INFLOW CONTROL

TENDEKA

Case Study:

Increased oil production in thin oil rim using FloSure Autonomous Inflow Control Devices (AICDs)

FloSure AICDs significantly improves oil production and reduces gas oil ratio (GOR) in a thin oil layer application.

Well Data

Location: Offshore Malaysia

Well Type: Oil producer

Installation Date: March 2016

Oil Column Thickness: West Belumut: 6 - 8m
East Belumut: 10 - 14m

Horizontal Section Length: 1.5 - 2.0km

Tendeka in collaboration with a major Malaysian operator implemented FloSure AICD applications in two different fields; East Belumut and West Belumut. A series of simulations were performed to optimise the AICD completions, to reduce the amount of water and gas production from the drilled infill wells, and to enhance the overall reserve recovery from the asset.

The Challenge

Presence of a large gas cap and a strong aquifer bracketing the thin oil column reservoir in the Belumut fields impose early gas and/or water breakthrough threats. After some years of production, the oil layer thickness further diminished from 14m to 8m for East Belumut and from 9.4m to 6.5m for West Belumut. During the initial phase of field development, the wells were completed with passive ICDs and stand alone screen (SAS) completions. Gas and water encroachment was observed at surface with high GOR and water cut (WC) indications. As a result, oil production was limited by the surface facilities restriction on gas flaring and water treatment limitations.

Tendeka Solution

FloSure AICDs were introduced for nine wells in East and West Belumut. Tendeka's AICDs have the ability to choke water and gas production and are particularly applicable in thin oil rim applications where water and gas breakthrough are anticipated at very early life of the wells. Prior to field installation, full scale laboratory tests with fluids replicating Belumut fields properties were performed to define the characteristics of the AICDs as in figure 1.

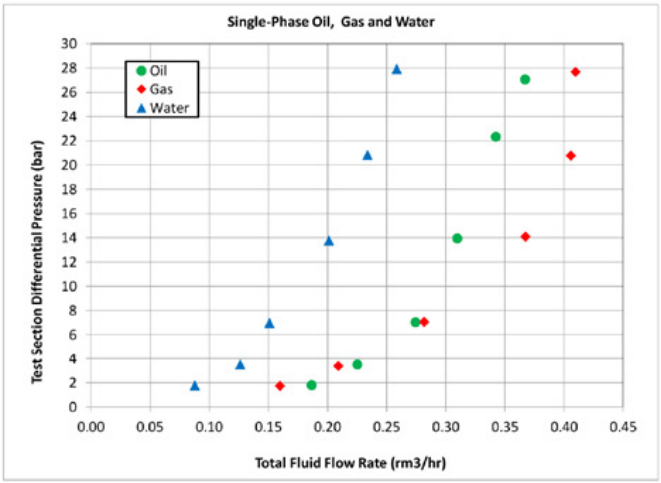

Figure 1: ***Single phase volume flow of oil, water and gas from laboratory test.***

Field specific regression coefficients are required in order to model the AICDs in static wellbore simulation software. The coefficients generated by mathematical methods were validated with laboratory results and a good correlation was achieved.

Tendeka also performed extensive AICD modeling to optimize the AICD size and number per joint for this application.

The operator had surplus passive ICD screens and in an effort to deplete these stocks, the ICD screens were modified into AICD screens after engineering evaluation by Tendeka.

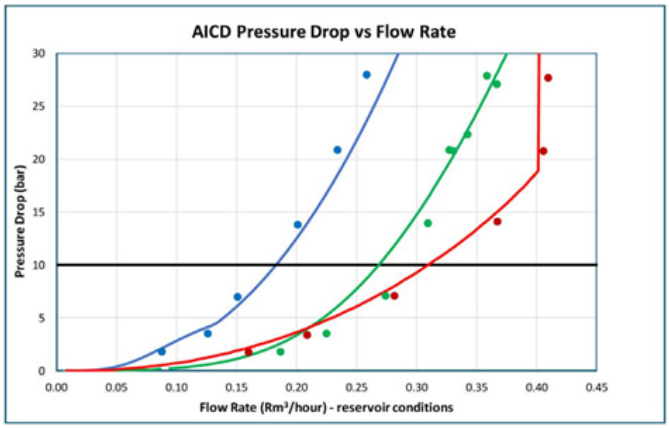

Figure 2: Good correlation between lab test and mathematical computation for single phase performance.

Project Results

A comparison of oil production was studied in passive ICD and AICD wells. AICD wells were able to produce on average 900bopd compared to 400bopd for ICD wells as shown in figure 3.

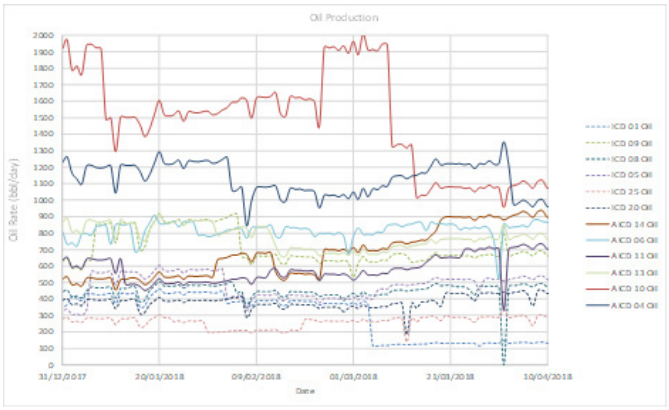

Figure 3: ICD and AICD well oil production

Figure 4 shows well oil rate and GOR for ICD and AICD wells. It clearly demonstrates that AICD wells can produce higher oil rate with lower GOR compared to the ICD wells.

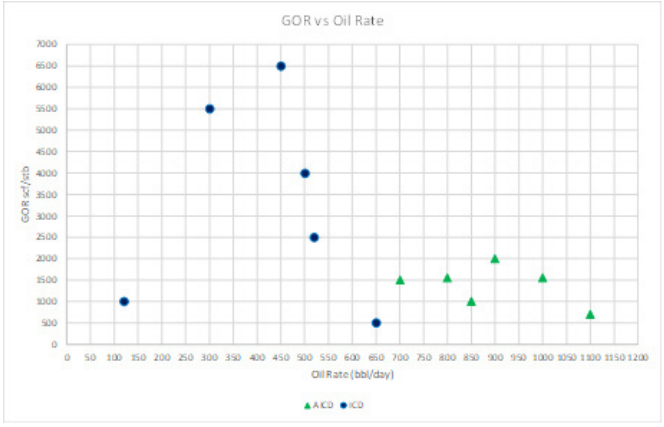

Figure 4: ICD and AICD well oil rate vs GOR

In summary:

- Tendeka's FloSure AICD proved to be a successful application in this thin oil rim development.
- Higher cumulative oil production by approximately 2MMSTB attributed to use of AICDs.
- 50% oil production increment in AICD wells compared to ICD wells in both East and West Belumut field.
- As much as 50% GOR reduction observed in AICD wells.
- The operator managed to deplete an inventory worth $3million by converting the existing ICD screens to AICD screens.