HPGR - High Pressure Grinding Roll for the minerals industry
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Global Installations

- Canada 2
- China 6
- Columbia 1
- Denmark 2
- India 9
- Indonesia 10
- Korea 6
- Malaysia 1
- Mexico 1
- Saudi Arabia 3
- Thailand 7
- Turkey 2
- United Kingdom 1
- USA 2

HPGR equipment is a modern energy-efficient comminution technology. During its relatively short mineral application history, HPGR technology has undergone significant development in machine roll wear surfaces & control philosophy.

FLSmidth is a worldwide supplier of HPGRs. HPGR technology has been used in the cement industry for many years. Over the past few years with technological improvements HPGR has also proven itself on more complex and harder ores.

The F-series HPGR, developed by FLSmidth, now incorporates a new Express Frame with Split Rail technology. This improvement to the frame and bearing housing design offers the miner an opportunity to greatly shorten machine roller module change-out time. This reduction in steel content has also helped to reduce the footprint. The design facilitates quick safe roll replacement.

How it works and benefits

In high-pressure grinding roller comminution the feed material is exposed to very high pressure for a short time. The high pressure causes the formation of micro-cracks and boundary weakening in the feed particles and thus generates a substantial amount of fine material. The pressed fine material product from the HPGR can be fed directly to a ball mill. As a significant amount of work has been effected before the ball mill, this makes it possible to increase the throughput of the ball mill and in most cases significantly reduce the specific power consumption of the total milling system.

HPGR - High Pressure Grinding Roll for the minerals industry
If HPGRs are operated correctly, ball mills can be downsized and use smaller grinding media, which substantially reduces steel ball consumption, increases the grinding efficiency and lowers operating costs of the milling substantially. The use of HPGR technology also promotes micro fracturing, which can expose minerals encased or locked within a particular ore. This has positive downstream benefits by improving leach rates and this is particularly evident for heap leach circuits.

**A flexible solution**
The HPGR is a flexible solution, highly suitable both for Brownfield expansions and for new or Greenfield installations and the wide variation available in flowsheets using HPGR indicates the high flexibility of the technology. HPGR technology delivers a wide range of unit capacity, and gives the operator maximum plant flow flexibility. A further measure of HPGR flexibility is its ability to run using a range of specific grinding pressures. Press force and power draw can be changed to optimize process parameters. This allows for consistent grinding performance, even as the ore in the pit changes.

**Simple operation**
Since press force and speed are the only parameters required for the operation of an HPGR, the process can easily be controlled. Operation training is easy and ramping up of the unit to full production takes only days. Changes in ore characteristics can easily be accounted for.
The FLSmidth Express Frame

Express Frame
The frame is a fabricated and machined steel welded assembly consisting of upper and lower sections with a pinned gable end section. This gable end is a solid casting. The use of pins allows a frame which is simple to erect and requires a minimum of lay down space for removing the roller assemblies. This Express Frame also incorporates a split-rail technology, in which the bearing notch slides in between two rails.

FLSmidth’s Express Frame is designed and built for the rapid replacement of mineral application roll surfaces.

The new design offers a new taper pinning frame design. Removal of the tapered bushing creates more clearance space for inserting and removing pins. The bearing housings have also been reduced in size and configuration as a result of the frame redesign. This design utilizes a wedge jacking system to take the load of the shaft and bearing housing for quick pin extraction and replacement. This results in using fewer raw materials and reduced weight in shipping and transport. The reduction in frame steel thickness makes it possible to use more project specific local suppliers. This affords clients the opportunity to streamline their procurement by increasing local content and reducing the need to ship large parts over great distances. The reduced shipping costs together with the minimization of any importation tax, also provides a cost benefit to the project.
Features and main components

**Roller assemblies**
Roller Assemblies comprise the finished roller tire with studs, edge protection and shaft. The roll shafts are fabricated from forged, heat treated alloy steel with integral journals. The journals have tapered withdrawal sleeves to accommodate the installation of the tapered bore bearings and include the necessary features for hydraulic removal of bearings.

The roller sleeve surface is provided with tungsten carbide inserts for wear protection. Edges of the roll also incorporate tungsten carbide sections to improve the protection of that portion of the roll.

**Roller modules**
Roller modules comprise the finished tire, shaft, bearings, and bearing housings all as a single unit assembly. The Express Frame F-series HPGR utilizes the fixed roller module as the fixed end of the frame. This fixed roller module has the frame pin holes incorporated directly into the bearing housing casting.

**Bearings and bearing housings**
Self-aligning spherical roller bearings are mounted on the roller shafts. Both bearings of each shaft are axially fixed within their respective housings. These housings are designed to be able to flex and allow for a decrease in the peak roller loads in the bearing as compared to a less flexible or rigid bearing. This leads to a significantly improved bearing life. The frame parts are furnished with low friction slideways to allow the bearing housings of the movable roller the freedom to easily slide during operation of the press. No lubrication of these slideways is required. The bearing housings are furnished with grease purged seals to prevent dust from entering the bearing housing. Oil containment is provided by double lip type shaft seals and housing bellows. The bearings are lubricated by a circulating oil system which filters and cools the oil.
Features and main components (cont.)

Inlet and cheek plates
The inlet is a heavy fabricated steel welded assembly with a flanged connection for the feed chute. The walls of the inlet are lined with easily replaceable wear-resistant plates. Adjustable cheek plate holders attach to the sides of the inlet and are accessed for maintenance through removable cover plates in the flanged connection of the chute. Replaceable cheek plate liners made of wear-resistant material are attached to the cheek plate holder in high wear zones.

Dust guard
The dust guard is integrated with the inlet and discharge openings and encloses the remaining portion of the rolls. The openings at the roll necks are enclosed by labyrinth type seals. Inspection doors are provided in the cover for access to the rolls. Vent air is required for de-dusting the housing.

Drives
Each of the two rolls is powered by an electric motor and planetary gearbox. The gearboxes are mounted on extensions of the roll shafts. The input shafts of the speed reducers are connected to the motors with universal joint drive shafts and each drive train incorporates a manually engaged torque limiter to guard against overload.

The speed reducers have heavy duty planetary bearings and heat exchangers to cool the oil and a temperature transmitter to warn of high oil temperature.

Edge diverter
The edge diverting discharge gate incorporates a manually adjustable HPGR discharge diverter capable of 5% adjustment increments to allow up to 40% edge diversion per side.

Feed control gate
To facilitate control of the “choke feed” press, FLSmidth has introduced a motorized feed control gate located just above the roller surface. The feed control gate is only required for choke feed. The gate is used for smoothing the feed start and is suitable for fine tuning of HPGR to optimize operation. It is also used for adjusting the throughput or power consumption of presses working with feed material of varying draw-in characteristics and/or friction characteristics.

Local machine control
The HPGR has its own local control panel (PLC). The panel is connected to the central control system.

The control panel includes a display that indicates status of the machine and has facilities for starting and stopping, making parameter changes, etc. The local control panel is delivered ready to use, thus saving engineering time during installation.

Edge diverter
Lubrication system
Roll shaft bearings are lubricated by a circulating oil pump set complete with sump tank, filters, oil / air heat exchanger, heating facilities, flow divider and high temperature transmitter. The system supplies a copious amount of filtered and cooled oil to the bearings to flush away contaminants and carry away heat generated by bearing friction and the heat generated during normal operation. This, along with an improved sealing arrangement for the bearings, provides long service life for the bearings. The heating facility provides for conditioning of the oil prior to a cold start, which also increases component life.

Hydraulic power unit
The press is equipped with a bilateral hydraulic pressing system, which ensures that the pressing force is largely uniform during the crushing process. In addition, the system serves to protect the press against localized overloading and stress. The system contains a skew control feature for limiting the grinding gap differential. Components for pressurizing the cylinders are integrally mounted and pre-piped on a common base consisting of a pump (with standby pump), filter, safety and control valves, pressure transmitter, and reservoir. Four double-acting hydraulic cylinders, mounted in pairs and rated for 200 bar (2900 psi) working pressure, are utilized.

Advanced skew control
The FLSmidth HPGR press incorporates roller skew control via the hydraulic power unit. This system keeps the two roller assemblies as near-parallel as possible during operation, thus reducing grinding pressure deviation across the roller width which in turn increases the consistency of the grinding process and product.

Minimization of damage by tramp
The FLSmidth HPGR includes a new-to-the-industry (patent-pending) hydraulic system, capable of accommodating large shocks. This system helps protect the critical roller surface from incidents such as tramp metal bypassing upstream metal detection and removal. The FLSmidth system utilizes a specially configured hydraulic accumulator which quickly activates without incurring the potentially catastrophic delay caused by a PLC needing to shift hydraulic valves.

Elimination of water cooling system
As the machine is equipped with oil lubrication, the requirement for water cooling is omitted/eliminated.

### Product range

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Area</th>
<th>Diam (m)</th>
<th>Width (m)</th>
<th>Tonnages (tph)</th>
<th>Feed particle top size (mm)</th>
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<tr>
<td>F360</td>
<td>0.36m²</td>
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<td>100-150</td>
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<td>2.17</td>
<td>3150-5850</td>
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</tr>
</tbody>
</table>
FLSmidth® F150 HPGR laboratory test unit

**FLSmidth F150 HPGR Laboratory Test Unit**

**F150 HPGR laboratory test unit machine specifications:**
- 500mm Roll Diameter
- 300mm Roll Width
- (2) 45 kW Motors
- Hydraulic drum dumper loads ore in the machine
- Adjustable diverter cuts edge from center product
- Discharge chute maintains separate edge and center product
- Conveyor moves product directly to rotary splitters for sampling

Micro-cracking in HPGR product

HPGR product

HPGR flake
Minerals testing

Mineralogy
- Quantitative XRD Rietveld mineralogy
- SEM and optical microscopy
- Automated mineral analysis
- NIR data base development
- Fourier transform – NIR
- Clay analysis

Comminution
- Bond crushing work & abrasion index
- Unconfined compressive strength (UCS)
- High pressure grinding rolls & abrasion
- JK Drop-Weight & Starkey SAG
- Bond work index ball & rod

HPGR testing
- HPGR specific throughput
- Specific energy demand
- Specific grinding force
- Feed and product PSD
- Variable roll speed
- Variable operating pressures (6000 kn/m² max)
- One drum of ore per hpgr test condition
- Acceptable top-size = minus 25mm

Metallurgy
- Gravity concentration
- Magnetic separation
- Flotation separation
- Hydrometallurgy
- Agitation cyanide leaching
- Column leach

Liquid/solid separation
- Flocculant screening, flux testing & settling
- Pressure filtration
- Vacuum filtration
- MaxR™ solids contact technology

Unit operations tests
- Pilot-scale HPGR & SAG mill
- Small-scale flotation cells
- High-rate & paste thickeners
- Filter press & automatic filter press
- Vacuum disc, drum, & belt filters
- Pilot granular media filter

Analytical
- Atomic absorption Spectroscopy
- Inductively coupled plasma – OES & MS
- Laser ablation for MS
- LECO carbon & sulfur analysis
- Fire assay
- Particle size analysis
- Rheology / solids density
- Dean stark analysis
Customer services

FLSmitdh is your One Source for spare parts, service, maintenance, asset management, and operational services. Our Customer Services provide a wide range of services for mineral processing equipment and systems including raw material testing, process design, equipment installation, troubleshooting, process and mechanical analysis, and commissioning of new plants. Customers are our most important assets. Once we have designed and installed your processing systems, we do everything possible to provide the tools to ensure that those systems continue to operate at optimum levels, all the time. FLSmitdh is the only place to find field engineers and technicians trained specifically to deal with the unique characteristics of this equipment. It is by no means a radical concept. Indeed, everyone promises it; we deliver it!

Operations and maintenance
Our Customer Services experts have the know-how to optimize your maintenance and shutdown management programs. We can help plan your preventive maintenance programs, manage scheduled repairs, and even implement these programs for you.

Rebuilds and modernizations
Keep your equipment current with the latest advancements to enhance your operations and provide for better efficiencies. FLSmitdh can rebuild your equipment or provide the most current state-of-the-art equipment improvements and/or system upgrades for operational efficiency and enhanced functionality.

Quality and reliable OEM parts
Contact our trained service personnel to get authentic, high quality, original equipment manufacturer (OEM) spare and replacement parts for your equipment.
HPGR chain of support

- Equipment island or complete flowsheet supply
- HPGR design and suitability test facility
- Complete ore characterization and mineralogy laboratory
- From comminution to leach and flotation HPGR evaluation
- On-site pilot HPGR and support personnel
- Experienced technical and R&D resources for continuous development
- Global service Supercenters
- Global after-sales support
- Full operation and maintenance support
- Flexibility of roll design per ore
- Seasoned, published HPGR professionals
- Purpose designed HPGR for mineral applications