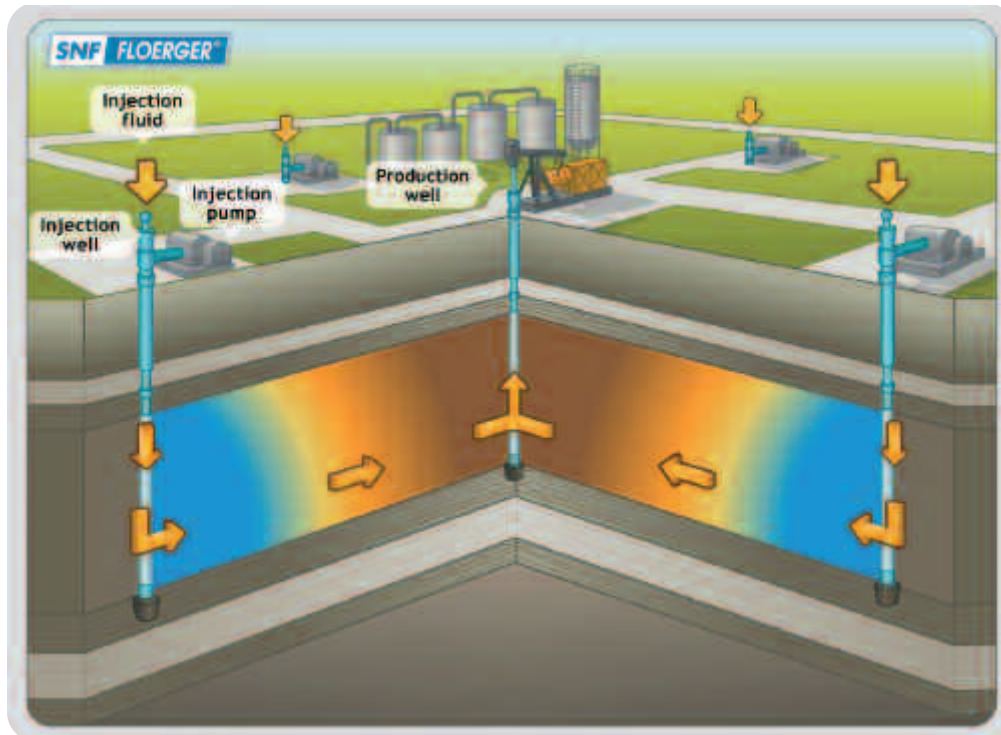


FLOPAAM™

Polymers for Enhanced Oil Recovery
from design to injection



SNF FLOERGER®



Polymers for Enhanced Oil Recovery

Viscosifying polymers to control the mobility of injected water have been employed for many years in Enhanced Oil Recovery (EOR) applications. Polymer flooding, to improve volumetric sweep efficiency, reduce channelling and breakthrough, has aided many operators to increase oil recovery and lower the cost per barrel of oil recovered. The same polymers are used with surfactants and alkali agents for increasing the sweep efficiency of these enhanced recovery floods.

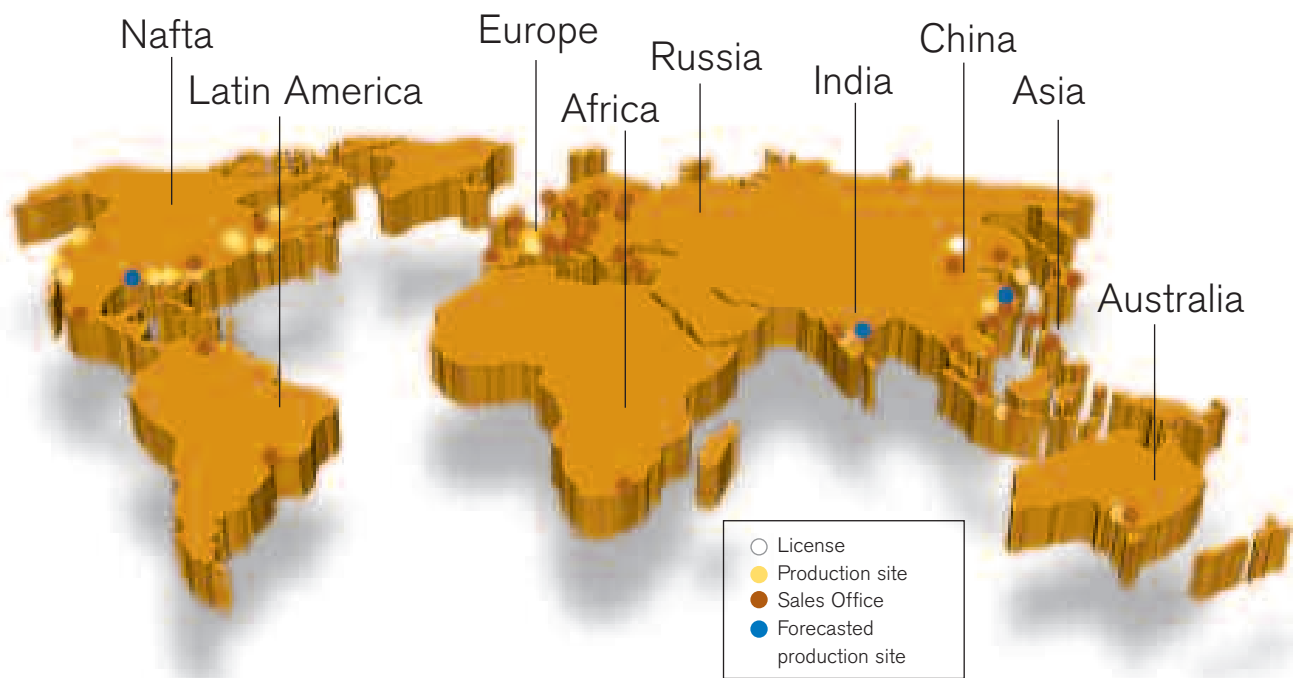
Polymer flooding can yield a significant increase in oil recovery compared to conventional water flooding techniques. A typical polymer flood project involves mixing and injecting polymer over an extended period of time until about 1/3–1/2 of the reservoir pore volume has been injected. This polymer "slug" is then followed by continued long term water flooding to drive the polymer slug and the oil bank in front of it toward the production wells. Polymer is injected continuously over a period of years to reach the desired pore volume.



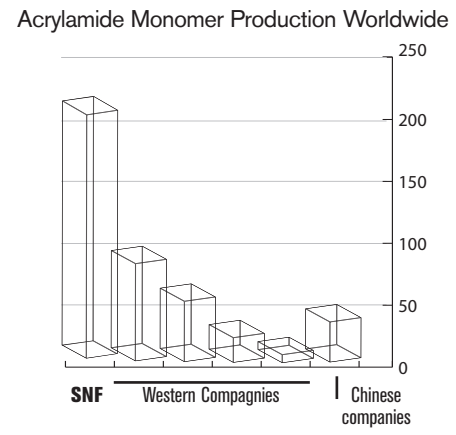
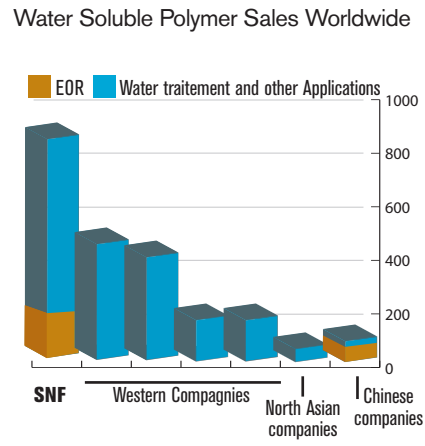
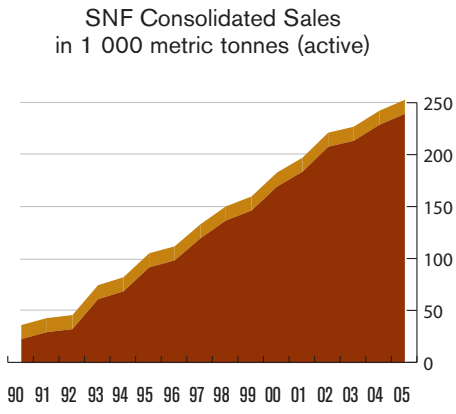
THE LARGEST INDUSTRIAL BASE

SNF is the world's leading producer of water soluble acrylamide-based polymers. SNF has, by far, the largest production capacity of the industry with 40% of the world capacity in polymer and 50% in monomer. SNF has invested more than 800 MUSD over the past 10 years to build state of the art manufacturing units worldwide. SNF has the largest and most effective manufacturing capacity in the industry.

SNF has 4 major manufacturing sites in France, the USA, China and Korea, and these are complemented by 14 satellite sites. This balanced production around the globe enables regional arbitrage based on local raw material and transportation costs, brings robustness to foreign exchange variations and **ensures that customers always benefit from best market conditions.** **SNF sales have reached 850 MUSD in 2005, in progression of 17 % over the previous year.**



SNF is using a new and unique acrylamide manufacturing process based on enzyme technology and bringing a 7%-8% cost advantage over competition



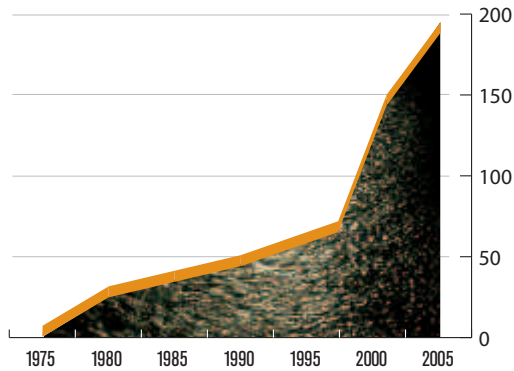
30 YEARS EXPERIENCE IN EOR

SNF has 30 years of experience in Enhanced Oil Recovery (EOR) and was one of the major innovators of this technology in the USA with PUSHHER and FLOPAAM. SNF is continuously improving its EOR polymer technology through close working relationships with research teams of oil companies, oil institutes, oil universities. SNF has extensive experience in EOR under a wide variety, of reservoir conditions both onshore or offshore, with over 40 references in 14 countries (see map).

In the early 1990's SNF sold Daqing Oil Field a license to manufacture EOR polymers based on an early version of its technology. Under this contract SNF built a polymer production plant in Daqing, China, which produces about 75 % of the field's needs. In addition, SNF is currently the largest supplier of EOR polymer to oil fields throughout China.

Over 40 references in 14 countries

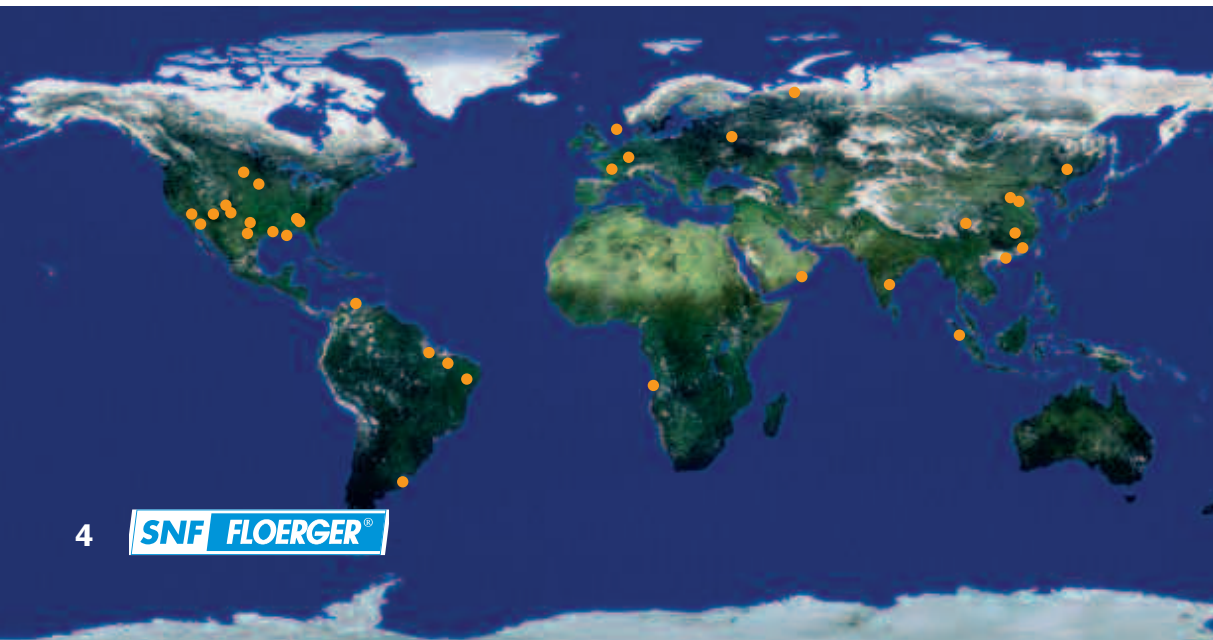
SNF has a diversified market base in the oil, water-treatment and mining industries, using the **same technology and the same manufacturing facilities. Oil field customers benefit from the large scale and technical breadth of other applications.**



Cumulated Sales of Polymer in EOR Applications

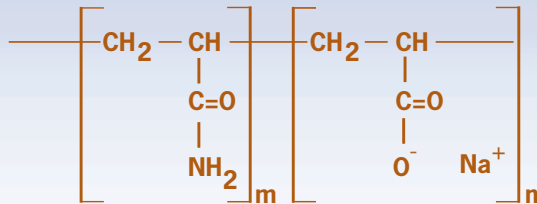
With about 30 years of experience, SNF has by far the largest experience in polymer flooding. Through the acquisition of Dow and Pfizer assets, SNF has been one of the key actors in polymer flooding since the very beginning.

Existing and projected EOR applications



HIGHLY SKILLED AND SPECIALISED RESEARCH

SNF is dedicated to support the growing interest of oil companies in EOR, investing 20 million USD annually in R&D with Research Centers in Europe, USA, India and China.



The unique position of SNF comes from :

- a multi-applications R&D environment promoting cross fertilization of know-how,
- a strategic backward integration on key monomers enabling to bring the latest fundamental discoveries directly to oil field applications.

Our state of the art application labs qualify every month dozens of **new polymers** with enhanced performances in oil field operations, thanks to reliable **polymerization processes** and **innovative monomer** research programs.

Innovative monomers : based on a new enzymatic process, SNF produces over 50% of the acrylamide monomer in the world. The development of the enzymatic monomer process has provided access to copper-free high purity raw material. SNF has the strongest in-house monomer design and production capacity with more than a hundred new proprietary vinylic, allylic and acryloyl monomers with a very wide range of chemistries such as hydrophobic, associative, rod-like, branched, comb, star, zwitterionic, sulfonated, heat resistant, etc.

Polymerization processes : SNF is a highly skilled, large scale oriented, polymer producer. Continuously reinvesting in technology, SNF has extensive industrialization programs of new polymerization processes using macro-initiators, macro transfer agents, RAFT, ATRP, NMP polymerization techniques as well as micellar polymerization.

New polymers : SNF's polymers now reach extremely high molecular weights, HPAM up to 30 millions g/mol and more. In addition to molecular weight, SNF's polymer architecture and polymer solution formulations are wide and varied to fulfill all specific EOR requirements: linear, branched, cross-linked, micro-structured, morphology and architecture controlled, star, comb, willow like, block, telechelic, sulfonated, amphoteric, etc.

State of the art application labs : To develop the right product for each reservoir, SNF has a dedicated state-of-the-art application lab to mimic injection and reservoir conditions. This enables SNF to fine tune polymer composition to provide optimized salt resistance, temperature stability, shear stability, injectivity, lowest adsorption, and highest viscosity, for each particular field.

R&D PARTNERS

UNIVERSITIES

- U of Austin, Texas
- U of Denver, Colorado
- U of New Mexico
- U of Pau, France
- U of Strasbourg, France
- U of Ufa, Russia
- U of Sichuan, China
- U of Sao Paulo, Brasil

OIL INSTITUTES

- Alberta Research Council, Canada
- RIPED, China
- IFP, France
- SWPI, China
- SURTEK, USA

OIL COMPANIES

- PVDSA
- PETROBRAS-CENPEC
- SHELL
- PDO
- CHEVRON-TEXACO
- NORSK HYDRO
- HUSKY OIL CY
- ENCANA
- CNRL
- TOTAL
- EXXON
- CNOOC
- SINOPEC
- PETROCHINA
- ONGC
- PETRONAS
- MEDCO
- CALTEX

A WIDE ENGINEERING EXPERIENCE

SNF has several on-going projects in the USA, Canada, Brazil, Venezuela, Indonesia, Angola, India.

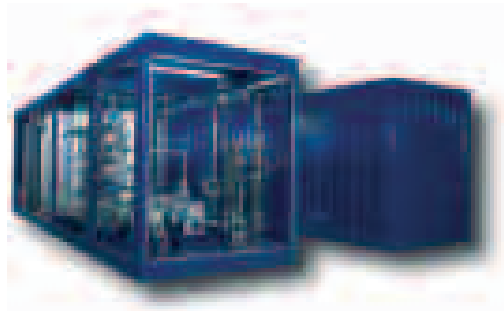
Driven by higher oil prices and the desire to keep older fields producing, the market demand for EOR polymers is expected to grow rapidly. The demand for EOR polymers could soon be higher than the total existing market for water treatment. Therefore reliable large scale supply of these polymers will become essential.

To support the expected market growth SNF is committed to more than doubling its current production capacity

SNF has the capability to support oil companies with the full design and construction of storage, dissolution and polymer injection station. SNF makes dissolution and injection equipment for EOR projects. Each injection unit is designed for the specific field conditions defined by the client. These conditions include flowrate, pressure, number of injection wells, operating environment (offshore, onshore, desert, tropical, arctic climate) level of automation.

The quantity of polymer supplied for injection operations may vary from 60 MT/yr. at pilot sites to more than 15,000 MT/yr. for actual field scale development. The FLOQUIP™ range of equipment varies from skid mounted units to indoor mounted large scale equipment.

SNF's engineering experience also includes the licensing, design, construction and commissioning of the Daqing, China polymer production plant in 1996. SNF has also built its own polymer plant in Taixing, China to serve the Chinese water treatment and EOR markets.



A FULL SET OF EXPERTISE FROM DESIGN TO INJECTION



Polymer flooding projects are more and more challenging and require a full set of integrated expertise from chemistry to system engineering.

To design a successful project, a wide variety of questions need to be answered :

- Selection of monomer
- Polymer structure
- Polymer dissolution
- Injection system
- Water pre-treatment
- Supply chain

SNF can provide oil companies with the full set of expertise supporting their EOR needs.

- Reservoir Engineering
- Monomer integration
- Polymer Selection Design
- Polymer Manufacturing
- Polymer Storage and Dissolution Equipment
- Injection Equipment
- Engineering and System Design
- Training, Start-Up and Commissioning



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