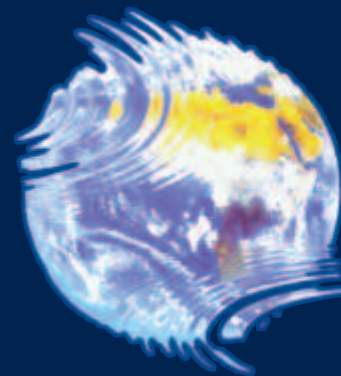


FLOQUIP™

*Dosing-Dissolution
Injection Units for Polymer
Flood Application*



SNF FLOERGER®

SNF world leader in enhanced oil recovery

For more than 15 years, SNF has been developing a complete range of polymers for use in enhanced oil recovery. These products are adapted to the wide variety of conditions encountered in the field:

- hydrolysed polyacrylamides of different molecular weights (Flopaam™) for temperatures up to 80°C,
- sulphonated polyacrylamides for temperatures up to 120°C,
- liquid xanthane gum (Flocon™ 4800C) for very high salinity levels.

With distributors throughout the world, SNF is able to operate on any of the major oilfields. A selection of references includes:

- Flopaam™ emulsion: Courtenay (France, for Elf); Mitchell (USA);
- Flopaam™ powder: Daqing, Shengli, Dagang, Liaohe, Karamay and Yumen (China); Carmopolis, Buracica (Brazil, for Petrobras); Pelican Lake (Canada, for Pan Canadian); Sanand (India, for ONGC);
- Flocon™ 4800C: Loudon (USA, for Exxon); Dielmann Sheerhorn (Germany).

The quantities of polymer supplied for injection operations may vary from 60 tonnes per year at pilot sites to more than 15 000 tonnes per year for actual development (as at the Shengli oilfield in China). Due to the success of the various pilot sites at Daqing oilfield, SNF was able to sell and install a polymer production plant there. This plant now produces more than 75 000 tonnes of polymer a year for enhanced oil recovery. SNF is also involved in a number of consortiums and research programmes with institutions in the USA, Europe, Russia, etc.

Equipment

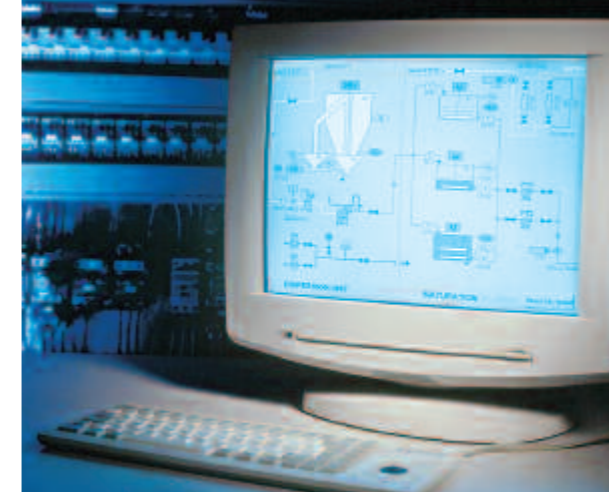
SNF makes dissolving and injection equipment for enhanced oil recovery projects.

In the case of pilot projects requiring small quantities of polymer, the equipment is assembled first of all in the factory on a skid and then sent to the site. For pilot projects using large quantities of polymer, the equipment is usually sent separately and then installed indoors on site.

To ensure proper injection, it is important for the polymer to be dissolved in the proper way, for the equipment to be compatible with the polymer and for the solution to be injected on a continuous basis. Because of this, SNF has developed specific systems for dissolving powder («FLOQUIP™ WU») and emulsions («FLOQUIP™ DE»).

With the «FLOQUIP™ WU» system, polymer is dispersed in the water and pumped directly to the maturing tanks, which are always sufficiently large to hold it long enough for complete hydration of the polymer to take place.

The «FLOQUIP™ DE» system is used to invert the polymer emulsion completely and instantaneously, and dilute it to the required concentration in line without sending it to the maturing tanks. All parts in contact with the polymer are made of stainless steel to prevent the solution from being contaminated by iron. Lines, pumps and other pieces of equipment are designed to minimise shear degradation of the polymer prior to injection.



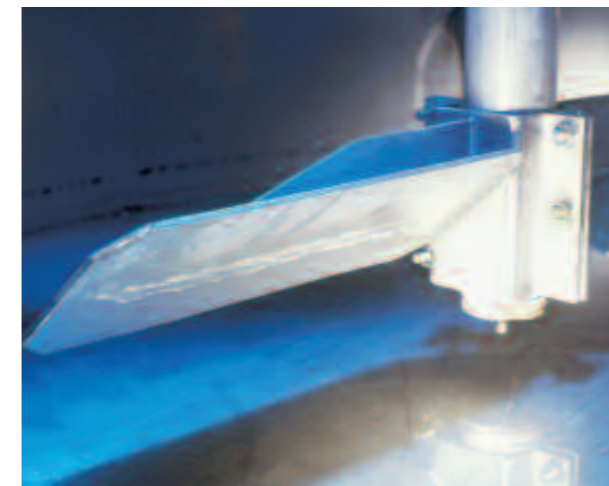
Interior of electrical equipment room, with control screen

Operations are carefully monitored from this unit, with times, flowrates, levels and pressure being measured and adjusted as necessary. The unit may be fully automated and include a supervision system (DCS).

«FLOQUIP™ WU»

dispersion unit viewed from above

SNF has developed special equipment for dissolving polyacrylamides in the form of powders or emulsions. Opposite: powdered polymer is mixed uniformly with water to ensure optimum dispersion.



Maturing tanks

Solutions have to be matured to ensure that the polymer is completely hydrated. Maturing tanks and mixers are specially designed for each pilot project to provide the right injection rate.

Manifold and injection lines

The number of injection lines and high-pressure pumps varies from one unit to another, depending on the specifications drawn up by the client. The final flowrate and concentration of the polymer solution are regulated by the control unit.



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General view of an injection unit

Each injection unit is designed on the basis of criteria defined by the client. These include flowrate, pressure, number of injection wells, environment (offshore, onshore, continental or tropical climate, automation, etc.). Many safety devices are incorporated, such as filters, maximum pressure detectors and level gauges, etc., to ensure reliable, uninterrupted operation.

SNF has drawn up a list of the main data needed for a preliminary study of an injection skid. This list can be provided on request.



Example of equipment

The client wished to inject a solution of Flopaam™ 3530S at a concentration of 500 ppm and rate of 200 m³/day into one well and 400 m³/day into another, at a pressure of 370 psi.

SNF built an injection unit consisting of two interconnected skids, with the following characteristics:

● capacity of injection unit:

- 91 tonnes of polymer/year,
- flow of water at dispersion unit intake: 25 m³/hour,
- quantity of powder dissolved: 125 kg/hour maximum,
- the unit is capable of dissolving 20-125 kg of polymer/hour,
- the unit is capable of preparing a mother solution at a given concentration within the range 1200-5600 ppm,
- two high-pressure pumps (1 and 2 m³/hour) for the polymer and two for the water (each 20 m³/hour), so that the mother solution can be diluted to 500 ppm and injected in both wells at a maximum pressure of 370 psi.

● characteristics of skids:

- net weight (without polymer solution): 25 tonnes,
- dimensions (L x W x H): 12 x 3 x 3.5 metres.

Skid I: dispersion unit, including:

- polymer storage for 1 week,
- dispersion unit: «FLOQUIP™ WU»,
- utilities: compressed air, electrical cabinets, supervision, air conditioner.

Skid II: injection unit, including:

- three 6.5 m³ maturing tanks and a 4 m³ buffer tank,
- filtering equipment for the mother solution: 200 and 25 microns,
- two high-pressure pumps for the water, including one on standby,
- two high-pressure triplex pumps for the polymer,
- dilution system, electromagnetic flowmeters, static mixers and regulation valves,
- three 1 m³ tanks and three dosing pumps (370 psi, 2 litres/hour) for additives such as tracer and biocide.

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Diagram of process and control system

This unit is completely automated. When a maturing tank is empty, the pumps are switched to the next one, and polymer dissolution begins in order to fill the empty tank, etc. Flowrates, pressures and levels are displayed in real time on the computer screen.

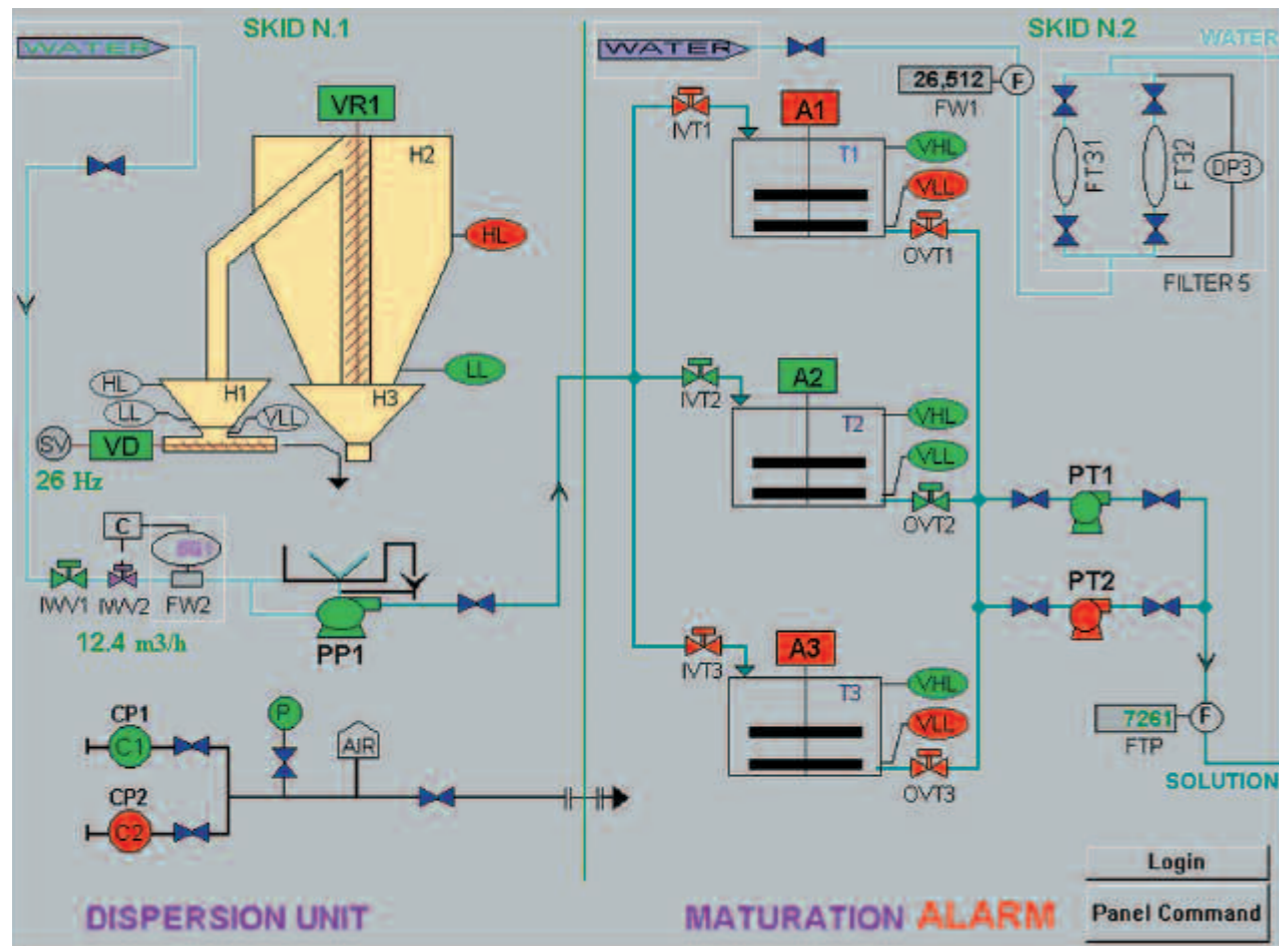


Figure 1:
Flow sheet of polymer dissolving and maturing stages

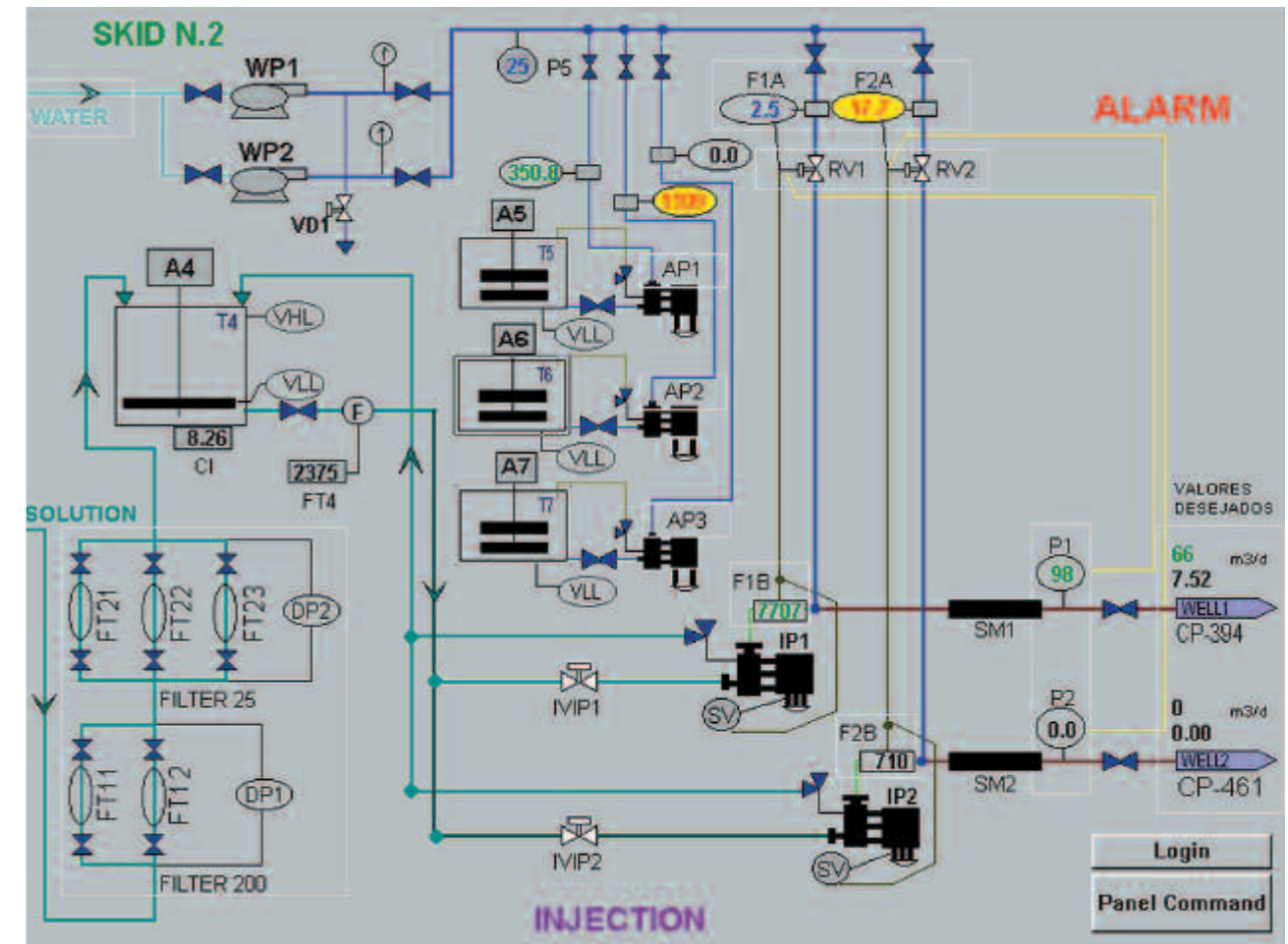


Figure 2:
Flow sheet of polymer dilution and injection stages
(in this case, the polymer may be injected into two wells at different rates and concentrations)