BATAC® & **ROMJIG®** JIGGING TECHNOLOGY

MBE COAL & MINERALS TECHNOLOGY GMBH
FORMERLY HUMBOLDT WEDAG COAL & MINERALS TECHNOLOGY GMBH

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Gottfried-Hagen-Str. 20, 51105 Cologne / Germany
Tel +49 221 99892 700
info@mbe-cmt.de
www.mbe-cmt.de

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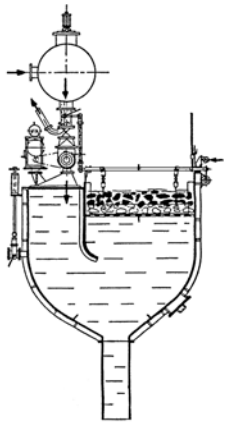
Jigs are widely used for the upgrading of coal, minerals, sand and gravel deposits and metal recovery from slag material all over the world. Stratification by means of jigging is one of the oldest separation methods employed with the longest history in mineral and coal beneficiation. Still to date, this environmentally-friendly and cost-efficient water-only technology is considered amongst the most important sorting approach for beneficiation plants.

This brochure provides information on our two key technologies in the field: BATAC and ROMJIG. After a brief chapter on important developments in jigging throughout the years, both technologies will be discussed in further detail.

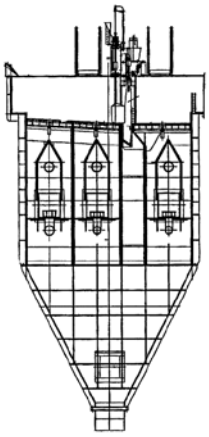
Besides information on capacities and general technical data, the focus is on stroke creation and material discharge. In addition, reference flow sheets illustrate the machines within the process as a whole.

Finally, we introduce the MBE R&D facilities where your material can be tested on a pilot scale to yield an accurate forecast of separation efficiency.

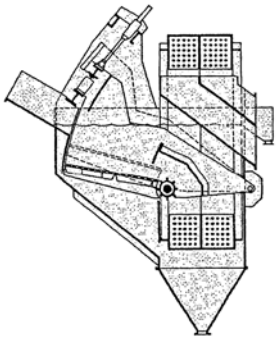
BATAC Jig for coal washing incl. de-sliming and de-watering screens



Side-pulsated BAUM Jig,
mainly used from 1891 – 1970



Modern under-bed pulsated
BATAC Jig



Movable screen jig (ROMJIG)
for run of mine size material.

JIGGING
DEVELOPMENT

MBE COAL & MINERALS TECHNOLOGY GMBH – originally the former KHD Humboldt Wedag – can look back on more than 150 years of engineering excellence in jigging technology.

In earlier days, technology was rather simplistic and achieved separation either by moving the entire material bed via pistons or through water pulsation generated in an air chamber underneath the jigging bed.

To overcome the limitations of these historical technologies, MBE took the technology leap in the 1960s to introduce substantially new high-throughput capacity equipment to the market.

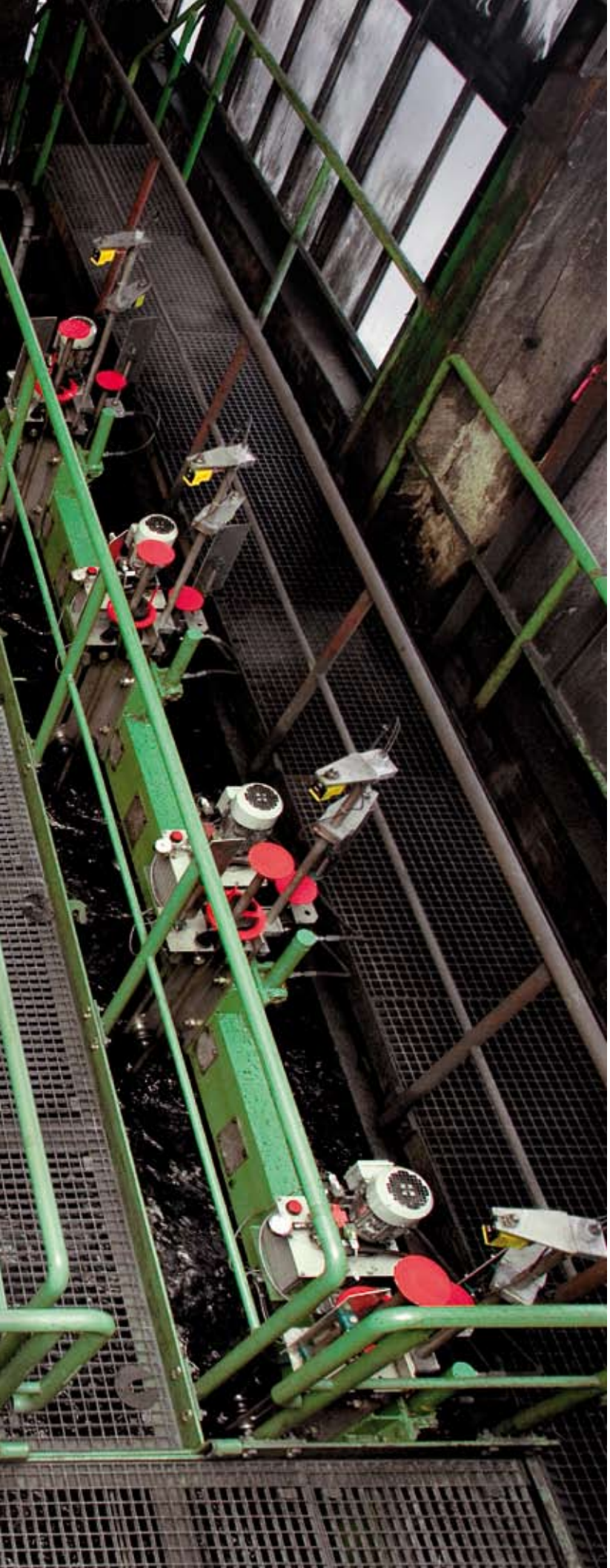
Since that time, machinery and processes have been continuously improved to yield MBE's flagship products in jigging:
– the moving bed ROMJIG, a path-breaking solution for run of mine material,
– the under-bed pulsated BATAC Jig for fine as well as course applications.

Through continuous in-house developments and experience gained in more than a hundred projects, MBE has established its clear leadership position whilst building up a worldwide unique expertise in the field. As a result, our BATAC and ROMJIGs do not only excel by their high separation efficiencies but also through:
– ease of operation,
– robustness in design,
– minimized maintenance costs,
– highest throughput capacities,
making them a preferred piece of equipment for numerous beneficiation plants over the years.

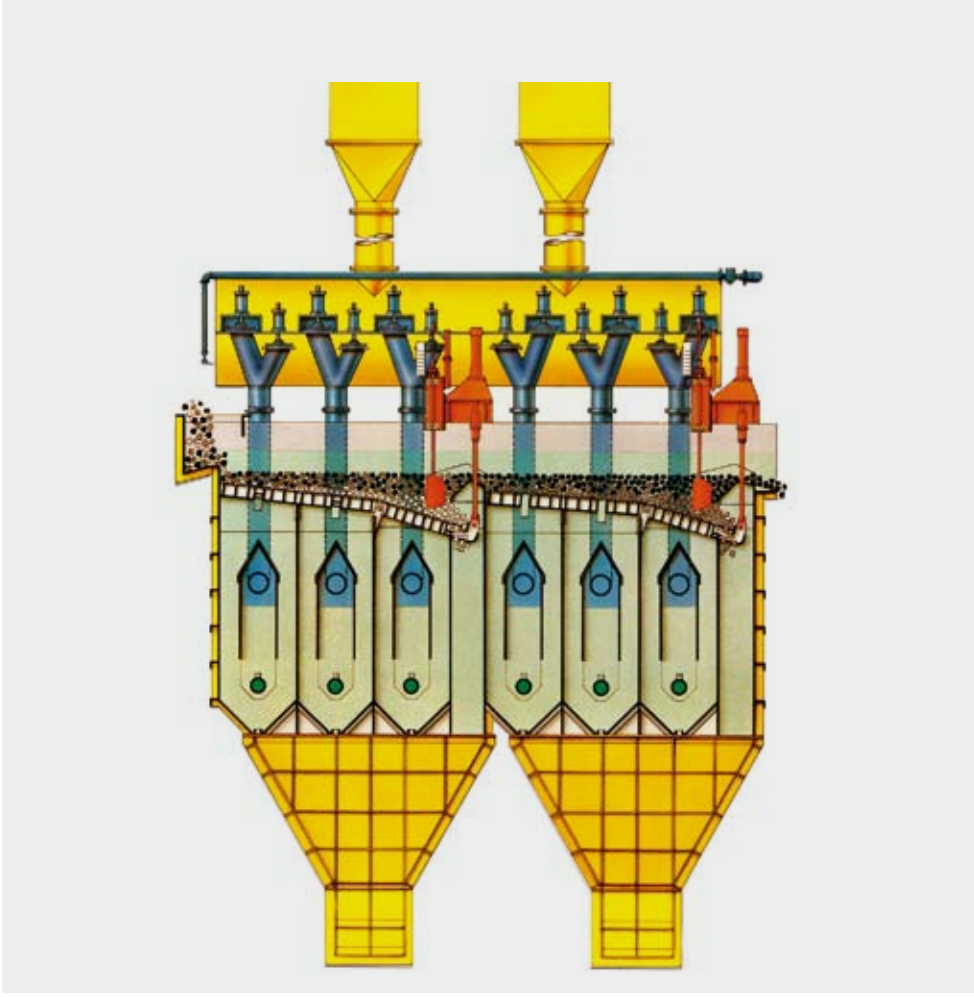
JIGS
SIZES

The introduction of the BATAC Jig in 1964 and the ROMJIG in 1984 allowed large jig widths and, consequently, larger capacities.

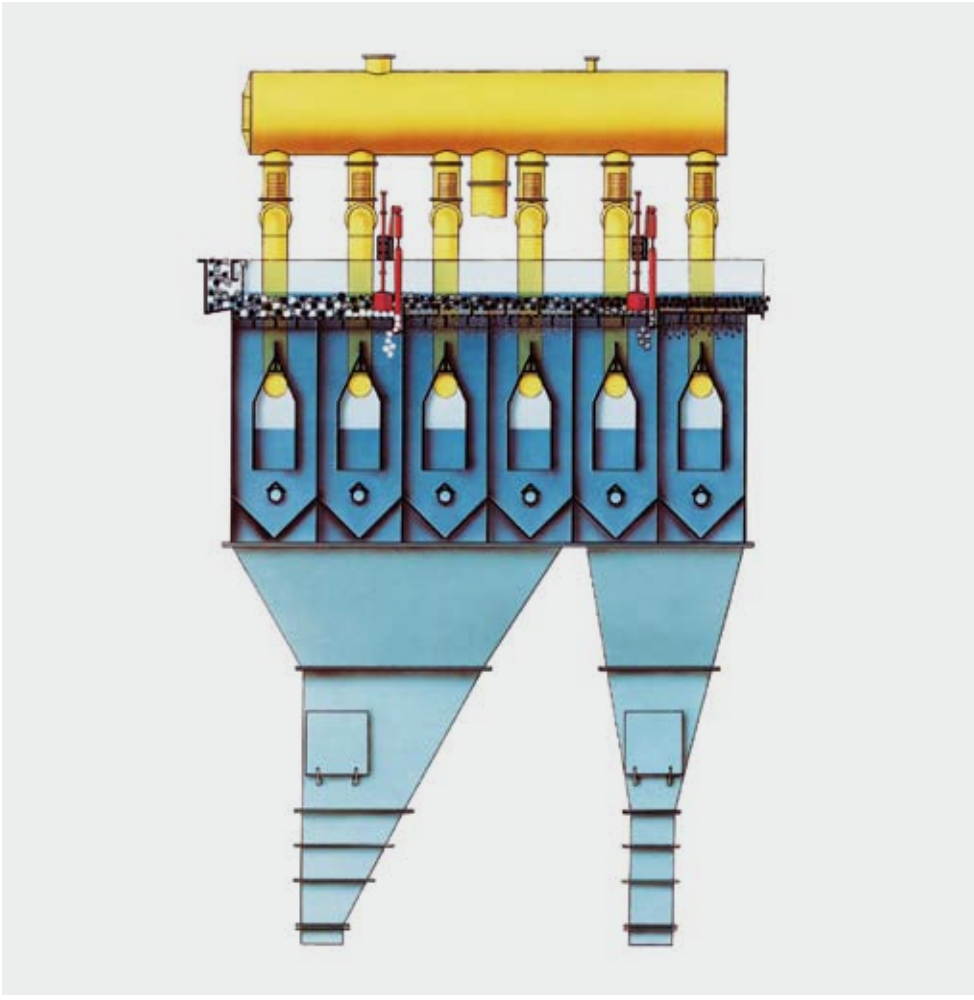
MACHINE		MAX. BED WIDTH	FEED SIZE RANGE	MAX. THROUGHPUT
BATAC	Jig for coarse coal	6.0 m	150 – 10 mm	720 t/h
BATAC	Jig for fine coal	7.0 m	10 (12) – 0.5 mm	600 t/h
ROMJIG	Jig for ROM coal	2.0 m	350 – 30 mm	400 t/h
BATAC	Jig for lump ore	6.0 m	45 – 6 mm	500 t/h
BATAC	Jig for fine ore	6.0 m	10 – 0.315 mm	450 t/h



BATAC Jig, RAG Anthrazit Ibbenbüren, Germany



Typical coarse material jig
for coal and ore applications



Typical fine and medium-sized material jig
for coal and ore applications

BATAC® JIG
COARSE, MEDIUM AND FINE SIZE

There is one decisive difference between a BATAC Jig and a BAUM Jig: the water current is not generated in an air chamber mounted adjacent to the screen plate but in air chambers underneath the jig bed. These air chambers are intermittently supplied with compressed air by an electronically controlled valve or flap valve system (pulse generator). The air is intermittently discharged from the system at atmospheric pressure after completion of the upward stroke. Motion is imparted to the water inside the jig as a function of the pressure generated inside the air chambers. Moreover, make-up water is added at the lowest location of every jigging chamber to intensify the upward current and to dampen the downward current. The feed is stratified according to its density by the pulsating motion of the water when preparing coal, e.g., in refuse, middlings and clean coal.

The heavy fraction of the stratified raw material is sensed by floats in accordance with the product qualities required. The system provides for controlled withdrawal of the heavy fraction over a discharge device. Jigs of great widths are equipped with independently operating discharge devices fitted with separate sensor systems and hydraulic units. This configuration ensures optimal product qualities over the entire jig width even if the material distribution is non-uniform.

BATAC® JIG
DISTINCTIVE FEATURES

In order to attain highest efficiencies, all modern under-bed pulsated BATAC Jigs are equipped with:
- a centre air chamber for each compartment for stable operation and uniform stroke distribution,
- permanent and adjustable air pockets guaranteeing fast and hassle-free startup,
- PLC-based jig controllers for all jig functions, inter-operable with all established process automation systems,
- independently working discharge devices, each equipped with separate hydraulic drive systems,
- ultrasonic sensor technology for highest discharge precision,
- large open-area jig decks with excellent durability, customized for each application.

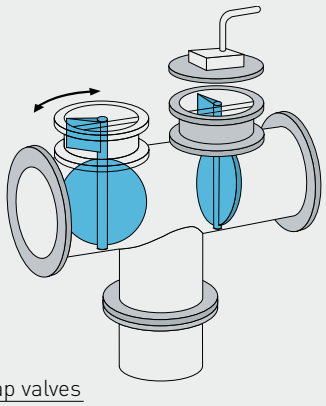
BATAC® JIG
PULSE GENERATOR

The magnitude and kind of kinetic energy used for the beneficiation process are of specific importance for successful separation. Therefore, special attention has recently been drawn to the development of pulse generators for the controlled admission of compressed air.

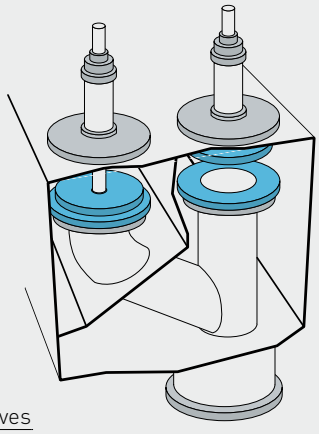
DISK VALVES are used for standard and square-wave pulsation in BATAC Jigs of width size > 5.0 m and also in ore and slag applications, where high energy input is required for the jigging process. Disk valves are actuated by compressed air.

ROTARY-FLAP VALVES work with blower air and are used for standard and square-wave pulsation.

The quantities of jigging air are controlled electronically both for disk valves and rotary-flap valves. They can be set individually by means of decade switches. An identical pulsation frequency (40 – 120 pulsation/min.) is set for all jigging chambers. The specific pulsation of every chamber is generated from additional time cards. The operating pressure is matched to the specific operating conditions from a PID controller operating on microprocessor basis. The nominal pressures have been stored in the controller. The operating pressure can be automatically matched to changed operating conditions by measuring the raw material feed rate (weight-feeder).



Rotary-flap valves



Disk valves

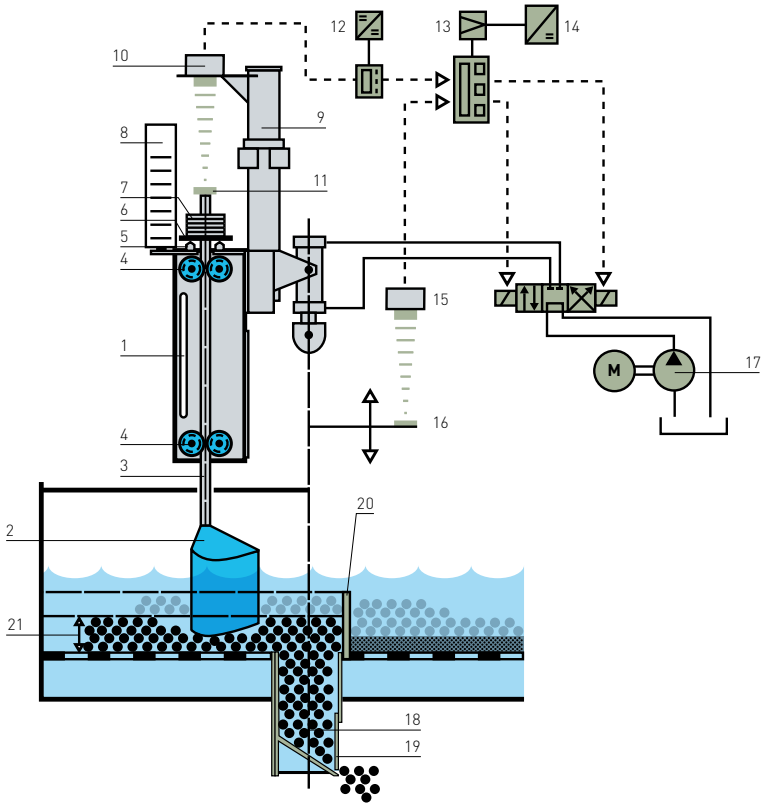
Control cabinet

BATAC® JIG
DISCHARGE CONTROL LOOP

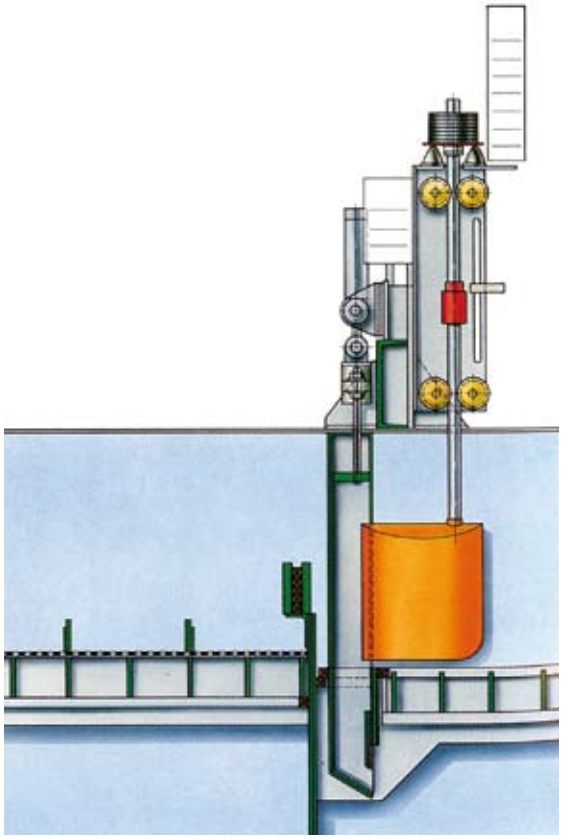
In order to maintain an accurate cut-point of the jigging process, the thickness of the material layers is sensed continuously by the aid of floats. For coarse adjustment, the basic float setting can be calibrated manually by additional weight segments, whereas precision adjustments are made full automatically using advanced control logics. To date, formerly employed induced current metering units have been replaced by ultrasonic displacement measuring systems. Their measuring values represent the input for PID controllers from which the hydraulic systems of the discharge gates are actuated. Further, a second set of distance sensors monitors the actual gate positions. The measurement of material layers is made with the float in its lowest position to preclude false measurements due to stroke influences. All sensor systems are highlighted by improved measuring and control accuracy whilst being insensitive to impact and vibrations.

Beside discharge control, all jigging parameters (e.g. valve settings, stroke frequency or the working air regulations) can be set directly on site as well as from remote. For the development of our BATAC controls, we worked together with all established suppliers of process automation. So no matter which system you choose for your plant, we can offer a fully compatible solution.

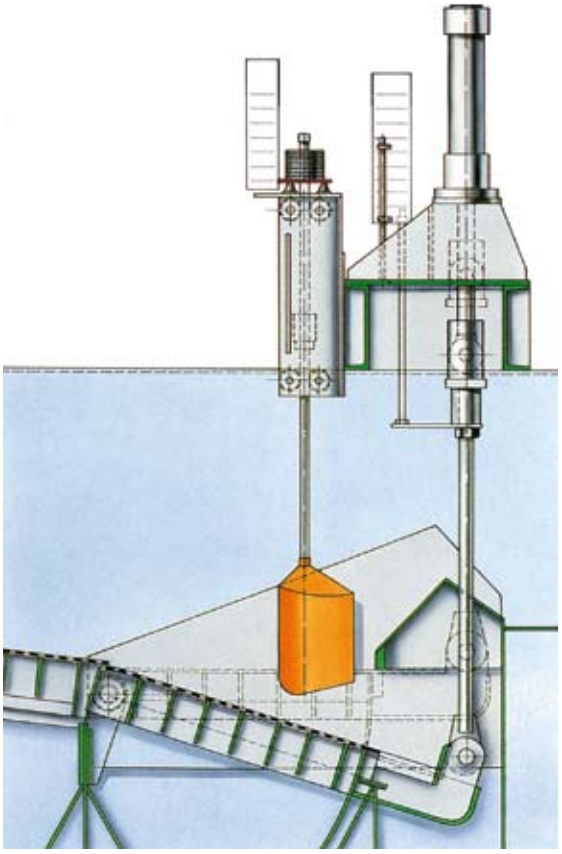
Discharge control loop
1 Chassis
2 Float
3 Float guide rod
4 Guide rolls
5 Rubber buffer
6 Indicator dial
7 Weight disks
8 Display panel – layer thickness
9 Adjustable receptacle for displacement sensor
10 Ultrasonic control bed level
11 Reflector
12 Converter
13 Controller
14 External set-point input
15 Ultrasonic control discharge opening
16 Reflector
17 Hydraulic unit
18 Discharge shaft
19 Gate
20 Overflow weir
21 Set-point – layer thickness



Fine ore BATAC Jig



Fine and medium-grain discharge devices



Coarse-grain discharge devices

All, coarse, middle and fine-grain jigs of large widths have several discharge devices for each cut, distributed over the machine width. All single discharge devices operate independently using their own hydraulic system. Each hydraulic system is actuated indirectly using float sensors.

COARSE-GRAIN DISCHARGE DEVICES. Heavy sinks and middlings products are taken to the discharge shafts over movable jig beds (swing bed) of maximum 2.0 m width. Wider jigs use several movable jig beds in a row. All jig beds can open up to 350 mm to allow all sinks to discharge. The shaft walls are protected against wear by ceramic tiles or special wear plates.

FINE AND MEDIUM-GRAIN DISCHARGE DEVICES. The heavy sinks and middling products are discharged into bucket elevators or equivalent discharge devices via the jig discharge gates and the chamber bottom outlets.

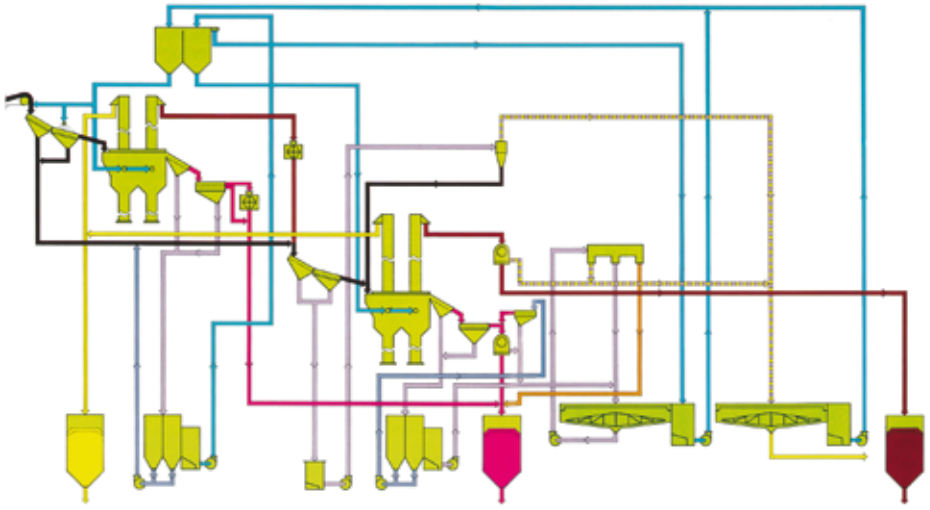
The design of all these discharge devices focuses on aspects of wear and therefore all outlets are built with replaceable, stainless steel insert boxes.

The shafts are 440 mm deep and depending on the jig width their opening measures between 115 x 1000 mm and a maximum of 2000 mm. The design concept was to keep a sizeable reserve layer (buffer) inside the shaft not only to prevent eddying but also to reduce the flow velocity of the material to be discharged.

The lower part of the gate (run-off plate) has been separated from the gate body and rigidly welded to the insert box. The proper gate consists of a 15 mm thick stainless plate which is moved and guided vertically with the aid of two stainless steel floats. Existing machines can be retro-fitted with this modified discharge gate. Every discharge gate is equipped with its own hydraulic cylinder mounted vertically above the discharge gate and joined directly to it. e.g. without interposing a shaft.

This arrangement results in the following benefits:
– extended lifetime thanks to the use of stainless steel,
– no wear occurring at the jig walls proper,
– reduced machining of mechanical components,
– lubrication of bearings is not necessary because of the absence of a shaft,
– rapid replacement of gates and/or insert box.

BATAC Jig for coal separation, Leeuwplan, South Africa



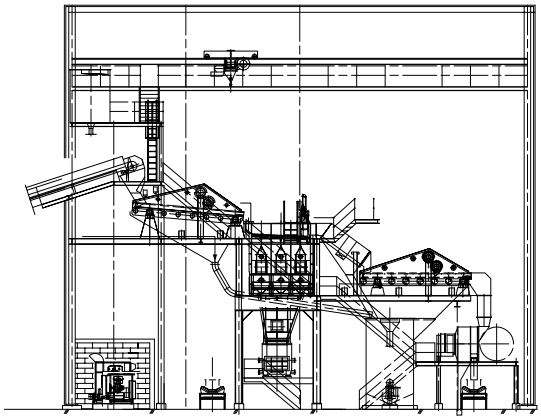
BATAC Jig for coal / typical flowsheet

BATAC® JIG
COAL PREPARATION

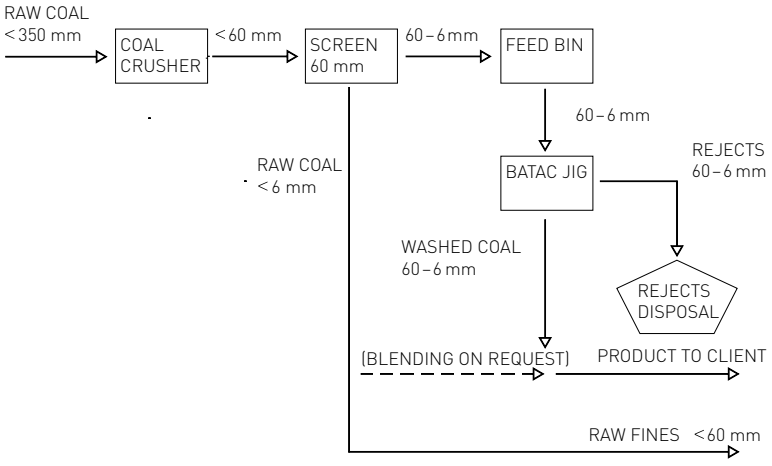
Because of their high throughput rates and excellent separating performance BATAC Jigs have been well accepted in the coal industry worldwide.

Units are available to process the full range of coal from coarse size up to 150 mm and down to fine coal in the size range 10 – 0.5 mm. The single unit principle based on one BATAC Jig unit per process line turned out to be the patent for the successful design of most of the coal preparation plants built today. The rapid detection of changes in the raw material, the quick reaction of jigs to such changes and easy operation of BATAC Jigs make jig plants most reliable for all kinds of applications.

BATAC Jigs in coal are used for de-stoning only and for production of final products for the steam coal and metallurgical industry. Common preparation systems based on BATACJig technology can handle throughput rates between 100 t/h and 1.200 t/h. A new system, based on an 8 m wide BATAC Jig to handle up to 1.400 t/h system capacity is under research.

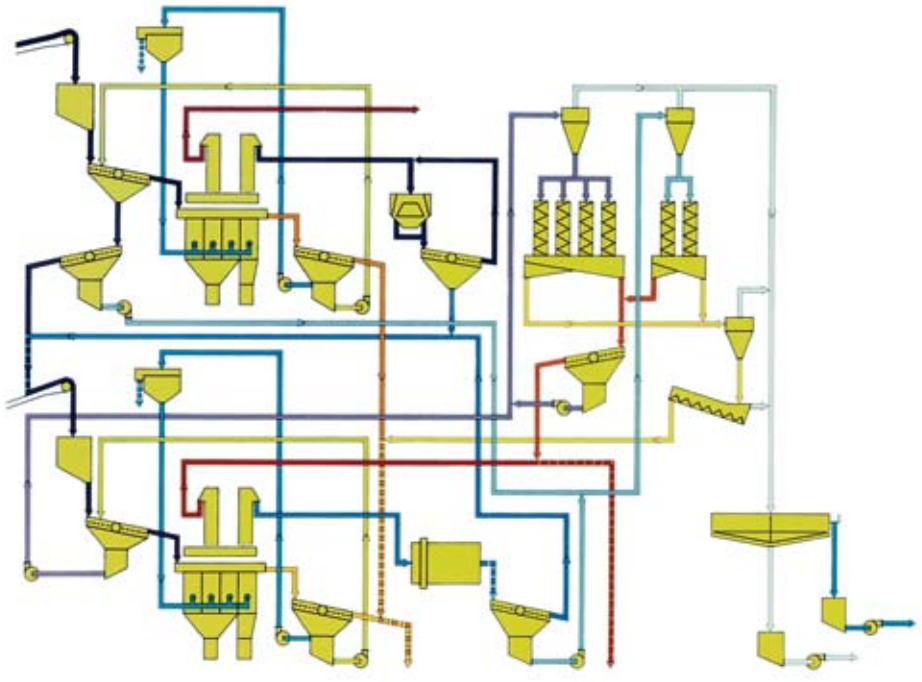


Typical plant layout section

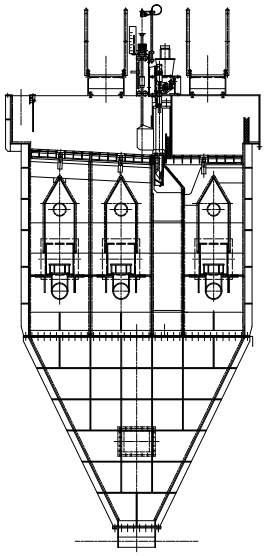


Typical block diagram

Jig plant for iron ore, South Africa



BATAC Jig for iron ore / typical flowsheet



Typical fine ore BATAC Jig with 1 cut-point

BATAC® JIG
ORE AND SLAG PREPARATION

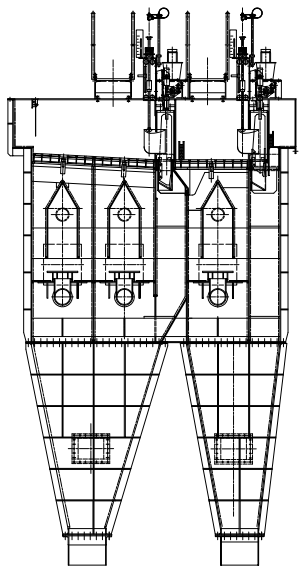
The quality requirements laid down by the mineral industry for raw materials to ensure efficient furnace operation are becoming increasingly more stringent.

Extensive experience gathered in Australia, China, Brazil, India, Russia and South Africa has proven that jigging of fine and lump ores as well as of metal from slag recovery is the most effective and economical process to beneficiate ores and recover metal from slag of different types.

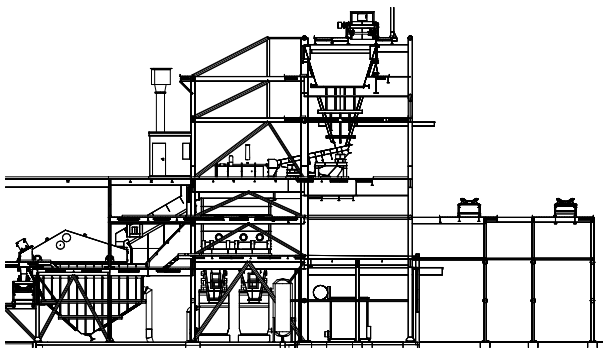
In general, the beneficiation of ores and slag is carried out into two major size range groups: a lump fraction anywhere between 45 to 6 mm, and a fine fraction anywhere between 10 to 0.5 mm. For both size ranges processes based on single cut-point and double cut-points per BATAC Jig are very common in the industry.

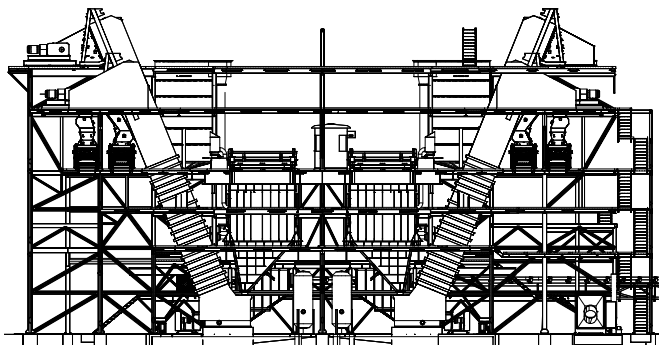
The separation cut-points for all ore/slag type BATAC Jigs can range from 1.3 kg/dm³ to 7.85 kg/dm³.

Rapid detection of changes in the raw material, quick reaction to such changes and easy operation of BATAC Jigs provide the highest level of reliability in a vast variety of applications.

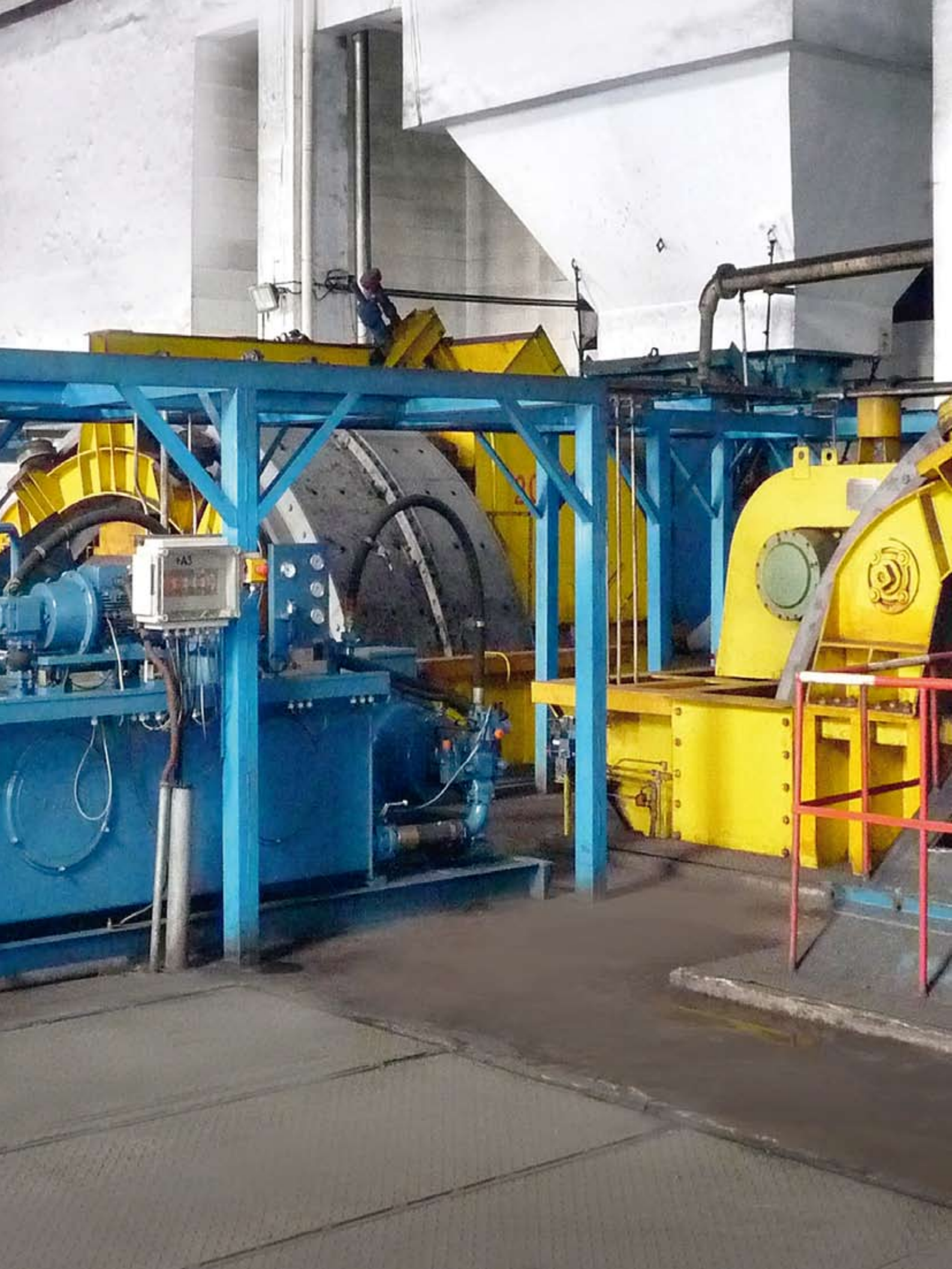


Typical lump ore BATAC Jig with 2 cut-points

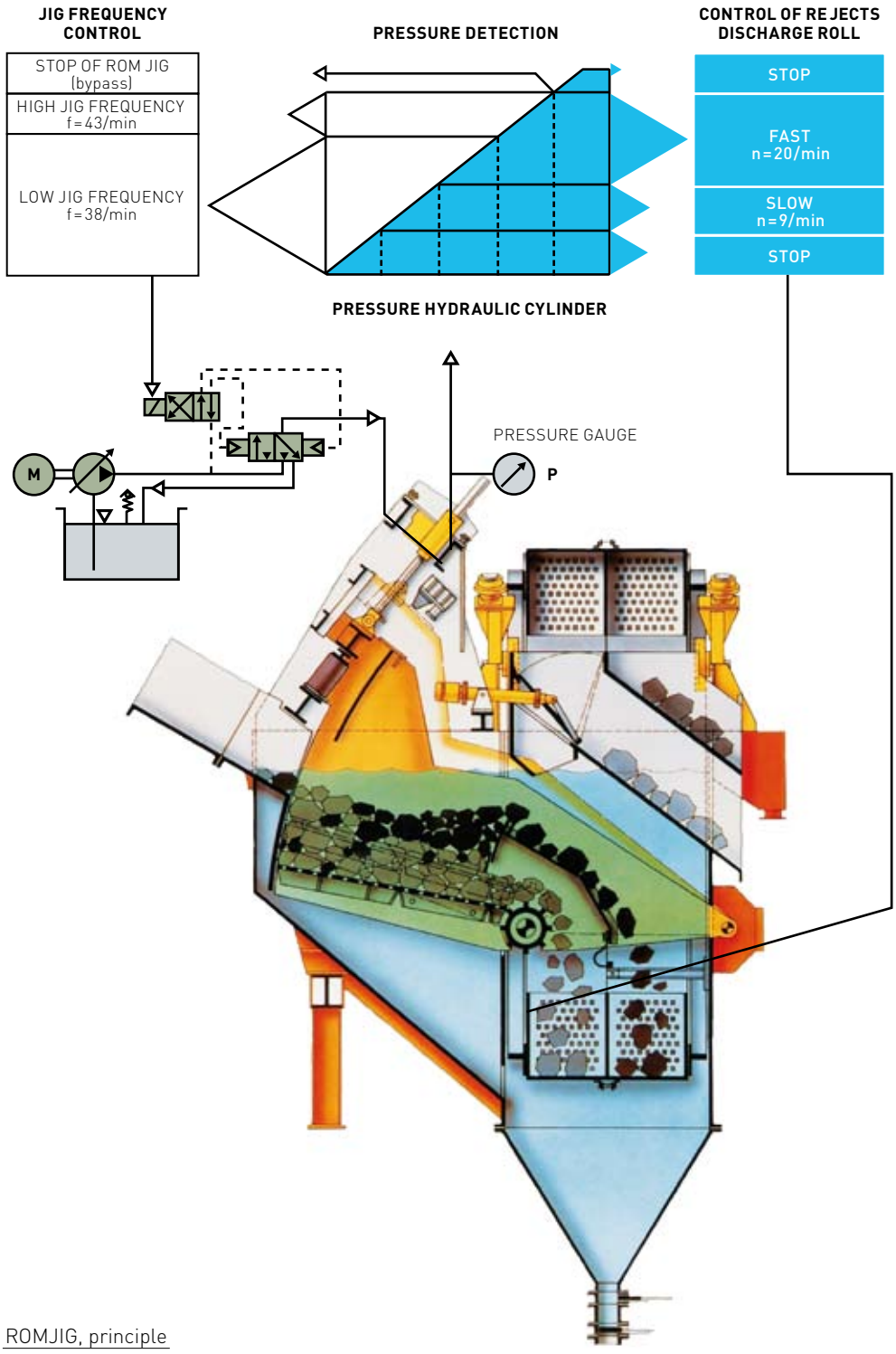




Layout of a typical lump and fine ore plant, using BATAC Jigs



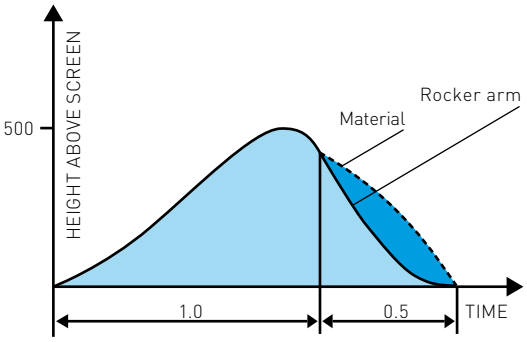
ROMJIG plant for run of mine coal, China



ROMJIG, principle

In jigs with movable screens, the grain mixture is loosened and straitfied after mechanical lifting of the mixture, i.e. in the course of the material's free fall (see pulsation diagram shown). Coarse-grained material mixtures of 400 – 30 mm size can thus be separated into a light and a heavy fraction at low specific operating cost.

The movable screen jig is a single-cut machine developed for primary separation of rejects from the coarse raw coal of 400 – 30 mm size. The applications of the ROMJIG have been extended to include e.g. preparation of steam coal and the cleaning of coarse-grained rubble.



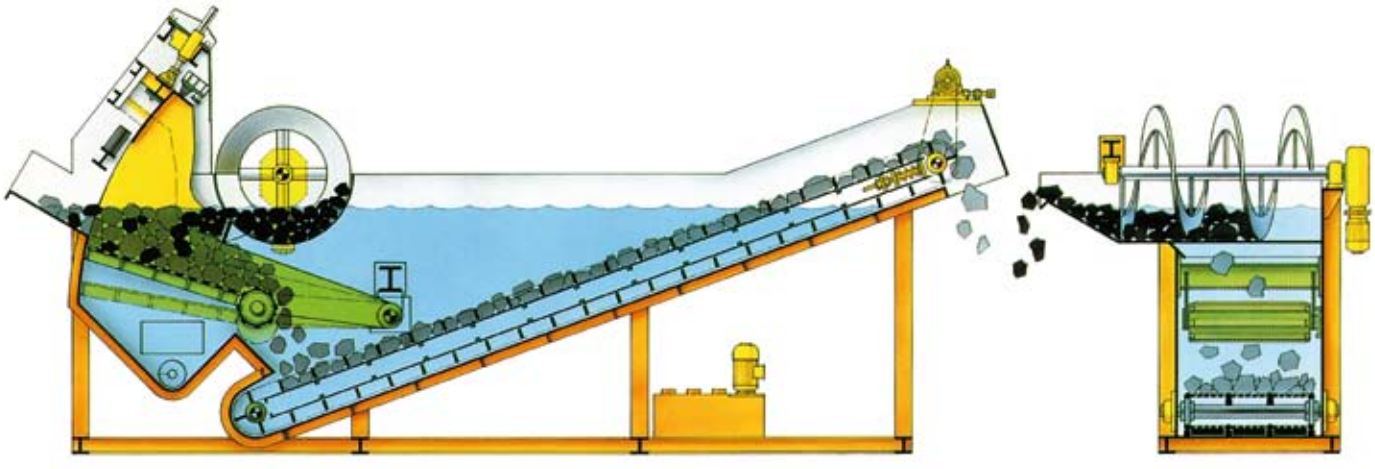
Pulsating diagram of the jig

Jigging takes place in a water bath. Loosening of the feed required for separation is achieved by lifting and dropping of a hydraulically moved rocker arm. The rocker arm movements and the slope pressure result in material transport. The rejects are discharged by a discharge-roll that has the effect of a retaining edge. The hydraulic pressure applied during the upward movementof the rocker arm reflects the reject layer thickness that has accumulated on the rocker arm. This value is used as a controlled variable for the discharge-roll velocity. The separated coal is transported over a chute incorporated in the rocker arm. The two products, i.e. rejects and coal / middlings are discharged and at the same time de-watered by a twin-type bucket elevator.

The fines dropped through the screen plates in the hutch are directed to fine-grain separation over a gate. The water discharged through the gate is recycled. Therefore, only the water bled off with the products needs to be replenished.

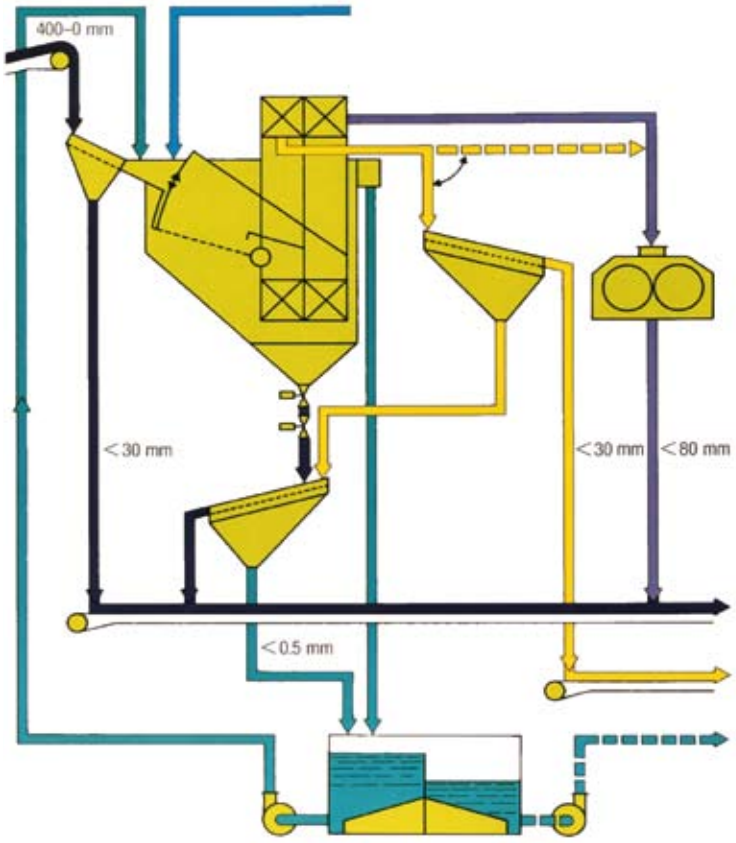
The ROMJIG movable screen jig for processing coarse-grained raw materials has a large potential of future applications. It is highlighted by major advantages, such as absence of hutch water clarification, low water and energy demand and small number of ancillary equipment. Therefore, it outrivals any other method of mechanical refuse separation.

A flat version of the ROMJIG for underground use is under research. This ROMJIG will be equipped with a chain conveyor for rejects discharge. It withdraws the rejects from the water bath and de-waters them at the same time. The light fraction is collected in a trough at the overflow and discharged to the side over a large-volume spiral conveyor. The hutch product is withdrawn from the hutch with a screw. It can be lifted and dewatered by a small bucket elevator.



ROMJIG for undergound use

ROMJIG, Bina, India



Typical ROMJIG applicator flowsheet

ROMJIG® JIG
PRIMARY REJECTS SEPARATION

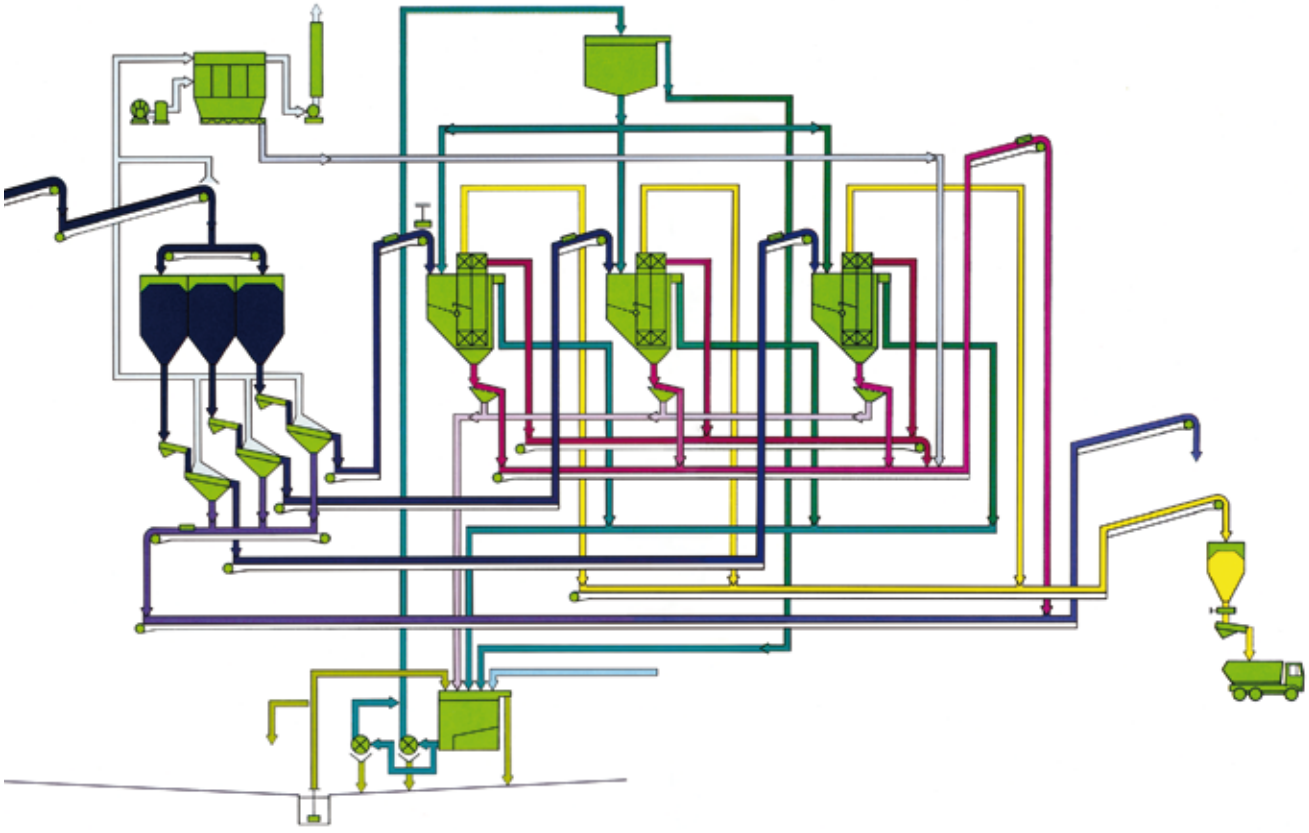
The first ROMJIG was successfully tested under harsh operating conditions during continuous operation in Emil Mayrisch, a German hard-coal mine.

The ROMJIG of the new generation with a jig width of 2.0 m separates the rejects at a purity of more than 95 % by weight (+1.9 kg/dm³) even at heavily fluctuating raw-coal feed rates and heavily fluctuating rejects portions in the feed. The rejects yield is >90 % by weight.

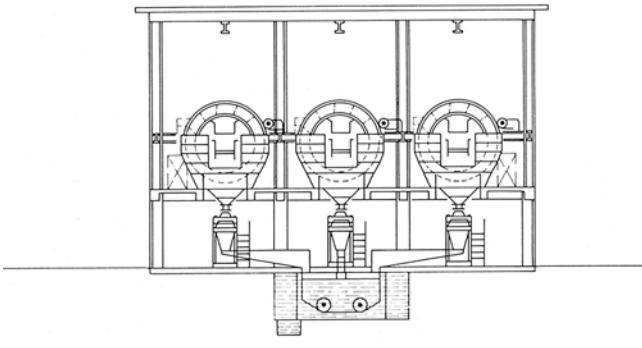
The ROMJIG operates in a closed water circuit without requiring additional clarification of the water. Only the water discharged with the products needs to be replenished. Consequently, the specific water demand is no more than 0.03 m³/t. The specific energy demand amounts to 0.2 kWh/t. The ROMJIG offers several advantages for the following preparation process:
- because of the homogenization of the raw coal the utilization of the down-steam process stages is optimal,
- less comminution of the fines,
- reduced ash content,
- reduced wear of machinery and equipment,
- reduced specific energy demand – as the coarse fraction has previously been separated.

The rejects separated in ROMJIGs can be stored in mined-out cavities to alleviate numerous impacts on the enviroment.

ROMJIG installation, China



Flowsheet for steam coal production, India



GA of ROMJIG installation for steam coal production, India

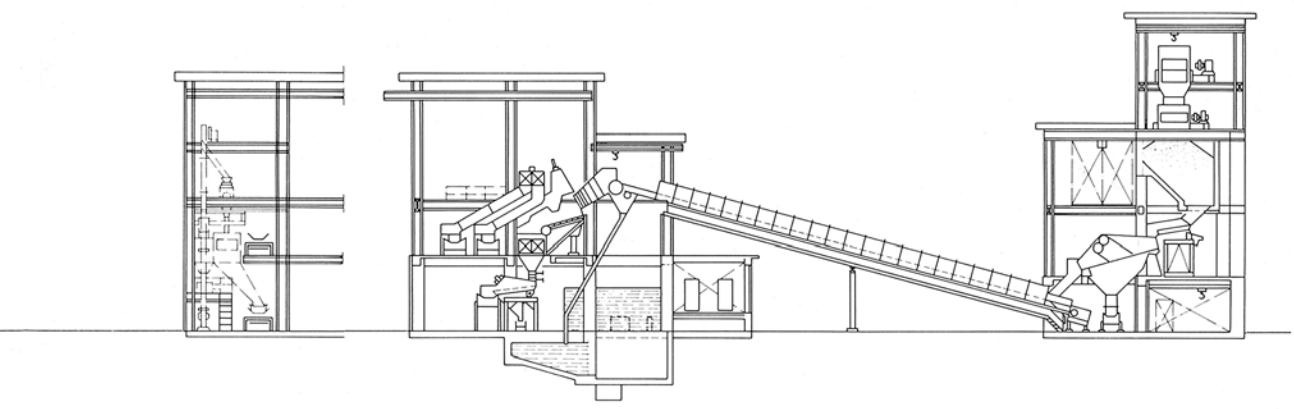
ROMJIG® JIG
PRODUCTION OF STEAM COAL IN INDIA

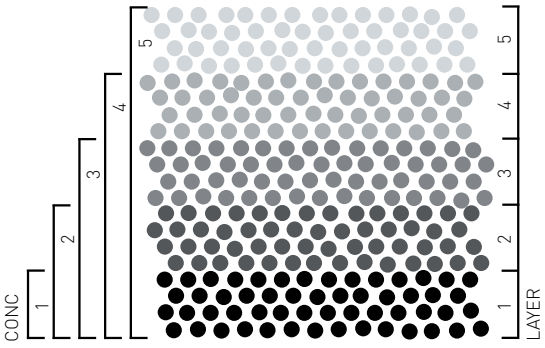
The movable screen jig ROMJIG can be used efficiently in many countries for the preparation of steam coal which in the past was fired as raw coal. The ROMJIG process reduces the specific transport cost to the power plant. The power plant is supplied with raw material of increased, constant calorific value. Moreover, wear in the boiler house is reduced.

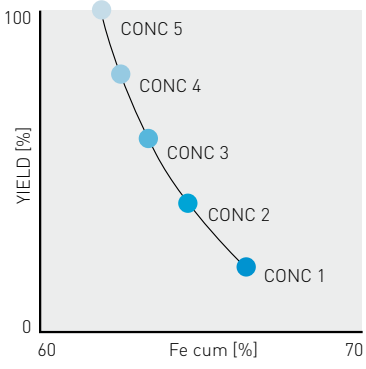
The raw coal of 45 % ash won by open-cast mining in Bina/India is crushed to minus 400 mm size in the central crushing system and screened at 30 mm. The coarse fraction (400 – 30 mm) is directed to three ROMJIG units operating parallel to be separated into a heavy and a light fraction. The light fraction (-1.9 kg / dm³) containing 31 % ash and the raw coal of 41 % ash content are delivered as a mixed product of 34 % ash to the power plant.

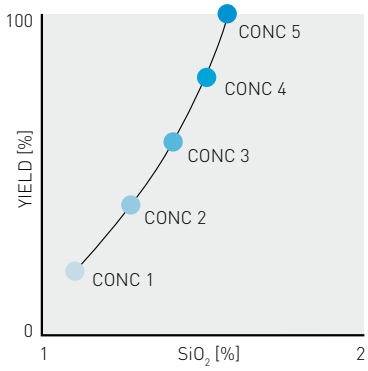
PRODUCTS	WEIGHT (% BY WEIGHT)	ASH (%)
Light fraction 400 – 30 mm – 1.9 kg/dm³	53.0	31.1
Raw coal 30 – 0 mm	24.0	41.0
Steam coal 400 – 0 mm	77.0	43.1
Rejects 400 – 30 mm + 1.9 kg/dm³	23.0	81.0
Raw coal 400 – 0 mm	100.0	44.9

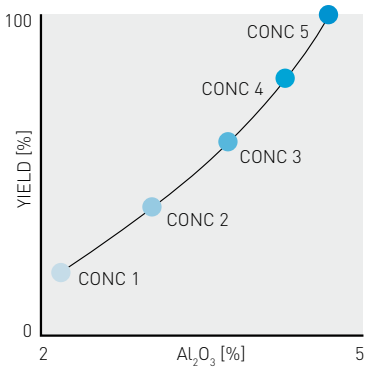
The ROMJIG process results in a coal product of constant total ash concentration and thereby allows optimal power plant operation.

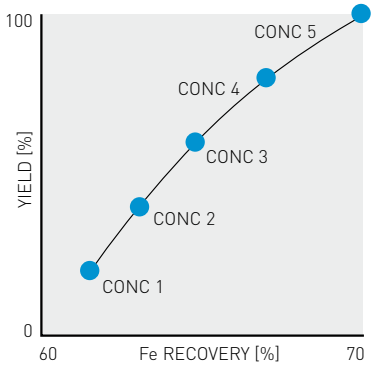


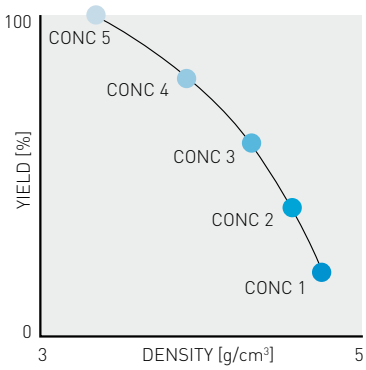




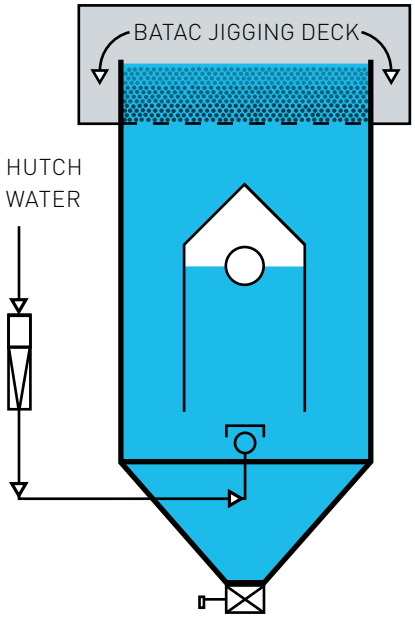








Typical test results are normally shown as a relation between weight and chemical components.



Pilot BATAC Jig for stratification tests

TECHNICAL DATA

Batch filling:	50 – 125 ltr.
Bed width:	0.5 m
Bed length:	1.0 m
Working air:	4 m³ (max.) 1.6 bar (abs.)
Frequency:	40 – 120 strokes / min
Hutch water:	20 m³/h (max.)
	1.8 bar (abs., max.)

In order to ensure that up-scaling data is as reliable as possible, we believe that the process conditions in a pilot scale trial should truly represent the industrial scale. This is why our pilot jig is dimensioned just like a compartment of its "big brothers" for continuous operation, enabling equal pressure conditions and stroke dynamics. Furthermore, the large jigging area allows an unbiased material setting behavior.

Our pilot BATAC jigs are built as an one-chamber version with 1 m length and 0.5 m depth for batch stratification tests. The design facilitates tests of all different kinds of lump ores as well as fine ores and coal. For ores, the top size feed material is limited to (max.) 40 mm. The total bed height for testing should not exceed 180 mm material for lump and 160 mm for fine material per test and reflects in a representative batch test with 100 – 120 kg of sample.

With the jig's own PLC the number of strokes per minute as well as the stroke profile can be exactly adjusted to match the jigging stroke to the specific requirements of the material tested. Furthermore, working pressure and the volume of hutch water can be set according to the test program.

Hence, the results you can expect from a test work series on your ore will provide a sound base for your project planning. Besides benefiting from our staff's extensive experiences in calibrating the right process conditions, the trials will help you to:

- ascertain separation results,
- attain a reliable estimation of achievable grades and yields,
- decide on jig layout with respect to jigging deck design and dimensioning and
- fix the jigging strategy and nominate the jigging parameters, such as range of stroke number and stroke design.

A simplified illustration of product curves excerpted from an exemplary iron ore test work is shown on the previous page.

MBE COAL & MINERALS TECHNOLOGY GMBH
FORMERLY HUMBOLDT WEDAG COAL & MINERALS TECHNOLOGY GMBH

Gottfried-Hagen-Str. 20, 51105 Cologne/Germany
Tel +49 221 99892 700, Fax +49 221 99892 709
info@mbe-cmt.de

MBE Minerals SA Pty. Limited
36 Wankel Street Jet Park Boksburg 1459
PO Box 8460 Elandsfontein 1406/South Africa
Tel +27 11 397 4660, Fax +27 11 397 4411
info@mbe.minerals.com

McNally Humboldt Wedag Minerals India Pvt. Ltd.
Ecospace Campus, 3rd Floor, -2B, 11F/2
New Town Rajarhat, North 24 Parganas Kolkata 700156/India
Tel +91 33 66281111/30141111, Fax +91 33 30141212/1213
gm@mbecl.co.in

MBE Minerals Processing Technology Beijing
c/o KHD Humboldt Wedag International Beijing Office
25 A CITIC Building, 19 Jianguomenwai Dajie, Beijing China 100004
Tel +86 10 6500 4101, Fax +86 10 6500 8623
zhang_ls@humboldt-wedag.cn

MBE Coal & Minerals Technology GmbH
Representative office in Moscow
Myasnitskaya str, bld.1 24/7, Office 108, 101000 Moscow
Tel +7 495 625 1844, Fax +7 495 989 4125
ninel.doronina@mbe-cmt.com

MBE Minerals Processing do Brasil Ltda.
Rua Rio Grande do Norte No. 1560 – sala 701 e 702
CEO. 30.130.131 Belo Horizonte, MG/Brasil
Tel +55 31 91582407
luiz.carlos@mbe-cmt.com

MBE Cologne Engineering GmbH
Dillenburger Str. 63, 51105 Cologne/Germany
Tel +49 221 99892 600, Fax +49 221 99892 619
info@mbe-ce.com

McNally Bharat Engineering Company Limited
Head Office
Ecospace 11F/12, Old Plot No. AA II/Blk 3, New Town Rajarhat
North 24 Parganas Kolkata 700156/India
Tel +91 33 6628 1111/3014 1111, Fax +91 33 6628 2277/3014 2277
mbe.corp@mbecl.co.in