Quality in sample preparation

for the mining industry

HERZOG

Content

HERZOG
System Experience

"Made by HERZOG": Ever since HERZOG was founded, our customers all over the world have been placing their confidence in intelligent solutions and the quality of our first-class products. As a leading supplier of laboratory systems, we develop innovative future-orientated machines for the world market.

We see ourselves as a partner of the international primary industry, offering our customers consulting and engineering from a single source with everything from the supply of high quality machines to full laboratory automation.

Satisfied customers and outstanding products are to a great extent the achievement of our motivated and highly qualified employees. As a family business with tradition, we feel a very special commitment to our employees as well as to our customers. Social responsibility and sustainability are by no means mere theoretical terms for HERZOG – they are part of the dynamic entrepreneurship which we practice every day.

HERZOGMining

HERZOG offers complete solutions from the idea to the system implementation. Our concepts extend from manual stand-alone solutions and linear systems to robot-controlled automation.

Innovative power, flexibility and quality are distinguishing features of our international business. HERZOG not only manifests competence and many years of experience in the planning and implementation of laboratory systems for optimum control of production processes. But in the development of our innovative products, we also respond to the requirements of the world market and orient ourselves according to the technologies of the future. Customer proximity is an integral part of our company policy. Therefore, HERZOG has branches in USA, Japan and China as well as representatives all over the world.

Thus HERZOG systems meet the needs of tomorrow's market.

Constantly changing requirements keep HERZOG dynamic and flexible. This flexibility is constantly applied in the close cooperation we practice with our customers. Together, we develop solutions which are specially tailored to their individual requirements. Our customers can always rely on a fast and dependable service.

Furthermore, a stringent quality policy according to ISO 9001 is a natural matter of course for HERZOG. This enables us to provide high quality machines with a long service life and which comply perfectly with our customers' requirements.
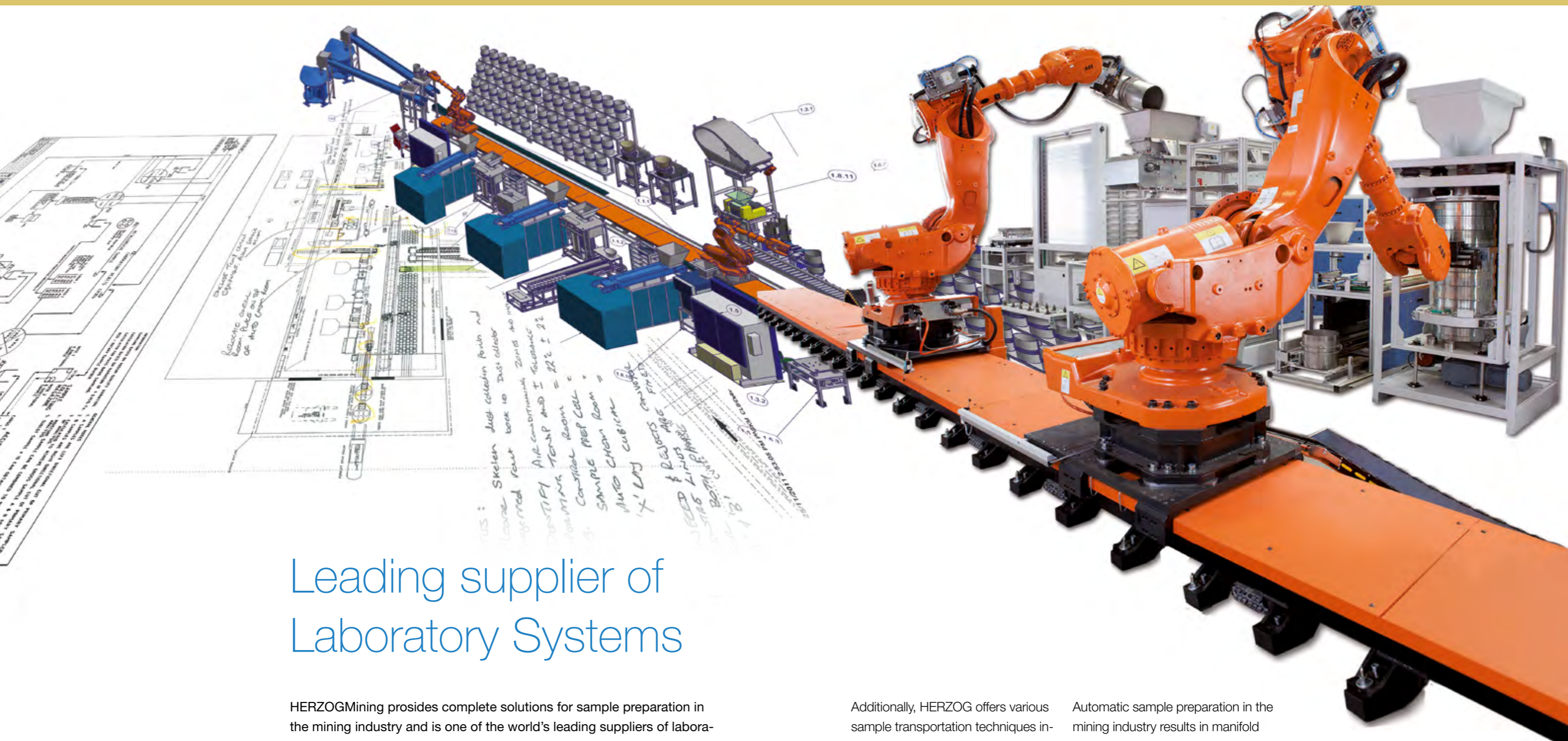
Leading supplier of Laboratory Systems

HERZOGMining prosides complete solutions for sample preparation in the mining industry and is one of the world's leading suppliers of laboratory systems for the iron ore, gold, copper and phosphate industry.

HERZOG systems are optimized for the control of all production steps in the mining industry and are used for the analysis of geological, concentration and flotation samples. HERZOG systems are scalable according to the customer's requirements and are implemented as manual on-site laboratories, fully-automatic central laboratories or port laboratories.

Our equipment is suited to fulfill the customer's requirements for safe, easy and fast sample preparation to achieve reliable and reproducible analyzing results. Our laboratories cover all important laboratory preparation steps including, XRF-analysis, moisture measurement, grain sizing, and wet chemical analysis.

Additionally, HERZOG offers various sample transportation techniques including air tube systems for powder and granule or receiving stations for slurry material. We are in the position to provide our customers with complete solutions including sample cutters and dividers. HERZOG offers full integration of every analyzer type or model no matter whether for online or offline analysis or which analyzing method is required for the material.

Automatic sample preparation in the mining industry results in manifold benefits for mining companies:

Advantages of laboratory automation
- Improved safety with lowered exposure to dust and noise and lowered manual handling risks
- Reduction in sample mix up
- Reduction in cross contamination
- Improvement in sample reproducibility
- Uniformity of sample preparation and analysis methodology
- Reduced occupational exposures to the operator
- Shortened sample turnaround time
- Reduced costs

Minimizing cross contamination

It is well known that poor sample preparation is, next to poor sampling, the largest source of bias in an exploration or resource evaluation project. Sample preparation methods should therefore be selected as carefully as the actual analytical methods.

One crucial item in sample preparation is minimizing of cross-contamination between subsequent samples. This is particularly important for low-concentration ores and material with widely varying concentrates.

HERZOG has integrated highly efficient cleaning mechanisms in its machines to avoid cross contamination.
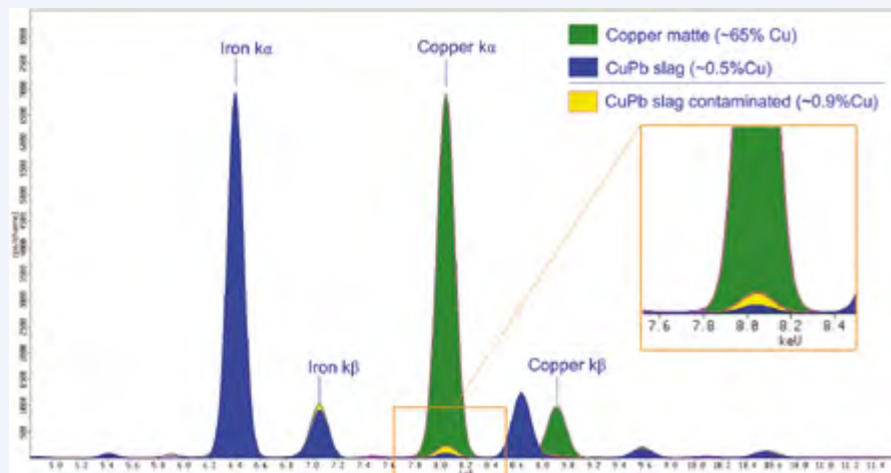
According to the material, the requirements of the customers and the machine design various cleaning methods can be applied including compressed air, sand cleaning, water cleaning or use of blank samples.

Here we show the capability for processing samples with widely

varying grades of copper on a single grinding machine (HP-MA). For the assessment of cross contamination we used high grade copper mate (65% Cu) and slag with a copper content <0.5%. Between grinding of the copper mate and the slag we interposed a sand cleaning process. Sand interposed cleaning effectively avoided cross-contamination of this very sticky material.
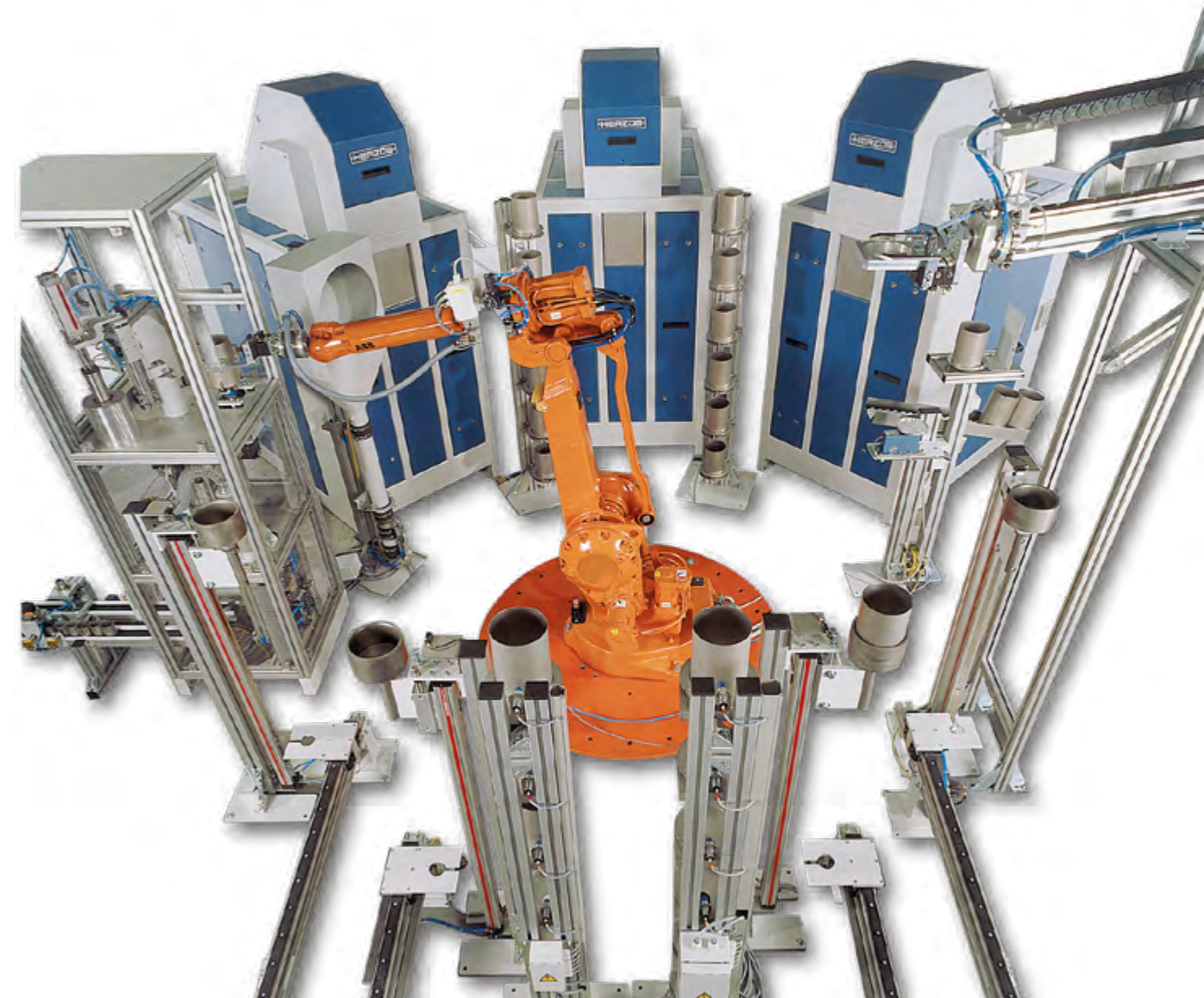
HERZOG is looking back on long-standing and worldwide activities in the mining industry. In recent decades we have successfully installed numerous large and smaller automations. We are proud to be the partner of the leading mining and engineering companies. This cooperation helps us to constantly improve our technology for better fulfillment of our customers' needs.
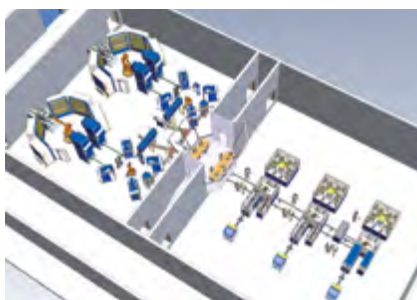
HERZOG has delivered some of the most innovative and extensive laboratory systems worldwide such as:
- The largest automation project in the world to Anglo Platinum (South Africa)
- The largest robotic sample preparation in the world for copper to Freeport-McMoRan (USA)
- The largest fully automated iron ore laboratory in the world to BHP Billiton (Australia)

HERZOG has recourse to large expertise in the mining industry. Our experienced team is composed of mechanical and software engineers as well as geologists and chemists. Furthermore, HERZOG has a close strategic cooperation with IMP, a company with longstanding experience and expertise in the mining industry and operations in Australia, South Africa, Canada, USA and Brazil. Since 20 years Herzog and IMP have successfully managed more than 100 large-scale mining projects.

EDX spectra showing the Cu - peak intensity of the copper matte (green) and the CuPb slag (blue) milled in the same grinding vessel with interposed sand cleaning (test with 30g). The contaminated CuPb slag (yellow) was milled directly after a copper matte sample without sand cleaning. Additionally labeled are the iron peaks.

Cleaning sand	CuPb slag (Cu %)
30 g	0.34 %
50 g	0.35 %
70 g	0.44 %

Results of the contamination test, to check the ability of the HP-MA with sand cleaning for copper samples.
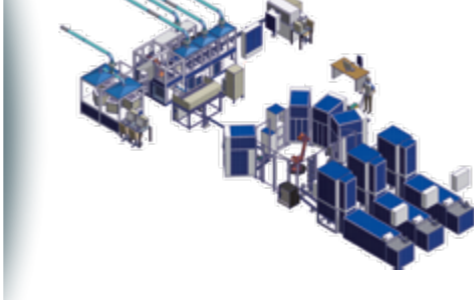
Examples of HERZOG automation for the mining industry

BHP Billiton
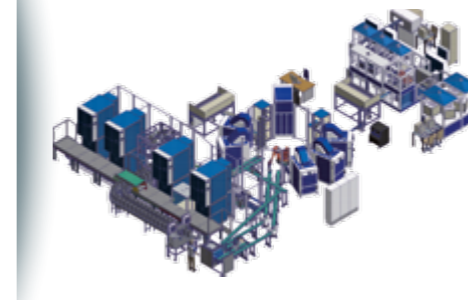Automatic laboratory for iron ore
(Newman Mine, Australia)

BHP Billiton
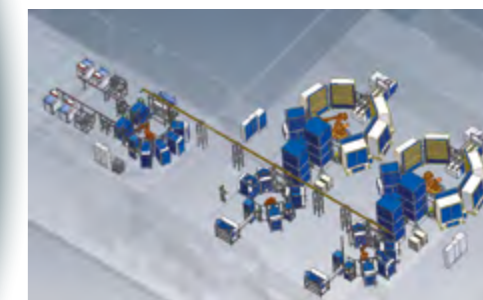Automatic iron ore fusion system HAG-6-HF
(Australia)

Fortescue Metal Group
Automatic laboratory system for iron ore
(Solomon Hub, Australia)

Assmang
Automatic laboratory for iron ore
(Khumani Mine, South Africa)

Minanalytical Laboratory Services
Automatic laboratory system for iron ore
(Australia)

Freeport McMoRan
Automatic laboratory for copper ore and concen-
trate samples (Arizona, USA)

Sample preparation of Iron ore Material

Sample preparation of iron ore material involves drying, crushing, splitting, pulverizing, pelletizing or fusion. Each sample is a representative subsample of the original ore stream. Therefore, reasonable care has to be taken during splitting and processing. HERZOG iron ore laboratories are configured according to customers' requirements and specification- either as a compact automation or an extensive installation designed for high-throughput. HERZOG is vendor of some of the largest iron ore producers in the word including BHP, Rio Tinto, FMG and LKAB.

Sample preparation of Copper ore material

HERZOG is providing systems for assessment of geological and technological copper samples. The automations are configurable according to the specifications of the customer and consist of input stations, drying cabinets, crushing/splitting machines, pulverizers, pelletizers and fusions machines.

Furthermore, HERZOG has delivered equipment for quantitative mineralogical analyses on blast holes, geological samples and specialty material. The copper ore material is pulverized and pelletized using special machines designed for XRD and NIR analysis.

We are proud to be the supplier of some of the largest copper producers in the word including Freeport-McMoRan, KGHM and Aurubis.

Sample preparation of Gold and other precious metals

HERZOG has delivered a number of automations for processing of gold ore including systems for fire assay around the world. HERZOG systems incorporate machines for crushing, splitting and pulverizing of ore material. IMP has patented its fully automated FIFA system for fire assay which has been engineered together with HERZOG. The major benefits include a massive reduction in lead oxide, large reduction in exposure of operators to noise, dust, heat and fumes. This is coupled with an increase in quality and productivity.
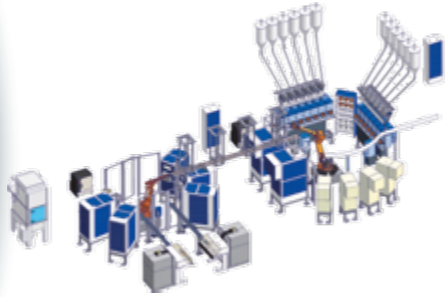
We are proud of having delivered systems to Xstrata, Newmont, Accurassay, Kalassay and other important mining companies.
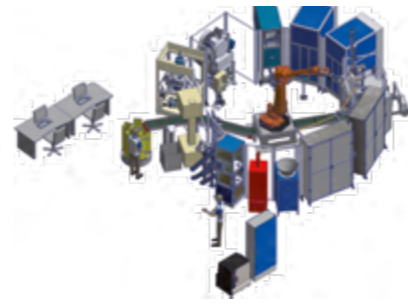
Examples of HERZOG automation for the mining industry

KGHM Polska Miedž S.A.
Automatic laboratory for geological and concentrate copper samples (Polkowice, Poland)
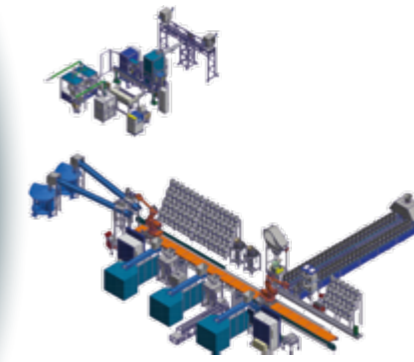

PhosAgro
Automatic laboratory system for slurry phosphate samples (Murmasnk, Russia)

Mitsubishi Materials
Automatic laboratory system for recycling of electrical scrap (Naoshima, Japan)

Fortescue Metal Group
Port laboratory for shipping of iron ore (Port Hedland, Australia)

Rio Tinto
Port laboratory for shipping of iron material (Cape Lambert, Australia)

Roy Hill Holdings Pty Ltd.
Port laboratory for quality control and shipping of iron material (Roy Hill deposit and Port Hedland, Australia)

Sample preparation of Slurry Material

HERZOG has developed special technologies for the sample preparation of different types of slurry material. After transportation of the slurry sample from the, flotation into the laboratory the material is dewatered by using the HERZOG drying system. In the filter dryers the water is pressed out by means of compressed air. A multifilamentic fabric that is especially adapted to the material properties of the sludge is used as filter textile. This system also makes use of self-reinforcing filter effects supporting the filtering of small particles and detachment of the filter cake.

The filter presses are available for manual or automatic operation.

Residual moisture is evaporated during controlled drying either in microwave systems or air circulation ovens. After drying the sample can be further processed by, pulverizing, pressing, grain sizing etc.

Port laboratories

HERZOG in cooperation with IMP is offering fully automated facilities for ship loading certification. Our systems are designed for splitting, sizing, moisture determination, crushing, milling and chemical analysis.

Sample aliquots are taken by a primary cutter which delivers a fixed sample mass to the robot laboratory. Within the laboratory the samples are processed through various stages of accumulation, splitting, crushing, pulverizing to achieve representative samples for the chemical analysis of the loaded product. At the same time, moisture content and particle size distribution are determined. The complete process is fully automated with a minimum time requirement to allow quickest possible analysis reporting.

Various designs are available according to the procedural and architectonic demands of our customers.

Exemplary configurations are one or two robot circuits or linear robot cells with one or two robots moving on a track.

HERZOG has delivered port lab systems to leading mining companies including Fortescue Metals, Anglo American and Rio Tinto.

PREPMASTER

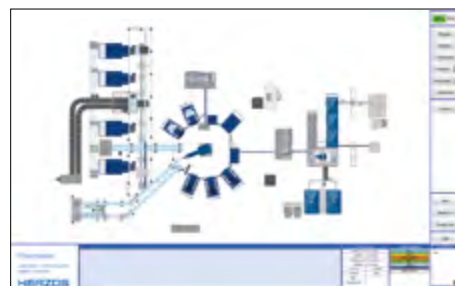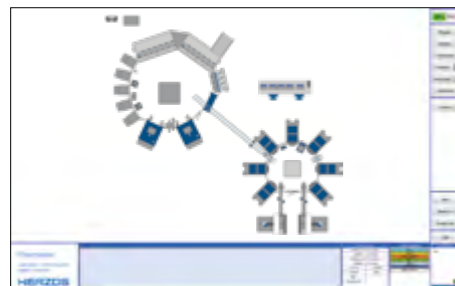# RESULTMASTER

TCP

IMPORT:
+ Database (SQL)
+ Webservices
+ TCP telegram
+ Customer database/Excel/Access
+ Customer-defined interface

EXPORT:
BULK EXPORT:
+ Database-interface (SQL)
+ Webservices
+ TCP telegram
+ Customer database/Excel/Access/other programs
+ Email
CONDITIONAL EXPORT:
+ Export of data/ information according to user-defined rules
• Alarm / signal notification on GUI

GRAFICAL USER INTERFACE (GUI)
+ Configuration
+ Status / information display

+ Analysis storage
+ Customer-specific data storage
+ Automatic backup
+ Replication server (optional)

+ Data merging of analysis results
+ Transfer logging

TCP

LOCAL

INTRANET

INTERNET

TCP

TCP

TCP

TCP

TCP

CUSTOMER EXTENSIONS ILS APPLICATIONS

LIMS WEB APPLICATION (BROWSER)

SAMPLE INFORMATION SYSTEM CONFIGURATION

BACKGROUND PROCESS

DATABASE (SQL SERVER OR CUSTOM DB)

SERVER (WEBSERVER ILS)

PREPMASTER
Examples

Our software solution, consisting of Prepmaster and Resultmaster, is a high caliber process visualization system for the uncomplicated and intelligent monitoring of our sample preparation and analysis procedure. Prepmaster and Resultmaster combine complete functional standards with a user-friendly surface. They offer optimal project development, scalability and adaptability to the special requirements of each customer. Prepmaster and Resultmaster are optimally tailored to the HERZOG equipment but also allow complete integration of other system components.

Our Prepmaster is designed to guarantee top functional standards, user-friendly and graphic interface, scalability and openness interfacing with all PLC and spectrometer systems. Prepmaster meets the requirements of the steel industry for an automatic and speedy sample preparation.

Some of the distinguished features of Prepmaster are:
• **Adaptive and priority-controlled sample administration** for quickest possible and smooth preparation of samples. The intelligent system manages high numbers and peak loads of samples without problems. Priority samples are given preference to receive important analysis results as quick as possible.
• **Sophisticated and flexible alarm systems:** The system immediately alarms if analysis results are out of the normal range. It takes appropriate measures like re-running the analysis or the sample preparation process.
• **Web-based design:** Web interface within Prepmaster allows the display of Prepmaster information on different web clients. This program architecture turns Prepmaster into a flexible system with multi-user capability.
• **Remote control:** The remote control function of Prepmaster provides the base for an easy remote maintenance of the system and therefore fast and uncomplicated servicing.
• **Redundancy through backup-systems:** In the unlikely case of failure, Prepmaster backup options guarantee the frictionless and continuous operation of the system. We offer a server-based virtualized system providing a fully executable standby system in case of need.

Resultmaster is a separate IT system for storage, visualization and analysis of information of the sample analysis process. The system allows a quick and target-oriented control and modification of the quality control process. Due to the universal program architecture and the modern ASP.NET web technology, Resultmaster can be individually adjusted to the specific requirements of each customer.

Main functions of Resultmaster are:
• **Data Acquisition:** The import manager of Resultmaster provides multiple interfaces to all types of analyzers. The interface configuration can be easily adjusted and extended. In addition, the user can enter data online from every access point of the laboratory.
• **Data Preparation:** Following data acquisition the results are filtered by pattern, converted into the specific customized laboratory format and transferred into the database structure. If necessary, the data values can be recalculated using an algorithm and joined to an existing or new table.
• **Data Management:** Data management is under control of an integrated relational database for storage and organization of data. The database structure is completely disclosed and accessible for the administrator.

• **Data Presentation:** The edited data are simultaneously displayed in any number of web clients. The software is protected by passwords and regulated by access rights. The communication to the Web Server uses TCP/IP protocols and can be encrypt by SSL. If there is a connection to Prepmaster, Resultmaster also provides information about the sample preparation.
• **Data Analysis:** Resultmaster provides functions for sorting, filtering and grouping data as well as applying statistics. The selected results can be displayed using different diagram types.
• **Data Distribution:** Resultmaster exports data to the user or specific IT systems of the customer. Therefore, Resultmaster provides multiple interfaces, export algorithms and direct access to the database of the customer. All results can be easily outlined by the report function of Resultmaster.

Sample input

Samples can be fed in either automatically or manually. The sample inlet station for granular samples consists of an automatic input flap and a double-chain conveyer for the transport of cups or trays. A barcode scanner system or RFID-based sample identification are available as an option. Subsequently, the weight and humidity is automatically determined (available as option) before the sample is transported to the handover point for further processing.

Alternatively, the automatic in-feed of sample material is possible either directly from samplers, via airtube receiving stations or cup ways.

Sample handling solutions

Robot system

Robotic systems under the control of the HERZOG Prepmaster system are able to flexibly handle all type of samples. Extension, modification and exchange of components can be done easily with the use of robotics. Furthermore, robot systems provide a maximum of maintenance comfort since single components can be easily taken out from operation without impairing the function of the complete system.

The configuration of the robot cell is customizable to achieve the best possible results for the end user.

HERZOG is offering robot systems in a circle or linear setup. The robot circle configuration ensures the most economic and quickest transport of samples from machine to machine. Linear systems allow the operation of more machines, the integration of larger foot-print components, and in case of a double robot system provide a high level of redundancy.

The Prepmaster control system ensures an optimal utilization of all components at full capacity. The intelligent sample administration allows the optimal handling of standard and high-priority samples and keeps track of the entire production process.

Sample handling

HERZOG integrates the sample handling which optimally meets the customers' requirements including robot, linear transport systems or other handling devices. HERZOG systems are adapted to fit the specific needs of the mining industry including port laboratories and on-site laboratoryies.

Drying / filter pressing

Specific Drying solutions for the Mining Industry

HERZOG is offering various options for sample drying which are optimally adapted to the sample properties. Those options include ovens and furnaces with air circulation, microwaves and infrared dryers.

HERZOG drying systems can be operated either manually or automatically.

Furthermore, HERZOG is providing solutions for sample preparation of slurry material as used e.g. in the flotation process for phosphate, copper or iron industry. Slurry material can be collected in a container for the primary sample. A subsample is taken by means of a divider passing through a vertically descending flow. A flocculant can be added and the subsample is transported onward into the filter dryer where, the water is pressed out by means of compressed air. In compliance with the material properties a special filter textile is used.

After the water has been pressed out the filter cake with the residual moisture content is discharged into a glass dish. Then the filter cake can be further processed by drying of the residual material within a drying oven or microwave, pulverizing, pelletizing, fusion, grain sizing or wet chemistry. Our filter press system can be configured as a manual or automatic system with a flexible quantity of filter presses within one unit. Maintenance is easy as the system is readily accessible.

Moisture analysis

As a widely accepted and ISO conform way of moisture analysis we utilize a sample oven and a weighing balance. Trays with sample materials are loaded into the oven for a predetermined time set in the Prepmaster control system. After the predetermined time has relapsed the robot removes the tray from the oven and weighs it on the balance. Based on the measured weight loss the moisture content of the material can be calculated. If the moisture determination has to comply with ISO standards the samples undergo repeated drying and weighing cycles until no further weighing loss can be detected.

The HERZOG oven door system is intelligently designed to minimize the heat loss while loading and unloading the trays.

According to the sample material and the customers' requirements HERZOG is offering other methods for moisture determination like, e.g. determination of the surface humidity by infrared measurement devices. The online data can be used for calculating the drying time within the oven.

Particle sizing

Particle size analysis

Sizing of ore material can be done by different approaches. The most common technique is to pass a sample through a screen stack and measure the mass of each fraction.

HERZOG screen shakers are designed in accordance of relevant ISO standards for size determination especially for lump iron ore material.

The material is fed in onto the top of the screen stack which generates oscillating movements by using specially tuned eccentric and vibrating motors. Due to gravity and excitation the ore particles divide up to the different sieves. After a predetermined time the vibration stops and the shaker can be unloaded. The particle size analysis unit incorporates a weighing scale for determination of each size fraction and a screen cleaning.

Additionally, HERZOG is offering other types of particle size analysis methods like screen shakers for iron ore fines, sieving maschines with ultrasonic excitation or different types of on-line and at-line analysis devices.

Solutions for representative splitting and dosing

HERZOG has options for dosing and representative splitting of sample material as required for bead XRF, TGA, wet chemical assessment and other analysis. Subject to the processed material and application type, different dosing techniques are available like, e.g., screw dosing or tipping filler dosing. Equipment units can be system-integrated like the dosage for material and flux within the HAG fusion system. Alternatively, dosing machines are flexibly placed at every point of a robot or linear automation.
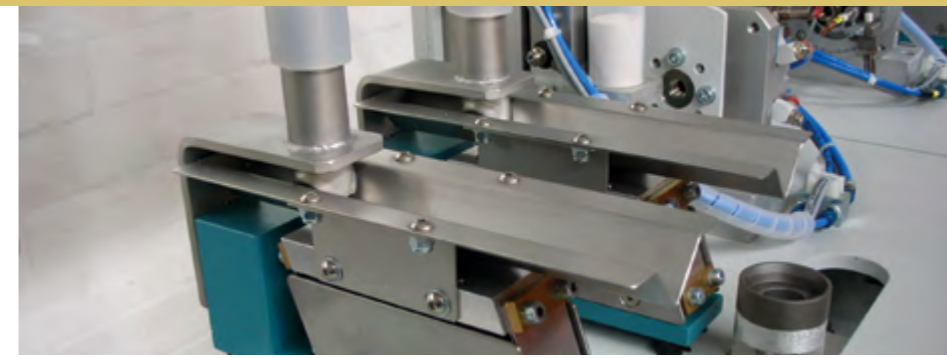
Dosing and splitting of sample material

For obtaining representative subsamples the splitting process complies with the relevant ISO rules. HERZOG makes use of a linear splitter system which allows the flexible and freely selectable partitioning for analysis, archive or monitoring samples. Alternatively, rotary splitting devices can be used to eliminate the largest systemic error sources in the production of subsamples. HERZOG is providing devices for dosing of material and additives with pinpoint accuracy required for fire-assay, CNS, fusion and other methods.

HP-SCD

The HP-SCD is a dosing device of fine samples with a volume of up to 1 liter. The cup containing the sample material is automatically brought into the in-feed position via a transport belt system. Subsequently, a specimen is taken and dispended into a small cup or vial which is transported into the machine output position or a magazine. Simultaneously, the input cup is removed from the HP-SCD.

Following this process the dosing device is thoroughly cleaned for the next sample.

The HP-SCD is flexibly configurable for dosing variant subsample amounts and number of samples.

The HERZOG system
for representative splitting

Representative sampling and mass reduction is one of the major concerns in sample preparation. Automation of the mass reduction process reduces potential error sources and consequently decreases the "total sampling error". Therefore, HERZOG is offering a sample splitter which is especially designed for operation in automatic mode. The linear splitting system is capable of creating subsamples for a wide range of different raw materials and products.
The HERZOG linear splitting unit provides the possibility to obtain up to three sub-samples from a "primary lot". For each of those sub-samples, a specific volume/mass can be defined independent from the input mass of the sample.
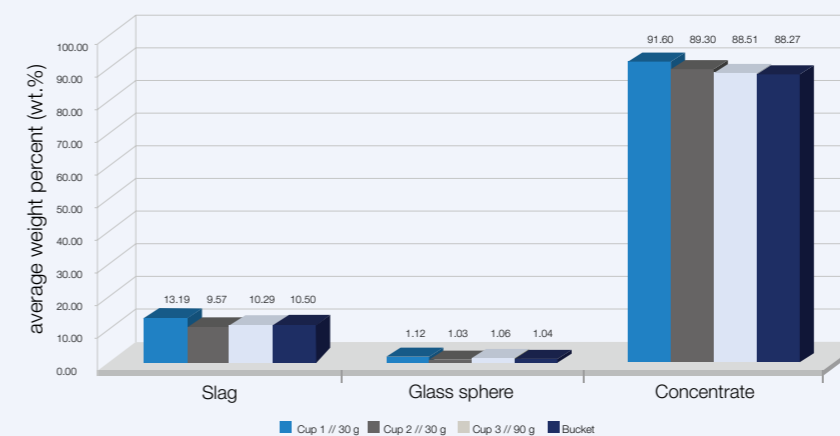
To assess accuracy and precision of the HERZOG splitting system we prepared a sample that consisted of phosphate concentrate (89%), blast-furnace slag (10%) and glass spheres (1%). To test accuracy we chose following subsample masses: Cup 1 with 30g, cup 2 with 30g, cup 3 with 90 g. The splitting test showed following results:

	30g	30g	90g	SUM
1	29.36	30.43	91.84	151.63
2	29.13	30.41	90.05	149.59
3	29.01	30.70	91.48	151.19
4	29.23	30.05	91.87	151.15
5	29.96	30.64	91.07	151.67
6	29.61	30.93	91.10	151.64
Average	29.38	30.53	91.24	151.15
Max	29.96	30.93	91.87	151.67
Min	29.01	30.05	90.05	149.59
Standard deviation	0.35	0.30	0.68	0.80

Accuracy of the obtained masses for splitting six times a 500 g sample into a 30 g, 30g and a 90 g sub-sample.

General setup of the splitting chamber used in the test.

1 Waste chamber
2 Sample chamber (sample cup A)
3 Sample chamber (sample cup B)
4 Sample chamber (sample cup C)
5 Waste chamber

To test the precision of the system we examined whether the composition of the subsamples were identical to the composition of the primary lot. The average weight percentage of each sample phase (phosphate, slag, glass spheres) where identical in each subsample without any significant differences.

These tests demonstrate that the HERZOG splitting system creates representative subsamples from a primary lot which is an absolute prerequisite for reliable analysis results.

HP-WCSA

The HP-WCSA is the machine for crushing and splitting. The splitter is designed to conform to the requirements of representative splitting. The intelligent software control for the linearly moving device allows the generation of splits of any desired subsamples amount. Based on the weight of the incoming material and the requested subsample outcome the movements of the splitter are calculated to acquire the output weights.

HP-RSD

The HP-RSD is a large-scale rotary splitter fit for particular use in port laboratories. The crushable sample material is fed in either by a robot system or transport belt. The sample is split by the rotating splitter with a given ratio. The filled buckets are transported to the output-position from where the robot carries them to the next process step.

Average concentration of each component refers to 20 splits. The target value for the slag is 10.00 wt. %, for the glass spheres 1.00 wt. % and for the concentrate 89.00 %.

Integrated solutions for Crushing

Crushing

HERZOG offers an extensive set of crushing options for samples of varying material properties, weight, grain size and hardness. HERZOG crushers are optimized to prepare coarse ore, mineral and similar material for subsequent processing steps like pulverizing. Due to their modular design HERZOG crushers can be used either as stand-alone devices or can be integrated into an automation together with other components. They can be combined with other function units for weighing and splitting within one machine.

HP-WCSA

Using the building block principle, the HP-WCSA contains a weighing device, a sample lift, a jaw crusher and a linear splitter with a variable splitting ratio based on current ISO norms.

The linear splitter in the HP-WCSA complies with the ISO standards for representative splitting. The software control allows completely flexible splitting of aliquot portions. Automatic feed and discharge magazines significantly increase the sample output and manpower efficiency. Large coarse sample received in the laboratory are loaded into the sample containers of the feed magazine. The operating parameters are preselected at the integrated control panel.

The HP-WCSA will always produce the predetermined final sample weights irrespective of the weight of the incoming sample.

Due to the linear design of the splitter, the weight distribution of outgoing samples (up to three aliquots) is absolutely flexible and changeable from sample to sample.
The HP-WCSA can easily be combined with other HERZOG equipment such as feed and discharge magazines, automatic pulverizing mills, pellet presses or fusion machines.

Based on the modular machine design principle it is easy to integrate other components like, a mortar crusher (HP-MCSA), a second crusher, pulverizer and other more.

HP-C

The HP-C fully automatic jaw breaker machine is a cost-effective solution for the crushing of a range of mineral types including ores, sinters, silicates, clinkers, ceramic materials, slags and other crushable. With its comprehensive automation the HP-C guarantees precise and reproducible analytical results.

The sample material is possibly fed in via a manual insertion point or in an insertion magazine. The cup is emptied automatically when the machine is started. The operation cycle is executed in accordance with the preselected processing parameters such as duration of crushing and cleaning time. Following the crushing process, the sample material is poured back into the insertion cup and returned to the insertion position.

The HP-C can be easily combined with various other HERZOG machines. It is fully enclosed and insulated against noise and requires a minimum of manual intervention and maintenance.

BB 100/200/300

The jaw crushers BB 100, BB 200 and BB 300 crush medium hard, hard, brittle and hard-ductile materials. Among others the BB100/200/300 can process materials like bakelite, bauxite, concrete, chemical raw materials, ores, rocks, glass, ceramics, coal, coke, corundum, artificial resins, alloys, quartz, salts, chamotte, slags and cement clinker.

The BB100, BB200 and BB300 are specially designed for the preparation of laboratory samples, but they can also be used to make samples and product in small quantities in industrial plants.

With a maximum feed size and a minimum gap width, the degree of crushing (feed size to end fineness) is up to 50 : 1. The throughput and end fineness depend on the model type, the gap width set and the crushing properties of the feed material.

Pulverizing

Reliable Pulverizing of Mining Material

HERZOG provides custom-tailored solutions for grinding of sample material. Our pulverizing mills are operated manually or can be integrated in any kind of automation.

HERZOG offers a wide range of different types of laboratory batch mills which are able to process a material weight of up to 5 kg.

The vibrating disc pulverizers quickly and reliably achieve the necessary particle size for high-quality analysis and are absolutely consistent with the requirements of the mining industry.

Our elaborated methods avoid cross-contamination even of very sticky and viscid material. For every type of material various cleaning technologies are available like, e.g., dry cleaning with compressed air, wet cleaning, sand cleaning or use of blind samples.

HP-M1500

Special features like automatic quartz sand- and compressed air cleaning between samples and the continuous magazine operation of up to 30 samples makes this unique machine suitable for mining and geological laboratories.

Up to 1500 ccm coarse sample material with a maximum particle size of 5 mm, fed by the operator manually into a stainless steel cup, is discharged into its original cup after fine grinding. The machine is self-cleaning after each sample preparation cycle. All parts of the machine which have been in contact with sample material are automatically cleaned by compressed air. Fine dust will be removed by an external dust collector which is controlled by the machine PLC.

The system is designed to allow the integration into automatic sample preparation systems with the use of special designed automation components like conveyor belts, dosing and magazine systems for sample cups.
Further automation concepts like the link to automated powder sampling and sample transport systems are available.

Up to 8 parameter-definable preparation programs can be stored and password-protected. The operation steps: grinding and discharge conditions as well as cleaning parameters can be set as program parameters at the mobile control panel.

HP-M5000

This grinding mill is optimal for the grinding of larger sample amounts up to 5 kg. The HP-M 5000 is suitable for the pulverisation of mineral samples like rocks, soil, ore, concentrates and others. The material is loaded manually or by external handling devices into a sample transport bucket and placed onto a start position in front of the machine.

The complete grinding process is fully automatic.

The ground material is released into the sample bucket at the start position for further processing. The sample mass before and after grinding is monitored by an integrated balance.

The grinding system is automatically cleaned by compressed air after each grinding cycle. An external dust extraction device is required to remove waste material and dust.
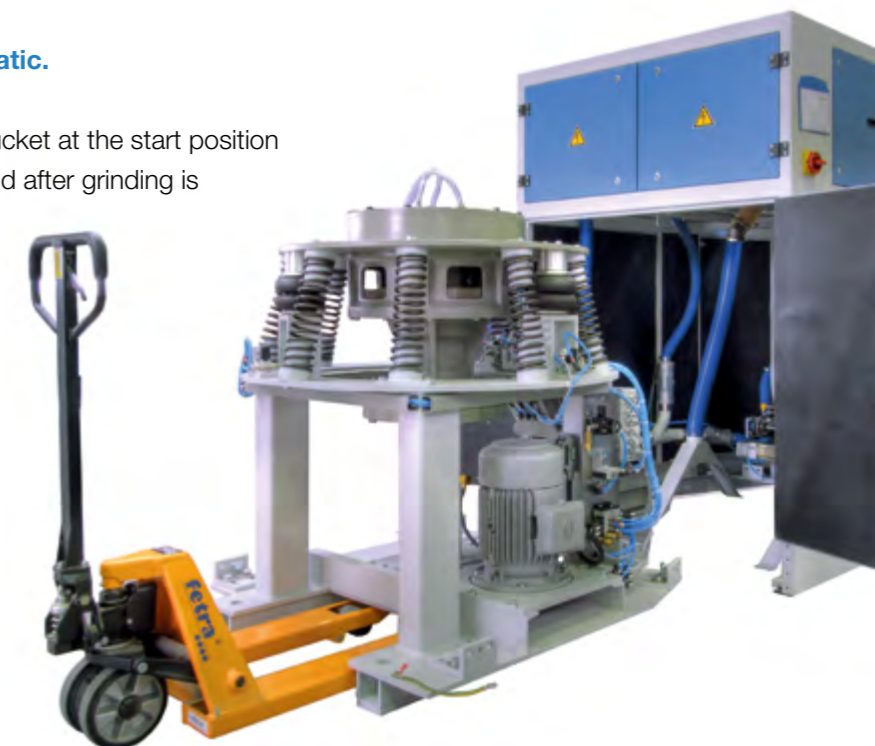
HP-M

The HP-M is the universal mill for grinding of mineral material. The high RPM of the drive motor guarantee short grinding processes even with hard materials. The robust construction with dual bearing support for the eccentric shaft ensures long service lives.

Additional features of the HP-M series are automatic emptying of the grinding vessel and availability of the sample material at the discharge point. Automatic cleaning of the grinding vessel ensures continuous operation even with consecutive preparation of different materials. Cleaning is carried out pneumatically of by wet-grinding followed by drying. Wet-grinding has the particular advantage that even the smallest grinding residues are removed.

Pelletizing

HP-M100P

The fine grinding mill is suitable for the pulverization of different types of sample material, including silicate, cement, ceramic material, ores, sinter and slags, as well as ferro alloys and various other minerals.
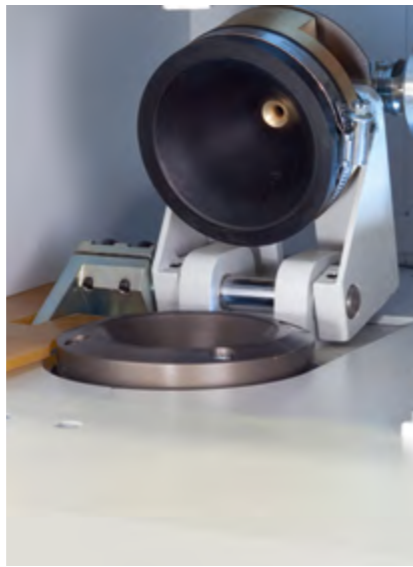
HSM 100

The HSM 100 offers the full benefits of HERZOG vibration mills – controlled grinding processes for the preparation of samples for XRF analysis. Control by programmable controller results in a substantial improvement in the reproducibility of sample preparation and consequently optimum analysis results.

Superior quality of pressed pellets

HERZOG pellet presses are the basis for the preparation of stable pressed pellets.

Our presses offer the properties which are crucial for achieving the desired uniformity and density of each individual pressed pellet. The design of the pellet presses ensures a high degree or reproducibility and uniform optimal quality.

Our press models can be operated as stand-alone machines or can be easily integrated in any kind of automation.

HP-P/ HP-PA

The HP-P and HP-PA are fully automatic pelletizing machines for production of stable pressed pellets. They offer the properties which are crucial for achieving the desired uniformity and density of each individual pellet.

All important pressing parameters such as total pressing force, pressing force slope and pressure holding time can be easily selected. The HP-P can be easily integrated into every type of automation like robot circles. The HP-PA, due to its modular design, is especially suited for linear automatic systems and can be easily combined with the crusher HP-CA and the pulverizer HP-MA.

HP-MP

The automatic machining cycle ensures fast and reproducible analytical results. The individual operations for pulverizing and pelletizing can be carried out separately.

The space saving design with the integration of the machine components for pulverizing and pelletizing in one machine housing makes this machine ideal for laboratory environments.

The hydraulic unit allows the automatic monitoring and control of the applied pressure for optimal results. Therefore, an absolutely reproducible pelletizing process is guaranteed which can be adjusted to the requirements of each customer. All the parameters which are important for the pellet pressing process such as total pressing force (50-160kN), incremental increase of the pressing force and pressure holding time can be preset.

The system is designed to allow the integration into automatic sample preparation systems with the use of specially designed automation components like conveyor belts, cleaning and magazine systems for steel rings. Standard Interfaces are available to connect the machine to most of the automated XRF instruments.

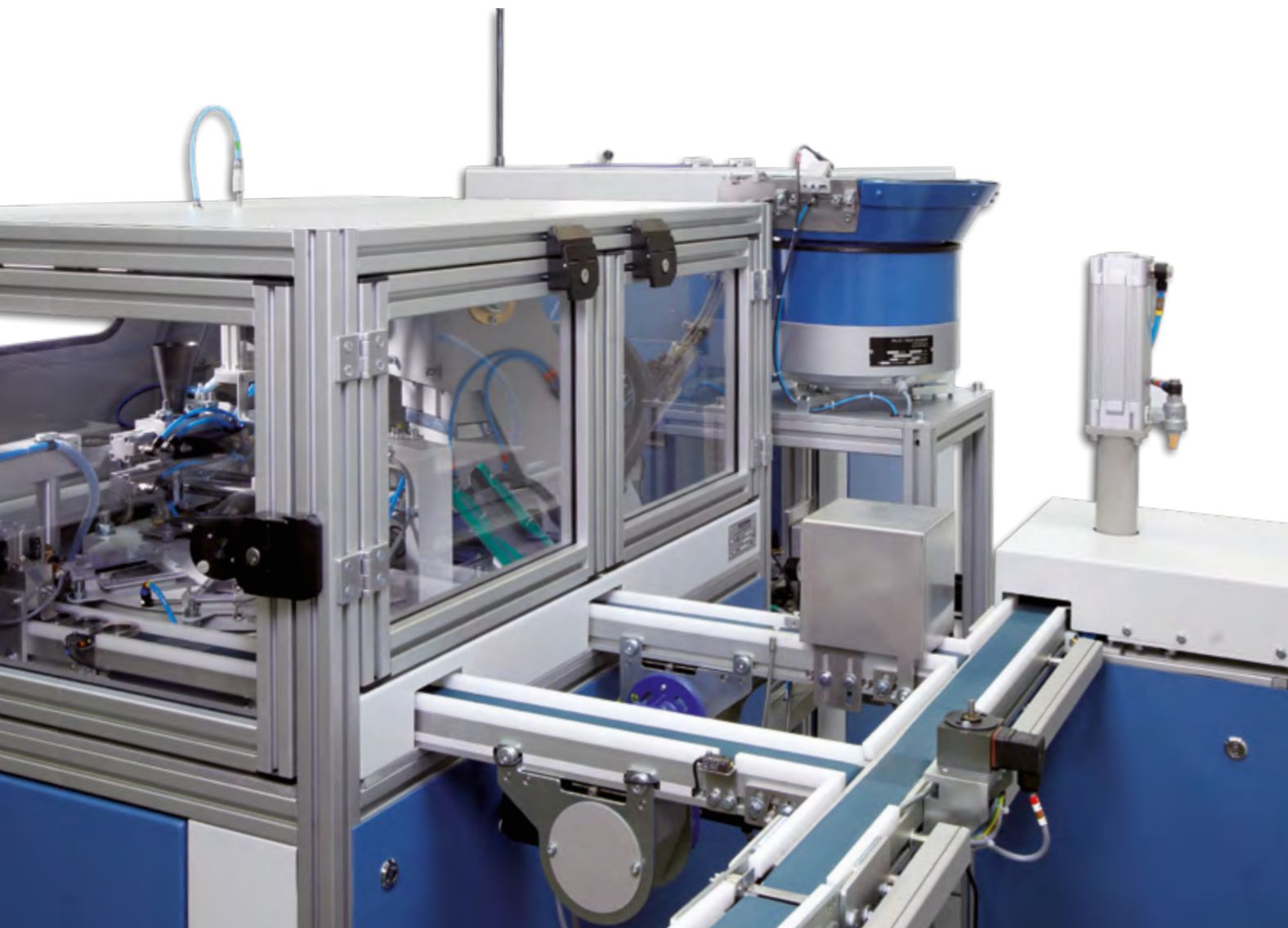|	
TP 20/40/60	This manually operated hydraulic press allows all the compacting operations common in the laboratory to be carried out.
TP 40/2d / TP 60/2d	By means of this manually operated hydraulic pelletizing press it is possible to easily produce tablets with different diameters.

Optimum preparation for XRD analysis

Sample preparation for XRD analysis

HERZOG provides optimum sample preparation for X-ray diffractometry (XRD) processes for the phase analysis of polycrystalline sample material. The combination of the HP-MA pulverizing mill and the HP-PD6 press is the ideal automation with which to create a suitable and effective diffraction surface for the XRD analysis.

The XRD automation by HERZOG has been especially designed to suit the requirements of the raw materials industry. Typical areas of application are investigations of:
- Samples from the mining industry for exploration and process control
- Floatation products in copper an other mining industries
- Bath samples in the aluminum industry

The HP-PD6 is the press which is especially adapted to the requirements of sample preparation for XRD. The HP-PD6 allows the precise dosing of the sample material into the ring at the dosing station. A special cleaning mechanism allows residue-free cleaning of the dosing system and prevents subsequent samples from contamination.

The material is pressed under application of low pressing forces using the back loading technology.

The sample material is pressed against the pressure plate positioned underneath via a button. The button has been previously inserted into the ring from above. This method guarantees effective pressing of the material with a minimum amount of binding agent and at the same time maximum conservation of the surface to be analyzed. The inserted button also stabilizes the sample material in the ring. At the output station the pressed pellet is turned around so that the analysis surface faces upwards and can be conveyed into the analyzer.

The special design of the automation with simultaneous sample processing guarantees a high sample throughput whenever required.
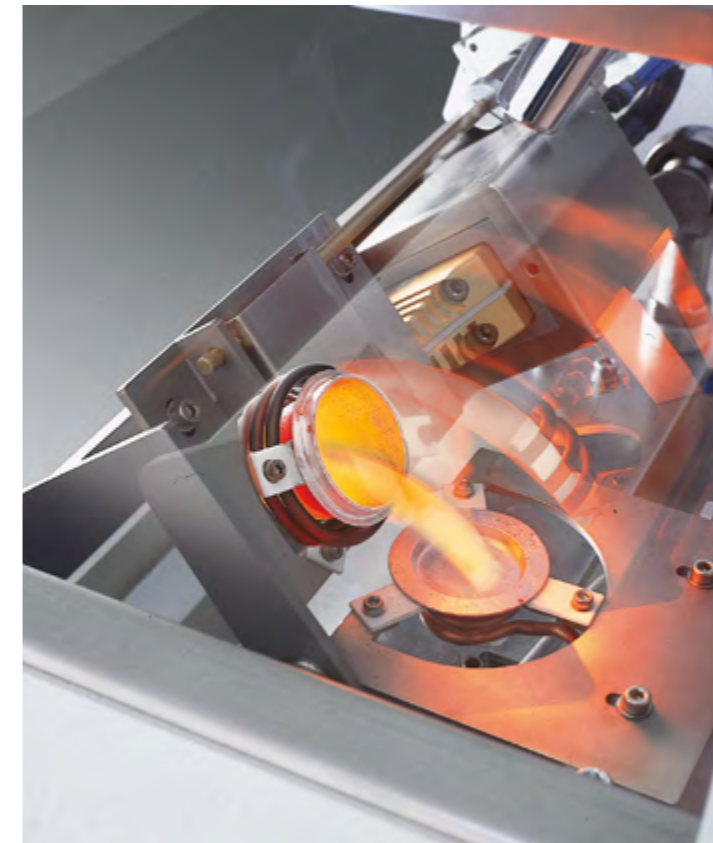
Fusion

Specially tailored for use in labs

HERZOG high-frequency systems for preparation of oxidic sample materials produce samples of exceptional analysis precision. HERZOG offers the full spectrum of fusion systems from the manual fusion machine to the fully automatic system covering all processing steps.

HAG-M-HF

The HAG-M-HF is the table-top machine for the inexpensive manual manufacture of melt fusion beads. The HAG-M-HF is safe and easy to use. The preweighed sample material is mixed with the fusion agent, put in a crucible and inserted into the machine. The casting dish is inserted in the retainer near the crucible. The following beat production is automatic. The crucible and casting dish are heated to the set temperature. Rocking of the crucible during fusion ensures a homogeneous and bubble-free melt. After the melting process and according to the preselected program the material is discharged into the casting dish or remains in the crucible until solid. The glass beads can be removed after the set cooling time.

Row of fusion units ready for operation.

Fusion units in operation.

Operating sequence in the fusion module with induction heating in the crucible, ...

... pouring into the casting dish, ...

... cooling within the casting dish.

Fully automatic HAG system

The HAG is a fully automatic high-throughput system for fusion. Main advantages of the automatic fusion process are:
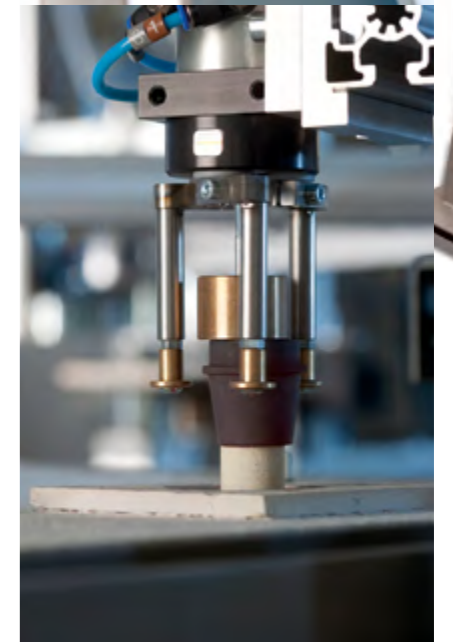
- Increased precision since every sample is identically processed and not subject to human error.
- Reduced mix up as manual processes like, e.g., weighing, labeling, fusion, bead labeling, loading and registering are reduced to a minimum.
- Labour saving which releases the operator's workforce for more efficient and responsible tasks.

Plastic vials with 20 to 50g of sample materials are manually or automatically placed into the tray of the input magazine. All following steps are fully automated: Sample dosing for flux weighing, fusion and transport of fusion beads to the XRF, cleaning of crucibles and casting dishes. The remaining sample and vial is returned to its original position in the tray.

According to the sample load, the fusion module consists of 4, 6 or 8 heating stations. Each heating station has two heating positions for the crucible and the casting dish. A linear system transports the sample from the turntable to the heating station, fused bead to the XRF belt, and dirty crucibles and casting dishes to the cleaning station.
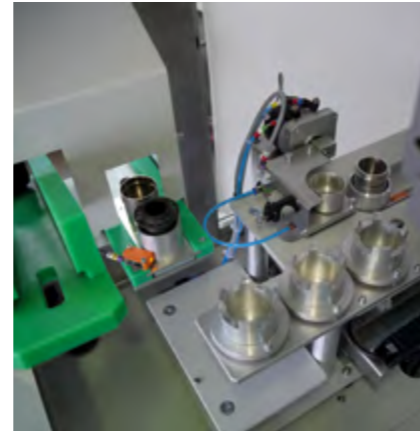
The crucible is heated by induction. During this process, the sample can be swirled to aid the mixing. In parallel, the casting dish is heated to a predefined temperature. When the heating cycle is complete, the sample is automatically poured into the casting dish. The bead is allowed to cool within the casting dish. Depending on the sample type different cooling regimes can be used such as fast cooling with compressed air.

The heating station is under control of a pyrometer. Therefore, it is possible to setup individual heating profiles for every sample type.
Before transported to the XRF, a special detector confirms that the fused bead is not cracked or moon shaped. Optionally, a camera system can be used to exclude that the bead is crystalline.

Sample and flux dosing unit

Internal sample magazine

HA-HF16

The HA-HF16 prepares oxidic sample materials for x-ray fluorescence analysis. The fusion technique produces extremely accurate samples.

The borate/sample mixture is pre-dosed into platinum/gold crucibles. Each of the crucibles is inserted in one of the 16 pockets of the input magazine.The operator then starts up the operating sequence on the touch screen. The program-controlled crucible movement ensuresperfect homogenization during the fusion process.

All components of the machine are neatly accommodated on a single stand. The integrated handling system silently and reliably takes care of all the transport routines in the machine. The two independently working high-frequency heating systems for crucible and casting disk guarantee the safe and reliable operation of the fusion system. The HA-HF16 has been purpose-designed to meet the requirements of modern laboratories.

A non-contact pyrometer holds the melt at a constant temperature. This ensures that a reproducible temperature curve, appropriate to the relevant sample quality, is maintained throughout the fusion process.
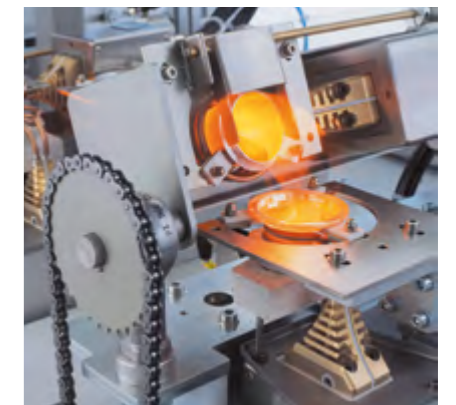
The procedures of the HA-HF16 are controlled by an integrated program-mable logic control system. This allows 16 different program sequences to be predefi ned and started separately on the touch screen for each sample.

Following the melting process, the melted sample material is poured into a preheated platinum/gold pouring dish and then gradually cooled. The melt is then cooled in the surrounding air until it solidifi es. After solidification, a special air jet cools the pouring dish further.

A vacuum pick-up takes only intact glass beads to the delivery chute. Up to 16 completed samples can be buffered. These are available to the operator to transfer to the analytical instrument. Alternatively, the glass beads can be transported back to the input maga-zine for further manual handling.

Input magazine

Fusion unit with crucible and pouring dish

HAG-HF

The HAG-HF accommodates all important processing steps for fusion within a compact machine stand. The HAG-HF automatically manages dosing, the fusion process and ultrasonic cleaning of the crucible and cast dish. The integrated robot performs all transport functions within the ma-chine, reliably and quietly.

After solidifying of the glass beat, the vacuum suction unit transfers only intact castings to the transport systems and the spectrometer. A sensor detects crystallized or broken castings and ensures that they are discarded. Optionally a second heating system can be installed for simultaneous pro-cessing of two samples.

Labels on technical drawing: Switch Cabinet, Cuplift, Mill Inlet, Material Output, Manual Input, Finished Sample

Modular design, compact dimensions

HP-BTM Combo machine

The combo machine HP-BTM is the compact sample preparation solution for the mining industry. It allows the easy and automatic crushing, splitting and pulverizing of ore material. Due to its space-saving design the HP-BTM is particularly suitable for installation on site or within the laboratory. Based on the modular design various options can be easily integrated as, e.g., input and output magazines, additional pulverizing mills or a dosing unit for cups and vials.
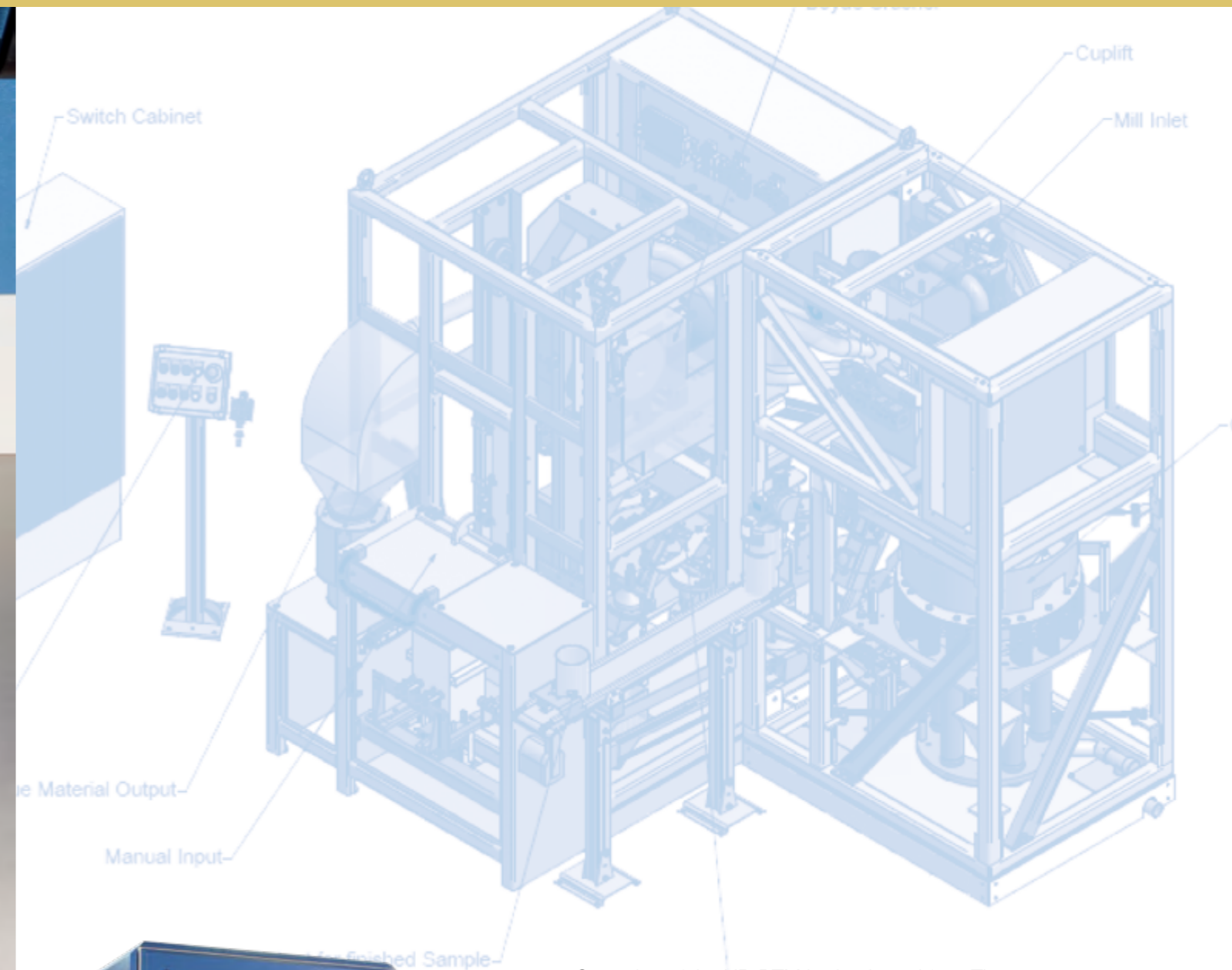
Operation of the HP-BTM is simple and fast. The operator selects one of the four individual programs by pushing a button on a separate front panel. The input flap will open automatically. The operator pours the sample into the feed position of the manual input and closes the input flap. The empty cup is placed on the input position for steel cups.

The basic sample preparation cycle starts automatically in the following sequence:

- Weighing and calculating the desired splitting ratio (sample / residue material).
- Feeding, crushing and representative splitting.
- Transport of the sample into the pulverizing mill and to the discharge position for residue material output.
- Fine pulverizing of the sample by means of a swing grinding mill, monitoring of sample weight prior and after pulverizing.
- Output of pulverized material into a stainless steel cup onto an output conveyor belt.

Autopotting
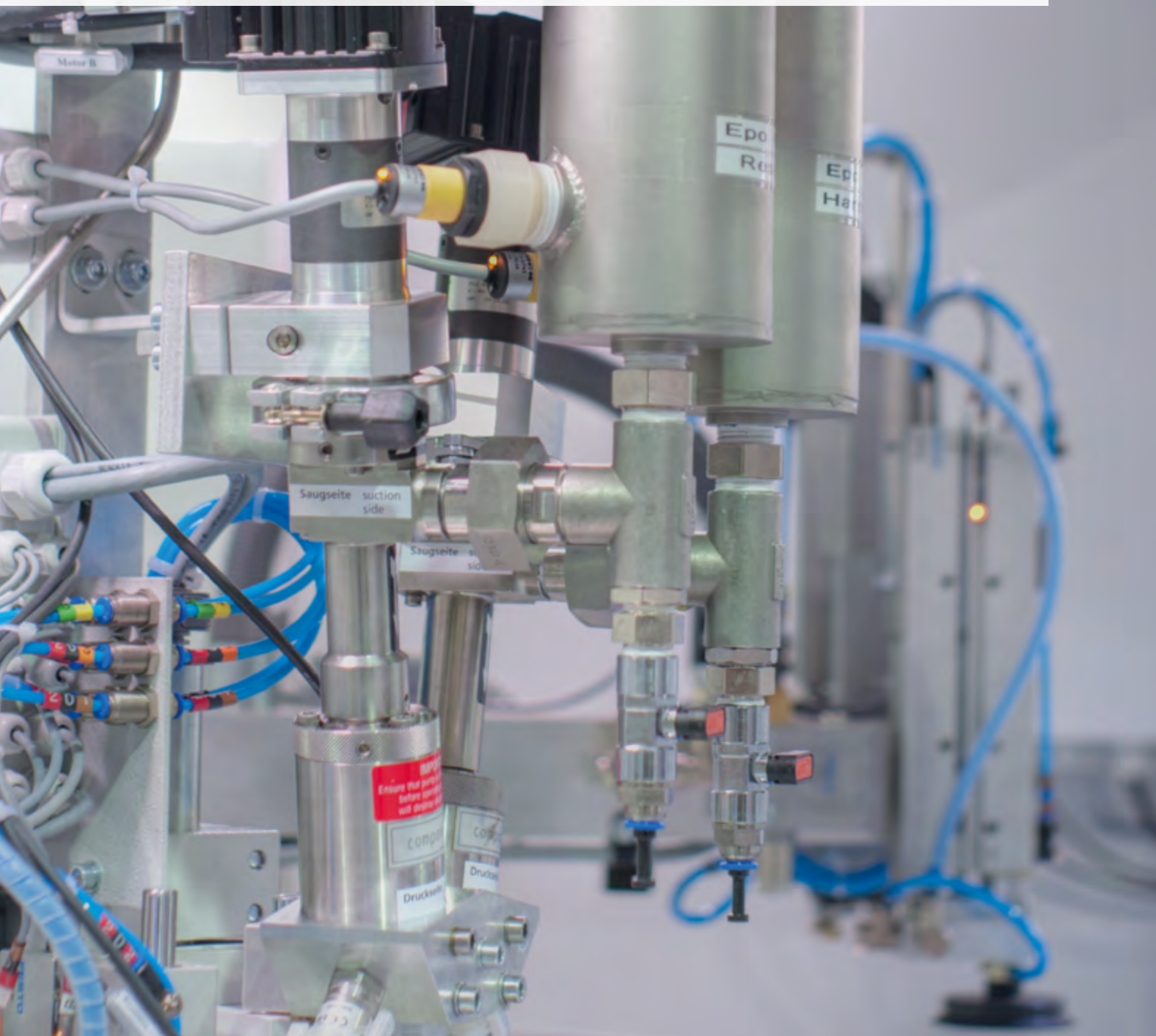
Automatic solutions for electron microscopic applications

The HERZOG autopotting system is for automatic encapsulating mineralogical samples in resin for preparation and analysis by electron microscopy applications (e.g. QemScan and MLA). Complete automation guarantees the highest sample quality.

The HERZOG autopotting system automatically adds resin and hardener into a sample cup, adds the sample, then adds more resin and hardener and homogenizes the sample into the resin by stirring action.

This process is repeated automatically to make up a batch of 12 samples in a carousel. The machine automatically transfers the entire carousel into one of five pressure/vacuum/heating chambers where, depending on the software program selected, the sample is subjected to vacuum, pressure and/or temperature for a selected pre-programmed period of time.

Once the sample carousel is complete it is transferred to an output position where the operator can remove the carousel and place it into a grinding and polishing machine. It is also possible to label samples and backfill with resin, prior to ejecting the sample.

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