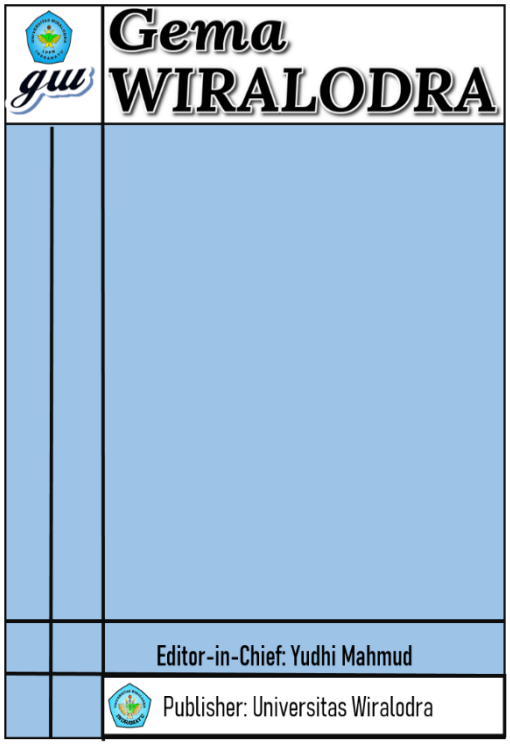
Gema Wiralodra

Publication details, including instructions for authors and subscription information:
https://gemawiralodra.unwir.ac.id



Glycol losses calculation in a gas dehydration unit

Adrian Indarti[a*], Nur Khozin Adi Nugroho[b], Agung Rizki Zaini[c]

[a*]Institut Teknologi Petroleum Balongan, Indonesia, adrianindarti88@gmail.com
[b]Institut Teknologi Petroleum Balongan, Indonesia, nurkhozinadhinugroho@yahoo.co.id
[c]Institut Teknologi Petroleum Balongan, Indonesia, agungrizkizaini11@gmail.com

To cite this article:
Indarti, A., Nugroho, N.K.A., Zaini, A.R. (2023). Glycol losses calculation in a gas dehydration unit. *Gema Wiralodra*, *14*(2), 736-741.
To link to this article:
https://gemawiralodra.unwir.ac.id/index.php/gemawiralodra/issue/view/22
Published by:
Universitas Wiralodra
Jln. Ir. H. Juanda Km 3 Indramayu, West Java, Indonesia

Gema Wiralodra, 14(2), 736-741
https://gemawiralodra.unwir.ac.id/index.php/gemawiralodra
p-ISSN: **1693 - 7945**
e –ISSN: **2622 - 1969**

Orginal Article

Glycol losses calculation in a gas dehydration unit

Adrian Indarti[a*], Nur Khozin Adi Nugroho[b], Agung Rizki Zaini[c]
[a*]Institut Teknologi Petroleum Balongan, Indonesia, adrianindarti88@gmail.com
[b]Institut Teknologi Petroleum Balongan, Indonesia, nurkhozinadhinugroho@yahoo.co.id
[c]Institut Teknologi Petroleum Balongan, Indonesia, agungrizkizaini11@gmail.com

[*]Corresponding Author: adrianindarti88@gmail.com
Submit 08-06- 2023, accepted 08-07-2023, published 10-07-2023

Abstract
The gas dehydration process separates gas from water content by mixing absorbents such as glycol in the gas dehydration unit. The gas dehydration process can use triethylene glycol type glycol, reducing the water content to a minimum of 7 lb/mmscfd. In the dehydration process, glycol losses will usually occur either in the reboiler or contactor; for this reason, this study aims to determine the causes of glycol losses, calculate the water content absorbed in the contactor, determine the percentage of glycol losses and calculate how much glycol is needed in each 1mmscfd of gas. Glycol losses are classified into two types: expected and up-standard. In this case, the research method starts by calculating the amount of water content that can be absorbed, the percentage of glycol losses, and the amount of glycol volume required in every one mmscfd of gas. Causes of glycol losses include the number of trays, contact time, absorption surface area, flow rate, and temperature in the reboiler. Of the 60.96 mmscfd of wet gas that entered the contactor, it was found that 32.11 lb/mmscfd of water managed to absorb glycol. Based on the calculation of glycol losses in some test data, the average glycol losses (0.087 gal/mmscf) are still categorized as ordinary losses because the glycol losses that occur do not exceed the safe limit set by the industry, which is 0.01 – 0.15 gal /mmscf. One way to reduce the occurrence of glycol losses is to adjust the pump discharge to the incoming gas flow so that excess glycol is not used when there is contact between glycol and wet gas.
Keywords: Absorption, Dehydration, Glycol losses

1. Introduction

Natural gas is a mixture of hydrocarbon and non-hydrocarbon gases that comes out of both gas wells and oil wells. Natural gas produced by production wells is generally at temperature and pressure (Alagorni et al., 2015). Contains hydrocarbon condensate, non-hydrocarbon gases, and free water vapor (Yang et al., 2021). Therefore, natural gas consists of two main components, namely hydrocarbon components and non-hydrocarbon components. Hydrocarbon condensate, non-hydrocarbon gas, water vapor, and free water must be separated to obtain a high hydrocarbon component of natural gas.

The moisture content in the gas must be removed because later it can inhibit the production rate; for example, the water content produced can cause rust in production equipment and cause scale in the pipe, inhibiting combustion. The absorbent used in the gas drying process must have high water solubility, not be corrosive, not easy to form a foam (foaming), be easy to regenerate, and be cheap (Awe et al., 2017). Absorbent included with dry gas, developing foaming, or included in the heat in the reboiler is called a loss absorbent (Zhang et al., 2016).

Glycol losses are the loss of some glycol content used during dehydration (Haque, 2012). Glycol losses can occur due to uneven contracting or too high a water content in the glycol mixture composition. The frequent occurrence of glycol losses in the gas dehydration process makes the use not meet the existing standards (Kusrini, 2023) (. Therefore, glycol losses must be maintained so the dehydration process can run optimally and continue tmically. This research aims to determine the causes of glycol losses, calculate the water content absorbed in the contactor, determine the number of glycol losses, and calculate how much glycol is needed in every mmscfd.

Gema Wiralodra is licensed under a Creative Commons Attribution 4.0 International License

p-ISSN: **1693 - 7945**
e –ISSN: **2622 - 1969**

Orginal Article

2. Method

Determination of Glycol Losses

Glycol losses can occur in several gas dehydration devices. Still, the most glycol losses occur in the triethylene glycol regeneration system (TGRS) and glycol contractors because these two devices are vrone to glycol losses. If in the triethylene glycol regeneration system (TGRS), glycol losses occur as a result of the reboiler temperature being too high, exceeding the boiling point of the triethylene glycol (TEG) so that the triethylene glycol (TEG) evaporates and goes with the water to be treated by the WWTP (Wastewater Treatment Plant).). While the loss of glycol in the glycol contactor generally occurs due to too much glycol make up, resulting in much glycol to foam when dehydration takes place, the number of trays on the contactor, and the temperature of the lean glycol which is too hot exceeds 15º above the temperature of the gas entering the glycol contactor. So lean glycol will be bound with gas, leading to the gas produced and causing glycol losses. The amount of glycol losses can be determined in the following way (Manning, 1991).

$$Glycol\ loss\ \left(\frac{gal}{mmscf}\right) = \frac{make\ up\ TEG(Liter)}{day}\ x\ \frac{1\ gal}{3.785\ liter}\ x\ \frac{1}{flowrate\ (mmscfd)} \quad (1)$$

a. *Glycol Losses*

Note:

GL = *Glycol Losses* (gal/MMSCF)

Convert gal to bbl = $\frac{1\ gal}{3.785}$

Day = Period *Make Up Glycol*

Make up Glycol = *Glycol* added (drums)

Q_{gas} = *Flow Rate* gas (mmscf)

b. Weight of incoming H2O/hour

Weight of incoming H2O/hour = Q x I x $\frac{1\ day}{24\ hour}$ (2)

Note:

M H_2O = Weight H_2O x (lbs/hour)

c. Weight *Water content*

Weight *Water content* = *Water Removed* x *gas rate* x $\frac{1\ day}{24\ jam}$ (3)

Note:

WR (*Water removed)* = Removed water (Lbs/hour)

Gas Rate = mmscf

d. Presentase *Glycol Losses*

Presentase *glycol losses* = $\frac{v\ losses}{v\ circulation}\ x$ =100% (4)

Calculation Data

Production Data

Gas flow rate = 60.96 mmscfd

Water inlet content = 20.23 lb/mmscf

Water outlet rate = 7.47 lb/mmscf

Water vapor content data

ρ water = 8.33 ppg

Weight of water = 607.817

Glycol data

ρ glycol = 9.377

Gema Wiralodra is licensed under a Creative Commons Attribution 4.0 International License

p-ISSN: **1693 - 7945**
e –ISSN: **2622 - 1969**

Glycol purity = 99%
SG glycol = 1.1257

Calculation of Glycol Losses

Below is glycol make up data.

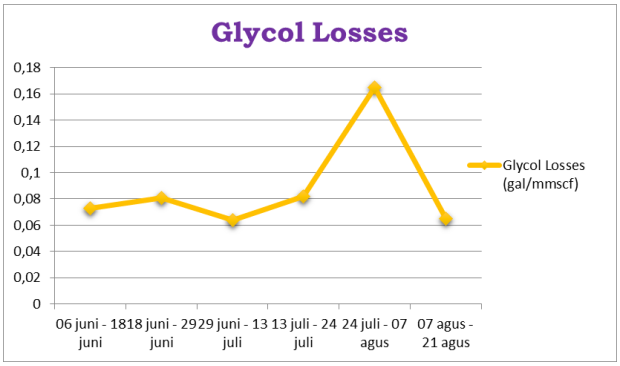
Table 1
Data Make up Glycol

Date	Day	Make up TEG (drum)	Liter	Avg. *flowrate* (MMSCFD)
06/06/22	12	1	208,18	60,35
18/06/22	11	1	208,18	61,16
29/06/22	14	1	208,18	60,87
13/07/22	11	1	208,18	60,70
24/07/22	11	2	416,36	62,40
07/08/22	14	1	208.18	60,28

Table 2
Period Glycol Losses Calculation Results

Date	Day	Make up TEG (drum)	Volume (Liter)	*Glycol losses* (gal/mmscf)
06/June/2022 - 18/june/2022	12	1	208,18	0,075
18/June/2022 – 29/June/2022	11	1	208,18	0,081
29/June/2022 - 13/Jule/2022	14	1	208,18	0,064
13/July/2022 – 24/July/2022	11	1	208,18	0,082
24/July/2022 - 07/Aug/2022	11	2	416,36	0,16
07/Aug/2022 - 21/Aug/2022	14	1	208,18	0,065

Figure 1
Glycol Losses Fluctuation Chart



The graph above shows the difference in losses that occur in each period; it can be seen that in the first four periods and the last period, the dehydration losses are low in glycol, so in that period, it can be said to be average losses. While in the period July 24 – August 7, the losses increased to 0.16 gal/mmscf. To determine the absorbed water content, the following data is needed:

Material Balance

a. Moisture Content inlet 20.23 Lbs/mmscf
b. Moisture Content outlet 7.47 Lbs/mmscf
c. Water Removed – Moisture Content Outlet = (20.23 – 7.47) = 12.76 Lbs/mmscf

From the following data, it is used to calculate the calculation below as follows:

Gema Wiralodra is licensed under a Creative Commons Attribution 4.0 International License

p-ISSN: **1693 - 7945**
e –ISSN: **2622 - 1969**

Orginal Article

Table 3
Glycol Losses Calculation Results

Intake H2O weight/hour	Gal. TEG circulated/hour	Weight TEG 99%/hour	The weight of the removed H2O
32,41 lbs/hour	64,82 gal/hour	607,817 lbs/hour	32,41 lbs/hour
Base 1-hour operation			
Lb *lean glycol*	Lb H_2O	Lb *rich glycol*	V *glycol* yang di sirkulasi
601,73 lbs	6,07 lbs	640,21 lbs	63,92 gal/jam
Presentase *Glycol Losses* 0,25 %			

3. Results and Discussion

From the discussions and facts in the field, the factors that influence the occurrence of glycol losses include:

a. The number of trays contained in the glycol contactor

The number of trays has an effect because when the tray used on the glycol contactor is less than four trays, it will cause inefficient absorption. Besides that, the tray functions as a glycol storage medium in the contactor, so when the number of trays is less than 4, much glycol will not be accommodated and will cause glycol losses; it can cause glycol to enter the bubble cup tray, making the glycol turn into foam, which can cause glycol losses.

b. Make up Glycol that is too big.

Suppose the glycol makeup is too large, in addition to wasting glycol. In that case, it will also increase the possibility of glycol losses because if there is too much glycol make up, the effect is almost the same as when the number of trays does not meet the specified standard, the glycol will foam on the contactor.

c. The temperature in the reboiler

The temperature in the reboiler also affects glycol losses because when the glycol in the reboiler is heated to a temperature that exceeds the boiling point of glycol (400°F), not only will water evaporate in the reboiler but also glycol will also evaporate.

The number of glycol losses that occur in the industry's gas dehydration process can generally be considered expected when it reaches less than 0.01 – 0.15 gal/mmscf. The calculation results in Table 4 show that glycol losses in the period June 6, 2022 – June 18, 2022 occurred glycol losses of 0.073 gal/mmscf. In the period June 18, 2022 – June 29, 2022, there were glycol losses of 0.081 gal/mmscf; in the period 29 June 2022 – 13 July 2022, there was a glycol loss of 0.064 gal/mmscf; in the period 13 July 2022 – 24 July 2022 there was a glycol loss of 0.082 gal/mmscf, in the period 24 July 2022 – 7 August 2022 there was a glycol loss of 0.16 gal/mmscf, in the period August 7, 2022 – August 21 2022 there was a glycol loss of 0.065 gal/mmscf.

From the results of these calculations, it can be seen that the most considerable glycol losses occurred in the period 24 July - 07 August 2022, namely with a value of 0.16 gal/MMscf, while the minor glycol losses occurred in the period 29 June - 13 July 2022, namely with a value of 0.064 gal/mmscf. Thus the average glycol losses (0.087 gal/mmscf) that occur in this study are still categorized as regular losses because the glycol losses that arise in triethylene glycol have not far exceeded the industry standard limit of 0.01 – 0.15 gal /mmscf.

In the dehydration process, there are several problems in the Absorber process, such as poor dehydration, foaming, the solubility of hydrocarbons in glycol, and Insufficient Dehydration.

Gema Wiralodra is licensed under a Creative Commons Attribution 4.0 International License

p-ISSN: **1693 - 7945**
e –ISSN: **2622 - 1969**

a. Insufficient Dehydration: if the dehydration is not sufficient, the dehydrated gas still contains water with relatively high levels. The reasons for this include the water content in the lean glycol being too large, the absorber design needing to be more adequate, the inlet gas temperature being too high, and the thin glycol temperature being too low.
b. Foaming will cause glycol to be carried away by the gas flow out of the Absorber. Some of the factors that cause foaming include:
   1) Too low concentration of glycol in the absorber
   2) Too significant a temperature difference between the wet gas entering the absorber and the lean glycol entering the absorber
   3) Too high glycol pH (pH > 9 will cause foaming and emulsion formation)
   4) Presence of hydrocarbon condensate
   5) Salt contamination.

The operational problem is control over the Dew Point, where the 'Dew Point' is the temperature at which water vapor begins to condense. In industry, the dew point indicates the water content in a gas stream. If the dew point is used to express the water content in a gas, then the pressure of the gas must be stated. If the decrease in the dew point of the dehydrated gas is too slight, there may be several causes, such as:

a) Low glycol circulating rate
b) Low concentration of lean glycol due to the poor regeneration system
c) Foaming (causing poor contact between the wet gas and thin glycol)
d) The references in the absorber are dirty or clogged
e) Too high gas velocity in the absorber.

To ensure that unwanted things do not occur, the things that must be done are:

a) Check the circulating rate of the glycol solution
b) Check the reboiler temperature and make sure that the temperature has been set correctly; if the temperature setting is correct, verify the reboiler temperature using a thermometer and make sure that the temperature control system is working correctly.

Glycol losses are affected by the number of trays on the contactor because the number of trays is very influential during the absorption process; the minimum number of trays on the contactor is four trays, while for the absorption process in the field use eight trays so that it can increase the efficiency of glycol absorption in the contactor. The Still Column and Reboiler temperature is designed at $340\ °F - 400\ °F$ so that the water contained in the gas can evaporate without evaporating the glycol. Mechanical problems often occur in the field, such as equipment that is jammed or difficult to start, such as the TGRS tool component, which takes a long time to turn on. The solution to this problem is to maintain or replace equipment due to the tool's condition that needs to be more efficient.

4. Conclusion

From the data calculations and discussions that have been carried out, several conclusions can be drawn as follows: (1) The cause of glycol losses in the gas dehydration unit is caused by various factors, including the number of trays that are less than four so that much glycol cannot be accommodated, the amount of glycol make up is too much, and the temperature in the reboiler is high. (2). The water content absorbed or removed in the contactor for feed wet gas of 60.96 mmscfd is 32.11 lbs/hour. (3) In this study, the average glycol losses are 0.087 gal/mmscf, which are still classified as ordinary losses. (4) The glycol needed in every one mmscf of gas is 24.5 gal/mmscf.

Gema Wiralodra is licensed under a Creative Commons Attribution 4.0 International License

p-ISSN: **1693 - 7945**
e –ISSN: **2622 - 1969**

5. References

Alagorni, A. H., Yaacob, Z. B., & Nour, A. H. (2015). An overview of oil production stages: enhanced oil recovery techniques and nitrogen injection. *International Journal of Environmental Science and Development*, *6*(9), 693.

Awe, O. W., Zhao, Y., Nzihou, A., Minh, D. P., & Lyczko, N. (2017). A review of biogas utilisation, purification and upgrading technologies. *Waste and Biomass Valorization*, *8*, 267-283.

Haque, M. E. (2012). Ethylene glycol regeneration plan: a systematic approach to troubleshoot the common problems. *Journal of Chemical Engineering*, *27*, 21-26.

Kusrini, D. (2023). Analysis Glycol Losses On Gas Dehydration Unit PT X Field Z. *Jurnal Bhara Petro Energi*, *2*(1), 26-35.

Manning, F. S., & Thompson, R. E. (1991). Oilfield Processing of Petroleum. Vol. 1. *Natural gas, 1st ed., Pennwell Publishing Co*.

Yang, D., Wang, L., Zhao, Y., & Kang, Z. (2021). Investigating pilot test of oil shale pyrolysis and oil and gas upgrading by water vapor injection. *Journal of Petroleum Science and Engineering*, *196*, 108101.

Zhang, W., Liu, H., Sun, Y., Cakstins, J., Sun, C., & Snape, C. E. (2016). Parametric study on the regeneration heat requirement of an amine-based solid adsorbent process for post-combustion carbon capture. *Applied Energy*, *168*, 394-405.

Gema Wiralodra is licensed under a Creative Commons Attribution 4.0 International License