The Recovery of Lode Gold in Jigs

II: Selection and operation of these machines

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THE first question about the installation of a jig is whether the jig will be a profitable investment. This should be carefully investigated before purchasing one, but too often is not. The determining factors are the per cent of the total values which will be recovered in the jig, the differences between the price paid for gold in bullion and for gold in concentrate, the cost of jig operation, and the decrease in tailings value. The first of these may be determined by using the proposed testing method, the second decided after examining smelter schedules, the third (which is dependent chiefly upon the price of the jig) may be estimated closely, and the fourth can be determined by flotation or cyanidation tests on jig heads and jig tailings. An example of such a calculation is given below.

Water—The distribution of water in a mill circuit is another problem which is often important in jig operation. The amount of water which can be admitted through the hutch sometimes limits the size of jig. If too much water is added at the jig, the dilution in the classifier overflow becomes too great and it becomes impossible to overflow the proper size. In the range of pulp dilution used in most mills, the lowering of the pulp density decreases viscosity and hence only small particles are carried over the classifier lip. Aside from classification difficulties, a low pulp density is undesirable in flotation. Recommended hutch water required for jig operation is shown in Table III.

An example of the calculation of water distribution in a mill circuit is given on the opposite page.

Launders—The design of the launders approaching the jig is an important factor usually overlooked. If the pulp flows evenly and slowly without turbulence, the heavy minerals will tend to concentrate in the lower part of the pulp. If this flow continues over the jig bed, without dropping over a step which would disrupt it, the heavy minerals come in contact immediately with the most active part of the bed, and hence may be efficiently treated. If the approach launder and jig bed surface are turbulent, heavy particles may be carried across the jig by a rapid current without being subjected to the action of the bed. The argument that turbulent flow is necessary to prevent loss of gold by surface flotation is not valid. Such a loss can be prevented by a horizontal strip across the approach launder or in the jig itself at the top of the pulp stream to hold back floating particles until they are settled.

Bed—Some operators report an extremely erratic amount of material in the hutch. This is probably caused by a faulty bed. Unless the jig bed is kept active and uniform, it is impossible to secure a satisfactory ratio of concentration. When a jig is first placed in operation, it may take several hours or a day to develop a good bed of heavy minerals even though a considerable amount of shot is used as a base. Meanwhile, an excess of sand will settle into the hutch. After a good bed has been built up, the best jigging conditions obtain. As operation continues, tramp iron and copper collect on the jig screen and fine sulphide particles become locked in the interstices until eventually jigging action is considerably hampered or prevented altogether. Even over a period of eight hours the bed becomes tight and impervious in spots.

For these reasons it is customary to stir or rabble the bed once every eight to twenty-four hours and to clean the screen once every two to four weeks. If an ore is deficient in sulphide minerals, it may be necessary to add some clean minerals to the bed, when operation is begun again, to aid in the development of a good bed. If a very large proportion of the ore is coarse

Example of Economic Jig Recovery

Assume:

V_b = price received for gold bullion (deductions made for mint charges and express) = \$34.80/oz.

V_c = price received for gold in concentrates (deductions made for treatment, penalties, freight) = \$30.80/oz.

h = mill heads assay = 0.15 oz./ton

T = tonnage each day = 100 tons/day

L = labor cost of jig = \$4.50/day

C = capital cost of jig (\$3,000, interest and sinking fund, for four years at 4% and 2%) = \$2.33/day

M = operating cost:

maintenance	\$0.02	
mercury	0.40	
power	0.36	
	0.78	= \$0.78/day

total cost = \$0.076/ton or \$7.61/day

t_1 = tailings assay with flotation alone = 0.015 oz./ton

t_2 = tailings assay with jig in circuit = 0.014 oz./ton

Find:

R_e = minimum economic jig recovery

Saving each day = $R \cdot h \cdot T\,(V_b - V_c) + (t_1 - t_2)\,T \cdot V_c$

Cost each day = $L + C + M$

R is a minimum when saving = cost:

$$R_e \cdot h \cdot T\,(V_b - V_c) + (t_1 - t_2) \cdot T \cdot V_c = L + C + M$$

$$R_e = \frac{(L + C + M) - (t_1 - t_2) \cdot T \cdot V_c}{h\,T\,(V_b - V_c)}$$

For the above assumptions (100-ton mill treating \$5.25 ore)

$$R_e = \frac{4.50 + 2.33 + 0.78 - (.001 \cdot 100 \cdot 30.80)}{0.15 \cdot 100 \cdot (34.80 - 30.80)}$$

$$R_e = \frac{4.53}{60.00} = 0.0755 \text{ or } 7.55\%$$

Any jig recovery greater than 7.55% will increase profits for this example.

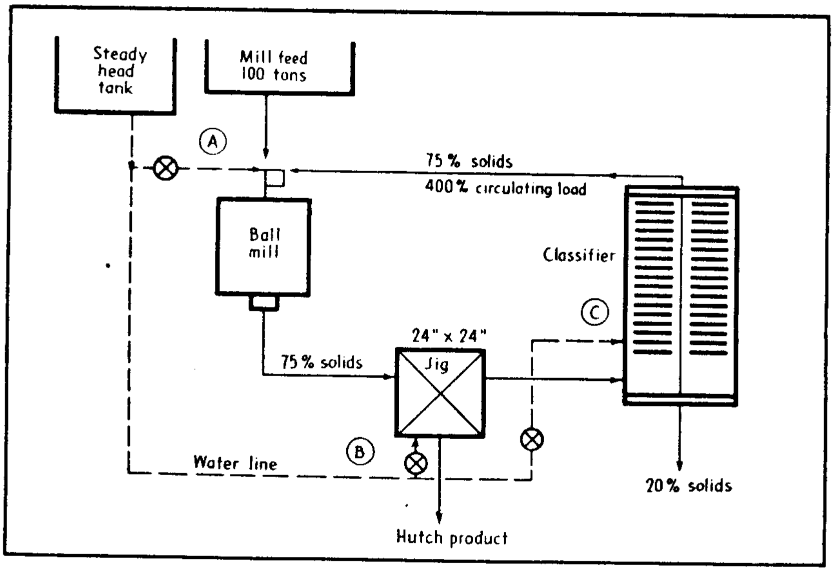

Fig. 9. . . . A flowsheet serving to illustrate the accompanying calculation of the distribution of water in a mill circuit. Points A, B and C are referred to in the text

Example of Calculation of Water Distribution in Mill Circuit

Assume:
- Feed = 100 tons/day
- Circulating load = 400%
- Classifier overflow dilution desired = 20% solids
- Classifier return = 75% solids

Find:
- Amount of water to put into circuit at points A, B, and C. (See Fig. 9.)

Calculations:

$$\text{Water removed at classifier overflow} = \frac{100}{0.20} - 100 = 400 \text{ tons/day}$$

$$\text{Ore passing over jig} = 100 + 400 = 500 \text{ tons/day}$$

$$\text{Water approaching jig} = \frac{500}{0.75} - 500 = 166 \text{ tons/day}$$

$$\text{Water in circulating load} = \frac{400}{0.75} - 400 = 133 \text{ tons/day}$$

Water to be added at A = 166 − 133 = 33 tons/day

If 15 gal./sq.ft./min. are needed for jig hutch (hydraulic jig), then, for a 24-in. jig

$$4 \times 15 = 60 \text{ g.p.m.} = \frac{60 \times 1440 \times 8.33}{2{,}000} = 360 \text{ tons/day}$$

Amount of water to be admitted at B = 360 tons/day

Amount of water to be admitted at C = 400 − 33 − 360 = 7 tons/day

Summary:

Water at A	33 tons/day	8,000 gal./day	5.6 g.p.m.
Water at B	360 tons/day	86,400 gal./day	60.0 g.p.m.
Water at C	7 tons/day	1,600 gal./day	1.1 g.p.m.
Total Water	400 tons/day	96,000 gal./day	66.7 g.p.m.

sulphides, it may be necessary to remove part of the bed at intervals to prevent the accumulation of too uniform or too deep a bed. A reasonable thickness (1 to 2 in.) of pulp should remain in teeter on top of the bed.

Amalgamation—This process is intimately related to jigging because it is usually used to recover the gold from jig concentrates. Unfortunately, it involves much hand labor. A continuous amalgamator makes the process considerably cheaper when enough material is being treated to make its use economically sound.

Grinding concentrates in batches is the usual practice. Small gold particles are released and consequently the recovery is greater. However, gold particles smaller than 700 mesh are amalgamated with difficulty, probably because they remain suspended in the pulp. The best grinding practice must be determined by trial, so as to release gold but not comminute the released particles.

If the gold is coated with rust, grinding a sandy concentrate usually scratches the gold particles so that they will amalgamate. It is sometimes expedient to mix jig and flotation concentrates for amalgamation. Grinding a sandy concentrate with mercury in an alkaline lime or sodium hydroxide solution will usually give good recovery in spite of the popular belief that flotation concentrate will not amalgamate.

Capacity—The capacity of a jig is determined chiefly by the width of the jig bed and to a less extent by the length. Most jigs are built as square units but are often used in tandem, the advantage being that the second unit can operate with different stroke, water and bed conditions, and so recover finer material. When two units are used in this manner, the capacity is largely governed by the size of the first unit. Because of the difficulty of evaluating the effect of the width and the effect of the length, the capacity of the jigs is generally expressed in terms of tons per square foot of jig-bed area for a certain period.

Placer sands are treated in open circuit, and both Bendelari and Pan-American mechanical diaphragm jigs can successfully treat as much as 60 tons per square foot per 24 hours.

The capacity of a jig in a closed circuit with some crushing or grinding machine is about the same, rating the capacity on the amount of new feed supplied to the circuit. The Pan-American pulsator jig is listed as being able to treat 40 to 50, the Titan jig 60 to 80, and the Denver jig 40 to 50 tons per square foot per day. If it is assumed that these jigs usually carry 500 per cent circulating load, they are actually handling material at the rate of 250 tons per square foot per day or more.

The indicated capacity of the mines studied in California varies from 12 to 36 tons of new feed in those mines which may be considered examples of good practice; the average of these mines is 26 tons, and of all mines is 36 tons per square foot per day. Almost all of these mines operated the jigs in closed circuit with a fairly large circulating load.

Mechanical Conditions—The average California practice for stroke and speed is shown in Table IV. The screen and shot sizes depend on the size of the concentrate desired. The

Table III—Hutch Water

Type	G.p.m. Per Sq. Ft. Bed Area
Conventional mechanical diaphragm jig.	5–10
Denver type rotary valve jig	2–5
Hydraulic diaphragm jig	12–25

Table IV—Stroke and Speed

Feed Size	3 Mesh to 20 Mesh	20 Mesh to 200 Mesh
Mechanical Jigs		
Stroke, diaphragm	⅜–1 in.	⅛–⅜ in.
Speed, strokes per minute	120–160	160–350
Hydraulic Jigs		
Stroke, valve	½–1 in.	⅛–½ in.
Speed, strokes per minute	250–400	400–600