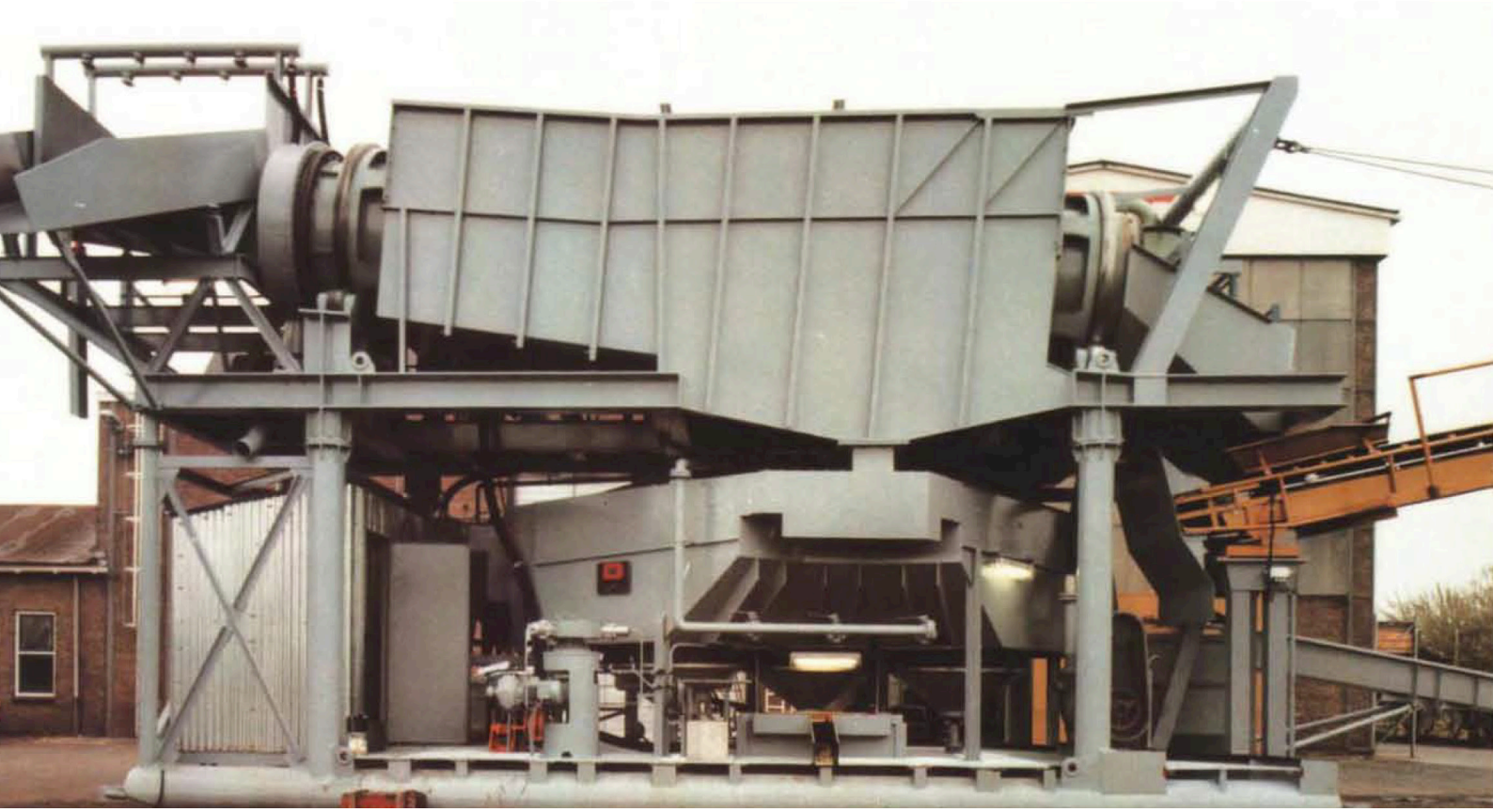
IHC Mining



IHC jig versus other gravity separators

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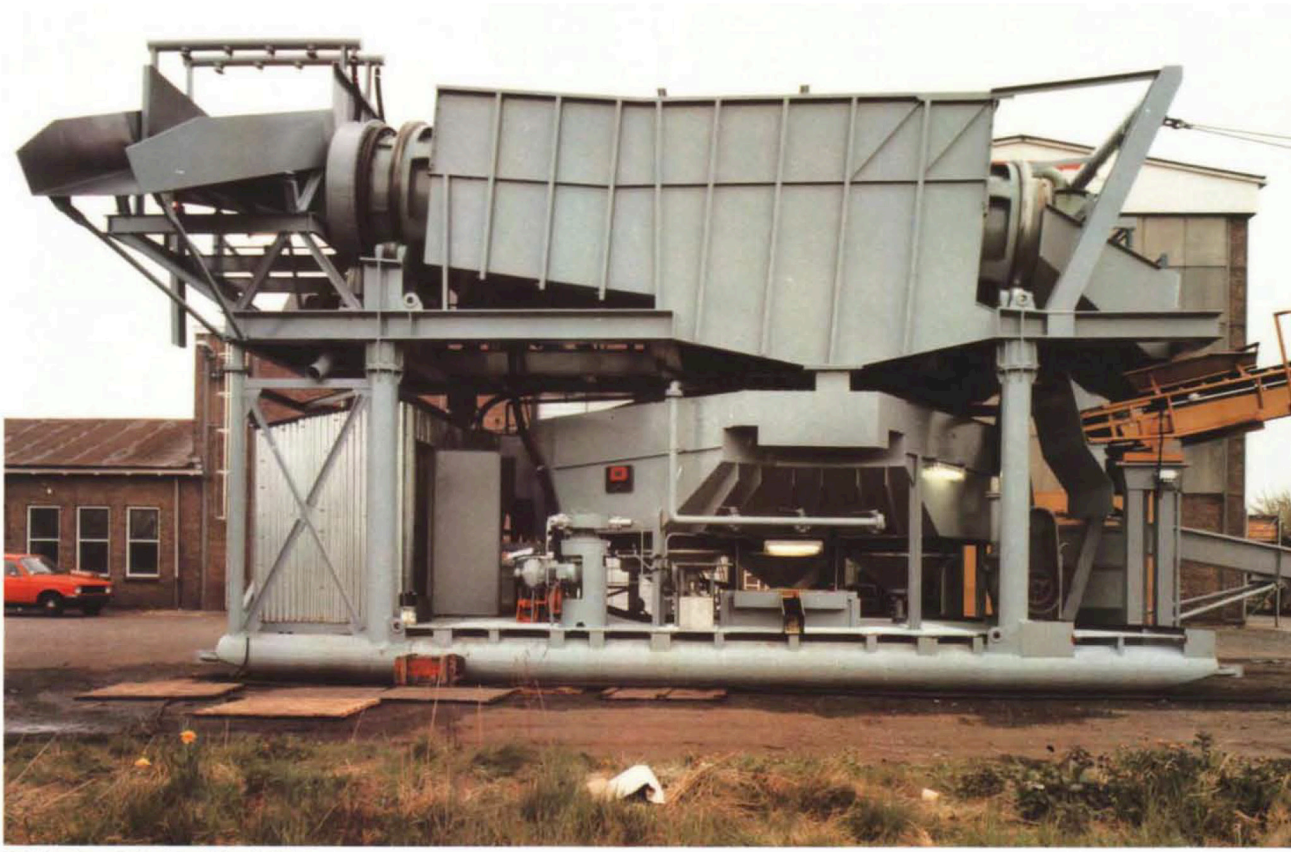


Gold treatment plant ready for delivery

Gravity separators

It is astonishing how wide a variety of machinery is being offered for gravity separation. This started with ground sluices and later developed into numerous devices, each claiming to be the answer to a particular separation problem.
For wet gravity concentrators, the applicability of the most common types pertaining to the particle size range is indicated in Fig. 1.

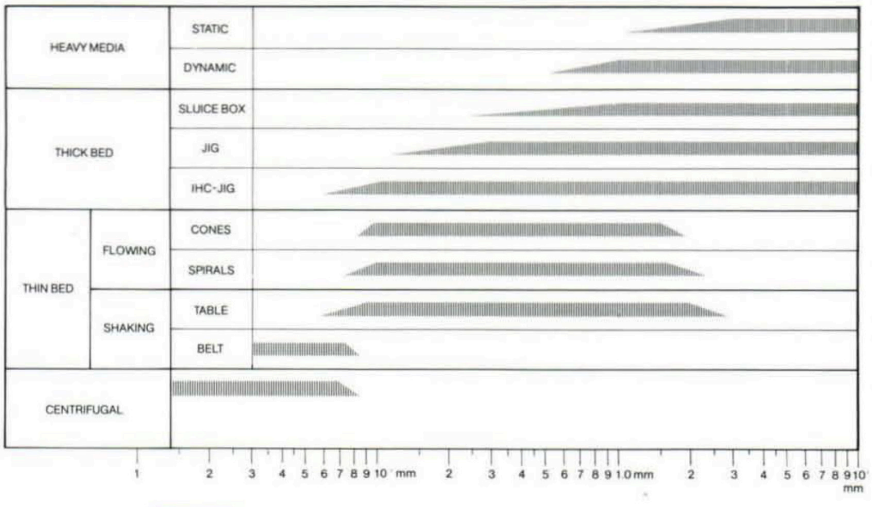
For the normal alluvial deposits (also referred to as placers) with the valuable minerals (gold, cassiterite, monazite, rutile, etc.) at a size range of 0.05 to 5 mm, the thick and thin bed separators should be considered for the beneficiation process.

Thick-bed versus thin-bed separators

Gravity separators can be classified according to the thickness of the solids (sand) bed where the separation takes place.

Obviously, the most familiar and widespread manifestations of the thick-bedseparator are the sluice box and the jig. The most important advantage of the thick-bed separator is the "accumulator"effect produced by the multilayer sandbed. A mineral particle entering the bed has a much longer retention or residence time than is the case in a "thin film" separator. This feature makes the thick-bed separator less sensitive to fluctuations in the feed. A sluice or a jig can treat a wide range and can tolerate fluctuations in feed capacity (transient over-feeding and periods of under-feeding), as well as variations in grade of the valuable mineral or mineral constituents. Dilution of the feed slurry is not critical.

Fig. 1. Diagram showing wet gravity separators' operating size range



The above characteristics make these separators the survivors in the mine washing plants, on land or onboard a dredger, as they are the true victors in the perennial battle against a multitude of other separating devices, however ingenious these may be. It cannot be denied that thin-film gravity concentrating devices (as termed by Burt and Mills) or flowing-film separators have their merits, especially in recovering the very fine particles, but these sensitive separators are best installed and used in closely supervised plants with well-controlled feed conditioning.

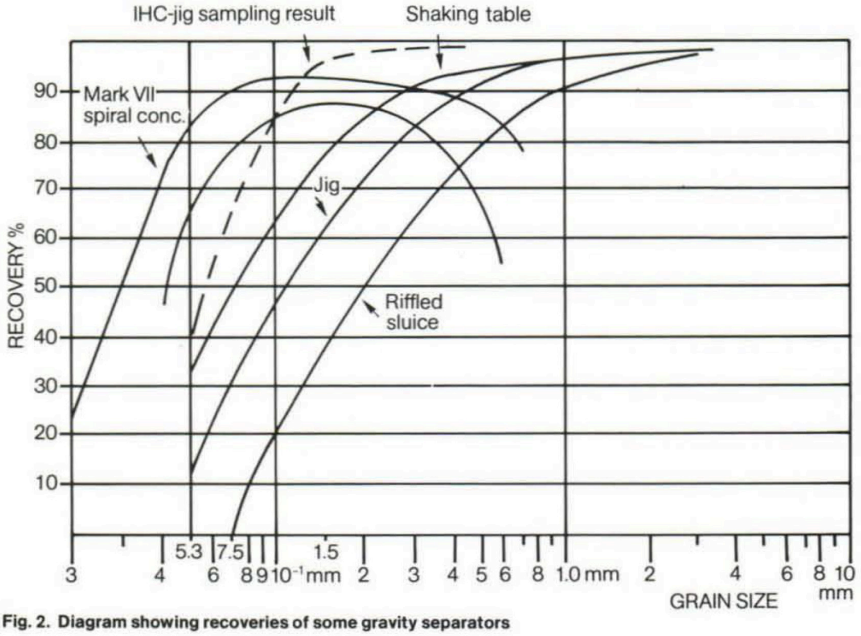


Fig. 2. Diagram showing recoveries of some gravity separators

Spiral

The spiral separator has been improved considerably since its invention by 1.B. Humphreys in 1943. The present modern spirals (Reichert, Vickers, Carpco, Budin, etc.) have varying through-profiles, making less use of wash-water and no longer have troublesome product removal ports. The optimum operating range is increased from 1.4-0.1 mm to 1.4-0.05 mm. However, a spiral is a thin-film separator and is therefore sensitive to feed fluctuations (quantity, dilution, grade). Moreover, the maximum grain size treatable is limited to less than 2 mm. It is therefore doubtful whether spirals can be used for primary separation (rougher) duty for other than heavy minerals (beach sand) mining. Most probably spirals can complement jigs in recovering the fines lost in the jig tailings and/or thickening tank overflows. Of course, the jig tailings should then be screened first at 1.5 or 2 mm; furthermore, cyclone thickening of the feed prior to the spiral is mandatory.

Mono jig plant in gold exploration project

Fig. 3. Sluice boxes treating tin ore

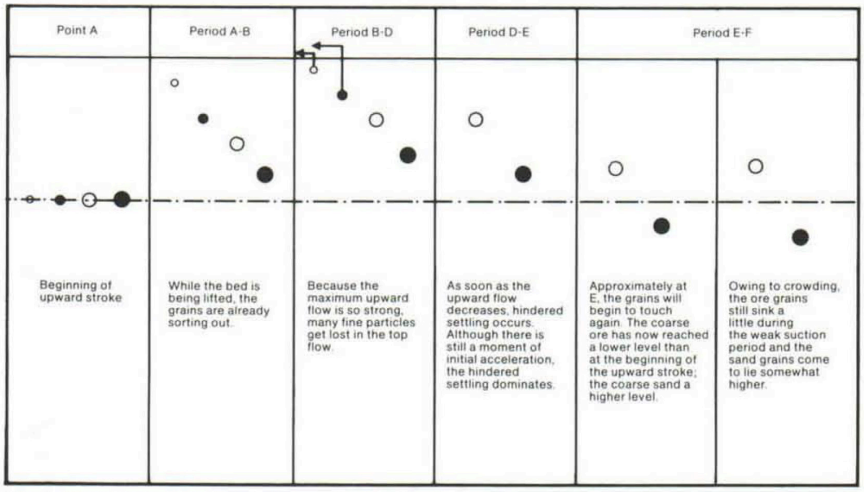


Fig. 4. Pictorial representation of harmonic form jigging cycle

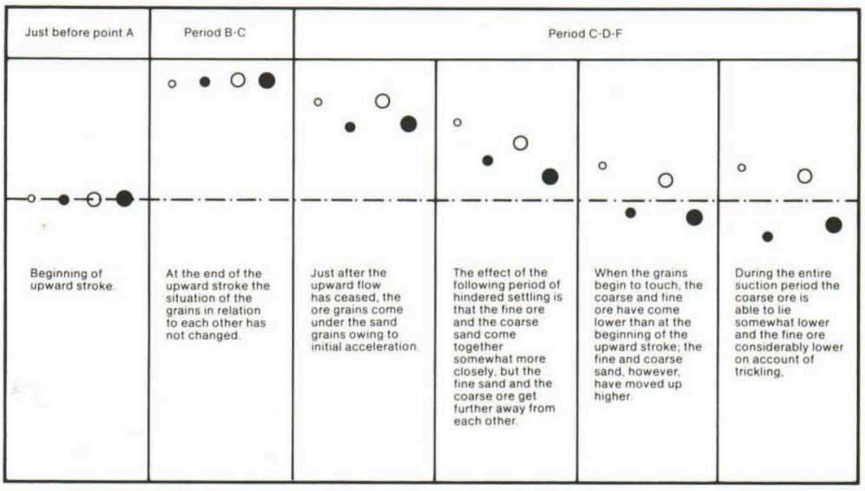


Fig. 5. Pictorial representation of IHC sawtooth characteristic jigging cycle

The possible additional recovery is shown in Fig. 2. Depending on the amount of these fines, it has to be decided whether it is worthwhile to invest in this complementary spiral circuit. After 2 years' spiral plant operation at the Indonesian tin mine of Tambang Timah in Belinyu it was concluded that: The employment of a spiral in Tambang Besar Sumedang II to re-treat tailings still containing fine-grained cassiterite of 200 mesh is effective only as an implement to check appropriate or poor jig performance, or whether the performance of palongs is suitable or not."However, as a production tool to recover fine cassiterite, it has proved to be inap-propriate, observing the poor yield of cassiterite and the low tin content, so that to increase its content to 70% (ready for export) at the tin shed, there will be substantial losses and much time taken up due to the repeated process".
(Pudjohartono Darusman at Intern. Sem. of Mining Technique for Alluvial Tin, 1poh 1984).

It should also be noted that the additional recovery by spirals in regard to IHC jigs for the fine grains is substantially less than when conventional jigs are used. Another warning is also appropriate in gold recovery, as flat, flaky gold can be lost more easily when it is swept into the higher velocity area at the periphery of the channel.
(Donald J. Cook; Conf. on Alaskan Placer Mining, Fairbanks 1979).

Sluice box

The sluice box, in its various forms, is still being used around the world. Fig. 3 depicts the treatment of tin ore by this method. Despite the ubiquitous use of sluice boxes, the wastefulness of sluicing has been recognized for quite a long time. Quite a few mining experts predicted the early demise of the sluice box. The con-census was expressed by Reaburn in an article in the Mining Magazine of March 1928: This is somewhat premature, but there is one thing certain and that is, that the simple sluice box with the human agitator, though it has served the mine well in the past, is now proving too wasteful for use in working poor ground."

Losses in a sluice box vary according to the nature of the ore treated and the expertise and opinion of the operator. Donald J. Cook cites loss figures for gold sluices of 10-20% and 15-40%. Thai officials estimate tin losses in a sluice box at 6-25%, but one paper even describes a negative recovery (more tin going out than coming in) when filling of the sluice box is prolonged without cleaning. Although it appears that sluicing is not yet extinct, it stands to reason that the additional recovery by jig justifies the replacement of sluice boxes by jigs.

Conventional jigs and the IHC jig

A jig is a gravity concentrator in which separation takes place in the thick sand bed, dilated to induced water pulsations. There are numerous types and models of jig, and a multitude of theories to explain the jigging process. The limitation of jigging studies as aptly described by Kelly and Spottiswood: "Jigging is probably the most complex gravity separation, because of its continuously varying hydro-dynamics. The mineral bed is repeatedly moved up by the water, expands, and then resettles, the resettlement occurring with the water flowing down at a lower rate (because of the addition of hutch water) than that which occurred on the upstroke. It follows that the wave form itself must be a significant parameter; the manner in which the bed expands is important, too, because it has a marked effect on the particle dynamics.

A number of experimental studies have been reported in the literature, but too often they fail to contribute to the understanding of jigging. This conflicting information appears to arise because many studies were carried out on a narrow set of ideal conditions that resulted in behaviour quite unlike that associated with practical jigs". Simply put; Jigging works with an intermittently dilated bed; correct dilation or bed expansion is vital for good separation.

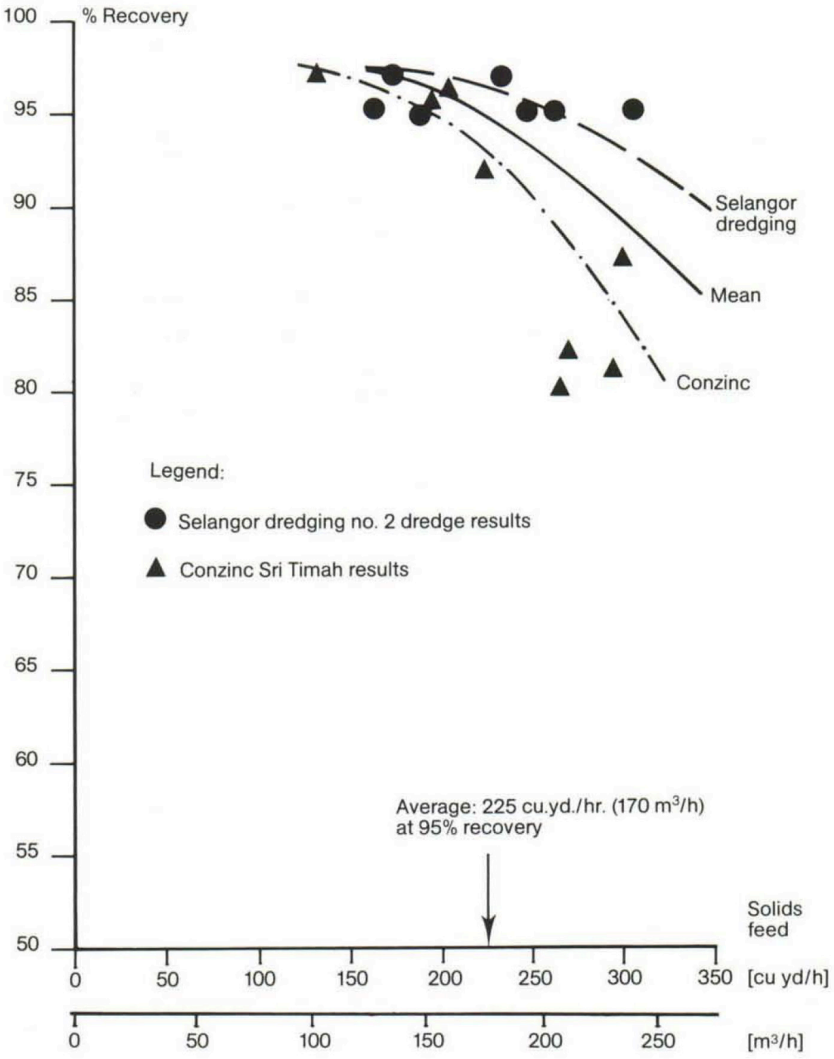


Fig. 6. Diagram showing IHC jig recovery for different capacities

Hydraulic driving cylinder IHC jig

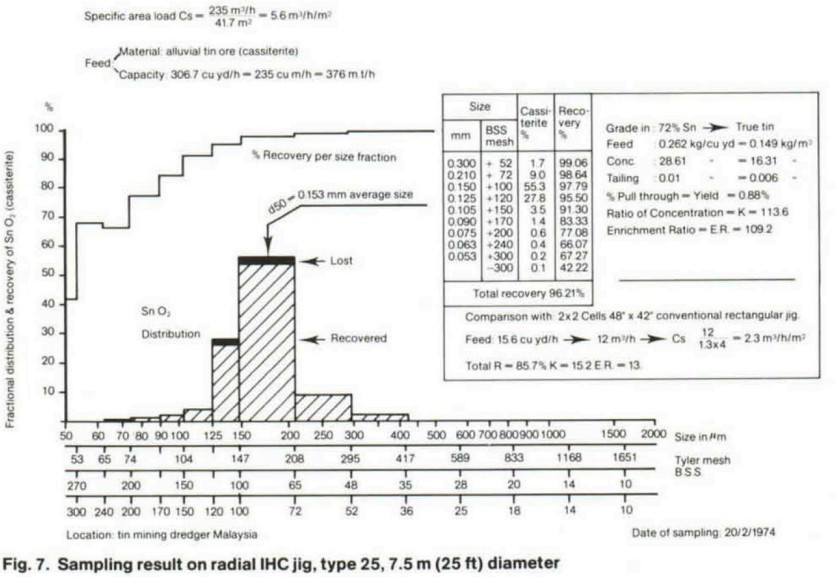


Fig. 7. Sampling result on radial IHC jig, type 25, 7.5 m (25 ft) diameter

A conventional jig, operated with an eccentric drive mechanism, causes a harmonic wave form. The IHC jig employs a special shaped cam drive system which produces a fast upstroke -slow downstroke (sawtooth) pattern, The effect of the above jigging characteristics on various grains during a complete jigging cycle is visualized in Figs. 4 and 5. The proof of the IHC jig's good performance on tin ore has been demonstrated on the Malaysian jumbo dredgers (Fig. 6). One outstanding sampling result is shown in Fig. 7, in which the recovery rate for each size fraction is shown.

It should be noted that a conventional jig had a much lower recovery figure when operating simultaneously on the same dredger and at less than half the specific area load. The high specific area load capability at an acceptable recovery rate results in the dramatic difference in treatment plant layout with IHC jigs compared with a conventional treatment plant configuration, as shown in Fig. 8.

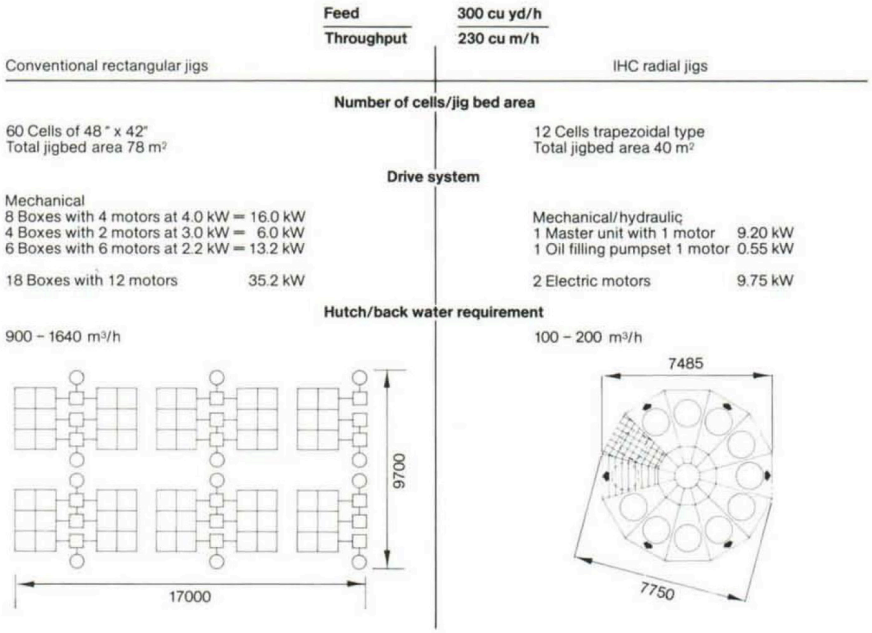


Fig. 8. Dramatic difference in treatment plant layout with IHC jigs as compared to conventional jigs

Six-module jig plant during testing