FLOQUIP PSU

High speed polymer dissolution equipment
High Speed Dissolution Equipment

The FLOQUIP PSU™ is a patented proprietary equipment designed for high speed dissolution of very high molecular weight polymer in water. Initially 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.

Polymer Flooding: PF, SP and ASP

SNF, the world’s larger producer of polyacrylamide (PAM), has developed a unique expertise targeted to polymer flooding applications, one of the most effective enhanced oil recovery techniques.

Polymer flooding consists in adding polyacrylamide to the injection water in order to increase the viscosity of the injected solution and to consequently improve the oil recovery factor. To ensure the maximum recovery efficiency, it is essential that the polymer solution be injected at the required viscosity level and be protected from further degradation once in the reservoir.

Polyacrylamide used in polymer flooding have high to very high molecular weight (typically higher than 15 million Daltons) and are quite sensitive to thermal, chemical and mechanical degradation. A great care should therefore be taken to design the polymer dissolution and injection system. To that end SNF has developed proprietary technology combining chemical and mechanical approaches. At the centre of this knowledge lies the polymer slicing unit (PSU). This technology has been patented worldwide.

Note: The molecular weight of the polymer is not affected by the slicing mechanism (see Screen Factor and Viscosity chapter on page 10)

Advantages

The FLOQUIP PSU™ is proprietary equipment designed for high speed dissolution of polymer in water, under inert atmosphere and without degradation of the molecular weight of the polymer. The main advantages of the FLOQUIP PSU™ include:

- Low speed equipment in order to decrease the maintenance to a minimum.
- Accrued protection of the polymer solution against chemical degradation by oxygen during the dissolution stage. Oxydo-reduction reactions are indeed at the root of the chemical degradation of polymers and it is essential to strictly control the amount of dissolved oxygen in water. This is achieved through nitrogen blanketing.
- Decrease the dissolution time of the polymer by at least 2 to 4 times and increase the concentration of the polymer up to 20 g/l, with a consequential reduction of the dissolution tanks by a factor of at least 4 and the application pumps by a factor of at least 2.
- Elimination of any filtration stage of the polymer solution due to the avoidance of the formation of so-called “fish-eyes” even at very high concentration. It is indeed essential to ensure the appropriate injectivity level of the polymer solution in the reservoir.
Features

Specifically designed for water soluble polymers
High Polymer Concentration 10-15-20 g/l
Nitrogen blanketing capability
Independent accessible transmission belt
Stainless Steel construction SS 316 L
Super Duplex construction on demand
## Floquip PSU ™ 100

**Specifications**

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## Floquip PSU ™ 300

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## Floquip PSU ™ 600

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Floquip PSU : Polymer Slicing Unit
The FLOQUIP PSU™ can use polymers in powder form with a standard particle size that are therefore easy to handle as dust is not formed. The polymer is first pre-wetted under nitrogen atmosphere with a limited quantity of water/brine and the dispersion is nearly instantaneous and occurs before the so-called shearing step. Through its grinding pump, the FLOQUIP PSU™ then reduces the polymer particle size from about 1000 to less than 300 micron. The premixed polymer is lastly diluted with the residual quantity of water/brine necessary for its final dissolution. The resulting solution is then transferred (using or not a complementary booster pump) and sent to a maturation tank.

The time required for all of the above process steps until final dissolution will fluctuate based on water temperature/characteristics and the type of polymer but will at least decrease by a factor of 2 to 4. The molecular weight of the polymer will be preserved and there will be no gel formation even at concentrations as high as 40 g/litre.

Conventional systems for dissolving high molecular weight dry polymers have a limitation around 5 g/litre in concentration due to the fact that the viscosity increase cannot be controlled long enough to allow for higher concentration. The FLOQUIP PSU™ can handle solution concentration of 10 to 15 g/litre and even 20 g/litre under specific conditions.

A typical system using the FLOQUIP PSU™ will include a storage hopper (1) for the polymer in powder form, which has a screw feeder (2) on its base for transferring the polymer into a pre-wetting funnel (3) where the polymer is mixed with around 1/3 of the required quantity of water. This pre-wetting funnel has a slicing unit (4) at its base, where the polymer powder is incorporated to water by a rotor/stator device. The premixed polymer is then immediately put into contact with the remaining quantity of water for total dissolution. The pre-wetting stage is performed in an inert atmosphere by supplying nitrogen (5). Once the polymer has been pre-wetted, mixed and diluted, it is transferred to the maturation tanks (6) and finally pumped (7) to the process which, in EOR, are high pressure injection facilities.
Size reduction

Traditional polymer dissolution units are pretty standard. A hopper contains the polymer powder, a screw feeder will bring a determined dosage to the wetting funnel, there are different types of wetting cones planes or jets, but whatever the system the maximum polymer concentration that can be achieved is 5000 ppm which induces relatively large installation footprints. An important reduction in equipment size and maturation time can be obtained by using the FLOQUIP PSU dissolution unit.

Example for a 300 kg/h installation

**Traditional process with eductor**

![Diagram of traditional process with eductor]

- 300 kg/h
- 5000 ppm
- 60 m³
- t = 60 minutes

**Compact process with FLOQUIP PSU 300**

![Diagram of compact process with FLOQUIP PSU 300]

- 300 kg/h
- 10 000 ppm
- 15 m³
- t = 30 minutes

Typical Equipment Size Reduction between an equivalent installation with or without FLOQUIP PSU

**Traditional Polymer Dissolution Unit**

Considering a 60 minutes maturation time and a polymer concentration of 5000 ppm, the maturation tank is therefore 60 m³ and the pump size to the process is 60 m³/h.

**FLOQUIP PSU 300 Dissolution Unit**

The polymer concentration that can be achieved is at least 10 000 ppm and the maturation time needed is maximum 30 minutes. Therefore the size of the maturation tank is only 15 m³ and the pump to process is 30 m³/h.
The FLOQUIP PSU dissolution unit does not generate any degradation of the polymer’s characteristics. Screen factor and viscosity of solutions of polyacrylamides dissolved using FLOQUIP PSU are similar to the values obtained by laboratory preparation or traditional mixing units.

**Screen factor and viscosity**

Viscosity of FLOPAAM FP 3630 S in a 5000 TDS Brine

Viscosity of FLOPAAM FP 3630 S in Process Water

A compact FLOQUIP PSU installed on an FPSO vessel

FLOQUIP PSU Dissolution Unit at a Canadian Tar Sands Site

Screen Factor Testing Equipment
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