

# Boundary layer fluid injection

## Extending pump ratings on solids handling pumps

Transporting pastes and sludges is very important in many fields of process technology, including water treatment, the construction industry and mining.

The delivery pressures to be developed in piston pumps for the purposes of hydraulic transport have risen considerably. The reasons for this are the advances made in solid liquid separation (higher proportion of dry matter) and extensions to existing plants (longer pipelines). In some applications, the allowable pressure limit for the delivery pipeline is no longer adequate, or is uneconomical.

## Boundary layer fluid injection

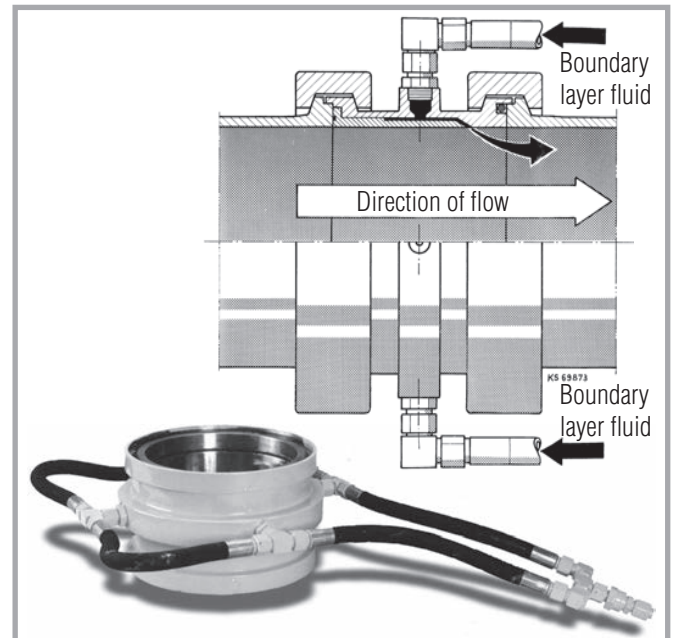
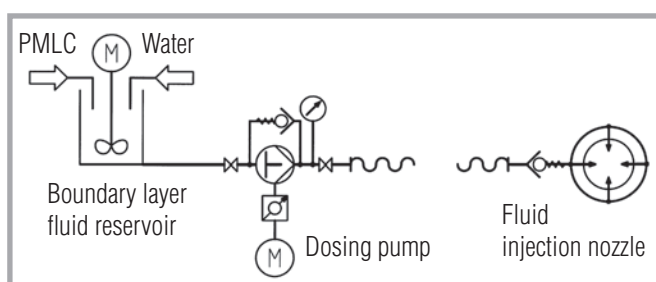
Selective injection by dosing pumps of boundary layer fluid into the delivery line can reduce the delivery pressure in the installation by up to 80 %. The pump can thus be operated at a lower power. Furthermore, it is possible to deliver pastes and sludges over previously impossible distances. The fluid injected into the pipeline forms a boundary layer between the material to be transported and the pipe wall. It reduces the friction in the pipe and, hence, the pressure losses to a considerable degree.

The system consists of the boundary layer fluid reservoir with agitator, the dosing pump and the boundary layer fluid injection nozzle. The boundary layer fluid is made up in the reservoir from PMLC, the base solution developed by Putzmeister, and water. The injection nozzle is integrated into the delivery pipe by means of the leak-proof Putzmeister ZX coupling system.

## The benefits of boundary layer fluid injection

Boundary layer fluid injection has proved its worth in many applications pumping stiff sludges and materials containing clay and soil. A variety of attractive benefits are realized by the reduction in delivery pressures:

- Delivery of sludges with high dry matter content
- Achievement of long delivery distances
- Lower wear, i.e. longer service lives for machinery and pressure lines



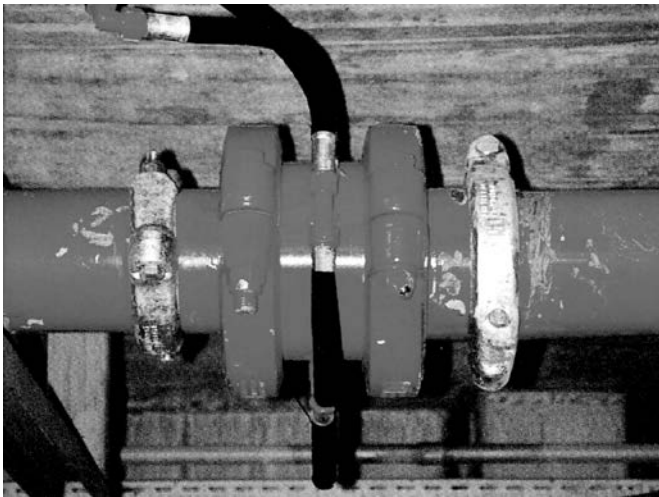
- Reduced capital costs (lower installed power, lower pipeline costs)
- Lower energy requirement
- Lower sound pressure levels
- Reduced pipe diameter and less wall thicknesses possible thanks to the boundary layer fluid

A cost/benefit analysis shows that the costs for a boundary layer fluid injection system can be recovered within 2.5 to 3 years.

Existing installations can also be retrofitted with boundary layer fluid injection quite easily.

The following versions are available, depending on your application:

- System with one dosing pump and one injection point in the delivery line (generally sufficient for delivery lines up to 70 m in length)
- System with a twin or multiple-head dosing pump and with one or more injection points in one or more delivery lines. Multiple injection points also allow pumping distances up to 900 m.
- Systems with manually adjustable dosing and optimized boundary layer fluid flow setting for systems with uniform sludge quality
- Systems with electrically adjustable dosing through
  - electrically actuated stroke adjustment
  - automatic measurement of the delivery pressure and consequent adjustment of the pump motor speed through a frequency converter (used in systems with highly variable sludge quality or to optimize the system by minimizing dosing quantity)



The boundary layer fluid injection nozzle fitted into the pipeline

## Boundary layer fluid injection nozzle

The boundary layer fluid is injected through an injection nozzle, which is designed as an annular nozzle, to form the boundary layer between the material being transported and the pipeline wall.

Many years of testing and design enhancements have allowed Putzmeister to develop an injection nozzle which guarantees optimum distribution of the boundary layer fluid around the internal surface of the pipe.

The boundary layer fluid is distributed uniformly around the pipe wall through the four connection points. The inner ring of the injection nozzle can be supplied in steel or polyurethane. The design is largely blockage-proof. When no boundary layer fluid is being delivered, the delivery pressure behind the sludge forces the inner ring against the outer ring, thus preventing sludge backflow. This also prevents crevice corrosion on the inner ring.

## Boundary layer fluid

The nature of the boundary layer fluid has a substantial influence on the reduction of friction on the pipe wall. For this reason, various liquids are used as the boundary layer fluid depending on the application (see table). The pressure gradient (pressure loss/delivery line length) is dependent on the amount of material to be delivered and the addition of various boundary layer fluids. Injecting PM's boundary layer fluid PMLC, for example, achieves a clearly greater reduction in the pressure gradient than does the injection of polymers or water. Putzmeister's PMLC also offers an additional benefit. Even if the system is shut-down for several days, it does not bind with the medium being transported.

## Boundary layer fluid recovery

It has been found that, in installations using PMLC as the boundary layer fluid, the PMLC does not mix with the sludge, i.e. the boundary layer fluid exists generally without contamination.

Thus, the boundary layer fluid may be recovered at the end of the pipe as a further cost saving. The boundary layer fluid can be recovered and re-injected by means of a specially designed device (Putzmeister patent).

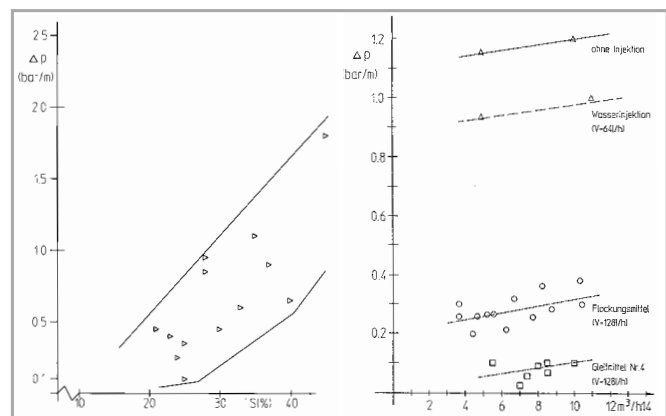
## Summary

Boundary layer fluid dosing systems in pipelines attached to Putzmeister pumps can optimize the installation and the operating conditions. The reduced delivery pressures, the resulting reduction in energy consumption and in the costs for wear parts and servicing are convincing arguments for the use of this technology.

Furthermore, it is only by using boundary layer fluid injection that the extreme pressures generated by thick sludges and slurries moving through long pipelines can be reduced.

## Advantages and disadvantages of various boundary layer fluids

Product	Arguments + for / – against	Pressure reduction
<b>Water</b>	+ cheap – mixes with sludge	20 – 50 %
<b>Heating oil, waste oil</b>	+ greater cost benefit when used as combustion aid – only in incineration plant	25 – 50 %
<b>Poly-electrolytes</b>	+ high efficiency – mixing station may be required	50 – 75 %
<b>PMLC</b>	+ extremely efficient + does not mix with sludge – mixing station required	70 – 90 %



Pressure losses are dependent on dry solids contents and amount of material when delivering sewage sludges.