocarbons tend to get adsorbed in the alumina, making the alumina impossible to be regenerated. Alumina can also react with mineral acid.

- **Molecular Sieves**

The molecular sieves are aluminosilicates (manufactured or naturals) having the highest selectivity and water capacity and consequently can get the lowest values of water dew point. These technology is commonly used upstream a NGL recovery plant, or in process where very cold temperatures are presents, to prevent hydrate and ice formation [22]. Water dew point of about -100ºC is possible to achieve with molecular sieves. With same changes on design or in operating parameters lower temperatures can be reached. To get a continuous process, a lead-lag arrangement is required, while one bed is operating, the other bed is getting regenerated and cooled. Cycles between 8 and 24 hours are usual. Molecular sieves are non-toxic, non-corrosive and available in different pore sizes [23, 24]. Advantages: Main advantage is the lower water dew point than can be reached. Disadvantages: They are usually more expensive than the other alternatives. Table 3 below indicates the main advantages & disadvantages of solid desiccants

Table 3: Solid desiccants (Adsorption Dehydration) Advantages / Disadvantages

Advantages	Disadvantages
• Dew points as low as –150 ºF. • They are less affected by small changes in gas Pressure, temperature and flow rate. • They are less susceptible to corrosion or foaming.	• Higher capital cost and higher pressure drops. • Desiccant poisoning by heavy HC's, H_2S, CO_2, etc. • Mechanical breaking of desiccant particles. • High regeneration heat requirements and high utility costs.

H.A.A. Farag et al. studied the natural gas dehydration by desiccant materials, built up a pilot scale unit for natural gas dehydration as simulation of actual existing plant for Egyptian Western Desert Gas Company (WDGC). The effect of different operating conditions (water vapor concentration and gas flow rate) on dehydration of natural gas were studied. They found that increasing water vapor concentration in inlet feed gas leads to a marked decrease in dehydration efficiency, a higher inlet flow rate of natural gas decrease dehydration efficiency, increasing feed pressure leads to higher dehydration efficiency [25].

M. Takbiri et al. studied Preparation of nanostructured activated alumina and hybrid alumina–silica by chemical precipitation for natural gas dehydration, and found that the activated alumina was prepared from aluminum isobutanolate has maximum pore volume and humidity sorption capacity. Addition of hybrid to precursor was caused to exfoliate in structure of alumina and increasing of acidity and consequently the humidity sorption increased [26]. C. Zou et al. studied the Failure analysis and faults diagnosis of molecular sieve in natural gas dehydration, and found that there are four main aspects for the unavailability of the regenerative molecular sieve. First, the pH values and surface alkalinity decrease. Second, the secondary pore structure diminished and blocked. Third, the crystallite size increases, and the crystals agglomerated. Finally, not only the hydrocarbons adsorbed, but also alcohols, ethers and carbonyl sulfides generated in pores [27].

1-1-4 Dehydration by expansion refrigeration,

The dehydration of natural gas can also achieved by refrigeration and/or cryogenic processing down to –100°C in the presence of methanol hydrate and freeze protection. The condensed water and methanol streams decanted in the cold process can be regenerated by conventional distillation or by a patented process called IFPEX-1[28]. In the latter process illustrated in schematic form in Figure (4) a slip stream of water saturated feed gas strips essentially all the methanol in the cold decanted methanol water stream originating in the cold process at feed gas conditions to recirculate the methanol to the cold process. The water stream leaving the stripper contains generally less than 100 ppm wt. of methanol. No heat is required for the process and no atmospheric venting takes place [29, 30].

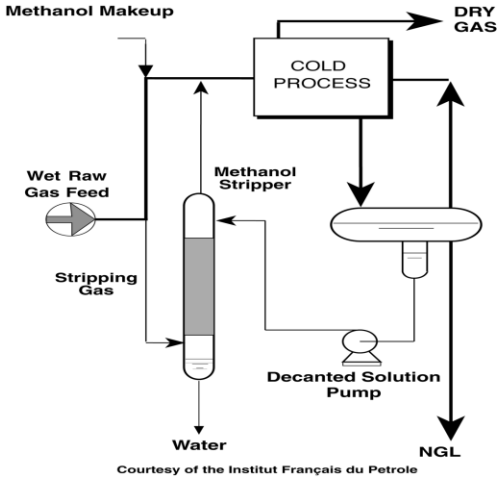


Figure-4 Basic Flow scheme for dehydration by expansion refrigeration

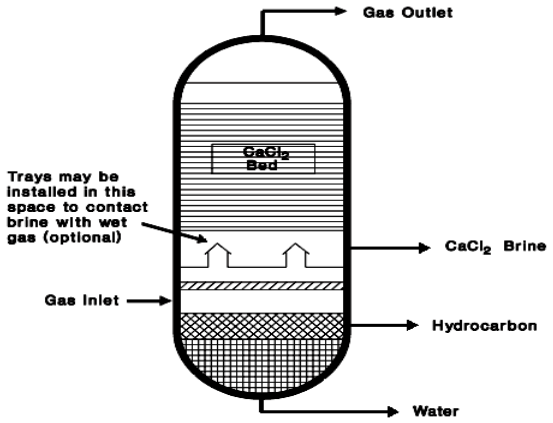


Figure -5 Basic Flow scheme for dehydration by $CaCl_2$

1-1-5 Dehydration by $CaCl_2$

The calcium chloride is a solid anhydrous that combinated with water generates a $CaCl_2$ brine solution. Fixed beds of $CaCl_2$ pellets are installed and the wetted gas flows through them [31]. Usually to increase unit capacity, 3 or 4 trays are installed below the solid bed to pre-contact the gas with the brine solution. In that way the upflows wetted gas get previously in contact with the brine solution and is a little dehydrated before taking contact with the dry

solid desiccant[32]. Figure (5) below indicates the flow diagram of gas dehydration by $CaCl_2$. Table 4 below indicates the advantages & disadvantages of gas dehydration by $CaCl_2$

Table 4: Dehydration by $CaCl_2$ Advantages / Disadvantages

Advantages	Disadvantages
$CaCl_2$ dehydrators can be used on remote dry well gas substituting glycol units on low rates.	The calcium chloride is a consumable desiccant to dehydrate natural gas. It must be changed out periodically. In low capacity – high rate units this may be as often as every 2-3 weeks. But the worst disadvantages, and what have made this technology less popular, are the environmental problems of disposing of the produced brine. Additionally, unit performance problems caused by gas channeling in case pellets may became a "solid bridge" in the fixed bed.

M.M. Ghiasi et al. studied Estimation of the water content of natural gas dried by solid calcium chloride dehydrator units, two mathematical-based models were developed to estimate approximate water content of natural gas dried by calcium chloride dehydrator, found that the results of both presented models were excellent agreement with reported data in the literature. The tools developed in this study can be of immense practical value for engineers to have a quick check on water content of natural gas dried by calcium chloride [33].

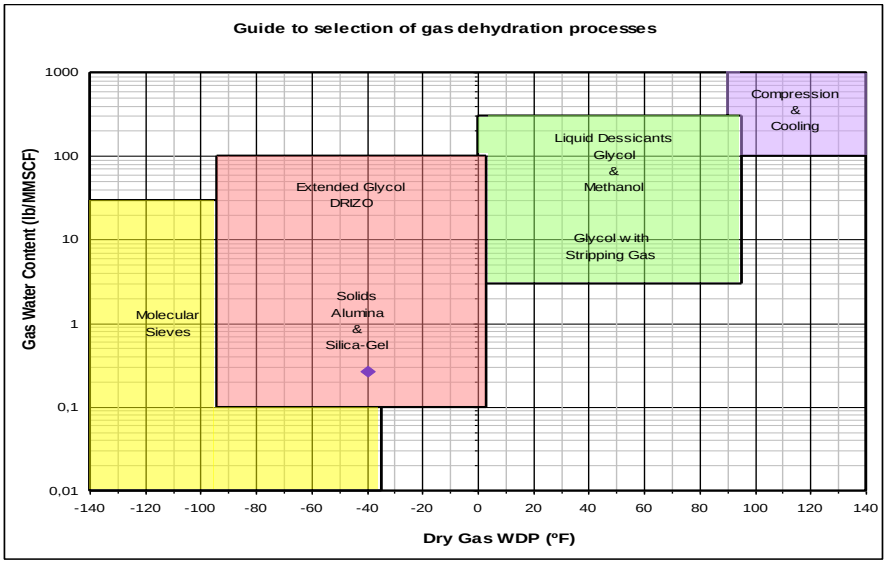
1-1-6. Dehydration by membrane permeation,

Membranes can be used to separate gas stream components in natural gas such as water, CO_2 and hydrocarbons according to their permeabilities. Each gas component entering the separator has a characteristic permeation rate that is a function of its ability to dissolve in and diffuse through the membrane [34]. The driving force for separation of a gas component in a mixture is the difference between its partial pressure across the membrane [35]. As pressurized feed gas flows into the metal shell of the separator, the fast gas component, such as water and CO_2, permeate through the membrane [36]. This permeate is collected at a reduced pressure, while the non-permeate stream, i.e., the dry natural gas, leaves the separator at a slightly lower pressure than the feed. The amount of methane and other natural gas components in the permeate stream is dependent on pressure drop and the surface area of the membranes. However, 5–10% of the feed stream is a realistic Figure 6. Dehydration by membrane permeation is therefore normally only considered for plants that can make use of low pressure natural gas fuel [37]. H. Lin et al. studied the dehydration of natural gas by using membrane technology, found that membrane processes with dry gas sweep on the permeate can be competitive with conventional glycol dehydrators for natural gas dehydration, and that spiral-wound modules with good sweep/countercurrent efficiency can be made [38]. McKee et al. compared diethanolamine PEA and membrane processes for a 1,000 psia gas-treating plant. For their base case, the amine plant was found to be generally more economical for plant sizes greater than about 20 MMscfd [39]. S. Shirazian, S.N. Ashrafizadeh studied LTA and ion-exchanged LTA zeolite membranes for dehydration of natural gas, the effects of the molarity of KCl solutions and the repetition of ion-exchange on the membrane performance were investigated to produce high-quality KA membranes suitable for dehydration of natural gas. Found that the membrane ion-exchanged in 1 M KCl solution for two times had the best separation performance [40]. J. Zhao et al. studied Fabricating graphene oxide-based ultrathin hybrid membrane for pervaporation dehydration via layer-by-layer self-assembly driven by multiple interactions. They found that the optimized separation performance of hybrid multilayer membranes with the bilayer number 10.5 was obtained with the permeation flux of 2275 g/m^2 h and water content in permeate of 98.7 wt. % under the conditions of 350K and water content in feed of 20 wt. % [41]. X. Chen et al. studied Fabrication of graphene oxide composite membranes and their application for pervaporation dehydration of butanol, found that graphene oxide membranes are suitable candidates for butanol dehydration via PV process [42]. J. Runhong Du et al. studied Membrane gas dehydration in a pressure-electric

coupled field, the results also showed that the activation energy for water permeation was reduced by the electric field [43].

2- Discussion

The North Africa Gas Project simulation indicates water content in the export gas of about 50 ppm corresponding to a water dew point of -15°C at CPF outlet pressure of 46.5 bar, which meets the export gas specification. This margin will provide operational flexibility and to cater for any upsets in glycol dehydration unit. A comparison is made between solid desiccants and liquid desiccants for North Africa Gas Project dehydration; table 5 below indicates these comparisons. Figure (6) represents a summarized selection chart for natural gas dehydration



Figur-6 Gas dehydration technology selection chart

Table 5: Comparison of Liquid and solid desiccants

Absorption using liquid desiccants	Adsorption using solid desiccants
Low installation cost	High installation costs
Low pressure drop: 5-10 psi	High pressure drop: 10-50 psi
Continuous process	Process in parallel
Low ratio of heat regeneration / removed water	High ratio of heat regeneration / removed water
Minimum water dew point = -40ºC	Minimum water dew point = -100ºC
For low water dew points other regeneration methods are needed: Stripping, Drizo, etc.	The reactive are poisoned in contact heavy hydrocarbons.
Low operating cost	High operating cost
Glycols are corrosive when are degradated or contaminated	Less susceptible to corrosion or foaming.
Highly affected due to changes of flow, pressure and temperature of the gas flow	Not highly affected due to changes of flow, pressure and temperature of the gas flow

From the above table, it can be noticed that Gas dehydration for North Africa Gas Project by using liquid desiccants is more suitable than using solid desiccants. A comparison was made between Glycol and Molecular Sieve for gas dehydration. The table 6 below indicates the main differences between Glycol and and Molecular Sieve for gas dehydration

Table 6: Comparison of Glycol and Molecular Sieve for Gas Dehydration

Glycol	Molecular Sieve
Glycol units have a single high pressure absorber tower	Molecular sieves require a minimum of two high pressure adsorbers, sometimes more, depending on flow rates and regeneration cycles
Lower CAPEX	Higher CAPEX
Glycol units have lower peak utility consumption as the glycol reboiler operates continuously	Molecular sieve regeneration gas heater is a cyclic service; therefore have higher peak utility consumption.
Glycol units operate at maximum temperature of 204°C. The equipment that operates at high temperature in a glycol unit is at low pressure.	Molecular sieves operate at maximum temperature of >315°C. The high temperatures occur at high pressures.
Lower pressures may result in a lower pressure piping class for glycol unit equipment and piping e.g. class 600 RF.	The combination of high temperature and high pressure may dictate the use of a higher pressure piping class for the molecular sieve equipment and piping e.g. class 900 RTJ. This may require an additional range of spare parts not found elsewhere on the plant.
Glycol units employ simple control loops only.	Molecular sieves require relatively complex valve switching logic and critical sequence timing.
Gas pressure drop < 0.3 bar	Gas pressure drop = 1.0 – 1.5 bar.
Liquid phase water droplets do not affect glycol units.	Molecular sieve desiccant material is intolerant to liquid phase water droplets. Impact of droplets on the sieve causes severe degradation of the desiccant producing fine solid particles, which migrate through the bed and entrained in the gas. Additional filters require maintenance and carry an attendant risk of non-performance.
No fine particles present in Glycol unit.	Attrition of desiccant creates fine particles of molecular sieve material, which entrained, in the dry gas. A fine gas filter is required downstream adding to the overall pressure drop of the system.

Figure (7) indicates the power consumption for each dehydration method for the North Africa project.

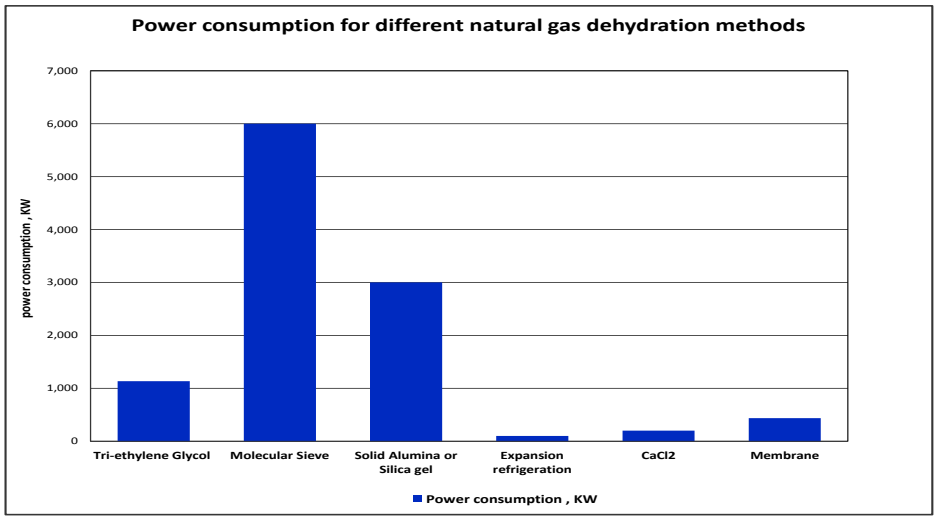


Figure 7: Power consumption for different natural gas dehydration methods

Figure (8) indicates the capital cost in million USD for each dehydration method for the North Africa project.

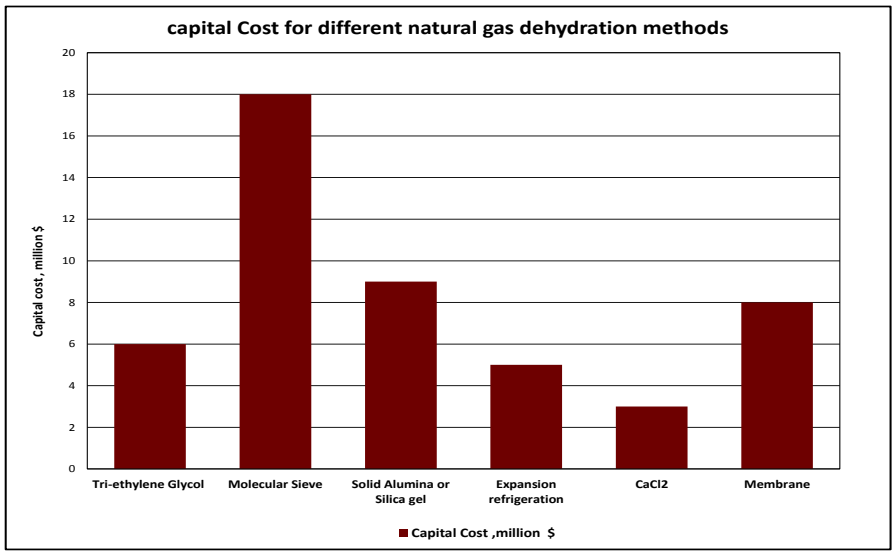


Figure 8: Capital Cost for different natural gas dehydration methods

Table 5 below summarizes the main differences between the dehydration methods.

Table 7: Comparison between Dehydration methods

Technology	Tri-ethylene Glycol	Molecular Sieve	Solid Alumina or Silica gel	Expansion or refrigeration	$CaCl_2$	Membrane
Power Consumption, KW	1,135	6,000	3,000	100	200	437
Suitability	Yes	Yes	No	No	No	No
Limition	None	Feed temperature, Product Loss	None	None	1-Environmental problems 2-Performance problems	Fragility, Short Life, Product loss
North Africa Reference	Yes	Yes	NA	NA	NA	NA
Capital Cost, million $	6	18	9	5	3	8

From the above table & chart, it can be noticed that removal of H_2O from gas project in North Africa by using tri-ethylene Glycol is the best choice to achieve the export gas specifications.

3- Conclusions & recommendations

It is recommended to use a TEG (Triethylene Glycol) based dehydration unit to meet the FEED filters such as robustness (operational flexibility), simplicity, and use of proven technology (increased operator awareness with no additional training, operating experience etc.).

It also recommended to cool the gas to 30 °C to optimize the dehydration unit by reducing the size of the Glycol Contactor and Glycol Regeneration Unit. This also relaxes the glycol purity requirements to approximately 99 %wt., which minimizes and may eliminate stripping gas requirements; however provision for stripping gas will be retained in the design to allow flexibility to handle plant upsets and to debottleneck the TEG regeneration system in future.

4- Nomenclature

Abbreviation	Description
BS&W	Basic sediment and water
BTEX	Benzene, Toluene, Ethyl benzene and Xylene

Abbreviation	Description
CAPEX	Capital Expenditure
CPF	Central Processing Facility
DEG	Diethylene glycol
DGA	Diglycol amine
FEED	Front End Engineering and Design
HSE	Health, Safety and the Environment
LPG	Liquefied Petroleum Gas
MEG	Monoethylene glycol
OPEX	Operating Expenditure
ppm	Part per million
TEG	Triethylene glycol
TREG	Tetraethylene glycol

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مقارنة طرق تجفيف الغاز الطبيعي

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نبذة مختصرة

يتراوح محتوى الرطوبة المسموح بها خلال عمليات انتقال الغاز الطبيعي من ٤ إلى ٧ MMSCF/pound (٦٤-١١٢ m^3 / mg) . المحتوى المائي قد يؤدي إلى تشكيل الهيدرات الصلبة، وتآكل خطوط الأنابيب ومحطات المعالجة خاصة في وجود CO_2 أوH_2S ، مشاكل الركود والتآكل في خطوط التدفق .كما أنه يؤدي إلى زيادة الحجم بقدر معين، وانخفاض القيمة الحرارية وتجميد في عمليات محطات امتصاص المبردة التبريد. ان تجفيف الغاز الطبيعي ضروري من أجل الحصول على نقطة الندى للماء تحت درجة حرارة التشغيل لتجنب تكاثف المياه والمياه الحرة اللاحقة على النظام وتشكيل الهيدرات .تم إجراء مقارنة بين أساليب الصناعة المختلفة على نطاق واسع لتجفيف الغاز الطبيعي من أجل اختيار طريقة مناسبة لتحقيق نقطة الندى المياه المطلوبة للغاز المصدر لمشروع غاز شمال أفريقيا . ومن هذه الطرق هي الامتزاز (باستخدام المجففات الصلبة)، وامتصاص (باستخدام المجففات السائلة)، والجفاف (بواسطة$CaCl_2$ ، التبريد المتوسع والمتغلغلة من خلال غشاء .(تمت المقارنة وفقا لطلبها على الطاقة وملاءمتها للاستخدام في بلدان شمال أفريقيا .وفي مرافق العمليات المركزية لشمال أفريقيا، في مشروع شمال أفريقيا للغاز في جنوب تونس يمكن أن يتراوح ضغط الغاز ودرجة الحرارة خلال التدفق بين ٥٤ و ٦٠ بار و ٢٥ درجة مئوية إلى ٥٠ درجة مئوية (في الشتاء إلى الصيف) على التوالي، وعليه فإن مواصفات نقطة الندى المطلوبة من غاز التصدير في الحقل هي -١٢ درجة مئوية عند أي ضغط .ونتيجة للمقارنة وجد أنه من المستحسن استخدام TEG (ثلاثي إيثيلين جلايكول) طريقة الجفاف وذلك لمزاياه العديدة.