# High recovery jigs

# Mineral dressing and gravity concentration

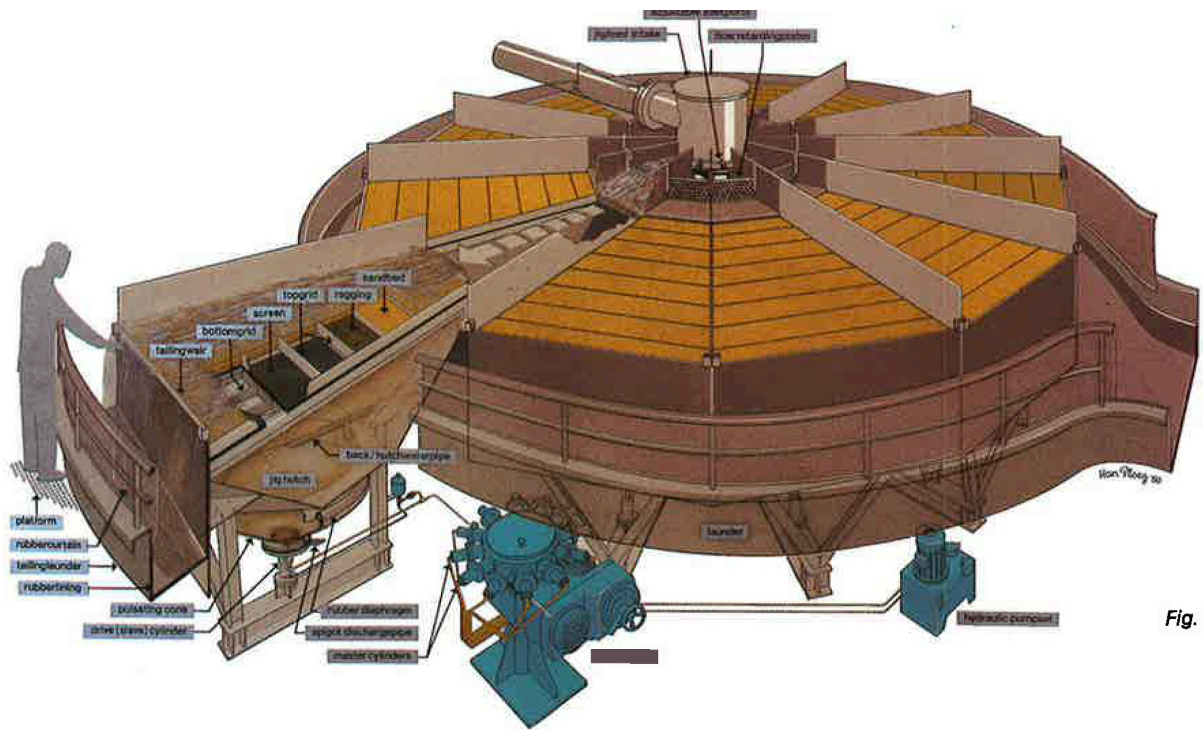



*Fig. 1*

**Mineral dressing is a necessity in practically all mining operations in order to process the mined ore to marketable products. Of the various mineral dressing methods, gravity concentration is a simple and widely used process to separate mineral grains of different specific gravities, and its usefulness has been proven for centuries. In fact, nature has given the example by creating alluvial, eluvial and residual ore deposits, in which gravity separation has played a dominating role. Man has copied nature in this process of concentrating the valuable specific heavy minerals by using sluice boxes, (called palongs in Malaysia) and by using hand tools such as the gold pan, dulang or batea. From these simple devices numerous gravity concentrating machines have been developed, of which the jig can be considered as the most versatile.**

## JIG

The most commonly mineral dressing jig is a mechanical gravity concentrator that effects the separation by applying water pulsations to the jig bed. Essentially the jig is an open tank filled with water, with a horizontal metal or rubber jig screen at the top and provided with a spigot at the underside for concentrate draw-off. The jig bed usually consists of a layer of coarse, heavy particles, the ragging, placed on the jig screen, and the mixture of sand and mineral particles (sand bed), fed as a slurry on top of the ragging, also penetrating into the ragging.

The slurry feed flows across the ragging and the separation takes place in the jig bed so that grains with a high specific gravity penetrate through the ragging and screen to be drawn-off as concentrate, while the light grains are carried away by the crossflow to enter the next jig tank (cell) or to be discarded as tailing (see figure 2).

The jig is a remarkable concentrator with the capability of handling large tonnages and thereby coping with widely fluctuating loads, not only in volume but also in pulp density and grain size.

It can take feeds coarser than 25 mm and as fine as 0.06 mm and will concentrate a wide range of minerals such as diamonds, gold, cassiterite (tin), scheelite (tungsten), magnetite (iron), etc.

The conventional jig consists of a combination of square or rectangular tanks (jig cells) and the pulsation of the jig bed is caused by an eccentric-driven diaphragm. The harmonic movement obtained by the eccentric drive is supplemented by a large amount of continuously supplied hutch (make up/back) water into the tank, thus enhancing the upward and diminishing the downward velocity of the water (fig. 3).

**Modern developments**
**I - IHC JIG Drive**
The addition of hutch water, the quantity of which far exceeds the spigot discharge draw-off, increases the cross flow velocity over the jig bed. While the coarse and heavy grains will pass rapidly through the bed, the fine sand lighter minerals take more time to settle into the bed and with the accelerated cross flow these fine grains remain in suspension and a large percentage will be lost with the discarded tailing. IHC Holland has undertaken theoretical and practical research into the design and performance of mineral dressing jigs. Lengthy and far reaching studies and tests were carried out by IHC. These resulted in the development of a greatly improved jigging cycle, where the harmonic motion of the conventional eccentric-driven jig is replaced by an asymmetrical 'saw-tooth' movement of the diaphragm with a rapid upward-followed by a slow downard stroke.

Fig. 3 shows the pulsator displacement versus time (a) of a harmonic drive, and the resultant water flow velocity through the bed, taking into account the back water flow (b).

It is clear that the upward flow takes most of the jig cycle, and the downward (suction) flow takes place only over a relatively short part of the time.

Similar curves for the IHC drive are given in fig. 4. it is apparent, that now the suction stroke, during which the fine particles are being drawn into the bed, is much longer and more constant. The upward flow rise is steeper accounting for a more effective bed dilatation.
This unique stroke pattern usually obviates the need of the continuous supply of hutch water in primary (rougher) jig duty; in some cases supply of a nominal quantity of make up water to compensate for spigot discharge draw-off is advisable.
A sampling on an IHC 12 module jig installed on a tindredger demonstrated that the IHC drive mechanism attained an over 95 percent recovery.

After the development of the optimal stroke-time pattern, a mechanism had to be designed which was able to provide this pattern, and which would give reliable performance under the severe conditions prevailing on mineral dredgers and in mines.
IHC Holland now offers two alternative possibilities to perform this task: a mechanical drive and a mechanical-hydraulic drive system.
Each system has its own features, and the choice which drive system to use will depend on the number of hutches to be operated.

One or two hutches will be driven by the mechanical drive system, while jigs halving more than two hutches will be driven by the mechanical-hydraulic drive system.

*IHC Mini Module*

**Power requirements:**
The mechanical and mechanical-hydraulic drives have a considerably lower power consumption per driven hutch than conventional drive systems.

**Flexibility of stroke and frequency adjustment:**
The mechanical and mechanical-hydraulic drives have a continuous speed regulation feature; for changing the stroke the jig must be stopped to adjust or change the cam.

**Stroke pattern adjustment:**
The mechanical and mechanical-hydraulic drive characteristics can be changed over a very wide range, and also almost any type of curve can be provided.

**Installation and service requirements:**
The mechanical and mechanical-hydraulic systems can be installed and serviced with normal technical skill and care.

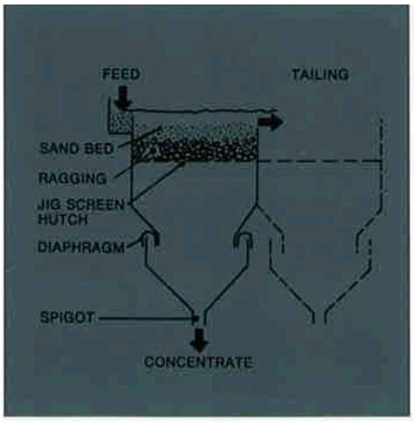



*Fig. 2* *Basic outline of a JIG*

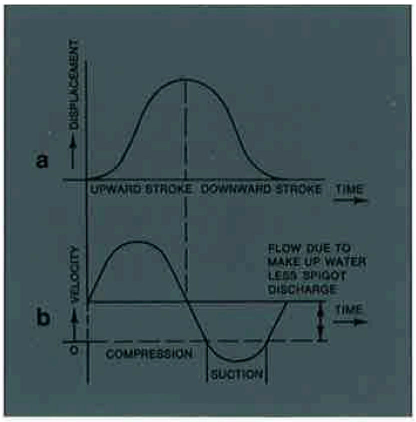


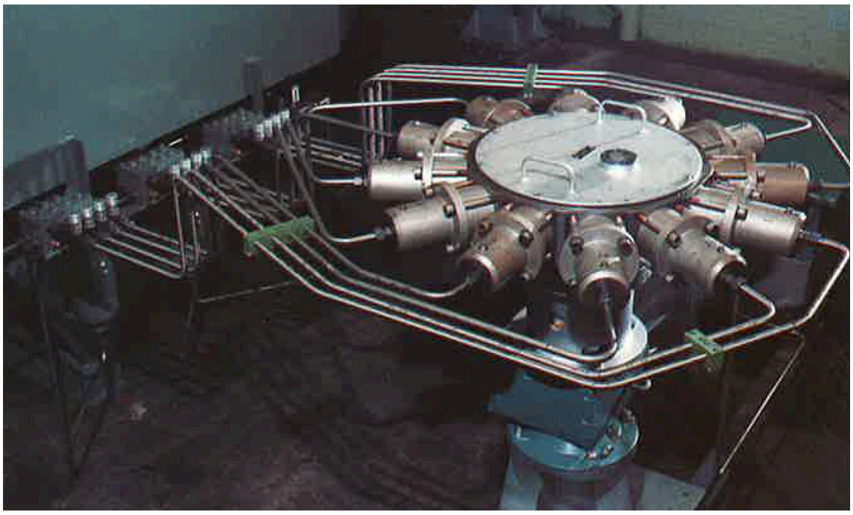

*Fig. 3* *Eccentric drive characteristic*

**II - Circular JIG**

The conventional jig as described earlier mostly consists of square or rectangular tanks combined to form 2, 3 or 4 cells in series.
To compensate for the increase of crossflow velocity over the jig bed, caused by the addition of hutch water or back water, trapezoidal-formed jigs were developed as the enlarging of the bed area towards the tailing end reduces the cross flow.

A logical sequence to the trapezoidal jig was the circular or radial jig, by arrang-ing the trapezoidal jigs as sectors of a circle. The feed enters the jig in the center and flows radially over the jig bed towards the tailing side at the circumference (fig. 5).
This circular jig concept has been in use in Indonesia for several decades with varying success, a problem sometimes being the even distribution of the pulp flow over the circumference. Main advantage of the circular jig concept is that it provides the potential for a large handling capacity in a single unit, with a single feed point, thus practically eliminating the need for a compli-cated splitting system necessary in treatment plants with a large number of conventional jigs.

The combination of the circular jig and the IHC pulsating pattern has resulted in he IHC-Radial Jig, which combines the advantage of both these major developmens of the jigging process. The drive mechanism is essentially mechanical and thus easy to under-stand for operation personnel. Hydraulics are only used to transmit motion to the individual pulsators.



The function of the hydraulic part is very comparable to the brake system of a car, and thus requires similar care and maintenance. The success of the IHC jig is best illus-trated by the fact that it has been instal-led on most newly built dredgers in Malaysia and Thailand since 1970, when this jig was designed. It was further installed in plants for separating gold, diamonds, iron ore, etc. The jig has been successfully used on onshore and offshore dredgers and mines.

**The advantages of the IHC Radial JIGS are:**

- Reduction of pulp flow velocity over the jig bed.
- Good pulp distribution over the total jig area.
- Significant reduction, of hutch water requirement.
- Increased handling capacity per unit of jig area.
- Low power pulsing mechanism. In terms of dredge design and operation these features mean:
- Simplified distribution system.
- Ability to handle coarser feed material.
- Improved recovery of fine grains.
- Improved performance under over-load conditions.
- Smaller total treatment plant area.
- Reduced total height of treatment plant.
- Reduced running cost because of no or minimal hutch water requirement and low power jig drive.

**III - Module JIG**

The first circular jigs were of relatively small size not exceeding 4 m in diameter. The benefits of the circular form become more pronounced at larger diameter jigs. This is the reason why IHC Holland supplies standard circular jigs up to 7.5 m (25') diameter. However, for transportable or semi-permanent installations the large size and weight can be a disadvantage. Therefore, IHC Holland has developed the module jig concept, which provides the building blocks for a dismountable large capacity jig.

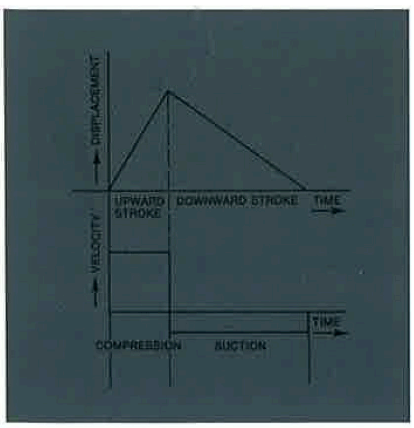



*Fig. 4* *IHC-Drive characteristic*

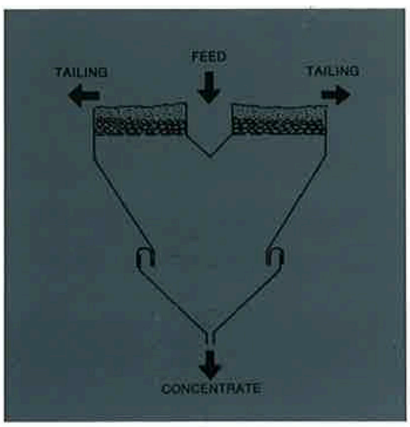



*Fig. 5* *Basic outline of a circular JIG*

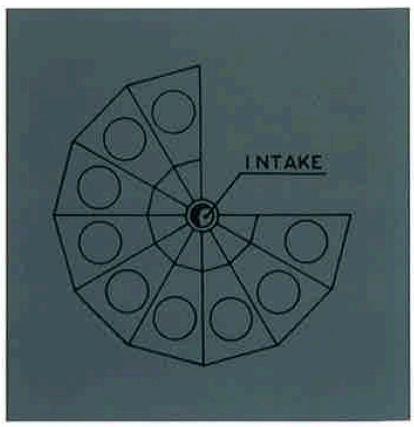



*Fig. 6* *Possible arrangement for 9 Module JIGS*

Twelve modules arranged in a circle make one 7.5 m diameter jig. Other arrangements are possible, such as in groups of 2 or 3, however, the circular arrangement has the advantage of one feed intake point and minimal requirement of floor area. For a smaller throughput less modules can be used, such as a 9 module unit. These 9 modules can also be arranged in a circle to form a radial jig with an outside diameter of 7.8 m (25') with a central feed intake and platform space between the modules (see fig. 6).

*12 Module IHC JIG ready for commissioning*

The specific advantages of this module jig concept are:

- Transportability
- Lighter construction weight.
- Flexibility in number and arrangement.
- Standard bed length.
- Easier maintenance and repair by shut-down possibility of each module independent of the others.

**IV - IHC Drive system for rectangular jigs**

IHC Holland also supplies rectangular jigs which can be used as secondary and tertiary stages, with circular primary jigs, for cleaner duty to achieve the required concentrate grade, making enrichment the the required concentrate  grade, making enrichment the primary factor and recovery being of secondary importance.

**IV - IHC Drive system for rectangular jigs**

IHC Holland also supplies rectangular jigs which can be used as secondary and tertiary stages, with circular primary jigs, for cleaner duty to achieve the required concentrate grade, making enrichment the primary factor and recovery being of secondary importance.

Besides, the performance of existing jig plants with a large number of rectangular primary jigs can be improved by replacing the present jig drives with the IHC drive systems.

**Summary**

The purpose of this brochure is to give a brief survey of modern jig develop¬ment, which may be summarized in the following points.

- The jig pulsation pattern, developed by IHC is superior to conventional patterns in eliminating or reducing hutch water requirement and improved recovery capability of the fine valuable minerals.

- The large diameter IHC-Radial Jigs have definite advantages for the primary or rougher stage, as they permit simplification of the feed distribution system.

The table shows the IHC program of mineral jigs; detailed information on the various types is available upon request. IHC Holland experts are

| Type designation | | micro | super micro | mini-mod. | 1 mod. | 2 mod. | 3 mod. | 4 mod. | 5 mod. | 6 mod. |
|---|---|---|---|---|---|---|---|---|---|---|
| Total jig bed area | (m²) | 0.25 | 0.56 | 1.15 | 3.2 | 6.4 | 9.6 | 12.8 | 16 | 19.2 |
| | (sq ft) | 2.7 | 6 | 12.4 | 34.4 | 68.9 | 103.3 | 137.8 | 172.2 | 206.7 |
| Cells per jig | | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 5 | 6 |
| Power installed | (kW) | 1.5 | 1.5 | 1.5 | 2.2 | 4.4 | 5.5 | 5.5 | 7.5 | 7.5 |
| * Capacity range | (m³/hr) | 1-2 | 2-4 | 6.0-15 | 15-23 | 30-46 | 46-69 | 60-92 | 75-115 | 92-138 |
| | (cu yd/hr) | 1.5-3 | 3-5 | 8-20 | 20-30 | 40-60 | 60-90 | 80-120 | 100-150 | 120-180 |
| Type designation | | 7 mod. | 8 mod. | 9 mod. | 10 mod. | 11 mod. | 12 mod. | RH-1 | RH-2 | RH-3 |
| Total jig bed area | (m²) | 22.4 | 25.6 | 28.8 | 32 | 35.2 | 38.4 | 1.15 | 2.30 | 3.45 |
| | (sq ft) | 241.1 | 275.5 | 310 | 344.5 | 378.9 | 413.3 | 12.4 | 24.8 | 37.1 |
| Cells per jig | | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| Power installed | (kW) | 7.5 | 7.5 | 9.2 | 9.2 | 9.2 | 9.2 | 2.2 | 4.4 | 6.6 |
| * Capacity range | (m³/hr) | 105-161 | 120-184 | 138-207 | 150-230 | 165-253 | 180-267 | 6.0-15 | 8.0-18 | 10-20 |
| | (cu yd/hr) | 140-210 | 160-240 | 180-270 | 200-300 | 220-330 | 240-350 | 8.0-20 | 10.5-23 | 13-26 |

* Capacity in solids througput per hour depends on specific gravity of minerals to be separated, amount of fines, pulp dilution, required recovery and ratio of concentration, etc. Please consult IHC Holland for your specific problem.