ISBN : 81-87053-53-4
Processing of Fines (2)
Eds. : P. Bhattacharyya, R. Singh and N. G. Goswami

Creation of column flotation cells of large volume chambers and their industrial applications

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ABSTRACT

The paper contains the information on the development and commercial use of a new generation of flotation pneumatic cells of large volume chambers. The description of a mechanism of a process technology, cells' design and some results of theoretical research are given.

Key words : *Flotation pneumatic cells, Design of flotation cell.*

INTRODUCTION

Flotation pneumatic column cells of 1.0, 2.5, 6.3, 10, 15, 20, 40, 60, 80 and 220 m^3 chamber volume for beneficiation of nonferrous metal ores, coal and other minerals have been created in Russia. The main cell parameters are given in Table 1.

EXPERIMENTAL

When selecting and substantiating a geometric form of new pneumatic flotation cells of large volume chambers it was taken into consideration that in most of flotation cells of a rectangular shape a flotation process proceeds in a volume closed in a cylinder and in this connection a pulp portion is out of aeration. So, preference was given to designing of a cylindrical shape of chambers both from a technological point of view of rational use of a chamber volume and manufacture simplicity and rational metal consumption.

A flotation cell (Fig. 2) is a cylindrical chamber made of steel sheet with a conic base having a 30-55°C taper angle. Aerators are made of elastic materials as perforated tubes, cylinders and rings.

A subsidiary washer aerator which is intended for starting a cell in operation under a load in case of its sudden long stop is installed in a bottom conic part along a cell axis.

Table 1. Technical characteristics of the tank-type pneumatic flotation machines developed by Gintsvetmet

Parameters	FP-1	FP-2.5	FP-6.3	FP-10	FP-25	FP-40	FP-80*)	FP-100*)	FP-220
Chamber capacity, m^3	1	2.5	6.3	10	25	40	80	100	220
Productivity by the pulp flow, m^3/min	up to 0.33	up to 0.62	up to 1.5	up to 4	up to 6	up to 10	up to 15	up to 20	up to 30
Chamber dimensions, mm:									
diameter	500	800	1200	2000	3400	3400	3400	3400	4500
height	5000	5000	5000	5200	3700	5200	11000	13000	16000
Excessive pressure at the aerator inlet, MPa	0.15	0.15	0.15	0.15	0.15	0.18	0.24	0.26	0.26
Power consumed by the motor (compressor) of the air blower, kW	-	-	-	14	25	40	70	75	100
Air flow rate per chamber (without airlift), m^3/min	Up to 0.5	up to 1.3	up to 3.2	up to 5	up to 10	up to 20	up to 40	up to 50	up to 110
Specific power capacity kW/m^3	-	-	-	1.4	1.0	1.0	0.87	0.75	0.49
Specific metal content, kg/m^3	580	440	343	320	232	180	150	140	118
Chamber mass, kg	580	1120	2160	3200	5800	7800	12000	14000	26000

*) The machine can operate the countercurrent, cocurrent and cross movement modes of the pulp and air.
The technical characteristics presented will be specified in the course of long commercial testing on different types of the raw materials.
The machines may be useful as apparatuses for preparing the pulp prior to flotation.

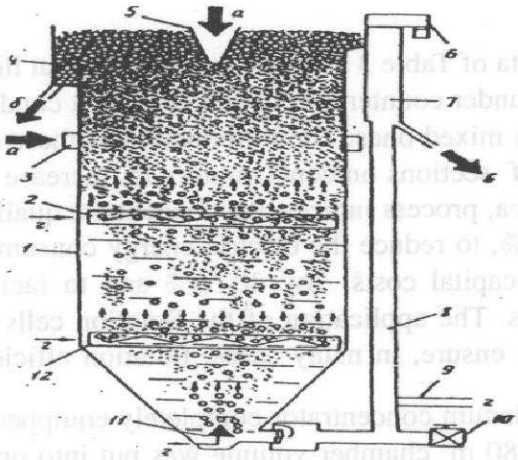

Fig. 1 : Schematic diagram of the flotation machine

a - feed; b - concentrate; c - tailings; d - air; 1 - body; 2 - upper tubular aerator; 3 - feed collector; 4 - chute; 5 - froth baffle plate; 6 - actuator; 7 - pulp level control; 8 - discharge collector; 9 - airlift; 10 - discharge valve for the chamber product; 11 - washer-type aerator; 12 - lower tubular aerator

Cell charging with initial feed can be realized in the center of its top part, along periphery as well as in a combined way. In this case a correct selection of a pulp flow direction relative to a direction of bubble movement with respect to liquid is of great importance. A froth product (concentrate) is discharged by gravity in a ring-shaped chute through a froth overflow threshold. A cell products is discharged through discharge devices (a valve box and gate pocket) thereby a pulp level in a cell is maintained. The control of the consumption and pressure of the air fed to aerators (dispersers) allows to control secondary pulp mineralization, the quality and yield of a concentrate. The cell is equipped with a system of automatic control of a pulp level and air consumption. Countercurrent, cocurrent and mixed conditions of cell operation are possible. Cocurrent conditions - movement of liquid and bubbles in one direction, countercurrent - movement of liquid and bubbles in reverse direction and mixed - interperpendicular movement of bubbles and liquid. To evaluate the influence of above conditions on the flotation efficiency a general case of the movement of a bubble and a particle in pneumatic flotation cell has reported earlier[1].

RESULTS AND DISCUSSION

Commercial tests with pneumatic column flotation cells of large volume chambers have been carried out and results are given in Table 2, as was reported in the literature[11].

Analysing the data of Table 3 it is possible to state that higher process indices have been obtained under countercurrent and cocurrent conditions of pulp movement as compared to mixed ones. The introduction of these cells has allowed to reduce a number of sections on concentrators to, increase specific capacity by a unit of the floor area, process indices, the concentrate quality by 1.2 -2.0 times, the recovery-by 1-2%, to reduce the electric energy consumption up to 0.4 kwh per ton of ore and capital costs - by 30-35% and to facilitate the service of flotation departments. The application of the flotation cells in addition to operating equipment can ensure, in many cases, flotation efficiency.

A copper-molybdenum concentrator completely equipped with column flotation cells of 10 and 80 m^3 chamber volume was put into operation in Russia in 1989.

Table 2 : Commercial tests and introduction of pneumatic column flotation cells of large volume chambers

Pulp movement conditions	Products	Yield, %	Metal content, g/t	Metal recovery,
Countercurrent	Concentrate	8.1	26.2	85.2
	Tails	91.9	0.4	14.8
	Initial	100.0	2.49	100.0
Cocurrent	Concentrate	12.1	18.1	86.2
	Tails	87.9	0.4	13.8
	Initial	100.0	2.54	100.0
Mixed	Concentrate	15.2	13.0	78.4
	Tails	84.8	0.64	21.6
	Initial	100.0	2.52	100.0

Table 3 : Pneumatic column type flotation cells in practice

Standard size	Raw materials treated and plant location	Effect produced
1	2	3
FP-10 FP-6.3 FP-1	Tungsten ores, rougher, scavenger and cleaner flotation	Recovery increase 0.7%
FP-40	Molybdenum - copper ores, rougher and scavenger flotation	Reduction of electric energy consumption and increase of molybdenum concentrate quality
FP-10	Molybdenum - copper - tungsten ores, scavenger flotation and after-flotation of valuable minerals from final tails	Increase of noble metal recovery - 3%, copper - 0.3% and molybdenum - 0.15%
FP-40	Lead - zinc - barite ores, scavenger flotation	Increase of zinc recovery - 1.5% and barite - 2%
FP-40 FP-25 FP-60	Lead - zinc - barite ores, rougher and scavenger flotation	Increase of zinc recovery - 1.7% and barite - 1.5 - 2.2%
FP-80 FP-100	Gold-bearing ores, rougher, scavenger flotation and after-flotation of noble metals from the tails of sorption leaching	Increase of gold recovery - 1.4%, silver - 2% and reduction of electric energy consumption - 3 mln. kW/year
FP-40	Bismuth ores, rougher and scavenger flotation	Increase of bismuth recovery - 5 - 10%
FP-40	Gold-bearing ores, rougher and scavenger flotation	Reduction of electric energy consumption
FP-1	Rare earth ores, scavenger flotation	Increase of concentrate quality and recovery - 1.2%

Contd.

1	2	3
FP-80	Copper-nickel ores, rougher and cleaner flotation	Reduction of nickel losses in a copper concentrate by 1% and increase of copper content in a concentrate by 3%
FP-6.3	Molybdenum - copper ores, rougher, scavenger and cleaner flotation and molybdenum concentrate selection	Reduction of electric energy consumption - 10 mln. kW/year, increase of concentrate quality and reduction of capital costs
FP-6.3 FP-1	Alunite ores, scavenger and cleaner flotation	Increase of concentrate quality - 8% and recovery increase - 8.3%
FP-220	After-flotation of cobalt and sulfur from the tails of autoclave leaching	Increase of cobalt recovery 0.5% and sulfur - 3% (expected)
FP-40	Copper ores, rougher and scavenger flotation	Increase of concentrate quality - 10%
FP-40	Copper ores, rougher flotation and after - flotation of the tails of scavenger flotation and the tails of cleaner flotation	Copper recovery - 0.3%
FP-25	Molybdenum - copper - tungsten ores, cleaner flotation of a bulk copper - molybdenum concentrate	Increase of concentrate quality - 2% and increase of molybdenum recovery - 1.5%

REFERENCES

1. Chernykh, S.I., (1995), "Creation of column flotation pneumatic type cells and experience of their industrial application at the ore-dressing plants". M. Tsniitsvetmet, p. 299.