



EOR Projects
ENGINEERING & EXECUTION



ENGINEERING & EQUIPMENT

Enhance your oil production

Backed by decades of successful field applications, polymer flooding represents a field-proven recovery technique to enable increased production efficiency and economic field-life extension of conventional oil producing assets. The technology also contributes towards meeting net-zero production greenhouse gas targets by reducing carbon dioxide emissions by 2-6 times per produced barrel. Providing improved mobility control, the increased swept oil volume results in decreased water production and a sustained period of higher oil rate.

SNF provides a complete range of design and fabrication engineering services for polymer injection (including alkali

and surfactant packages, if any), either based on standard modular units (PIU) or engineered, tailor-made and fully-integrated solutions.

SNF has also the full knowledge and expertise to supply and execute end-to-end projects including upstream water treatment facilities (water softening, filtration, etc.), oil & water separation units or produced water deoiling packages.

Our 150-strong Engineering Team can handle any specific project to meet customer requirements encompassing all specific constraints



SNF

SNFU 902181/5

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WHAT MAKE US DIFFERENT

Why Choose Us

Backed by world-class equipment and engineering support, qualified applications specialists, efficient manufacturing of quality water-soluble polymers, and optimized supply chain management, SNF is a recognized leader in the development of high-performance chemical solutions designed to exceed the needs of our customers in the Oil & Gas Industry.



SNF Andrézieux site, one of the 21 manufacturing plants of SNF Group

Worldwide Leader

With 21 production facilities and subsidiaries in more than 50 countries, SNF's Group is the world's leader in water chemistry.

30 Years of Experience in Oil&Gas

Over the last 30 years, SNF has acquired a solid understanding of clients' constraints on oil fields. Combined with Polymer expertise we offer full engineering systems to optimize injection for polymer flooding applications.

Polymer manufacturer

As a global leader in manufacturing water-soluble polymers, SNF is continuously improving a range of more than 1,000 products, which help reduce energy needs and carbon intensity while contributing to the responsible extraction of key mineral resources essential to the energy transition.

Fully integrated company

SNF is a fully integrated company. We have channelled all of the supply chain to be internal - from research and development to production, from your equipment design to its installation.

150 Oil&Gas experts

We are engineers, developers, technicians, and oil and gas experts who strive to solve your challenges. Together we aim for excellence in every step we take : from the first on-site audit to the training of your staff.

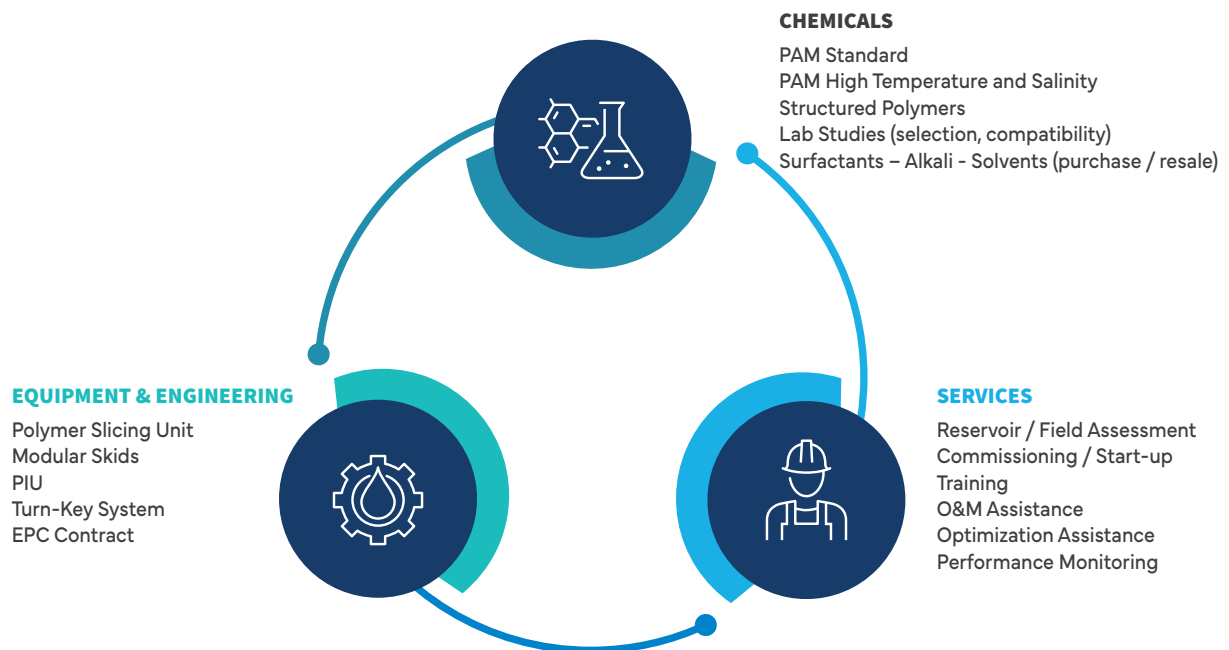
Industrial Strike Force

SNF polymers are manufactured in 21 plants, covering 5 continents which allows us to provide polymer solutions to the Oil & Gas Industry in a cost-effective, energy-efficient manner.

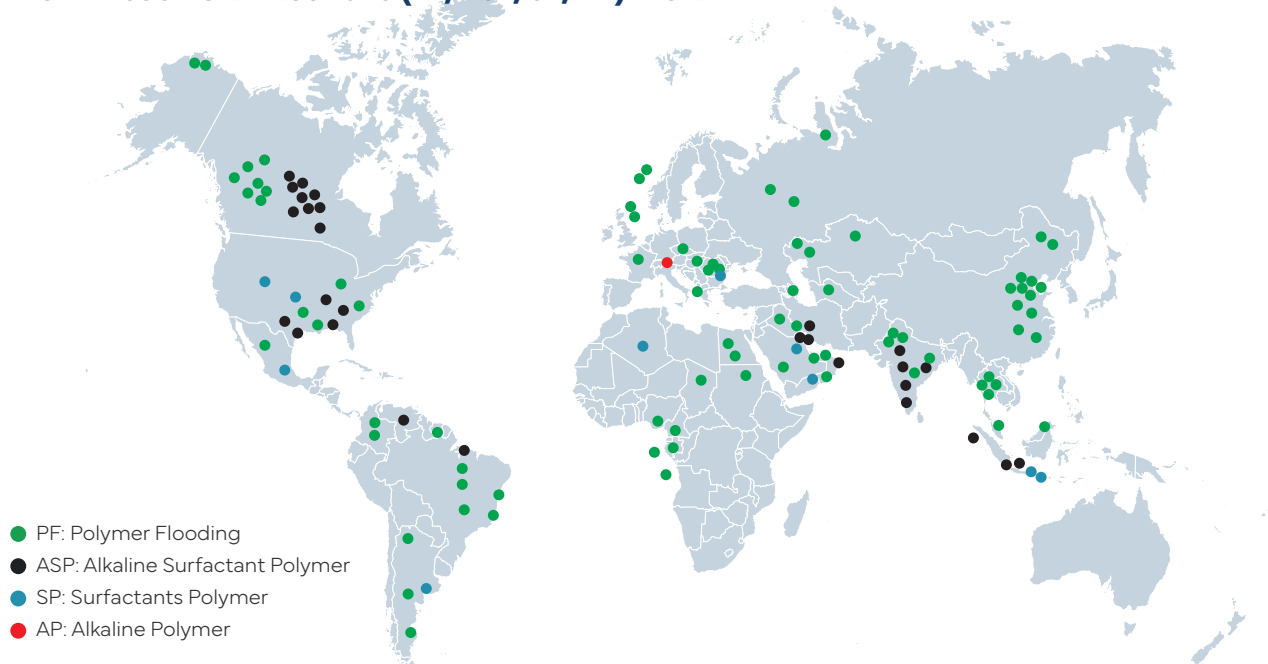
OUR KNOW-HOW

End-to-End Solutions

Thanks to our integrated capacities, we support you from the early beginning of your project to the chemical manufacturing, equipment and engineering, and services and monitoring. Combining the capabilities of a leader in polymer manufacturing and a team of 150 Oil & Gas experts with an integrated engineering department, SNF will be your single contact point, eliminating any unnecessary steps.



OVER 350 EOR PROJECTS (PF, ASP, SP, AP) WORLDWIDE



ENGINEERING

Whole Project Life Cycle



Early Project / Conceptual Study

SNF is always open to bring our 30 years of experience to support the Oil companies screening new EOR projects and implementation.

This will help in assessing the best candidate considering the project location, the site constraints and challenges, the logistic access, etc.

Together we would define together the most relevant deployment strategy and polymer technology considering all the technical and economical parameters.



Innovation & Development

SNF has developed specific technologies required for a proper EOR project deployment. Innovation is at the heart of our process with specific yard testing facilities enable testing of new polymer related devices and technologies, and to assess new polymers with existing equipment. Specific tests for customers can thus be performed under various field conditions including type of brine, temperature, and equipment.



Detailed Design

SNF engineering department is structured with more than 150 specialists from different disciplines (process, mechanical, structure, civil, electricity, instrumentation, automation, procurement, project control, schedule, etc.).

The whole process facilities for the EOR solution storage, preparation and injection will be fine tuned to match all the customer expectations and specifications.



EPC Project

Thanks to SNF's significant experience in executing EOR projects all over the world, the most relevant partners will be selected for the procurement of the equipment and the construction of the skids and containers.

All those activities will be performed under the supervision of the SNF allocated experienced project manager who will be directly involved from the initial project discussions up until its final completion.



Factory Acceptance Test

Prior to shipment, any equipment manufactured by SNF is water tested in order to ensure efficient operation and smooth start-up at site. Dedicated areas, within SNF premises, facilitate this important task.



Commissioning and Start-up

Flawless start-up of polymer injection is crucial for the success of any project. Prior to commissioning, SNF supports customers by advising them on the installation and set-up of polymer injection facilities. SNF's dedicated team will then take care of the entire commissioning and start-up process, combining expertise in terms of injection units operation, logistics and chemistry / wells monitoring.



Training and Troubleshooting

SNF provides specific training on how to use equipment and run injection facilities. This educational guidance is meant to provide operational autonomy to facility operators. In addition, SNF is always available, both on-call or with site visits to provide troubleshooting services. Also, remote access to your system and preventative maintenance via our easEOR digital solution may be an available option to assist operators during production.



Operation and Maintenance Support

SNF operational experience within different constraining environments has led to an optimized maintenance program. Throughout the project life cycle, our dedicated Operations and Maintenance Support Team can be quickly mobilized. This service may include basic laboratory analyses and chemicals management.

MODULAR SOLUTIONS

PIU – Polymer Injection Units

SNF has developed pre-designed and standardized modular solutions, enabling the injection of polymer into wells at specified viscosities and flow rates. These modular PIU (Polymer Injection Unit) systems consist of 40 ft. High Cube standard sea containers that are assembled together, integrating all of the required equipment for polymer storage, dissolution and injection, as well as utilities.

Modular injection systems can be connected to existing water injection lines, without the need to develop new infrastructure. These units allow for quick installation and start-up with shortened site works with limited manpower, the **Plug&Pump** system. Modular systems facilitate polymer injectivity test, polymer flooding pilot and full field progressive and modular deployment.

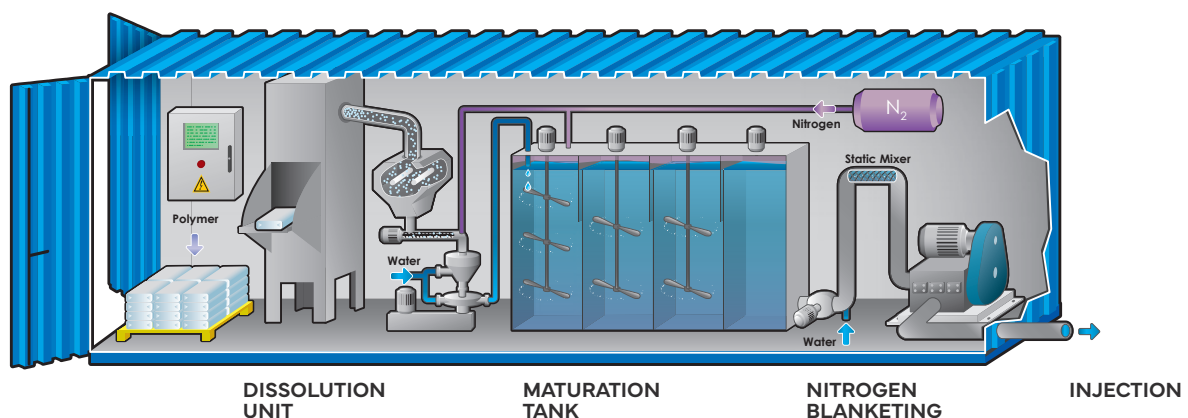
Benefits

- Plug & Pump design
- Quick installation and start-up
- Optimized cost and delivery time,
- Possibility of rental or leasing
- Design and Construction as per SNF Oil & Gas engineering Rules and Practices
- Compact unit, based on 40ft standard container(s)
- Shorten transportation at minimum cost
- Moveable, if required
- Minimum site works and preparation
- Smooth deployment
- Gradual investment
- Limited initial cash exposure

Plug&Pump

The PIU relies on the following dissolution principle for polymers: Powder-grade polymer coming from a storage silo is proportionally mixed with water to create a polymer mother solution, using a patented **FLOQUIP™ PSU** (Polymer Slicing Unit).

After hydration and full viscosity development, the highly concentrated mother solution is then diluted and injected without filtration into wells, in accordance with injection rate and pressure guidelines. Nitrogen blanketing is used to preserve the polymer during the dissolution process.



Polymer Injection Unit Models and Related Capacities

SNF offers several models of the Polymer Injection Unit (PIU) to dissolve varying quantities of polymer utilizing our FLOQUIP™ Polymer Slicing Unit (PSU) technology.

Typical PIU models, primary design purposes, and capacities are outlined below.

MODEL	PURPOSE	MOTHER SOLUTION CAPACITY	DRY POLYMER CAPACITY	CAPACITY WITH 1 500 PPM INJECTED SOLUTION
FLOQUIP PIU01-05-x	Injectivity test / Single well tracer test	5 m ³ /h	1.8 MT / Day	7 500 bpd
FLOQUIP PIU03-10-x	Injectivity test, Pilot, small injection rates	10 m ³ /h	3.6 MT / Day	15 000 bpd
FLOQUIP PIU03-20-x	Pilot, medium injection rates	20 m ³ /h	7.2 MT / Day	30 000 bpd
FLOQUIP PIU06-40-x	Pilot, large injection rates, partial, full-field	40 m ³ /h	14.4 MT / Day	60 000 bpd

SNF can provide a large range of standard Polymer Injection Units with a short delivery time. All these standard units can be customized, extended as per client requirements and local conditions. For example, a dry bulk silo can be added to store Polymer. Alkali and Surfactant skids can be connected to the Polymer Injection Unit.



POLYMER DISSOLUTION

PSU – Polymer Slicing Units

The **FLOQUIP PSU™** is a patented proprietary equipment designed for high speed dissolution of very high molecular weight polymer in water. Specifically designed for the oil industry, the **FLOQUIP PSU™** is recommended whenever time of dissolution and space for maturation are an issue in large volumes of use.



Major Features

- Preparation of polymer solution at high concentration, usually from 10 to 15 g/l,
- Reduction of dissolution time by at least 50% compared to conventional dissolution system
- No degradations of polymer characteristics
- No fisheyes, no filtration of polymer solution
- Blanketed by nitrogen (with very low consumption)
- Compact design
- Easy maintenance

MODEL	MAX. DRY POLYMER FLOW RATE
FLOQUIP™ PSU 100	100 kg/h
FLOQUIP™ PSU 300	300 kg/h
FLOQUIP™ PSU 600	600 kg/h
FLOQUIP™ PSU 1500	1 500 kg/h
FLOQUIP™ PSU 3000	3 000 kg/h

STORAGE SOLUTIONS

Horizontal silo

For containerized units, SNF has developed its own patented integrated "horizontal" silo made of 40ft customized sea containers with internal central screw to move powder. It is installed on top of the polymer preparation container, with a Plug & pump design for quick installation and start-up.

2 configurations are available: single or double silo, with storage capacities of 30 T and 80 T respectively. It is equipped with load cells for weight monitoring and can be loaded by external pneumatic transfer system or by pressurized truck.



PUMPING TO THE WELL

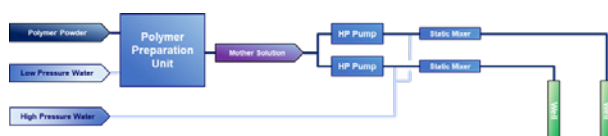
Injection Configuration

The polymer solution can be diluted at low or high pressure depending on the existing water injection configuration in the field.

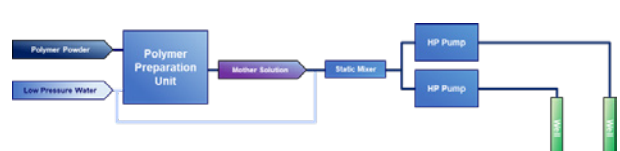
The availability or not of high-pressure water on site will modify the skid layout as well as the size of the HP pumps needed for the injection. The two graphs below summarize the different configurations. The rest of the skids and their equipment is not modified. The capabilities are not modified either.



When water is available at injection pressure



When water is not available at injection pressure



FLOW CONTROL

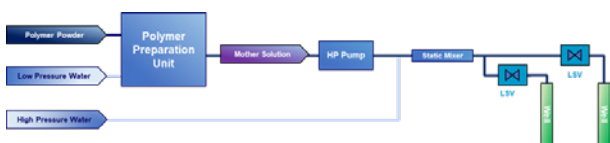
Low Shear Valves

In practice during polymer flooding, there are 2 conceivable options to control injection: one injection pump per well, or one injection pump for several wells. In terms of CAPEX, especially for full field deployment, going with one pump injecting into several wells is preferential. In classical water flooding systems, injection flow / pressure to each well is controlled by an individual device called choke valve.

In EOR process where polymer solution is used, using a standard choke valve is not recommended at all, due to mechanical degradation induced by the high shear generated through the choke as soon as pressure drop is higher than 5 bar.

The main objectives of the Low Shear Valves are to provide a stable and accurate control of the polymer injection without significant degradation of the solution, even up to 45 bar pressure drop across the device.

SNF provides different models of Low Shear valve. Selection is done on case by case basis, using actual injection parameters (polymer type and concentration, temperature, water composition, flow and pressure ranges...). Systems can be designed to be fully manual with manually operated valves or fully automated using air/electrically actuated valves.



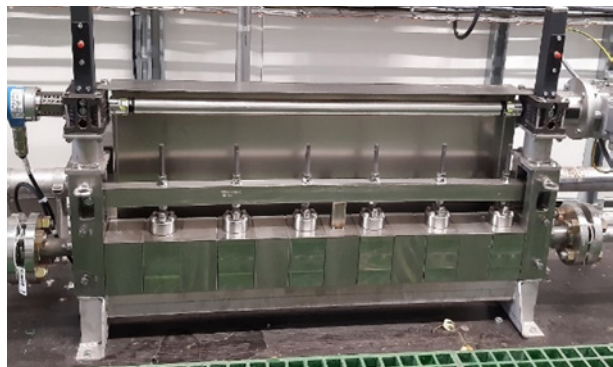
Major Features

- Accurate Flow / Pressure Control
- No significant polymer degradation
- Solutions available for diluted and mother solution
- Installed either centralized or remotely at each well head
- Manual or fully automatic control



VPR

Vortex Pressure Reducer



VPR-c

Vortex Pressure Reducer Compact



LPR

Linear Pressure Reducer



CPR

Conical Pressure Reducer

MONITORING INJECTION

In Line Viscometer

Controlling injection parameters is essential to polymer feed consistency. SNF has therefore developed specific devices to ensure Continuous Polymer Viscosity measurement.

Benefits

- Continuous in-line viscosity measurement
- Stable and accurate viscosity measurement
- No polymer solution degradation – Not exposed to O₂
- Direct low shear measurement comparable to lab viscometer
- Remote monitoring (that can be fully integrated in a global digital EOR management system)
- No waste
- No lab operator required



FLOQUIP™ VDH

High-Pressure model (200 bar)



FLOQUIP™ VML

Low-Pressure model (12 bar)

DIGITAL OPERATIONS

EASEOR

As an end-to-end service provider with global experience in EOR (Enhanced Oil Recovery), SNF Group supports you through the entire lifecycle of your project, from development to field operation. SNF has introduced EASEOR™ as a smart monitoring system for Enhanced Oil Recovery applications. Based on IIoT technologies (Industrial Internet of Things, i.e., using sensors and analytics), EASEOR™ solution enables data collection to improve projects' efficiency, productivity and safety.



Instant Access / Remote monitoring

EASEOR™ helps you get more value out of your data.

With EASEOR™, you'll gain control of your oilfield with a comprehensive view of the entire skid. On a single user interface, EASEOR™ gives you a quick overview of key performance indicators. EASEOR™ dashboard makes it easy for anyone to get descriptive visibility into the most important up-to-date information.

Predictive Maintenance

Implementing predictive maintenance based on live data collection and analysis will improve the overall uptime of the Polymer Injection Unit resulting in a higher efficiency of the EOR process.

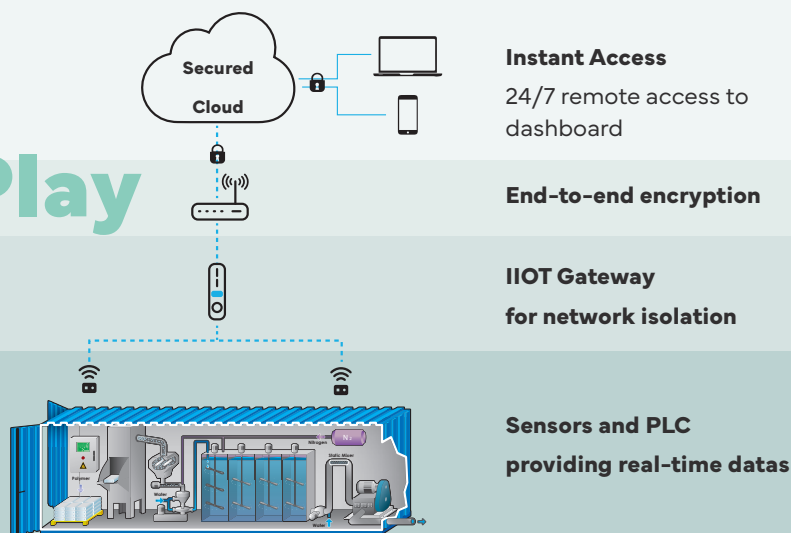
Anticipating the equipment maintenance will also reduce the OPEX of the project with a longer lifetime of the asset.

Design for Cybersecurity

EASEOR™ has been designed to be secured at each step. First, the solution is gathering data on «read only» mode from PLC source and End-To-End encrypted SNF's digital solution ensures a full network segmentation, and thus totally isolated from the plant network.

It is fully compliant with ISO27001 and IEC 62443 standards.

Pump&Play



TAILOR-MADE SOLUTIONS

Tailored Projects



Customized Design

SNF has capabilities and competencies to adapt the design and construction of polymer facilities to match with client's specific requirements

- Design as per specific standards & specifications (client's own standards, API, ASME....)
- Use of client's approved vendor list
- Specific quality system & requirements (ITP, material certificates, third party inspection....)
- Significant increase of cost and delivery time compared to SNF standard systems
- Integration of site constraints (climatic conditions, soil, available footprint...)

Turnkey Projects

Our global network enables us to achieve complex turnkey projects, not only focusing on polymer injection but also including water treatment and oil separation, offering our customers fully integrated solutions for their field development projects.

SNF's knowledge and experience enables execution of full EPC contracts:

- EPCI (Engineering, Procurement, Construction, Installation)
- DBOOM (Design, Build, Own, Operate, Maintain)



Offshore Design

Offshore environments differ from onshore. Environmental and space constraints must be recognized and identified. SNF's Engineering Team will take these requirements into consideration to provide our clients with optimized designs and systems, integrating those specific constraints

- Minimized footprint and weight optimization
- Specific construction codes
- Potential large storage requirements (hull or deck storage)
- Special corrosion consideration
- Full hazardous classification
- Automatic operation and monitoring
- Logistics integration

ALWAYS IMPROVING OUR TECHNOLOGIES

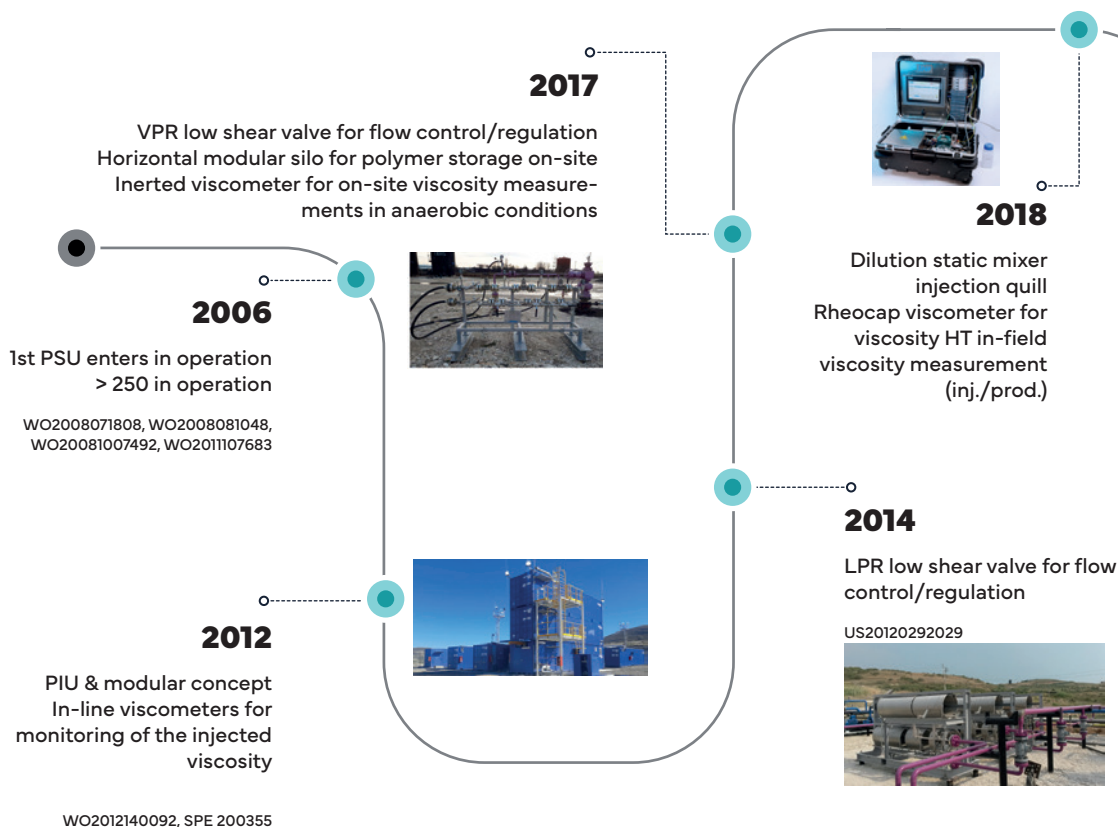
Innovation & Development

To maintain our position of market leader and to bring solutions to customer needs, SNF keeps improving the processes of its units and to always offer ever more innovative technical solutions.

For the last 20 years, SNF has offered revolutionary technological solutions specifically developed for the EOR applications, such as:

- Modular concept unit PIU (Polymer Injection Unit)
- **FLOQUIP PSU** (Polymer Slicing Unit)
- Horizontal storage silos
- Low shear valves
- Inline viscometers
- Field rheometers
- Digital Monitoring Tools (EasEOR)
- etc.

Constantly Innovating



A dedicated SNF team is in charge of those continuous activities with permanent access to testing facilities and support from laboratory specialists. Mains objectives of the work are focused on process improvement and technical solutions development but also:

- Qualifying new technologies / equipment / supplier
- Validating project design basis
- Trouble shooting on-going projects
- Evaluating and improving back produced water treatment technologies



2019

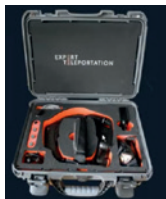
CPR low shear valve for flow control/regulation
Offshore bulk delivery solution

OTC 31527



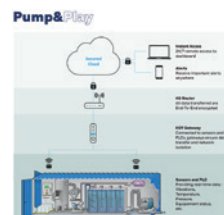
2020

Smart glasses for remote assistance
Horizontal PSU for skid design optimization



2022

Deployment of EasEOR™ IIoT
Inline refractometer for injected concentration monitoring



2023/24

ECOPAM™ Series
(bio-sourced raw materials)
Portable SEC device

ESSENTIAL PACKAGES

Water Treatment

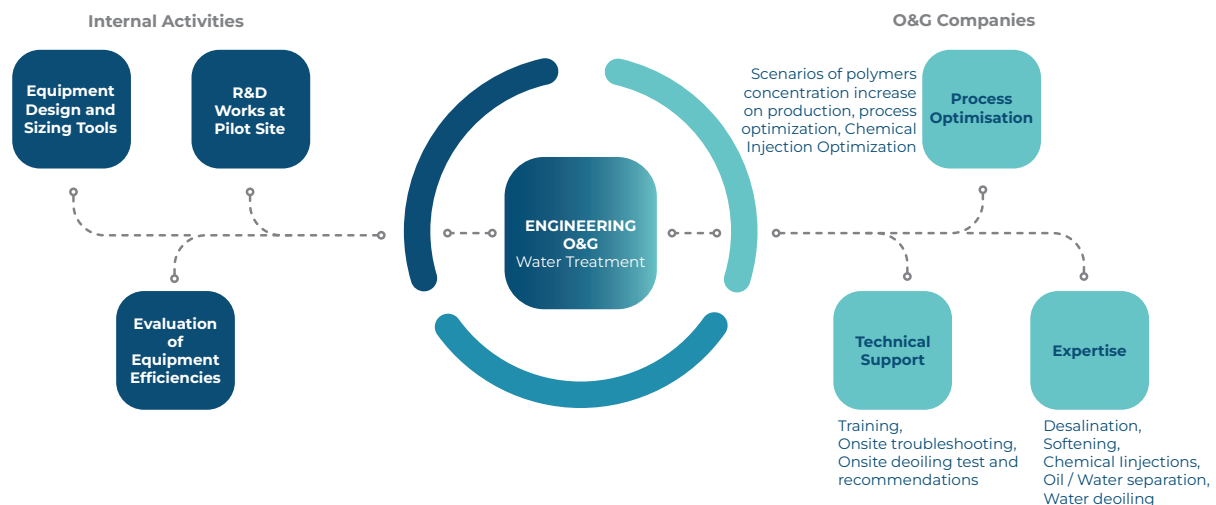
To make each EOR project a success, water treatment on the injection or on the production side is crucial. O&G companies are more and more requiring complete service packages on the projects. Consequently, taking advantage of the SNF dual competences in polymer c-EOR and water treatment, a specific activity has been developed over many years in SNF on this topic.

On the injection side, the objectives are to protect the surface facilities, including Polymer Injection Units, to match the injectivity specifications, and to protect and better stimulate the reservoir. It includes Water Softening Units (resins, membranes, etc.), desalination, solids and oil removal or chemical protection (against corrosion, bacteria, scaling) activities.

On the production side, the objectives are to properly manage the different oil and water separation steps, to reach oil quality specifications and to correctly treat produced water for exportation, re-use, re-injection or discharge according to the global water management strategy and required quality objectives. If not anticipated and not managed correctly, produced polymer is known to have some impacts that can lead to process or quality issues. Mitigation is possible but requires specific expertise and support, ideally at the earliest steps of the projects.

Organisation and activities

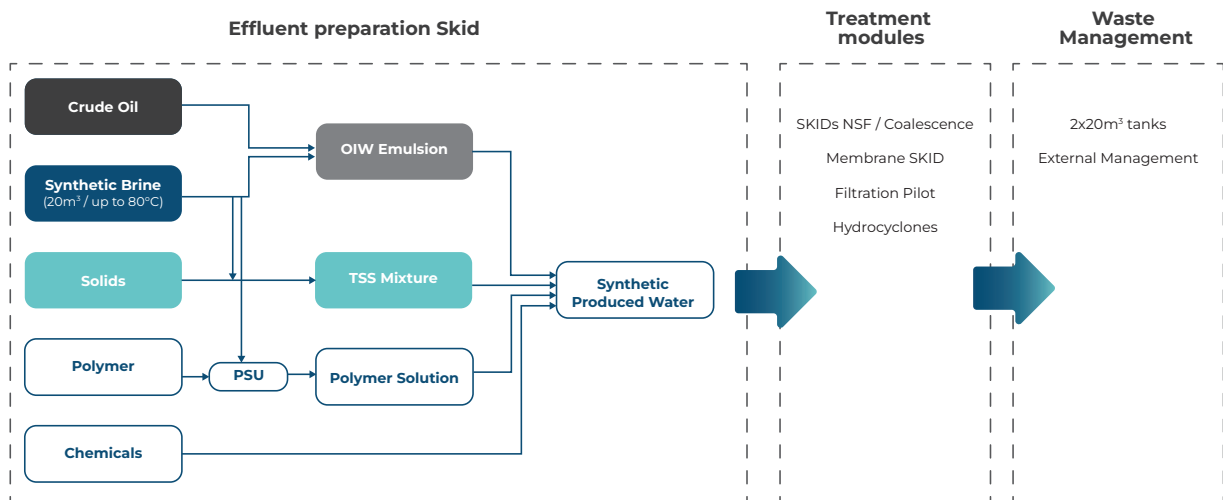
For standard polymer flooding or ASP projects, SNF scope of supply use to be end-to-end including the water treatment packages. In this case, the activity consists in engineering the treatment operations before providing the equipment and chemicals, directly or through subcontractors.



Internal testing capabilities

Besides engineering proposals and customer technical support, by mimicking the operational challenges faced in any given oilfield, SNF have also developed a range of proprietary water treatment testing capabilities for oil and gas projects at the pilot scale.

The objective remains to keep advanced technical knowledge and skills, especially with polymer in fluids, to better support the EOR projects and the customers.



Monitoring: flowrates, pressures, OIW and TSS analyzers, advanced characterizations in laboratory



Water Science Servicing EOR

HIGH-PERFORMANCE CHEMICAL SOLUTIONS FOR EOR

Backed by world-class equipment and engineering support, qualified applications specialists, efficient manufacturing of quality water-soluble polymers, as well as optimized supply chain management, SNF is a recognized leader in the development of high-performance chemical solutions designed to exceed the needs of our customers in the Oil & Gas Industry.

SNF polymers are manufactured on 5 continents, which allows us to provide polymer solutions to the Oil & Gas Industry in a cost-effective, energy-efficient manner. Regionally dedicated SNF Manufacturing, Engineering, Logistics, and Service Centers support our clients worldwide.

REDUCING WATER CONSUMPTION AND CO2 EMISSIONS

In Enhanced Oil Recovery (EOR), polymer flooding is a cost-effective approach to maximize the productivity of existing assets.

A polymer flood project can reduce water consumption by 80% per barrel of oil produced. Likewise, the amount of CO₂ required to produce a barrel is reduced by 50% to 80% due to a reduction in pumping energy required.

Combined with Polymer expertise we offer complete engineering systems to optimize injection for polymer flooding applications.

EOR PLUG AND PUMP SYSTEMS

Over the last 20 years, SNF has acquired a solid understanding of clients' constraints with an involvement in more than 350 projects worldwide. Combined with Polymer expertise we offer full engineering systems to optimize injection for polymer flooding applications.

Based on a modular approach, SNF developed Plug and Pump systems that can easily be transported and deployed on-site. Adapted to any existing well configurations, our portable units enable polymer solution preparation and ensure quick and efficient injection once installed.

