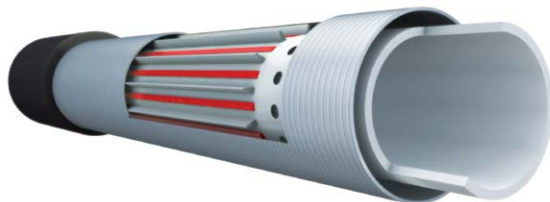


CASE 2

RESMAN Tracers Integrated Into ICD Completion Provides New Insight Into Reservoir Performance

Inflow Control Devices (ICD) are often integrated with sand screens which are designed to establish a more even distribution of inflow along horizontal wells. This is accomplished by creating additional pressure drops at each ICD to create equal drawdown across the reservoir interval which delays breakthrough of water and gas. ICD screen manufacturers use a variety of designs to create pressure drops by forcing the produced fluids through nozzles, tubes or spiral configurations located at one end of the screen joint.

Figure 1: Red strips represent RESMAN Intelligent Tracers Installed in ICD Screen



RESMAN INTELLIGENT TRACER Technology has provided valuable information to operators with wells using a variety of ICD sand screen designs. It is worth noting that RESMAN tracer performance and analysis works with any style of ICD.

Intelligent Tracer Technology matrix strips are installed in the ICD screens during the screen manufacturing process. The matrix strips are designed to fit in the space between the wire wrap and the base pipe as illustrated in Figure 1.

With the matrix installed in the ICD screens, the completion is installed in the well without any deviation from normal procedures.

Figure 3 illustrates that once activated by contact with oil, the matrix begins releasing its unique chemical fingerprint. Early in the well's life it is brought to a static condition for a short period of time. The matrix continues releasing during this static period causing a high concentration of the tracer to build up in the oil surrounding the ICD screen.

The well is then started up and the oil containing the high concentration of tracer is flushed out of the ICD screen as illustrated in Figure 4.

At the surface, samples of the produced oil are collected during the time that the high concentration tracer oil is expected at the surface. These samples are then analyzed by RESMAN labs.

Figure 2: Well with ICD Screens Across Reservoir Interval



CASE 2
RESMAN TRACERS
INTEGRATED INTO
ICD COMPLETION
PROVIDES NEW INSIGHT
INTO RESERVOIR
PERFORMANCE

Figure 3: Contact with oil causes the strips to release their chemical fingerprint (tracer).

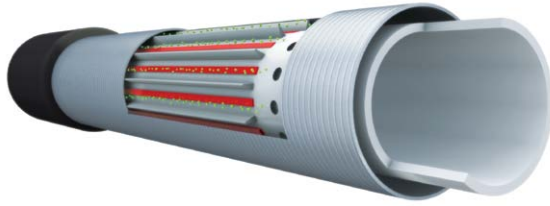


Figure 4: Flow of oil from the reservoir flushes out the oil with high concentration of tracer

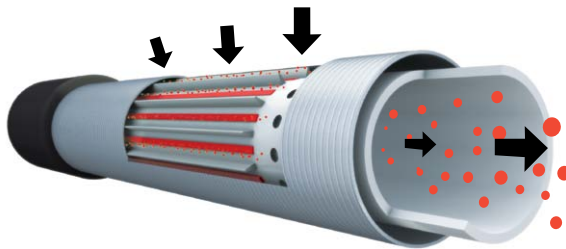
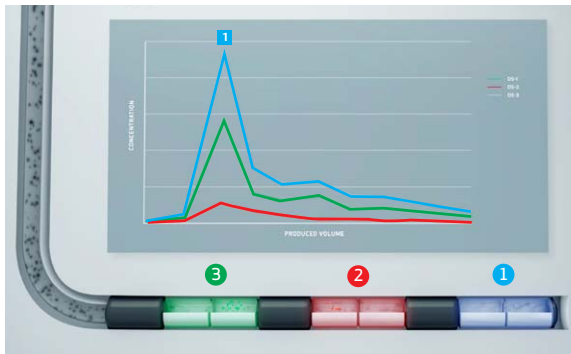
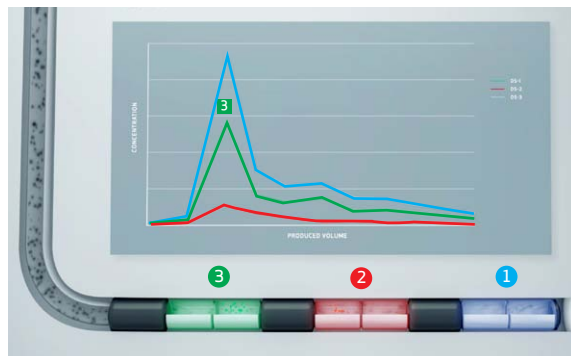


Figure 5: Sample analysis data (tracer response curves)



ZONE 1 SHOW HIGHEST PERFORMANCE

Figure 6: Sample analysis data (tracer response curves)



ZONE 3 SHOWS LESSER PERFORMANCE

Remember, that each unique tracer is identifiable in each sample and the precise location of each tracer along the reservoir intervals is also known.

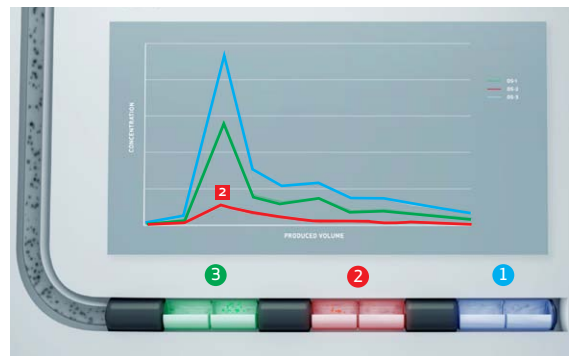
The data is presented as plot of concentration versus produced volume. The zones that are the highest producers are indicated by high amplitude and rapid decline in concentration. The zones with higher flow rate will rapidly flush out the ICD into the flow stream. This creates a higher peak concentration and a faster concentration decline than zones with a lesser flow rate. No detection of tracers at a particular ICD screen interval indicates zones that are not producing. The primary indicator of zonal contribution is the rate of decline of the tracer concentration curve following arrival of the peak.

Figure 6 shows the decline in tracer concentration of the Zone 3 tracer is noticeably less than Zone 1 indicating lesser inflow performance from Zone 3. Figure 7 highlights the response from Zone 2 which indicates very little flow is contributing from that zone.

Figure 7 highlights the response from Zone 3 which indicates very little flow is contributing from that particular zone.

RESMAN tracers in combination with ICD screens are providing new insights into reservoir performance that are enabling smarter reservoir management decisions.

Figure 7: Sample analysis data (tracer response curves)



ZONE 2 INDICATES VERY LOW FLOW