FLOWSERVE

Mining and Mineral Processing Pumps

Beneficiation • Hydrometallurgy • Refining



Experience In Motion







Pump Supplier to the World

Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered, and special purpose pumps and systems.

Supplier of Choice to the Mining Industry

The varying and complex methods used to extract and process minerals present the most demanding pump services in the industry. Flowserve has demonstrated application know-how in the industry's toughest services for more than 100 years. Yet, it is also in the forefront of new pumping technologies like those required for deep field bitumen recovery.

Whether pumping abrasive slurries or chemical reagents, the comprehensive range of products and broad industry experience of Flowserve have resulted in an unparalleled leadership position in mining and mineral processing.





Product Brands of Distinction

ACEC™ Centrifugal Pumps

Aldrich™ Pumps

Byron Jackson® Pumps

Calder™ Energy Recovery Devices

Cameron™ Pumps

Durco® Process Pumps

Flowserve® Pumps

IDP® Pumps

INNOMAG™ Sealless Pumps

Lawrence Pumps®

Niigata Worthington™ Pumps

Pacific® Pumps

Pleuger® Pumps

Scienco™ Pumps

Sier-Bath® Rotary Pumps

TKL™ Pumps

United Centrifugal® Pumps

Western Land Roller™ Irrigation Pumps

Wilson-Snyder® Pumps

Worthington® Pumps

Worthington Simpson™ Pumps





Pump Designs

Flowserve offers a wide range of complementary pump types, built to recognized global standards and customer specification. These include:

- Single-stage process
- Between bearing single-stage
- Between bearing multistage
- Vertical
- Submersible motor
- Positive displacement
- Nuclear
- Specialty

Available Configurations

- Sealed and sealless
- Axially and radially split
- Volute and diffuser
- Close coupled and long coupled
- Single and double casing



Committed to the Complete Pump System Life Cycle

For more than two centuries, Flowserve has served industries requiring solutions that add value and reduce costs throughout the life cycle of a pumping system.

- Oil and gas
- Power generation
- Chemical
- Water
- General industry



Flowserve partners with customers to respond to the dynamic business conditions that affect them. Flowserve works with customers to improve efficiency, maximize throughput and control process quality. Whether customer needs involve on-site technical assistance, equipment upgrades or broader project planning with full turnkey responsibility, Flowserve delivers professional, reliable results.



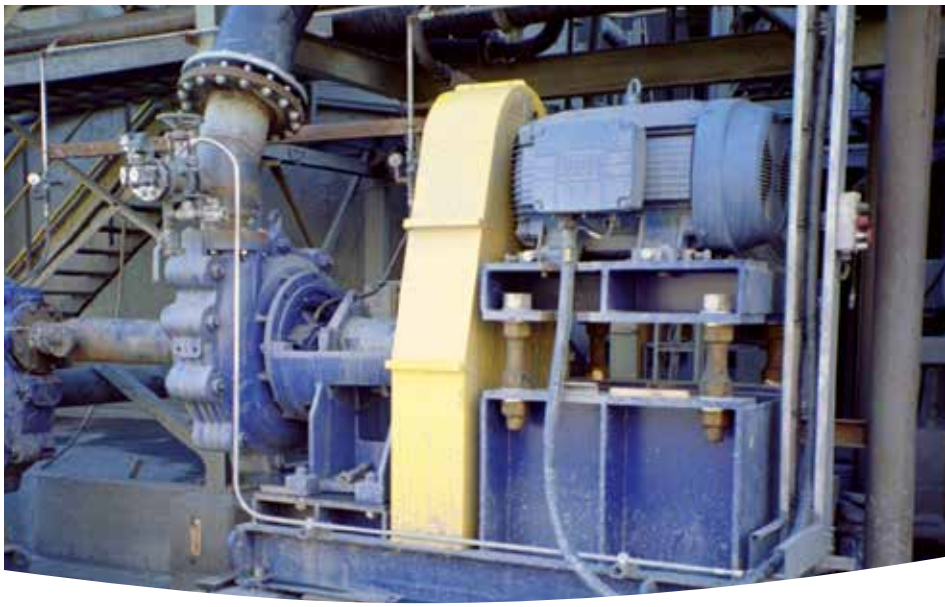
Beneficiation

Grinding, classifying, separating and concentrating minerals require the most abrasive pump applications in all industry. Experience, industry-leading materials and the latest erosion-resistant designs are built into every Flowserve solids handling pump.

From copper and gold to phosphate and bitumen, Flowserve corrosion- and erosion-resistant designs are extending equipment life in metallic and nonmetallic minerals applications around the globe.

GOLD • SILVER • COPPER • NICKEL • ZINC • PHOSPHATES • POTASH • BITUMEN • BAUXITE • CO
MERCURY • CALCIUM SULPHATE • ZIRCONIUM • ALUMINUM • MANGANESE • CHROMIUM • POTASSIUM





Grinding and Classifying

Pumping crushed and ground ore requires extreme abrasion resistance. Successful wear life is sometimes measured in weeks and months. Hard metal and rubber lined slurry pumps provide the necessary toughness and versatility to maximize equipment life in a severe application like cyclone feed.



Separating

Separation techniques vary widely depending on the mined ore. The transfer of mineral slurries through agitation cells and precipitators requires careful consideration of erosion, corrosion and temperature factors. Flowserve pumps can be found at the heart of the most demanding separation processes, including:

- Mineral/flocculant transfer for base metal flotation
- Entrained air handling designs for bitumen flotation
- Submersible designs for solids handling
- High temperature acidic or alkaline liquors
- Heavy media separation

Concentrating

Removing liquid from slurried concentrates and tailings is generally accomplished by thickening or filtration. Hard metal pump designs from Flowserve deliver superior reliability through high efficiency, abrasion-resistant operation.



Hydrometallurgy

Throughout its history, Flowserve has continually demonstrated its dedication to materials science. As a result, Flowserve offers the world's broadest range of alloys, hardened metals and non-metallic materials, ideal for handling aqueous solutions, dissolving agents, and corrosive and erosive slurries found in solvent extraction. Already a leading provider in many traditional applications, Flowserve is poised to lead in new technologies such as microbial leaching through the application of advanced materials and leakproof pump designs.





In Situ, Dump and Heap Leaching

Pumping chemical reagents for in situ, dump, and heap leaching requires high pressures and high flow rates combined with maximum chemical resistance. Flowserve offers the world's most respected line of chemical process and API pumps for handling leaching agents such as hydrochloric acid, sulfuric acid and high alkaline solutions as well as pregnant leachate.

The diverse range of Flowserve products affords users the flexibility to specify large horizontal, multistage horizontal and barge-mounted vertical pumps for leachate collection and transfer applications.



Agitation Leaching



Transferring corrosive underflow between mixing cells frequently requires the flexibility of Flowserve rubber-lined pumps that resist chemical attack and erosive wear.

In addition, Flowserve multistage centrifugal and positive displacement pumps are applied in high temperature agitation leaching applications such as autoclave feed for nickel laterite processing. Hard metal designs are routinely used for red mud waste disposal from bauxite leaching.

Purification

Pregnant leachate, returned raffinate, loaded organics including activated carbon and various solvents are just some of the pump applications in the adsorption and extraction process. Flowserve metallic and non-metallic process pumps provide the design flexibility required for each service.



Refining

Smelting

Removing impurities through smelting requires a variety of auxiliary pump applications. Flowserve offers an extensive range of pump types applicable to a wide range of critical air pollution and power plant services.

- Flue gas desulphurization scrubbers
- Ash handling
- Sulfuric acid recovery
- Boiler feed
- Condensate
- Cooling water

Electrowinning

Mineral-rich electrolyte solutions represent valuable and often dangerous pumping media. Electrolyte transfer is frequently accomplished by using lined or solid non-metallic process pumps. Magnetic drive pumps offer the security of zero leakage.





Special Purpose Pumps

Dewatering

Maintaining dry underground pits and open pit water levels requires a combination of design flexibility and horsepower that only Flowserve offers. Design options include submersible motor pumps, axially split single- and multistage pumps and reciprocating plunger pumps.

Process Water

Mining processes require steady and reliable delivery of fresh and reclaimed water for processing, heating, cooling and more. Flowserve gives users the most flexibility in pump type and size selection, ensuring optimum operating efficiencies.

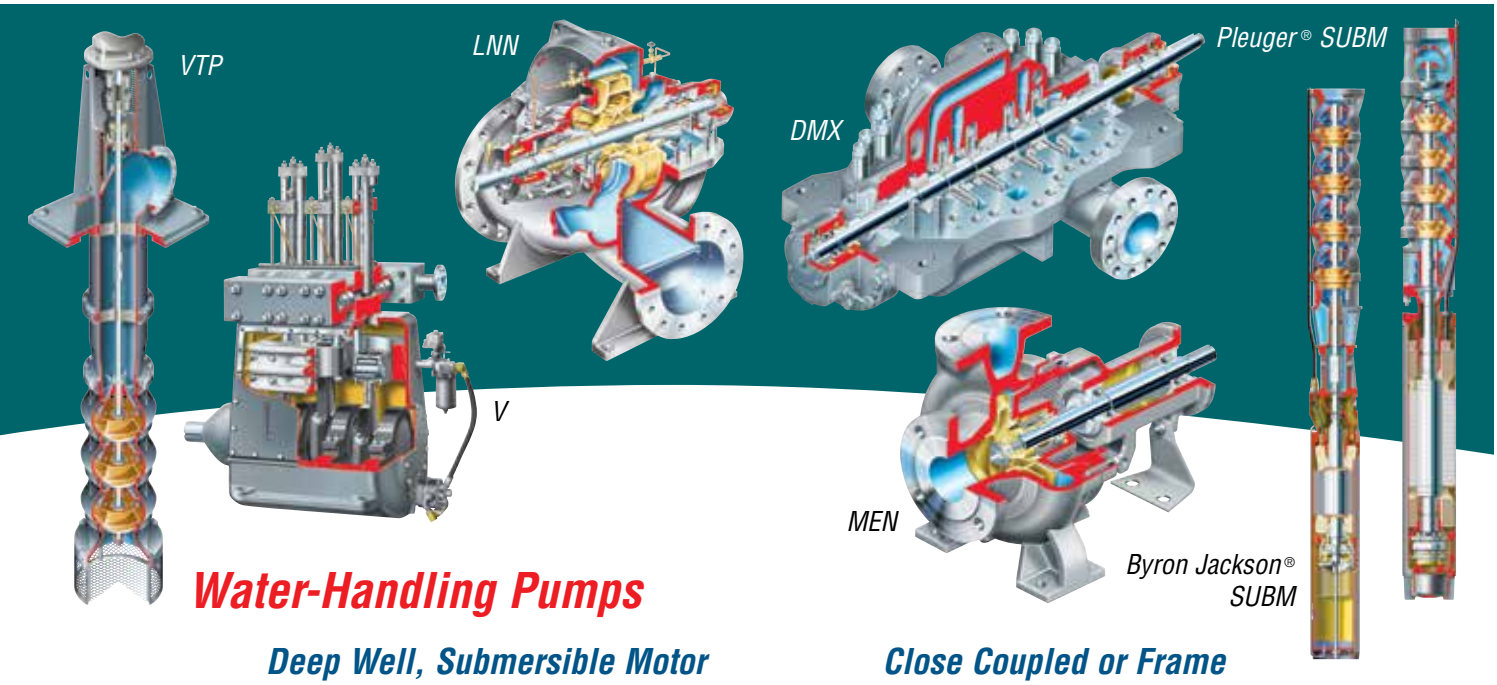
Slurry Pipelines

Flowserve accommodates numerous combinations of media, distance and pressure requirements.

- Hard metal pumps in series for high abrasion, low pressure
- Piston pumps for less abrasion, high pressures
- Plunger pumps for high abrasion, high pressures

The transport of highly abrasive slurries at high pressures can require special technology such as the Flowserve synchronized flush system used in specialty plunger pumps.





Water-Handling Pumps

Deep Well, Submersible Motor

Dewatering, land reclamation and water supply

- Water-cooled and oil-filled motors
- MSHA certification

Operating Parameters

- Flows to 6000 m^3/h (26 415 gpm)
- Heads to 800 m (2625 ft)
- Motor sizes to 5000 kW (6700 hp)

Vertical Turbine Pumps

Multistage, above or below discharge designs for dewatering, reclamation water and water supply

Operating Parameters

- Flows to 13 600 m^3/h (60 000 gpm)
- Heads to 700 m (2300 ft)
- Sizes 150 mm (6 in) to 1375 mm (54 in)
- Settings to 365 m (1200 ft)

Vertical Wet Pit, Double-Suction Pumps

Water reclamation and fresh water supply

Operating Parameters

- Flows to 25 000 m^3/h (110 000 gpm)
- Heads to 500 m (1640 ft)
- Sizes to 1500 mm (60 in)



Close Coupled or Frame Mounted General Service Pumps

Process water supply

Operating Parameters

- Flows to 800 m^3/h (3520 gpm)
- Heads to 140 m (450 ft)

Between Bearing, Single-Stage Pumps

Axially split, double-suction design for fresh and process water supply

Operating Parameters

- Flows to 30 000 m^3/h (132 000 gpm)
- Heads to 300 m (985 ft)

Multistage, Between Bearing Pumps

Ring section and axially split designs for mine dewatering, fresh and process water supply, and well injection

Operating Parameters

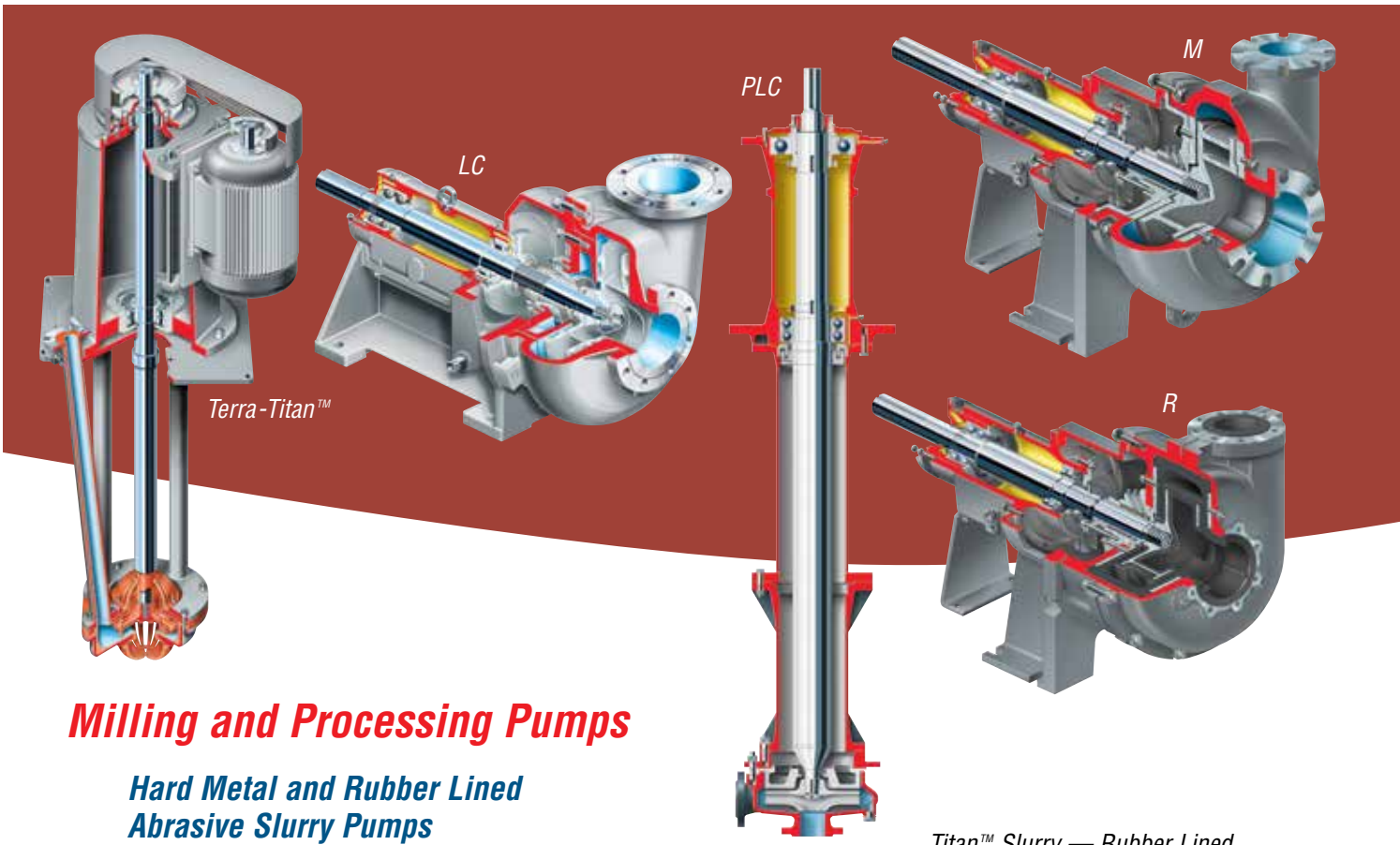
- Flows to 2950 m^3/h (13 000 gpm)
- Heads to 2130 m (7000 ft)

Reciprocating Pumps

Plunger designs for dewatering service

Operating Parameters

- Flows to 1140 m^3/h (5000 gpm)
- Pressures to 2070 bar (30 000 psi)



Milling and Processing Pumps

Hard Metal and Rubber Lined Abrasive Slurry Pumps

Primary cyclone feed, tailings, chemical slurries and abrasives (fine and coarse)

- Special materials and designs specifically for phosphoric acid and alumina processing
- Special impeller designs for entrained air

Operating Parameters

- Flows to 10 000 m^3/h (44 000 gpm)
- Heads to 90 m (300 ft)

Chemical Slurry Pumps

Special materials and alumina processing

Operating Parameters

- Flows to 8000 m^3/h (35 200 gpm)
- Heads to 90 m (300 ft)

Vertical Cantilever Abrasive Slurry Pumps

Rubber or urethane lined and hard metal designs for mineral slurries and flotation pulp transfer

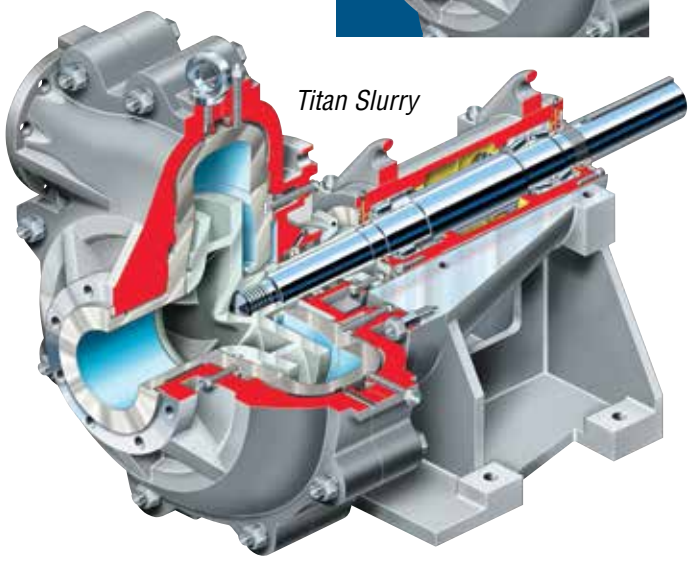
Operating Parameters

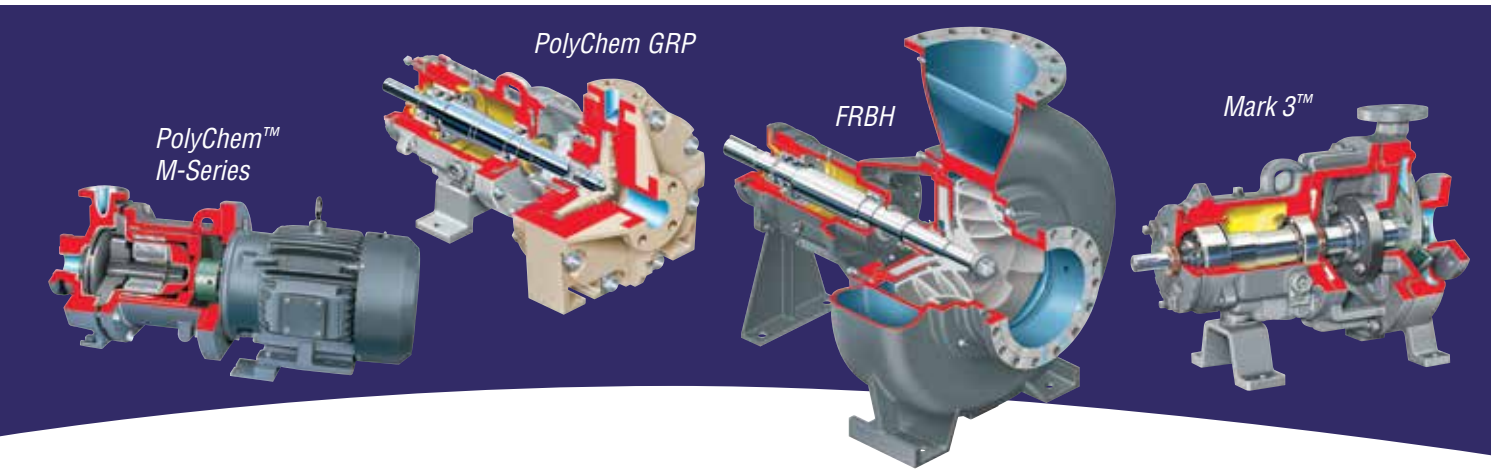
- Flows to 3200 m^3/h (14 000 gpm)
- Heads to 60 m (200 ft)

Titan™ Slurry — Rubber Lined



Titan Slurry





Solvent Extraction and Electrowinning Pumps

Vertical Turbine Pumps

Corrosion-resistant materials for leachate collection

Operating Parameters

- Flows to 13 600 m^3/h (60 000 gpm)
- Heads to 700 m (2300 ft)
- Sizes 150 mm (6 in) to 1375 mm (54 in)
- Settings to 365 m (1200 ft)

ANSI and ISO Chemical Process Pumps

- Horizontal metallic and non-metallic designs for severe corrosive services including leaching acid spray, solvent, raffinate and electrolyte service
- High chrome iron wet ends for abrasive service

Operating Parameters

- Flows to 4540 m^3/h (20 000 gpm)
- Heads to 300 m (985 ft)

Vertical Wet Pit Process Pumps

Versatile, fiber-reinforced polymer and metallic designs for severe corrosive services

Operating Parameters

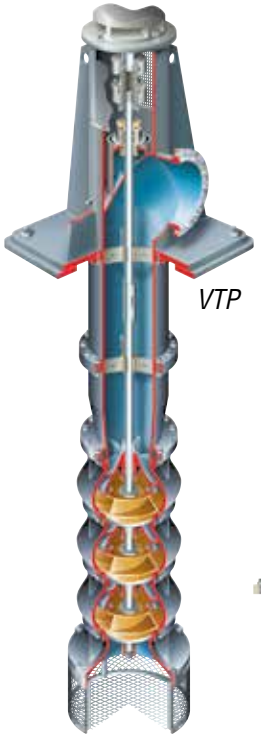
- Flows to 1400 m^3/h (6160 gpm)
- Heads to 250 m (820 ft)

Heavy-Duty Process Pumps

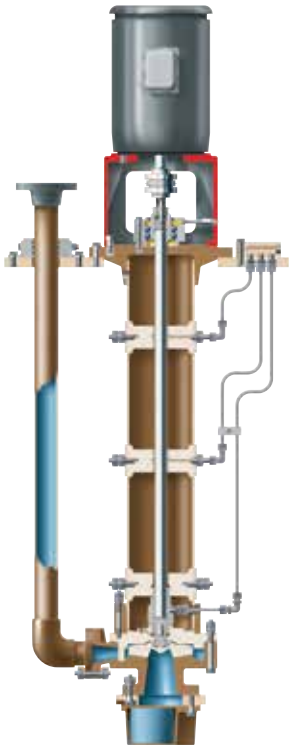
Horizontal and vertical designs for leach application

Operating Parameters

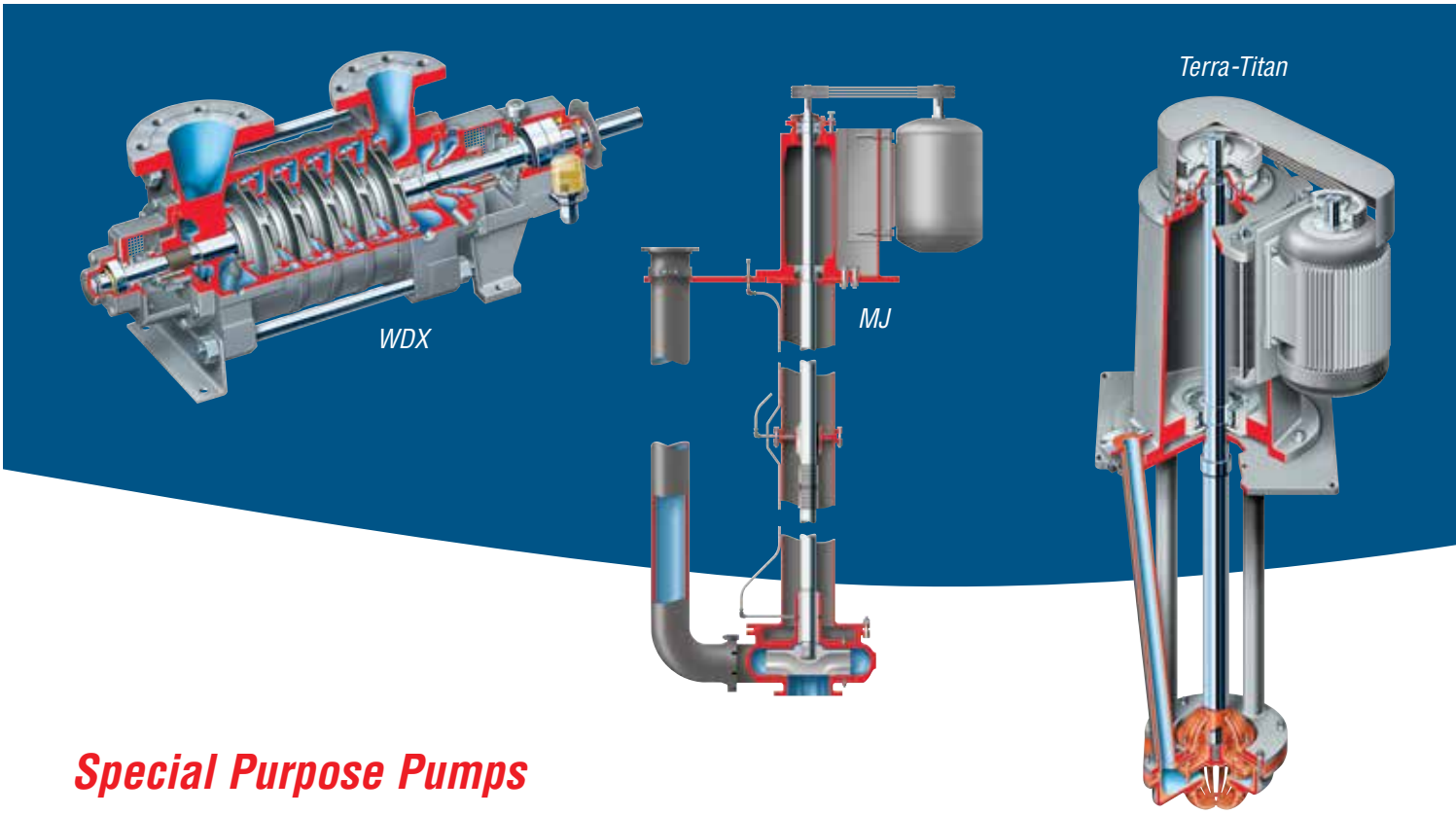
- Flows to 9085 m^3/h (40 000 gpm)
- Heads to 100 m (330 ft)



VTP



PolyChem VGRP



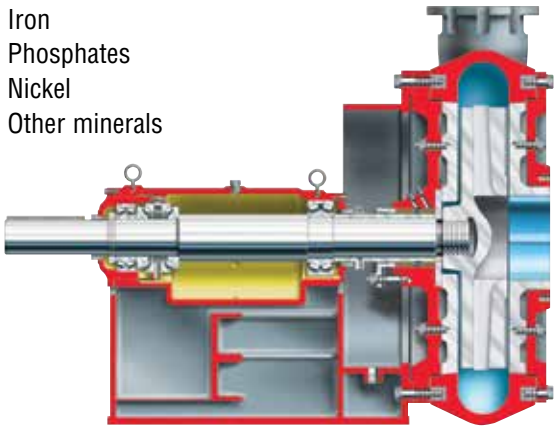
Special Purpose Pumps

Slurry Pipeline

- Hard metal pumps for high abrasion, low working pressure
- Piston pumps for less abrasive mixtures like bauxite and coal at higher pressures
- Plunger pumps for services that are highly abrasive or operating at high working pressures

Applications

- Bitumen
- Coal
- Bauxite
- Copper
- Iron
- Phosphates
- Nickel
- Other minerals



Type M Severe Duty

Power Generation

- Boiler feed water
- Circulating water
- Condensate
- Flue gas desulphurization
- Support services

Runoff, Washdown Sumps

Vertical hard metal, polyurethane and rubber lined designs for abrasive sump services

Operating Parameters

- Flows to 2700 m^3/h (12 000 gpm)
- Heads to 100 m (330 ft)







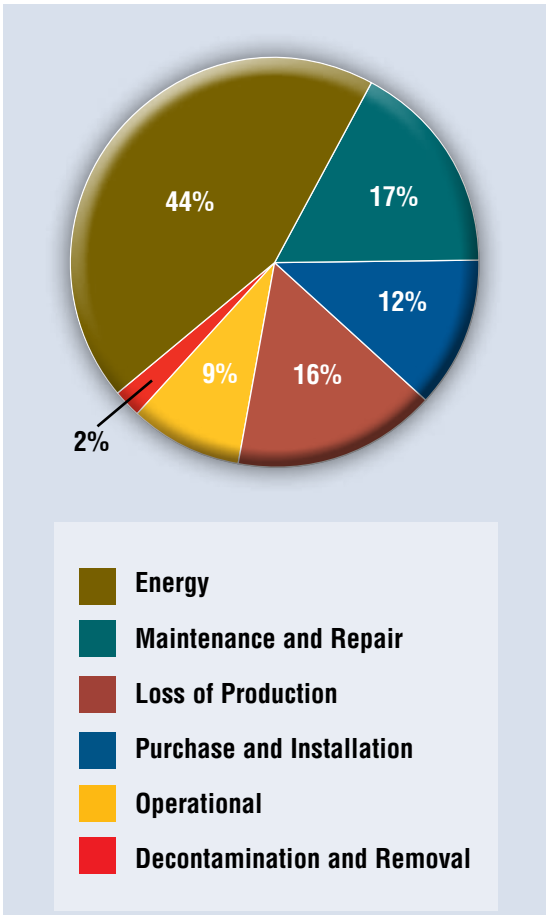
Life Cycle Cost Solutions

Typically, 90% of the total life cycle cost (LCC) of a pumping system is accumulated after the equipment is purchased and installed. Flowserve has developed a comprehensive suite of solutions aimed at providing customers with unprecedented value and cost savings throughout the life span of the pumping system. These solutions account for every facet of life cycle cost, including:

- Capital Expenses
  - Initial purchase
  - Installation
- Operating Expenses
  - Energy consumption
  - Maintenance
  - Production losses
  - Environmental
  - Inventory
  - Operating
  - Removal



Typical Pump Life Cycle Costs[1]



[1] While exact values may differ, these percentages are consistent with those published by leading pump manufacturers and end users, as well as industry associations and government agencies worldwide.







Innovative Life Cycle Cost Programs

New Pump Selection
Flowserve provides front-end consulting services that balance initial procurement cost with longer-term operational concerns including equipment reliability and energy consumption. Proper upfront selection of a high-efficiency, high-energy pump can literally save millions of dollars in operating costs over the life of the system.

Turnkey Engineering and Field Service
Flowserve offers turnkey engineering capabilities to streamline capital expenses related to piping design, foundation engineering, electrical systems and instrumentation. Flowserve technicians can offer installation and commissioning solutions that significantly reduce installation time such as advanced laser alignment and ungrouted foundation solutions.

Energy Management
Pumping systems can comprise between 20% and 50% of energy usage in typical industrial plants and as much as 95% in pipeline systems. On behalf of its customers, Flowserve actively pursues hydraulic re-rates, pump upgrades, and system enhancements that offer energy savings between 30% and 50% of existing levels. A typical improvement program may involve field assessments, analytical modeling and investment recommendations.

Pump Availability
Flowserve engineers and technicians have been specially trained to help customers analyze, diagnose, and solve those issues that cause problematic pump breakdowns and unscheduled outages. Engineers are equipped to collect real-time data, review performance problems, analyze data, and make recommendations that result in improved pump system availability and higher profits.

Proactive Maintenance
Flowserve technicians are trained to provide services that go beyond simple reactive maintenance and repair. By analyzing failure modes, Flowserve can offer upgrades ranging from materials and coatings upgrades to hydraulic re-rates – all aimed at increasing pump reliability.

Inventory Management
Programs that help standardize materials, maximize interchangeability, and increase part and assembly availability can have a significant impact on costs associated with spare parts inventory. Asset management experts from Flowserve can offer customized programs that reduce inventory levels while ensuring availability of critical parts.



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