Unlock tight oil reservoir production potential in the Ordos basin through optimized completion and fracturing techniques.

Use unconventional completion and fracturing design with Mangrove* engineered stimulation design in the Petrel* E&P software platform to improve tight oil production and horizontal well production potential.

Increased oil production eightfold to 755 bbl/d from initial production compared with that from vertical wells within the field.

The Ordos basin is the second largest basin in China and the fourth most petrologically productive. PetroChina Changqing Oilfield Company needed to optimize completion and fracturing techniques to improve production within the Ordos basin. This included improving reservoir understanding and completion performance through a multidisciplinary data integration approach that effectively designed optimized fracturing treatments.

Each perforation and fracturing stage was designed based on reservoir quality and completion quality parameters. An overall quality index was developed and used for the staging and perforation placement. Comparisons of reservoir quality with completion quality included good-good, bad-bad, good-bad, and bad-good.

In this field, the tubing-conveyed packer technique was used for the fracturing job to minimize costs. The packer would be set by pressure differential, which needed to exceed the setting rate within the tubing. Mangrove stimulation design was used to design unconventional fracturing treatments for every stage based on the following parameters:

- The hybrid fracturing technique was selected based on the Chang 7 formation properties, the presence and quantity of natural fissures, potential risk and complications of excessive height growth, and offset well experience.
- The pumping rate for each cluster was higher than 3 m³/min based on the field study and experience in this area. The primary purpose for increasing the rate was to ensure the maximum contact area between the fracture and formation through dilation and connection with the natural fissures; proppant could then be transported along the fracture length and result in adequate fracture conductivity.
- Each stage would consist of two perforation clusters placed in areas of similar stress based on the wellbore geomechanics model. Likewise, it was important to avoid sections with bad cement quality or where there was a chance to perforate across one of the casing collars.
- To better understand fracture growth behavior and to optimize treatment designs, microseismic monitoring and real-time fracture modeling updates were performed for this first well.

Simulated hydraulic fracture geometry matching the microseismic event footprint.
Horizontal well staging optimization with microseismic application

During the execution of this well, the microseismic data was used to optimize the perforation and pumping schedules to ensure good coverage along the lateral section. Through the application of microseismic monitoring data, the following optimizations were made to the well program:

- After treatment, the subsequent perforation stages were modified to ensure fracturing coverage of the lateral section. Furthermore, to minimize the operation failure risk, the high-stress intervals were avoided when designing the perforation stages. The perforation placement with respect to stress profile and microseismic results was crucial for Stages 7 through 11.

- In most cases, the actual volumes pumped were similar to the designs. Subsequently, the production and pressure did not decline as quickly as in vertical wells completed with a single stage.

As a result of the plan developed using Mangrove stimulation design, initial oil production increased 755 bbl/d with in comparison with other wells. This initial success with Mangrove stimulation design has encouraged PetroChina to continue the development program while incorporating more horizontal wells.

CASE STUDY: Mangrove stimulation design enables eightfold oil production increase, China