

Intelligent tracers verify frac job effectiveness

Operator optimizes fracturing strategy

Challenge

Many operators are fracturing long horizontal wells in multiple locations without any feedback on the effectiveness of these stimulation treatments.

Knowledge of the flow from each zone would allow improvement of frac design, well placement and well length.

Solution

RESMAN intelligent tracers (RES•OIL) with uniquely identifiable signatures were installed in eight stages of a multi-stage frac well (Fig. 1). Proprietary inflow models developed by RESMAN were used to quantify the inflow from each interval.

Application

The RES•OIL systems were placed in the annular space, adjacent to the frac valves from each stage via pup-joint carriers. The equipment was run in-hole without deviating from normal procedures and with no additional rig time or extra personnel at site.

RESMAN's patented Flush Out model* was used to quantitatively measure the amount of inflow from each zone. Production was shut in for 24 hours and the well was re-started. Production fluid samples were taken at the surface to be analyzed and the results modeled.

Each purple square in Fig. 2 shows the concentration of the RES•OIL system installed in stage 1 (heel of the well). The dashed line represents the Flush Out model results for this data set. In contrast, Fig. 3 shows the flush out response from stage 8 (the interval toward the toe of the well).

* Refer to Technical Bulletin 2 for more information on RESMAN's Flush Out model and flow loop verification of model accuracy.

Fig. 2 - Stage 1 RES•OIL concentration versus produced volume and Flush Out model fit.

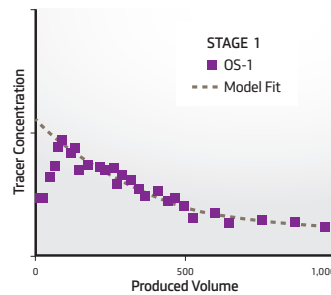
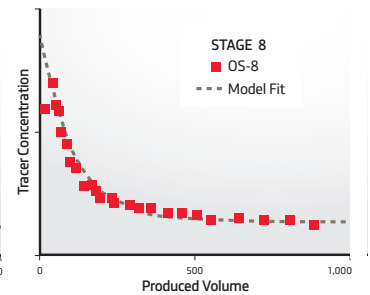


Fig. 3 - Stage 8 RES•OIL concentration versus produced volume and Flush Out model fit.



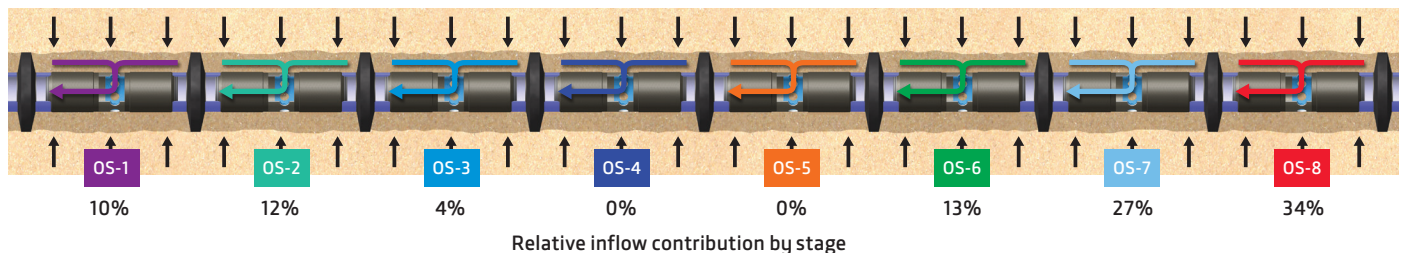
Results

The rate of decline of the profile from stage 1 (Fig. 2) was noticeably less steep than the rate of decline of the profile from stage 8 (Fig. 3), indicating inferior flow performance from the heel of the well (stage 1) when compared to the toe (stage 8).

The inflow distribution calculated for each producing interval (Fig. 1) revealed that more than half of the production of this well originated from stages 7 and 8, while the middle of the well (stages 4 and 5) displayed very poor performance.

With this information, the operator reevaluated its reservoir models and improved its drilling and completion strategy for future wells in the field.

Fig. 1 – Horizontal multi-stage frac well with 8 stages and 8 unique RES•OIL systems



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