



Maximizing the Gas Recovery from Brown Field of Tripura

**Anjali Verma, ONGC-India, Pramod Kumar Verma, ONGC-India*

Email: verma_anjali@ongc.co.in

Keywords

Deliquification, Plunger Lift, Enhanced Gas Recovery, Tubing size replacement.

Abstract

Over the years the number of huge new Oil & Gas discoveries is getting lesser. Therefore, maximizing recovery from the Brown fields is the difficult task for Oil and Gas companies. In current scenario, Oil & gas production is in declining phase and introduction of new technologies in Oil & Gas Brownfields is the call of the hour. In an uncertain oil/gas price environment, brownfield redevelopment is becoming an increasingly attractive option to manage production decline. With fewer new fields being discovered, brown fields are being worked on to increase their recovery efficiency. Maximizing the recovery from brownfields requires strategic planning and sustainable recovery efforts that balance environmental, social, and economic considerations. This abstract presents an overview of the key strategies and approaches for optimizing the Gas recovery from brownfields.

Liquid loading of a gas well is the inability of the produced gas to remove the produced liquids from the wellbore. Under this condition, produced liquids will accumulate in the wellbore as the gas velocity decreases, leading to reduced production and shortening of the time until the well no longer will produce. Nearly all gas wells produce some liquids even if the rate of liquid production is small as the gas velocity reduces below the critical and the well experiences loading with liquid accumulation in the wellbore leading to reduction in production.

This paper focused on the different deliquification methods used such as Artificial Lift Methods, Replacement of 2 7/8" tubing by 2 3/8" tubing and Low pressure booster Compressor schemes to enhance primary recovery of field that has produced over time. The objective of the study is to determine how much gas can be recovered from the field using each of these methods. The result shows that each method has a significant effect on overall recovery. A

recovery factor of eighteen percent (18%) was obtained through rigless well intervention (Plunger System) & SRP and recovery factor of seventeen percent (17%) was obtained through Low pressure Booster gas compressor scheme.

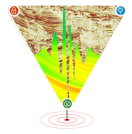
Introduction

The "Brown Field" in specific is expressing the oil & gas field that has more than one cycle of development and production decline. Market development and Oil & Gas prices are affecting the economics and the projects evaluation. The already existing of infrastructure has positive impact on saving time and money. The level of the interpretation of the reservoir properties and type of EGR/EOR method adoption is mainly dependant on the level of details of the integrated study of the reservoir. The low natural energy of some reservoirs, which consequently might lead to depletion of the reservoir pressure, and these depleted pressure reservoirs might be proper candidates for artificial lifting or EOR / EGR schemes. Surface facilities de-bottlenecking is adding considerable positive value for the hydrocarbon recoveries.

Tripura Asset of ONGC is mainly gas producing Asset. In gas wells, liquid loading is the most common cause of production impairment which can lead to erratic slug flow and decreased production from the well. The well may eventually produce at the rate less than the well potential or stop producing if the liquids are not removed continuously. Hence it is necessary to identify the cause of liquid loading and suitable remedial actions are needed to be taken.

Method

With declining reservoir pressure most of the wells in ONGC, Tripura is experiencing liquid loading tendency. Liquid loading has resulted in decreased production in many wells and will further result in a



Maximizing the Gas Recovery from Brown Field of Tripura

reduction in well productivity as liquids saturate the near-wellbore region, causing a reduction in gas relative permeability. Liquid loaded wells need frequent N₂ and foam jobs. In last few years liquid production increased from 50 m³/day (2015) to more than 250 m³/day (2020-21). Hence, it is necessary to adopt suitable deliquification mode in wells which are approaching towards liquid loading.

To sustain production from the liquid loaded wells deliquification measures needs to be adopted. Artificial Lift mode is being suitably used for deliquification in Gas wells. Tripura Asset started Artificial lift mode from 2017 onwards and is using multiple / suitable deliquification techniques on pilot basis in Gas wells for gaining better understanding and experience in field –specific conditions.

Gas Deliquification techniques used

In house analysis carried out at by using PIPESIM software, for wells of different fields of Tripura approaching toward liquid loading.

As a result, Tripura Asset has commissioned 32 nos. of Artificial Lift Systems which includes sucker rod pump and plunger lift contributing approx. 18% of total gas production per day.

Installation of smaller tubing in candidate wells is also one the common methods of deliquification. Replacement of tubing 2 7/8” with 2 3/8” completed recently in one candidate well in Tripura.

Gas compression as enhanced gas recovery method (EGR) has been widely adopted by the petroleum industry and is validated as a reliable method for improving reserves base. As gas fields mature, their reservoir pressure declines with an associated reduction in gas production rates. Compression at wellhead or at the facility elongates well and field life resulting in tapping additional reserves. Low Pressure Booster Gas Compressor Scheme adopted in one of the Gas fields of Tripura. FTHP (Flowing tubing head pressure) maintained at 10 kg/cm²g and Separator pressure maintained at 2 kg/cm²g.

Examples Plunger Lift System

Plunger lift system is a means of Artificial Lift that is mostly utilized in Gas wells for removing the built-up liquid in the well bore. In a well with Plunger lift system installed, a travelling block (the plunger) moves up and down the tubing of the well, as per the set frequency, continuously removing the built-up liquid and thus maintaining optimum gas production from the well. As the build-up pressure of the well itself is utilized for operation of the system (apart from a small solar panel for the controller operation), there is no external power source required by the system. Thus, it proves to be an ideal stand-alone system for deployment in Tripura Asset, where most of the wells are scattered in hills, jungles and other such areas with different logistical constraints. Tripura asset has installed 25 no. of Plunger Lift system. Figure 1 explains the effect of Plunger lift system on liquid loaded wells.

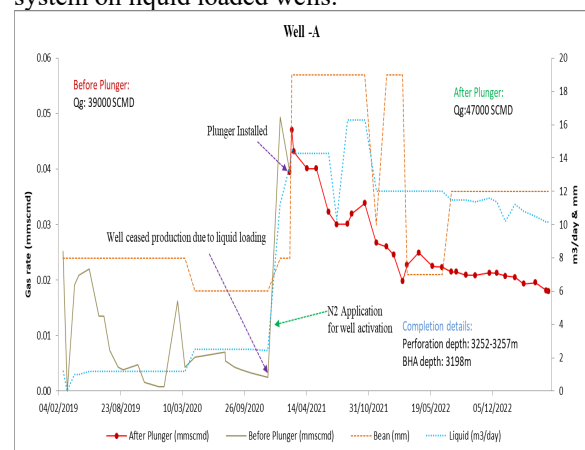


Fig 1: Effect of Plunger lift system on liquid loaded wells

Case study of candidate well which was revived after using plunger:

Well-C started flowing from 2015 @ 99000 SCMD in 8 mm bean (Self flow) and liquid rate was around 1.4 m³/day. Within 1 year its production decreased upto 2000 SCMD due to liquid loading. Changing of bean size also tried from 8 mm to 11 mm bean. The difference of CHP and THP was approx. 30 KSC. In March 22, liquid unloading carried out and well started flowing @ 42000 SCMD and in June 2022, Plunger lift system installed in this well. Plunger cycle is around 2 times daily and till November 2022, well is producing in the same rate and no liquid loading observed. Currently difference of CHP and



Maximizing the Gas Recovery from Brown Field of Tripura

THP is approx. 2 KSC. It's a sign that liquid unloading issue has been resolved in this well and Plunger lift is in optimum condition. **Plunger type:** Conventional Raptor, **BHA depth:** 2608 mtr **Well profile:** Vertical

Tubing size: 2 7/8" **Tubing Depth:** 2631m **Perforations depth:** 2675.5-2678.5m

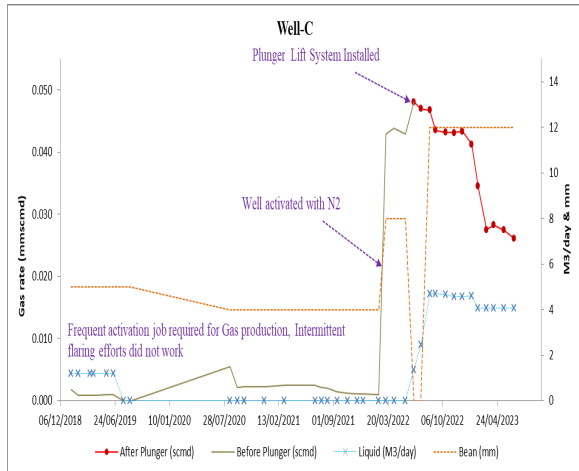


Fig 2: Well activation with Plunger Lift

SRP Unit

Surface Team, ONGC, Tripura Asset had installed 7 nos. of Sucker Rod Pump (SRP) surface unit along with Sub-surface Pumps and accessories, leading to a gas gain of 98%. Figure 3 explains the effect of SRP in revival of Gas well.

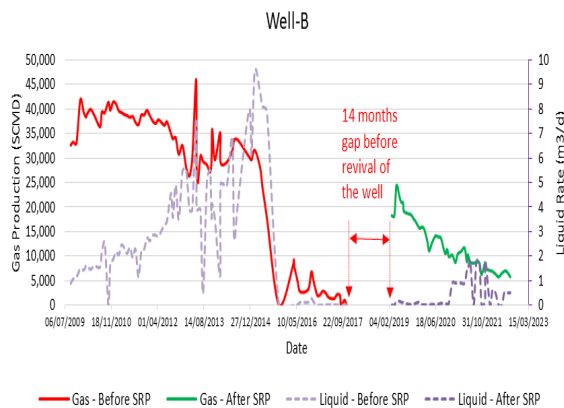


Fig 3: Effect of SRP in revival of Gas well

Replacement of tubing 2 7/8" with 2 3/8"

One of the deliquification which is adopted in Tripura is installation of smaller tubing i.e., 2 3/8" tubing, in candidate well, to increase the gas velocity; however, this benefit needs to be balanced with the increased friction imparted by the smaller tubing. A well free from liquid loading will follow an exponential type of decline curve. Rates falling off decline curve, at rates below the critical rate, are indicative of possible liquid loading in the well.

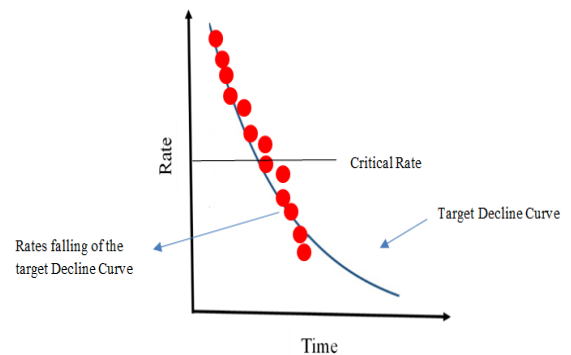


Fig 4: Rates falling off decline curve indicative of possible liquid loading in well

With 2 3/8" tubing, production is expected to fall off the target decline curve at a lower rate than with 2 7/8" tubing. After installation of 2 3/8" tubing, in candidate wells, the production may or may not increase very much. However, if the steep decline curve is arrested and a flatter decline with less interference from liquids loading is achieved, then the installation will be a success and more recoverable reserves will be a consequence.

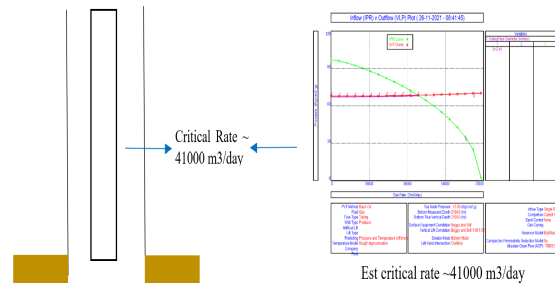
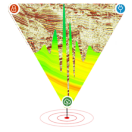


Fig 5: Critical rate with 2 7/8" tubing



Maximizing the Gas Recovery from Brown Field of Tripura

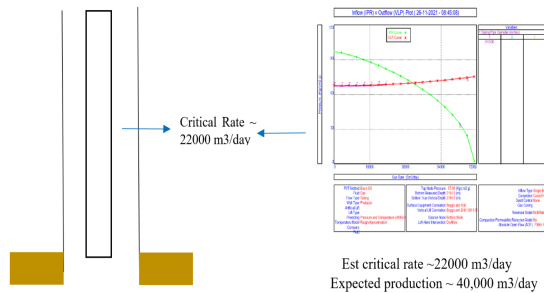


Fig 6: Critical rate with 2 3/8" tubing

Gas Recovery through Low Pressure Booster Gas Compressor

One of the ONGC's fields at Tripura was producing average 0.109 MMSCMD through 10 Wells in FY 2022-23.

In order to increase the recovery of gas from the reservoirs, EGR – Enhanced Gas Recovery concept i.e. change in operation from HP/MP to LP mode with reduction in FTHP to 10 kg/cm²g and Separator pressure to almost 2.0 – 2.5 Kg/cm²g is adopted at this Field.

A study to operate existing HP separator at low pressure was carried out. Existing HP Separator which was operating earlier at 18-20 kg/cm²g, now operating at 2.0 kg/cm²g. All the 10 wells are diverted to this separator operating at 2.0 kg/cm²g. Booster gas compressors are installed downstream of separator to boost pressure from 2.0 kg/cm²g to 20 kg/cm²g for further supply to consumer.

After operating separator at low pressure, initial gas gain observed is 0.03 MMSCMD. With few modifications in existing HP train, now field is producing average 0.128 MMSCMD in FY 2023-24.

Conclusion

This paper provides comprehensive study and results of artificial lift system and Low pressure Booster Gas compressor scheme in mature field of ONGC in Tripura. A total of 32 wells with Plunger Lift system and Sucker Rod Pump systems are studied and results are found satisfactory. A total optimized initial gas increment in 25 wells with Plunger Lift System is observed approximately 0.22 MSCMD and in 7 wells with SRP is approximately 0.133.MMSCMD. With tubing replacement in candidate well from 2 7/8" to 2

3/8", it is observed that no activation has been required in the well. Sustained production being obtained. Similarly with LP booster gas compressor scheme gas recovery of approximately 17% is observed in two months.

With the successful use of SRP and Plunger Lift in Tripura Asset, application of the same could also be followed for other fields. The lift mode could be selected taking into consideration the life of the well and economics as the main purpose is to remove liquid from near the perforation and to take the well optimally to depletion.

There are several outlooks that need to be considered when evaluating gas wells, it is important to understand:

- How fast the phases are moving (e.g., gas velocity, water velocity, condensate velocity)
- How much is being produced from each fluid (e.g., gas rate, water rate, condensate rate)
- How big is the space available for the fluid to flow inside the wellbore (e.g., cross sectional area of tubing, cross sectional area of casing, annular space)
- How to interpret tubing and/or casing pressure changes

In conclusion, maximizing the recovery from brownfields necessitates a holistic and sustainable approach. There are different methods of maximizing field recovery.

References

Optimization of Plunger-Lift Performance in Liquid Loading Gas Wells (E. Ozkan; B. Keefer; M. G. Miller) Paper presented at the SPE Annual Technical Conference and Exhibition, Denver, Colorado, October 2003. Paper Number: SPE-84135-MS

Design of Plunger Lift for Gas Wells ,G. M. Hashmi; A. R. Hasan; C. S. Kabir

Paper presented at the SPE North America Artificial Lift Conference and Exhibition, The Woodlands, Texas, USA, October 2016. Paper Number: SPE-181220-MS

New Techniques for Plunger Lift in Conventional and Nonconventional Gas. Stanley J. Morrow,



Maximizing the Gas Recovery from Brown Field of Tripura

William Hearn, and Ramiro Cisneros, Weatherford.
SPE 104556

Coleman, S. B., Clay, H. B., McCurdy, D. G., and H.
L. N.III, 1991. A New Look at Predicting Gas-Well
Load Up. Journal of Petroleum Technology.

Rehman A, Soponsakulkaew N, Bello O, Falcone G.
A Generic Model for Optimizing the Selection of
Artificial Lift Methods for Liquid Loaded Gas Wells.
Paper presented at SPE Annual Technical Conference
and Exhibition held in Denver, Colorado, USA, 30
October–2 November 2011. SPE 146606

Acknowledgment

The authors are grateful to ONGC management for granting permission to publish this paper. The views expressed in this paper are solely those of the authors and do not necessarily represent the view of ONGC/management.