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The Incredible Power of FloWell

A project began recently on a gas lift oil well which was subject to such enormous contamination that it had to be scraped every 24 hours. This well was chosen because it was due to be subjected to a work over because of the large build-up of legacy precipitation within the production tubing and maintenance work on the gas injection equipment.

Previous preventative measures included large amounts of xylene being injected via the gas injection line into the production tubing in an effort to offset the effect of the precipitation. This was proving ineffective as can be noticed by the frequency of the scraping of the production tubing.

This well had an extraction regime of 5 minutes gas injection (pumping) and a recovery period (dwell) of 40 minutes.

The effect of the paraffin precipitation meant that even though a flowrate of 0.75 m^3 per hour of liquid flow (18 m^3 per day) was achieved directly after the scraping this rapidly depleted throughout the day resulting in a reduction down to an average of 0.29 m^3 per hour of liquid flow (7 m^3 per day).

This provided quite a challenge for the FloWell solution and it was decided that a potential 500 PPM reducing down to 200 PPM over 14 days to be pumped into the gas injection stream.

On the first day of the project, due to an inaccurate setting of the injection pump, the dosage rate initially applied was only 200 PPM. This was not identified until the tank sight gauge measurement recorded 24-hours later indicated that potentially insufficient FloWell was being injected.

However, this did not detract from the amazing results received.

A scraping was organised for the following day, 24-hour is after the start-up of the injection process. Immediately prior to this a measurement was taken on the SCADA monitoring system which indicated a surprising flowrate of 0.8 m^3 per hour (19.2 m^3 per day) instead of the expected 0.29 m^3 per hour.

The amazing results did not stop there.

When the scraping crew arrived, they reported that there was **no new paraffin precipitation** in the production tubing. The scraping tools went down to the previous days level indicating there was indeed no new paraffin precipitation. Indeed, they were able to scrape out a little more legacy precipitation because it had softened sufficiently to remove approximately another 50 m.

It was only then that it was discovered that the dosage rate was indeed 200 PPM as opposed to the proposed 500 PPM originally planned. The decision was made to increase the dosage rate to

see if it was able to work more efficiently on the legacy precipitation within the production tubing and the 600 m flowline.

What happened next was even more surprising.

Although there was no more precipitation appearing in the production tubing, the readings over the next 10 days indicated a reduction from the 19.2 m^3 per day of around 10% to 15% per day. Flowline pressures were increasing proportionately and rose steadily from 3 kg/cm^2 to almost 9 kg/cm^2.

Much discussion was made as to the cause and effect and one analysis was that something somewhere was causing the flowrate reduction and it could be the release of the particulates from the legacy precipitation. The analysis indicated that the viscosity of the oil was diluted so much by the released paraffin that the particulates were dropping out of the oil flow and accumulating.

At the 10 day mark the SCADA reading showed an almost zero flow rate. This immediately caused the well production team to visit the well site in case the well itself had ceased production. A quick examination showed that liquid was indeed flowing.

The well production team went to visit the outgoing end of the export pipeline and discovered that there was a blockage as the export pipeline rose out of the ground.

It was discovered that the analysis of the particulates dropping out of the oil flow and accumulating proved to be perfectly true. Although the oil flow could drive the particulates down a relatively level export pipeline it could not drive them up the rising pipeline out of the ground and subsequently caused a blockage in the export pipeline.

Fortunately cleaning of the pipeline was a relatively easy procedure, it appears that this had happened previously and the maintenance team knew exactly what to do. The pipeline was cleaned and returned to service in a couple of hours.

Once the pipeline was cleaned and oil flow resumed 43 m^3 of liquid flow was recorded immediately after. However, this was put down to the accumulation of oil in the flowline/header/export line. Due to this analysis, it was regarded as a one-time event. Future events proved this analysis correct.

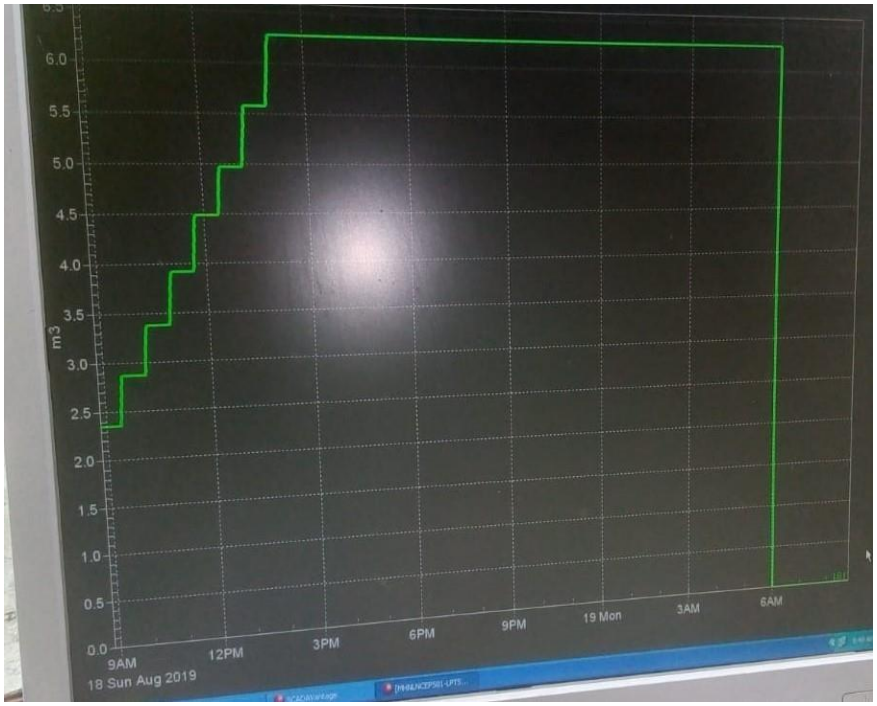
Over the next three days the scraping team arrived finding legacy precipitation up to the top of the header. This was misidentified as new paraffin precipitation, causing concern as to why the previous zero precipitation rates had occurred and precipitation was re-occurring.

Each day after scraping away what was obviously legacy (OLD) precipitation, it was found that it was being replaced back to the top of the production tubing. After thorough analysis it was proposed that the legacy precipitation was being driven up the production tubing by the gas lift pressure but this was not confirmed until the final event which was again a mistaken observation.

On the 12th day of the application a report was received that flowrate was zero causing great concern with the well production team. The SCADA operator stated that there has been no oil flow since 6AM and assumed something must be blocked. He stated that there has been gas flow and he had registered it but there was zero value for the oil.

The SCADA readout told a different story than the one that was delivered, although it is agreed that at 06:00 the flow did indeed reach zero and because of the previous events this was not unexpected.

If you look at the picture you will immediately identify that there was indeed flow prior to 6AM



The screen graduations indicate the visual as being 0 - 7 m³. If you study the picture thoroughly you will see that at each cycle event there is an increase in flow and although it began on screen at approximately 2.3 m³ every cycle it increased even more, until it ultimately reached a value 6.3 m³.

This continued for 21 cycles of 45 minutes and ended at 06:00 where all of a sudden, the flowrate plummeted to zero.

The operator mis-identified this as a blockage. However, to the trained eye seeing the unbelievable flow rates recorded it is plainly obvious that so much oil had been extracted out of the well, the increase had depleted the well to such an extent, sucking oil lower than the end of the production tubing, an event which happens occasionally, there was no more oil to be extracted and because the oil was lower than the production tubing, it was sucking gas out of the casing as opposed to any oil that was available.

This would continue until sufficient oil came into the production tubing to enable the cycle to run again. What must be noted is that at 3 PM the following afternoon a flow time of three minutes was recorded. This underpinned the analysis that the well had been thoroughly exhausted and it took eight hours to recover sufficiently to provide some flow. Regulating the flow regime would have indeed provided at least a 100% improvement on previous flows without exhausting the well and indeed there was the possibility of more.

The peak of 6.3 m³ was achieved at 14:00 the previous day. This flowrate was continuously recorded for 21 cycles which ended at 06:00 the following day when the oil ran out. This amounted to an impressive return from a well that was reported to us originally as 7 m³ per day max flow.

Taking that much oil out of the well depleted the level so much, that it was anticipated that it would take at least 10 hours to replenish the well sufficiently to repeat the same performance. It had been constant for too long to deny that it could be done again but there had to be sufficient oil in the well to do so.

Operations were suspended on the well because of the pre-planned work over and the continuation of the FloWell management program will begin on completion of the work over. Further information will be forwarded when this is done.