

Total System Analysis

Total System Analysis (TSA) is normally a one-week visit by one ALLIANCE expert to review with production engineers existing facilities, production chemicals used, and to infer the compatibility of those existing facilities with the EOR process. At the end of the visit, recommendations for dedicated laboratory tests will be delivered.

The main purpose of the visit is to understand the field lay-out, to gather production and field data and to take samples of different well fluids in order to start the “compatibility” testing in the lab of the surfactant/polymer chemicals with the current well fluids and currently used production chemicals.

FIELD DATA TO BE REVIEWED:

Detailed review of current field lay-out:

- Reservoir structure;
- Number of production and injection wells;
- Injected volume;
- Oil and water cut;
- Pressure and production data;
- Pumps and flow rates (injection and production);

Review of field development plan including chemical EOR.

Fluids separation & specifications:

- Water management system (water treatment units for injection/production/re-injection, separators...).
- Specifications requirement for

produced water disposal/re-injection (oil, solids...);

- Oil management system. Specifications for produced oil (water content, salt level...);
- Operational conditions (temperatures, residence times...);
- List and dosage of currently used production chemicals;

Lab study

Operational Conditions

- Brine analysis

Injection and production brines will be analyzed to determine:

- Determination of cations & anions
- TDS content
- pH
- Oil content in water

The study will be carried out using reconstituted brines matching injection brine analysis. Because some salinity heterogeneities are expected at field scale, different salinities will be investigated in a salinity window ranging from injection brine composition to formation brine composition.

Final validation tests will be performed with 10 liters of production brine. In order to stabilize the brine, the iron ions will be oxidized with air and removed by filtration before all the analysis.

Crude oil

All the tests will be performed with crude oil (40 liters). The water in oil content will be determined (Karl-Fisher). The oil will be analyzed in terms of SARA analysis, TAN, density, viscosity and IFT with produced water.

CHEMICALS TO BE HANDLED

- EOR Chemicals
- Surfactant
- PAM
- Production chemicals (not exhaustive)
- Demulsifier
- Defoamer
- Flocculants
- Corrosion inhibitor
- Oxygen scavenger, biocide...

Impact of surfactant-polymer on produced fluids separation

The bottle tests are performed to evaluate the potential hurdles related to emulsion formation/stability. It could also be used to assist in the selection of demulsifiers, which will most effectively resolve the emulsion and separate oil and water effectively for a given field.

The stability along with time of the created emulsions will be monitored using our automated robotic imaging platform at water treatment unit temperature.

The study will be focused on:

- Emulsion properties of brine/crude oil system without added chemicals;
- Emulsion properties of brine/crude oil system with currently used production chemicals (including demulsifier, if any).
- Effect of Surfactant solution on the separation of oil and water with and without currently used demulsifier.
- Effect of Polymer solution
- Effect of Surfactants/Polymer solutions
- Effect of the incumbent demulsifier and/or alternative demulsifiers

The study may also include additional characterization of the emulsion and produced water such as drop size, shear rate, pH, type of emulsion, stability, turbidity, oil content, etc...

The Bottle tests need to be performed to study the change impact of the anionic surfactant, polymer, adsorption inhibitors and their combinations. Through the Bottle tests we can observe the behaviour of different chemicals involved in the EOR on the production chemicals, and improve the oil water separation after surfactant-polymer flooding.

Impact of surfactant-polymer on produced water treatment

As the polymer and most of the surfactant will go in the produced water stream after the separation, it is important to assess the risk of their impact on water treatment processes, like skimming tank, hydro cyclone, gas flotation and filtration if needed to achieve the specification in terms of water quality for reinjection.

The objective of this task is to study the impact of EOR chemicals on water stream treatment processes efficiency. Laboratory tests have been set up and will be used (25°C) for screening the main impact of EOR chemicals and currently used water clarifier. Program could be adapted according to existing surface processes.

On selected samples from the precedent task corresponding to poor water quality after gravity separation (bottle tests) and reference samples, laboratory tests will be performed to assess the impact of polymers and surfactants and combination on water treatment surface processes at lab scale.

Bottle Test (optional)

In order to select a more effective demulsifier than the incumbent it is proposed to do onsite bottle test.

The aim of this task is to assess the risk of emulsion formation on-site (with fresh fluids collected at well head). This step is critical to be able to make efficient recommendations for next steps.

Several pre-selected promising additives (demulsifiers) could be tested directly on-site.

The aim would be to find a suitable product to resolve the emulsion by identifying a suitable demulsifier for fluids separation when surfactant-polymer flooding is applied.

Crude oil and production brine will be collected at a selected production well with significant chemicals production. Bottle tests will be performed to identify a suitable chemistry.

After this primary risk evaluation, complementary options could be of interest:

- HP/HT emulsion destabilization tests under dynamic conditions on selected samples using the IFPEN "dispersion rig" set-up allowing the follow up of phase separation kinetics under pressure and temperature using an instrumented cell
- Impact of EOR formulations on production chemical performance (corrosion, scale inhibitor, biocide....)
- Produced water reinjection context: impact of produced water composition (oil & solids) on EOR performance and injectivity and also impact of filtration cake on EOR performance.

Recommendations for field implementation

At the end of the study recommendations will be elaborated to prevent any major issue, linked to chemical EOR, related to water management facilities or water and/or oil quality.

This might include recommendations for equipment revamping or use of specialty chemicals to prevent identified hurdles. Potential proposed scenarios/solutions will be provided with cost estimate (CAPEX/OPEX).

A report will detail the results of Total System Analysis and lab study as well as specific recommendations from the Alliance experts.