Solutions for the Unconventional Market

Production Enhancement
A revolution in Fusion
Made to work together

By unifying our innovative tools with advanced chemistry and subsurface engineering, Tendeka transforms workflows to arrive at a better result from every production enhancement project.
Completions & Production Optimisation

Providing technology and servicing to E&P operators in US unconventional shales

Tendeka is a global advanced completions and production optimization technology provider, with the vision to optimize every drop of energy produced from the planet.

Driven by this vision, Tendeka directly offers E&P operators with assets in US unconventional shale formations disruptive advanced completion and production enhancement solutions. This not only serves to increase recovery factors, but also improve operational efficiencies so E&P operators achieve maximum return on their investments.

Tendeka’s unique solutions for unconventional formations, detailed within, include the MajiFrac Solution, ReFlow Control, FloFuse Stim and FloDual, each of which were innovated around the challenges of shale plays.
Challenges in Unconventionals

Current challenges of E&P operators with assets in unconventional shale plays

The current environment of drilling and completing new wells in US unconventional shale plays has shifted from deploying cookie-cutter and “pump-and-pray” fracturing treatments to an environment driven by science engineering and extreme cost savings.

Roughly 70% of wells currently being drilled in the US are infill wells. Infill drilling brings with it a high level of risk of damage to the parent wells from frac driven interactions, where clean outs may be needed, and reduced production may be inevitable. The infill, or child well, is more than likely to underperform compared to the production of the parent well. As the industry recognizes the inevitability of avoiding frac-driven interactions, particularly if missed reserves from previous field development are going to be produced, the demand to design and implement better fracturing treatments with leaner expenditures will no doubt continue to grow.
Improve operational efficiency
With the heightened risk of damage from frac driven interactions brought on by the increase in infill drilling, operational efficiency and stage cost reduction continue to be a top priority. Decreasing fluid costs, fluid volumes, pump down times, fracturing treatment time, horsepower requirements, plug mill out times are among some of the ways that operational efficiency can be achieved along with stage cost reduction.

Low recovery in new completes
With the need to tighten up expenditures, many of Tendeka's customers have eliminated additives that were once a staple of the fracturing fluid system, such as surfactants as flowback agents, as marginal production improvement, if any, was observed. Nonetheless, the appetite for technology that has the potential to increase low recovery factors still exists provided performance can be demonstrated, and acceptable production results achieved at economical rates.

Enhanced oil recovery (EOR)
EOR treatments from legacy shale wells is a developing practice and is commonly executed with huff-and-puff treatments conducted with natural gas that migrates into existing fractures. These help to unlock additional reserves only a few inches into the nanonetwork matrix of the fracture walls, before being produced back to surface.

Produced water use for fracturing
To minimize disposal costs, using 100% recycled produced water is becoming a growing trend. However, there are many challenges that arise when fracturing with produced water. Some of the challenges include the impact of the total hardness and dissolved solids of the produced water on the fracturing fluid performance, which can result in increased friction pressure and jeopardization of the treatment design and production.

Produced water disposal
In a given day, if every well were to be fractured with recycled produced water, this would account for less than 10% of the total volume of water produced. Therefore, produced water disposal is still needed in addition to recycling. However, the time needed to obtain a permit to drill a new well is growing, especially in states like New Mexico. Therefore, economically and effectively stimulating underperforming disposal wells drilled in carbonate formations is a key objective.

Maintain safety
Minimizing hazards related to QHSE is a top industry priority. One key challenge is the handling, storage and pumping of hazardous chemicals at the wellsite, such as strong acids like hydrochloric acid. This produces fumes which can have irreversible damage to internal organs, is highly corrosive to dermal and metals, damages surface equipment, and is regulated for transport in the US.
MajiFrac Solution

A solution that results in less pump time, lower cost, reduced water consumption and enhanced production.

During a fracturing treatment, it is not uncommon to pump tens of millions of gallons of fluid into a single well. This procedure can result in escalating cost and risk associated with not only handling the water but also managing the energy required to pump the fluids from surface far into the formation. Furthermore, production potential is compromised as oil remains trapped in the unfractured nanonetwork.

Unique to Tendeka, the MajiFrac Solution increases production by tackling the intensive fracturing water and pumping requirements of shale formations and the challenges associated with using produced water in fracturing treatments.

As a suite of environmentally responsible technologies, the strategically sourced portfolio aims to reduce water use and pumping time during completion operations in unconventional shale plays.

The portfolio includes:
- FracRight Composite Frac Plug
- Enviro-Syn-HCR-7000-WL
- ShaleModifier
- MajiFrac HVFR

The overall result is less pump time, lower cost, reduced water consumption and enhanced production.
The high-performance tools and chemical systems can be used individually or sequentially to optimize fluid distribution across the interval. This can lead to more contact area with the formation resulting in increased production.

**Tendeka’s acid resistant FracRight Composite Frac Plug**

The superior design incorporates a pump down feature to minimize fluid bypass reducing the amount of water required to get the plug to setting depth and allowing for placement of particular fluid spacers behind the plug. The fast mill out time of the FracRight Fully Composite Frac Plug also reduces operational schedules with small remaining debris that can be readily produced back to surface.

**Enviro-Syn-HCR-7000-WL**

The combination of spotting a spearhead acid with the frac plug and perforating guns boasts superior ultra-long-term corrosion protection compared to hydrochloric acid (HCl) or urea-based acids. It can be prepared in produced water, utilized and exposed to perforating tools and wireline at high temperatures over long periods with minimal effect. Harmless to the skin, it minimizes unsafe exposure levels and effluent rates, as well as costly transport and storage. Not only is superior breakdown possible with Enviro-Syn-HCR-7000-WL, it is in place when the perforations are created resulting in more efficient perforation cleaning helping to more uniformly place the fracturing treatment and access energy.

**ShaleModifier**

Behind the acid, there is a hydrophobic oil-based surface modifier that is synthesized with an organometallic binder, that adheres to exposed silicone oxide sites, changing the surface energy of the rock. ShaleModifier has been optimized using nanofluidic reservoir analogs to ensure fluid penetration and superior displacement efficiency in a nanostructure as small as 100 nm. It is pumped as a pre-pad stage to the main fracturing treatment. This can increase oil flow recovery from shale formations during initial completions and remedial treatments. It also allows access to nanosized oil wet areas enabling enhanced oil flowback from the nanonetwork.

**MajiFrac High Viscosity Friction Reducers**

Designed and manufactured in-house by Tendeka’s Production Enhancement team, this gives improved drag reduction, without the need for a booster, at ultra-low dosages. Because of its elasticity, it can transport high loadings of sand at low dosages. It can also be used across a wide range of tough produced water conditions without losing its efficacy.
FloFuse Stim

FloFuse Stim is a cost-effective and engineered solution for injection wells that is used to dispose of produced water from unconventional fracturing operations. For many of Tendeka’s customers, maintaining injectivity into these wells is critical for the success of the nearby hydraulic fracturing operations. Therefore, a successful acidizing treatment is critical.

As a fusion of an advanced completion design, it enables proportional fluid distribution across intervals of any length and a high performing modified acid system that achieves dominant wormholes with roughly 40% less fluid and at lower injection rates compared to 15% HCl.

The FloFuse Stim completion is a permanent open-hole completion system, installed with SwellRight swellable open hole packers. It consists of interventionless injection rate limiting control devices that includes a biased open valve that is mounted into base pipe and closes when the displacement reaches a pre-determined trigger rate. Target rates and trigger rates can be varied by application, thereby preventing a disproportionate amount of acid being displaced into one zone. The acid is then diverted to the next zone and the process repeated, resulting in uniform distribution throughout the wellbore, which is otherwise unachievable with the current diversion practices being deployed in the industry today.

The use of the smart modified acid improves wormhole penetration length and does not reprecipitate calcium carbonate when fully spent and pH increases, unlike HCl.

Furthermore, the modified acid system has ultra-low corrosion rates on metals, is low fuming, minimal impact on dermal, and is non-regulated for transportation in the US.

Tendeka provides its customers with acidizing software simulations coupled with sub-surface software simulations that are optimized based on targeted injection rates. The acidizing software simulations allows for our customers to compare a FloFuse Stim design with their current acidizing treatment design.
ReFlow Control

Advanced completion solution

The recovery efficiency of unconventional oil reserves is very low due to the micro-permeability of reservoirs and rapid depletion of pore pressure close to the fractures and wellbore.

While several EOR methodologies exist to stimulate production and increase recovery efficiency, key to recovery efficiency is the effective distribution of the injected gas and the ability to keep the gas in the reservoir to maintain energy. Back-producing the injectant and reservoir fluids in the same wellbore after a suitable ‘soak’ period is one such solution.

Commonly known as ‘huff and puff’ control, Tendeka’s ReFlow Control Advanced Completion technology deploys the company’s proprietary FloCheck Injection and FloSure Autonomous Inflow Control Devices (AICDs) to optimize EOR methods.

FloCheck Injection allows controlled flow in the injection direction only and is used to balance the distribution of gas injection along the length of the wellbore. FloSure AICDs are an active flow control device which managed the early back-production of gas and delivers a variable flow restriction in response to the properties (viscosity) of the fluid or gas flowing through it.

When used in a horizontal well and segmented into multiple compartments with Tendeka’s SwellRight series of swellable open hole isolation solutions, this design prevents excessive production of gas after breakthrough occurs in one or more compartments producing gas.

This results in more effective pressure maintenance and extended soak times and ultimately, an increase reservoir recovery.

Key benefits

- Even distribution of gas to all zones along the length of the wellbore
- Produces oil with as little back pressure as possible
- Restricts zones producing free gas to keep gas in contact with reservoir
- Reduces oil saturation
- Improves oil recovery
- Maximizes soak exposure time

In combination with novel chemistries, subsurface engineering & design and reservoir monitoring, ReFlow Control provides an optimized solution in gas EOR.
In some wells, particularly long horizontals, it is sometimes necessary to regulate the distribution of flow in both the injection (outflow) and production (inflow) direction. For example, injecting an acid treatment at a specific rate then producing the well at a different rate. In this case, the use of a fixed inflow control device (ICD) nozzle to provide optimized control in both directions may negate benefits and hinder performance.

In horizontal injection wells, for instance, ICDs can provide important functionality to ensure effective well clean-up during flowback operations. During high rate injection operations, this may lead to unnecessary or excessive back pressure impacting pump selection or achievable injection rates.

Conversely, in production wells, outflow control can ensure effective distribution of the treatment fluids along the wellbore. Inflow does not deliver any advantages in hydrocarbon production and is only required if the well needs regular treatment to improve flow assurance or extend well life.

To address these challenges, Tendeka has developed FloDual for both injection and production wells. The device features a spring-loaded dual disc biased in the direction where the lower control setting is required. This provides multiple flow paths through the valve to the larger nozzle fixed in the housing. The higher control nozzle, located in the dual disc, compresses, closing all other flow paths reducing total flow area.

The pressure equilibrium between the annulus and tubing is achieved through the valve during shutdown. The T-Choke valve is held in injection position, which can be designed and pre-set according to the pressure conditions in the wellbore between 10 and 600psi.

The FloDual Valve in action

Injection operations

The disc is pre-loaded to position itself against the seat on the nozzle. The pressure differential during flow will keep the disk in position and choke the flow based on pre-determined and calculated hole in the disc. This provides an engineered pressure drop during flow in the production direction but has a higher flow area during injection.

Production operations

The valve is biased open and will compress due to the differential pressure and friction resulting from the flow of fluid from the reservoir. This will keep the disc away from the seat at the nozzle, enabling unrestricted flow. The production flow rate and the pressure drop is sized according to the required production profile. While this provides little inflow control during production, it does allow a greater restriction to flow in the injection direction.

FloDual can be used in combination with modified acid to provide an optimized treatment for carbonate rich shale plays.
When it comes to fracturing fluid additives, Tendeka strives to bring the manufacturing of its technology as close to our customers as possible, making our solutions more affordable and customizable.

We offer our customers a full suite of competitively priced fracturing additives blended at one of our strategically located blending facilities. We boast chemical manufacturing and quality control experts, as well as experienced application engineers inhouse, so that chemical formulations, such as Tendeka’s MajiFrac HVFRs, can be tailored to fit the needs of its customers. We also have access to in-basin laboratory facilities, delivering quick product evaluation and compatibility testing with reservoir fluids.

We provide our customers with complimentary access to a digital logistics app, Velostics. This allows both parties to track orders from the manufacturing facility to the project location. Velostics provides insight to driver and equipment certification and load details to help minimize non-productive time related to chemical management.

Once the product is at the wellsite, we offer onsite chemical inventory management and fluid consultancy personnel, as well as a fully equipped field lab trailer where onsite product optimization can be conducted. Our operations are managed by an experienced team, where QHSE is an integral focus.

We also provide a variety of modified acid systems delivered to location in acid transport units. These can be used to remove calcium carbonate scale from ESPs, treat damaged saltwater disposal wells, as well as the wireline safe acid described previously in the MajiFrac solution.

We work with E&P operators to deliver solutions for newly completed wells, as well as for legacy wells in shale formations and strive to be the leader in Enhanced Oil Recovery (EOR) as we continue to deploy our latest disruptive EOR solutions, such as ReFlow Control.

Our team of experts have significant experience in new technology development and are driven to accelerate product development with reservoir recovery and production optimization as our focus, making Tendeka an ideal technology partner for E&P operators.