

High-Pressure Slurry Pumping for Catalyst Feeds and Biofuels Research

Application Note

The Application

A growing number of research and pilot-scale processes require pumping slurries — fluids carrying suspended solid particles — at high pressure with precise, continuous flow. Feeding a catalyst slurry into a reactor is a classic example: a suspension of solid catalyst particles in a liquid medium must be metered continuously and accurately into the process. Biofuels research is another, where pyrolysis processes that convert biomass into liquid fuels involve pumping thick, abrasive slurries. The same challenge appears across many pilot-plant and reactor-feed processes that handle particle-laden fluids.

This note is about slurries in the strict sense — solid particles suspended in a carrier fluid. If your additive is fully dissolved or blended into a clear liquid (a homogeneous catalyst solution, for example), it is not a slurry, and a standard VIPR-Series or VP-Series pump will handle it without the modifications described here. The slurry configuration below is for fluids that carry undissolved solids.

Slurries are hard on pumps. The very thing that makes them useful — suspended solids — is also what causes trouble:

- **Solids settle and pack.** Particles tend to accumulate in dead spaces and at the end of a pump's stroke, where they can compact into a plug that the pump cannot clear.
- **Ports and valves clog.** Narrow inlet and outlet passages and conventional valves are natural choke points where solids bridge and block flow.
- **Particles are abrasive.** Hard particles caught between moving parts — a piston and a cylinder wall, for instance — cause wear and can score sealing surfaces.
- **The process still needs precision.** Despite all of the above, the application usually still demands accurate, continuous, pulse-free delivery at pressure — the slurry does not relax the performance requirements.

Why the Vindum Slurry Configuration

We offer a slurry-specific configuration of the VIPR-Series syringe pump, modified throughout the flow path to keep solids moving and to minimize the places where they can settle, pack, or plug. It is the most forgiving setup for pumping particles that we know of.

- **Domed cylinder cap.** The cap at the end of the cylinder is domed rather than flat, so solids are far less likely to build up and compact at the end of the pumping stroke.
- **Adjustable stroke that stops short of full extension.** VPware lets the user set the stroke length and stop the piston before it fully extends. Because full extension is exactly where particles tend to plug, this software control is one of the most effective ways to keep a slurry pump running.
- **Straight-in ports for larger tubing.** The inlet and outlet ports run straight into the cylinder — no tight turns for solids to bridge across — and accept 3/8" OD tubing rather than the 1/4" used on standard VIPR pumps, giving solids more room to pass.

- **Air-actuated 3/8” ball valves.** Full-bore ball valves, pneumatically actuated, replace conventional valves at the ports. Their large, smooth opening is much harder for solids to clog.
- **Continuous, pulse-free flow.** As with other VIPR applications, two slurry-configured pumps are paired and run as a single dual-cylinder system — while one delivers, the other refills — so the pair delivers continuous, pulse-free slurry flow without stopping.
- **Corrosion options when needed.** For corrosive carrier fluids, optional Hastelloy C-276 wetted parts, Hastelloy needle valves, and Hastelloy C-276 tubing are available.
- **Pressure range.** Our slurry setups have been built to date on the 3,500 psi VIPR model, which has covered the demand we have seen. Higher-pressure VIPR models can be configured for slurry service on request.

Will the VIPR Work With Your Slurry?

This is the question customers ask most, and the honest answer is that it depends on the slurry. Whether any pump can handle a given slurry comes down to a few factors:

- **Particle size and concentration.** Larger particles and higher solids loading are harder to keep suspended and moving, and more likely to settle or plug.
- **Density contrast.** The relative density of the particles versus the carrier fluid drives how quickly solids settle out of suspension.
- **Particle hardness.** Hard particles are the most likely to cause wear or scoring if they become trapped between the piston and the cylinder wall.

Because these factors vary so widely, we cannot promise in advance that the pump will handle every slurry — but our slurry configuration is built specifically to be as forgiving as possible across all of them. The best path is to tell us about your slurry, and where helpful, evaluate the pump with your actual fluid.

Recommended Configuration

A typical continuous slurry setup uses a pair of slurry-configured VIPR-Series pumps, each with the domed cap, straight-in 3/8” ports, and air-actuated 3/8” ball valves, controlled by VPware with the stroke length set to stop short of full extension. Vindum pumps cover the roles below.

Need	Recommended Vindum solution
Continuous slurry pumping	A pair of slurry-configured VIPR-Series pumps (two are required for continuous, pulse-free delivery)
Preventing solids buildup at end of stroke	Domed cylinder cap, plus VPware adjustable stroke length that stops the piston short of full extension
Preventing solids plugging at the ports	Straight-in inlet/outlet ports sized for 3/8” OD tubing (vs. 1/4” on standard VIPR pumps)
Valves that won’t clog on solids	Air-actuated 3/8” ball valves
Catalyst slurry feed to a reactor	Slurry-configured VIPR-Series, sized to your flow and pressure
Pyrolysis / biofuel slurries	Slurry-configured VIPR-Series, built to date on the 3,500 psi model

Need	Recommended Vindum solution
Other particle-laden process fluids	Same slurry configuration; feasibility depends on the slurry
Higher-pressure slurry service	Higher-pressure VIPR models can be configured on request
Corrosive carrier fluids	Optional Hastelloy C-276 wetted parts, Hastelloy needle valves, and Hastelloy C-276 tubing

VPware and all of our pump-control software — including Modbus, DDE, a DLL, and a LabVIEW Instrument Driver — are provided free with every pump. The same VPware software controls up to 16 Vindum pumps from a single PC and supports OPC UA and analog/digital control at no extra charge. The pumps communicate over USB and RS232, and the RS232 port can be placed on an Ethernet network using a serial-to-Ethernet converter, so the slurry pumps integrate cleanly into custom and automated process and pilot-plant systems.

In the Field

Vindum slurry-configured VIPR pumps are used to feed catalyst slurries and in biofuels and pyrolysis research, along with other processes that meter particle-laden fluids. Vindum pumps more broadly are in service at national user facilities, major oil and petrochemical companies, catalyst and biofuels researchers, and university labs worldwide — a track record that spans more than three decades.

“... the ability to dose difficult liquid gases up to highly viscous ... feedstocks like bitumen or biomass based feedstocks, pulsation free.” — Dr. Anton Nagy, CEO, ILS – Integrated Lab Solutions. [Read the testimonial](#)

Talk to Us About Your Slurry

Every slurry is different. Tell us about your particles — their size, concentration, density relative to the carrier fluid, and hardness — along with your pressure and flow requirements, and we'll help you determine whether the slurry configuration is a good fit and, where helpful, arrange to evaluate the pump with your actual fluid.

Contact: sales@vindum.com · +1 281-782-8312, ext. 1 · vindum.com/contact-us