

HYDRAULIC SLUICING.

Capacity of Sluices.

In sluices of similar character, as well as in other channels for the conveyance of water, the velocity of water is proportional to the square root of the hydraulic mean depth multiplied by the gradient.

In hydraulic sluicing as carried out at Kumara (the largest hydraulic-sluicing goldfield in New Zealand) the widths of the sluice-boxes are so regulated in claims that are properly worked that there is but little variation in the hydraulic mean depth of the sluices in use on the field. Such being the case, in the calculation of the velocity of the water in sluices at Kumara, or other places having alluvial wash of a similar character, the hydraulic mean depth need not be taken into consideration, and the velocity of water may simply be stated as proportional to the square root of the gradient. And as the power (or force) of water is proportional to the quantity (or weight) of the water, multiplied by the square of the velocity, and as the velocity is proportional to the square root of the gradient, then it follows that the power of water is directly proportional to the quantity of water multiplied by the gradient. This is only a modification of the well-known laws of water—the velocity of water is proportional to the square root of the hydraulic head, and the power of water is directly proportional to the quantity of water multiplied by the hydraulic head.

Experiment has shown that these laws are not only applicable to hydraulic heads, but also to gradients of sluices and other open channels; and, as the velocity of water from nozzles is proportional to the square root of the hydraulic heads, so velocity of water in sluices having uniform hydraulic mean depth is proportional to the square root of the gradients.

The following rule is in accordance with the laws of hydraulics, and its correctness has been checked by experiments and measurements made at Kumara, and by the experience of most of the hydraulic miners working on that field, extending over a period of several years. The rule gives the quantity (in cubic yards) of ordinary (Kumara) alluvial wash sluiced away per hour, in ordinary sluice-boxes, paved with wood (on end) blocks, with various quantities of water, on various gradients. The rule is: The quantity of water in sluice-heads multiplied by the fall in inches per box of 12 ft. gives the number of cubic yards sluiced away per hour:—

Examples.		
Number of Sluice-heads.	Fall per Box of 12 ft.	Quantity sluiced away per Hour.
10 heads ×	6 inches =	60 cubic yards.
8 " ×	8 " =	64 "
12 " ×	7 " =	84 "
14 " ×	8 " =	112 "
10 " ×	12 " =	120 "
12 " ×	14 " =	168 "

The number of cubic yards per hour required to be sluiced away, divided by the fall per box, gives the quantity of water required for that purpose.

The number of cubic yards per hour required to be sluiced away, divided by the number of sluice-heads of water available, gives the required fall per box.

The rule will give a close approximation of the quantity of ordinary alluvial wash that will be sluiced away in sluice-boxes paved with wood blocks, provided a proper use is made of the water, and the width of the box is in proper proportion to the fall, and quantity of water.

The nature of the material to be sluiced away must always be taken into consideration, as with material of high specific gravity and large quantities of spawled stone the quantity put through will be less, and with material of low specific gravity and well-rounded stones the quantity will be more. Wash is more easily sluiced when it contains a fair proportion of well-rounded stones, from 4 in. to 18 in. in diameter; and fine heavy wash is the most difficult: the stones keep the finer and heavier material from settling firmly on the bottom of the sluice.

All the blockages that occur at Kumara in the sluices there are composed of fine, heavy sand, and are seldom or never due to stones. It is necessary that the whole of the material in sluices should be constantly on the move, as otherwise blockages will occur, less material will be sluiced away, and gold will be lost.

As the parties running water and tailings into the main tail-races or channels have to pay a fixed price per shift of three hours for maintenance and repairs, it became necessary to devise some means of regulating the quantity of tailings sluiced by each party into the main tail-race. As the price per shift for each party was equal, it was arranged that each party should sluice an equal number of cubic yards of tailings into the main tail-race; and the trustees of No. 3 channel embodied in their regulations the following table for that purpose. The table was calculated so that each claim would sluice into the channel 64 cubic yards of tailings per hour, thus equalising the wear-and-tear, and giving each party equal advantage of the flush-water supplied free from the Kumara Race.

WATER.—Relative Quantities of Water for Hydraulic Sluicing for Various Falls per Box.

Fall per Box of 12 ft.		Number of Sluice-heads.	
1 in 48·00, 3 in. per box	...	21·33 sluice-heads.	
1 in 36·00, 4 in. "	...	16·00 "	
1 in 28·80, 5 in. "	...	12·80 "	
1 in 24·00, 6 in. "	...	10·66 "	
1 in 20·57, 7 in. "	...	9·14 "	
1 in 18·00, 8 in. "	...	8·00 "	
1 in 16·00, 9 in. "	...	7·11 "	
1 in 14·40, 10 in. "	...	6·40 "	
1 in 13·09, 11 in. "	...	5·81 "	
1 in 12·00, 12 in. "	...	5·33 "	