A Case Study On Gamij Field using Coiled Tubing Intervention

Abhinav Gupta, M.J.A. Prince
Assistant Professor, Assistant Professor
Department of Petroleum Engineering
AMET University, Chennai, India

Abstract: The objective of this paper is to study an oil field intervention of a specified oil field in the state of Gujarat. Gamij field showed the presence of probable oil reserves on primary field exploration. The use of Coiled tubing intervention is proving to be a breakthrough in quick and exploring deep oil reserves with minimal loss and disadvantages. In this paper, we thoroughly study the outcomes of the explored field by using Multistage fracturing in a horizontal well. Multistage fracturing is employed to access multiple pay zones of an oil reserve with a single well. Multistage fracturing systems allow multiple stages to be stimulated in a wellbore with a single continuous operation. Cemented or open-hole, these systems help get the most from a reservoir with increased efficiency. Hydraulic fracturing (also fracking, fraccing, frac'ing, hydrofracturing or hydrofracking) is a well stimulation technique in which rock is fractured by a pressurized liquid. The process involves the high-pressure injection of 'fracking fluid' (primarily water, containing sand or other proppants suspended with the aid of thickening agents) into a wellbore to create cracks in the deep-rock formations through which natural gas, petroleum, and brine will flow more freely. When the hydraulic pressure is removed from the well, small grains of hydraulic fracturing proppants (either sand or aluminum oxide) hold the fractures open.

I. Introduction

Gamij is a field which is situated in Kheda district of Dehram taluka of Gujarat state under ONGC Ahmedabad [1]. The multistage fracturing is done along with the coiled tubing operation in the horizontal new well. ONGC has invested 1,881 Crores in the Gamij oil field which yielded 25.94 million tons of crude oil and 23.52 billion cubic meters of gas which goes to the nearest Gas Gathering System (GGS) units numbered GGS#1, GGS#2, GGS#3 which is situated in Halderwas in Kheda district. Gamij becomes the first small marginal field of ONGC to produce 15,000 standard cubic meters/day (SCMD) for period of 5 years.

The details of Gamij field is given below (**Figure 1**): -

- Coordinates of Gamij field:
  Latitude – 72 55‟ 58.01” (N)
  Longitude – 23 55‟ 6.01” (E)
- Nearest Railway station – Chandkheda, Ahmedabad, Kalol Railway Station – 15 kms, Sardar Vallabhbhai Patel International Airport – 30 kms.
- Nearest town/city/ village – Kheda Village, Gujarat.
- ONGC Tender No: D 16BC15013
- Well Details: Services for multistage fracturing in four zones of horizontal well of gamij field of ONGC, Ahmedabad asset.
- Cost to Capital: 1,881 crores (282.52 million USD approx.).

Figure 1: Well head of Gamij Field

II. Process Description

Hydraulic fracturing has been very well known well stimulation method since many decades back and continues to prove its worthiness enhancing the well productivity if applied properly. But, without a proper technology update on the design management and wellbore tools involved, limited additional improvement is experienced. Over the last 10 years many technical developments and solutions have been made to better stimulate pay zones containing hydrocarbons [2]. New well completion assemblies, to accompany with formation fracturing technology, have to be more reliable, efficient, profound and cost effective in extreme downhole conditions. Many times, with layered complex reservoirs, more than several individual pay zones are required to be stimulated and completed with specifically designed treatments. Multistage fracturing technology is an effective solution for less costly treatment of such complicated reservoirs. This report demonstrates technological solutions for multi-zone treatments and its application to different well conditions (temperature, pressure, open hole, cased hole etc.). Multistage fracturing can be done differently, and well completion and treatment design is done with intention to access the reservoir the best possible way. A coiled tubing attached to well head is shown below (**Figure 2**):

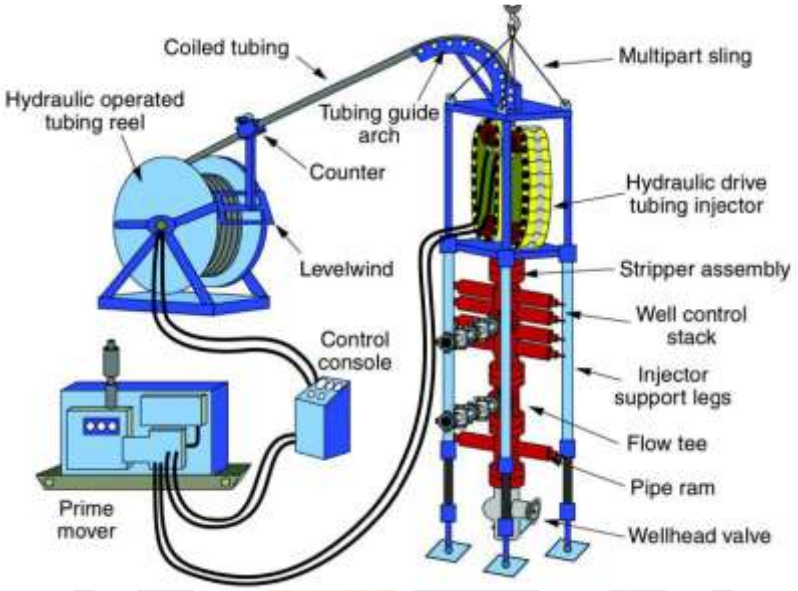

Figure 2: Coiled Tubing attached to wellhead.

III. Coiled Tubing Components

The coiled tubing unit is comprised of the complete set of equipment necessary to perform standard continuous-length tubing operations in the field.

The unit consists of four basic elements (**Figure 3**):

1. **Reel** - for storage and transport of the CT.
2. **Injector Head** - to provide the surface drive force to run and retrieve the CT.
3. **Control Cabin** - from which the equipment operator monitors and controls the CT.
4. **Power Pack** - to generate hydraulic and pneumatic power required to operate the CT unit.

Figure 3: CT Unit in operation.

IV. Hydrajet Hydraulic Fracturing

Hydrajet assisted fracturing is a relatively new technology combining hydrajet perforation tunnel creation and hydraulic fracturing. Although the hydrajet system can be deployed on jointed tubing pipes, coiled tubing, drill pipes or combination of jointed pipes and coiled tubing, the most frequent usage is with coiled tubing [3]. Basically, the technique consists of three separate processes and that would be:

• Hydrajetting,
• Hydraulic fracturing through tubing, and
• Injection down the tubing/casing annulus.

V. Completion Methods

Plug 'N' Perf Method

Plug-and-perf completions are extremely flexible multistage well completion techniques for cased hole wells [4]. Each stage can be perforated and treated optimally because options can be exercised up to the moment the perforating gun is fired. The engineer can apply knowledge from each previous stage to optimize treatment of the current stage. The process consists of pumping a plug and perforating guns to a given depth. The plug is set, the zone perforated, and the tools removed from the well. A ball is pumped down to isolate the zones below the plug and the fracture stimulation treatment is pumped in. The ball-activated plug diverts fracture fluids through the perforations into the formation. After the stage is completed, the next plug and set of perforations are initiated, and the process is repeated moving up the well (**Figure 4**).

- Allows rapid perforating, stimulation and production of multiple stages
- Accounts for 70 - 80 % of unconventional wells
- Communication established with TCP & toe section stimulated
- Perforating guns with a composite plug are circulated on wireline to bottom
- First section perforated and stimulated
- Process repeated 300 - 400 ft intervals (40 stages)
- Plugs milled out with coiled tubing

Figure 4: Plug and Perf Method

VI. Technical Details of the Gamij Field

- Tubing: $2^{7/8}$ inches
- Casing: $5^{1/2}$ inches
- Total Depth: 1960 ft or 597.408 m
- Packer: 1916 ft or 583.998 m
- Maximum psi: 2500 psi
- Running in hole (RIH): 1.5 inches with foam and N_2 pumping
- Perforations:
  - 1927-30 ft (3 ft)
  - 1932-34 ft (2 ft)
  - 1936-41 ft (5 ft)
  - 1943-46 ft (3 ft)

VII. Results and Summary from the field

- Little sand in return line.
- Foam obtained along with chemical used for pumping.
- Broken gel obtained in return from Hydro-Fracturing (HF) job done.
- N_2 obtained in return creating a self-flow.
- Pumped N_2 gas in return.
- No sticking/buckling in pipes so job easily done.
- No fishing operations required.
- Return bottom obtained.
- Effective hole cleaning and less trips required.
- Reciprocating action in the tubing string to avoid sticking.

VIII. Summary

- Some calculations show that straight wall tubing strings can reach total depth greater than 33,000 feet using available 120,000-psi material, and tapered tubing strings can reach 40,000 feet for reasonable buoyancy and pressure.
- The optimum tubing diameter for tradeoff of pump pressure and fatigue life is from $2^{3/8}$ inch to $2^{7/8}$ inches.
- Fatigue life goes down as tubing diameter increases, and flow loss goes up as tubing diameter decreases. These factors determine the choice of tubing, which in turn defines the maximum weight of tubing and therefore the maximum anticipated deck load for the CT reel.
- The maximum load on the motion isolation system (MIS) is the weight of the injector, plus, the breaking strength of the tubing.
- Nitrogen job circulated along with foam is useful for hole cleaning jobs.
- Hydro-fracturing done with Coiled Tubing proves advantageous as it saves time, tripping time, labor, capital, ease of completing job, etc.
- Slim hole technology combined with the coiled tubing technology, which has a considerable number of advantages over conventional drilling methods in certain applications, such as reducing drilling cost and risk, increases drilling efficiency and is more environmentally friendly.
- Coiled tubing along with straddle inflatable packer application of coiled tubing fracturing open-hole method has been implemented in the Kisbey, Saskatchewan, Canada area. This new method has allowed all potential pay intervals to be efficiently stimulated, as compared with traditional methods of stimulation. This new approach of stimulating the open hole, without having permanent packers and frac sleeves has resulted in better/reduced cost completions and more sustained production. The one-trip multi-stage 30 fracturing completion process utilizing straddle inflatable packers reduces rig time and cost for hydraulic fracturing services, accelerates production and improves reservoir drainage.

REFERENCES

[1] https://petrowiki.org/PEH%3ACoiled_tubing_Well_Intervention_and_Drilling_Operations, 2015

[2] https://petrowiki.org/Coiled_tubing_drilling, 2015

[3] https://www.slb.com/services/well_intervention/coiled_tubing.aspx, 2016

[4] https://www.slb.com/services/completions/multistage_stimulation_systems/plug_and_perf.aspx