



试验浮选柱
Experimental Flotation Column
说明书
Instructions

前 言

Introduction

随着全球矿产资源的入选品位日渐贫乏，浮选柱在矿山的应用日益广泛。

With the increasingly lacking of grade ores of mineral resources across the world, flotation column is more widely used in mines.

为了让用户更加方便的使用试验浮选柱，做好设备的维护工作，特编写此手册。本手册分 5 个部分，即浮选柱概述、浮选柱的安装、浮选柱操作、浮选柱常见问题及解决办法。

This book is hereby compiled for the purpose of making the user use Experimental flotation column more conveniently and maintain it well. This book includes five parts, namely, overview of flotation column, installation of flotation column, operation of flotation column, and common problems and solutions of flotation column.

第一章 浮选柱概述

Chapter I Overview of flotation column

浮选柱是一种新型高效具有柱型槽体结构的无机械搅拌充气式浮选设备，采用矿粒与微细气泡逆流平稳接触的流动方式，提供了大量捕收矿粒的机会。该新型试验浮选柱主要有以下创新特点：

Flotation column is a new and efficient inflatable flotation device with column-type groove structure and without mechanical agitation, and it is of flow type of countercurrent stable contact between ore particles and micro bubbles, providing lots of opportunities to capture ore particles. Such new Experimental flotation column mainly has the following characteristics of innovation:

- 柱内气泡细小均匀，表面积大，在逆流条件下与矿粒接触机会更多，消除了有用矿物在浮选过程中的“短路”现象，有利于提高浮选速度和回收率。
- The bubbles in the column are fine and uniform, with a large surface area, which can have more opportunities to contact the ore particles under countercurrent condition, therefore eliminating the “short-circuit” phenomena of useful minerals in flotation process, and facilitating the improvement of flotation rate and recovery rate.
- 泡沫清洗系统减少泡沫杂质的夹带量，提高选矿富集比，提高精矿品位。

- The foam cleaning system can reduce the impurity entrainment, increase the enrichment ratio, and improve the concentrate grade.
- 可调节空气喷射系统可以控制气泡的大小。
- The adjustable air injection system can control the size of bubbles.
- 特殊材料制作的发泡枪，发泡大小均匀，使用寿命长。
- The bubble generator made of special material can generate bubbles of equal size and have a long service life.

浮选柱的名字来源于柱体的几何形状。传统的浮选机往往使用比较浅，矩形槽，浮选柱往往是比较高的柱体，通常是 10—12 米的高度。

The flotation column is of column shape, hence the name. The traditional flotation machine often uses a relatively shallow rectangular groove, while the flotation column often has a higher column body, generally 10-12m.

同等体积容量，浮选柱的表面积远远小于浮选机。这个面积减少，可以形成非常深的泡沫层和有利于提高泡沫的稳定性。

With the same volume capacity, the flotation column is generally smaller than the flotation machine in surface area. With such reduction in area, a very deep foam bed can be formed, and the foaming stability can be improved.

浮选柱的另一个重要特点是泡沫洗涤系统，从浮选泡沫中去除杂质。

洗涤水添加在柱体的顶部，通过淋洗泡沫层泡沫，增加泡沫的合并和二次富集作用，可显著提高精矿品质。

Another important characteristic of flotation column is wash water system, which can eliminate impurities from flotation froth. The washing water is added to the top of column, to wash the bubbles of foam bed, so as to increase the consolidation and secondary enrichment of bubbles, therefore greatly improving the concentrate quality.

浮选柱不同于传统的浮选机，浮选柱不使用机械搅拌，有利于提高细颗粒的回收率。浮选柱分选过程：矿浆通过位于柱身的上部三分之一的一个或多个进料口，在浮选柱底部喷枪产生的泡沫作用下，目的矿物被泡沫带到浮选柱的顶部排出，脉石从浮选柱的底部排出。其工作液面高度和充气量由自控系统进行操作和管理。

Different from the traditional flotation machine, flotation column has no mechanical agitation, which can help to improve the recovery rate of fine grains. The process of flotation by flotation column: pulp passes through one or several feed ports at 1/3 of the column body, and under the foaming effect of bubble generator at the bottom of flotation column, target minerals are brought to the top of flotation column by foam, and then the gangue is discharged from the bottom of flotation column. The working level height(i.e. the froth bed) and aeration rate are operated and managed by auto-control system.

试验浮选柱的发泡枪是用特殊的高分子材料制作而成。这种特殊的材料制作的发泡器可以使空气良好的分布在柱体中，并且可以防止泥浆回流到供气系统，充气量可以根据试验现象手动调节。

The bubble generator of experimental flotation column is made of special high polymer material. The foam generator made of such special material can make the air well distributed in the column, and prevent slurry flowing back to the air supply system. The aeration rate can be manually adjusted according to actual working conditions.

2、试验浮选柱规格列表

2. Specification list of Experimental flotation column

型号说明：ZG S Y F - xxx

Demonstration of the type: ZG S Y F - xxx

其中：ZG—中工矿业；SY—试验；F—浮选柱；xxx—柱断面直径，mm(高度预设 为 2 米)。

In which, ZG—Zhong Gong Mining; SY—Experimental; F—flotation

column; ×××—diameter of column section, mm(height is preset as 3m).

设备型号 Model	主要技术参数 Main technical parameters			
	有效容积 (L) Effective volume (L)	处理量 (kg/H) capacity (kg/H)	给矿浓度% Feed concentration %	给料粒度 Feed size
ZGSYF-50	3.9	2.5-8	10--30	-0.075mm 70% 以上 -0.075mm 70% and above
ZGSYF -80	9.5	6-20	10--30	
ZGSYF -100	15.0	10-35	10--30	
ZGSYF -150	30.0	20-65	10--30	
ZGSYF -200	62.8	40-140	10--30	

注：试验浮选柱的直径和高度可以根据实际试验需要进行适当调整。

Note: The diameter and height of experimental flotation column may be adjusted according to the actual test needs.

注意：本试验设备使用 220V 交流电，其他电压可能导致设备的损坏。

Caution: 220V AC electricity applies to such testing device, and other voltages

may cause the device damage.

第二章 浮选柱的安装

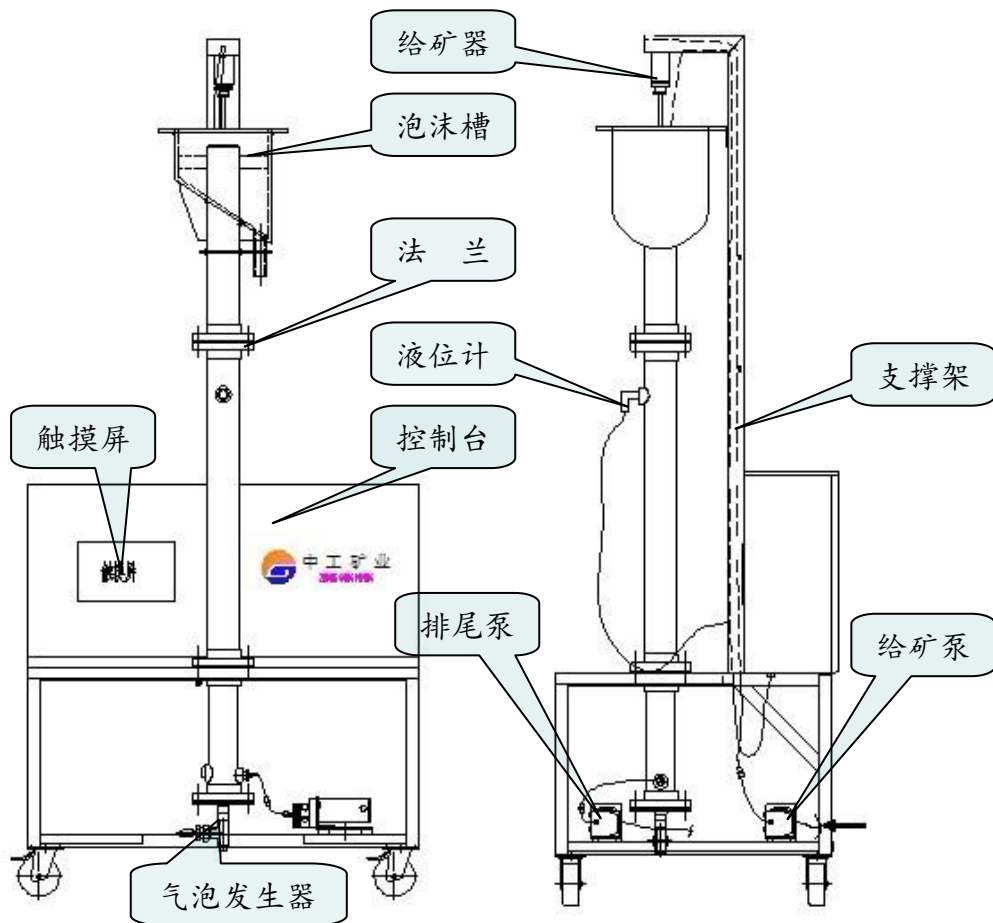
Chapter II Installation of flotation column

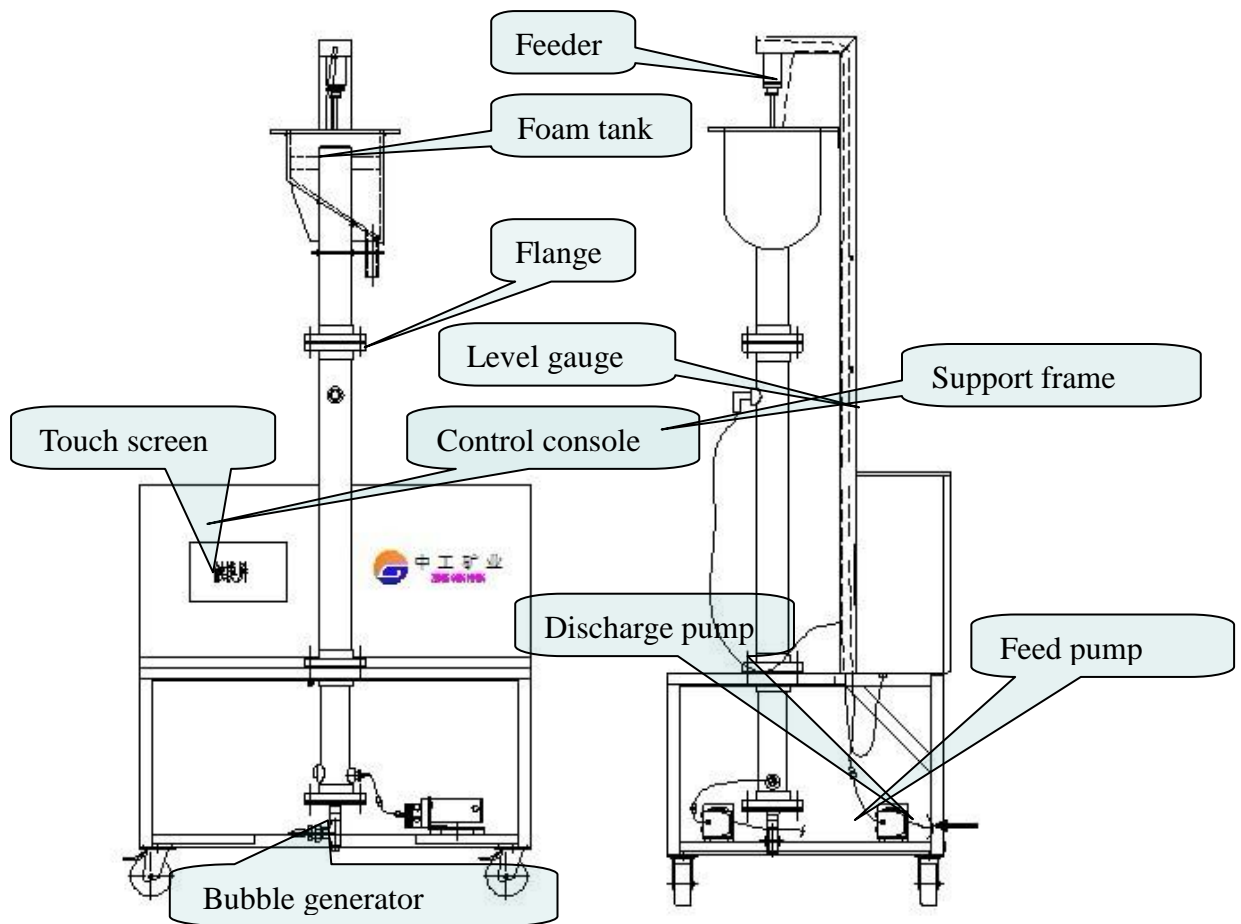
1、浮选柱柱体的安装

1. Installation of flotation column body

柱体分三个部分：上部（泡沫槽）、中部、下部。三部分采用法兰连接。具体见下图：

The column body is divided into three parts: upper part (foam tank), middle part, and lower part. The three parts are of flanged connection, as shown in following figure:





该类型试验浮选柱带有成套的操作平台和支撑架，不需要额外搭架操作平台，安装方便。

Such experimental flotation column is provided with full set of operating platform and support frame, so no additional operating platform is required, therefore, it is easy to be installed.

注意：浮选柱柱体安装必须完全垂直，可用水平尺检测。

Caution: The flotation column body shall be installed vertically, which can be

tested with horizontal rule.

2、浮选柱供气系统的安装

2. Installation of flotation column air supply system

试验浮选柱的供气系统主要由空压机、减压阀、压力计、气量调节阀、气泡发生器组成，各部分气管主要采用快插连接。由于空压机噪音较大，**建议将空压**

机安装在远离设备的单独机房中。

The air supply system of experimental flotation column is mainly composed of air compressor, reducing valve, pressure gauge, air pressure regulator, and bubble generator. The air pipes of each part are mainly of fast-inserting connection. With a big noise, **the air compressor is suggested to be installed in a separated room far away from the device.**

3、浮选柱控制系统介绍（出厂前已安装完毕）

3. Introduction to flotation column control system (completion of installation before delivery out of factory)

3.1 配套控制系统的特点：

3.1 Characteristics of supporting control system:

3.1.1 系统特点

3.1.1 Characteristics of system

- 高精度
- High precision

运算强大的运行核心 PLC

Operating core PLC with strong computing power

系统控制核心采用国际知名的德国品牌西门子，具有高精度和高稳定性的特点，平均使用寿命达到八年以上，故障率低，而且在我国的使用率在同类产品中属于前茅，使用的普及使备品备件来源特别方便。

The system control core is of world-famous Siemens brand, which is featured by high precision and high stability, with an average service life reaching more than eight years, and moreover it has a low failure rate and is in the leading position in terms of utilization rate among the similar products. Its widespread use makes the spare parts easily got.

- 强抗干扰能力

● Strong resistant to interference

本系统设计首先考虑了工业现场对于控制系统和通讯的电磁干扰造成数据大幅度跳动或者通讯无法连接的因素，并进行了充分的实验，包括低压的设计、布局及选型，使我们的系统可以做到几乎零干扰，保证了数据和通讯的高稳定性。In the design of this system, the factors of data pulsating or unavailable communication connection caused by electromagnetic interference of control system and communication on the industrial site are taken into account, and also sufficient test is made, including the low voltage design, layout, and type selection, making our system almost can realize zero interference, therefore making sure the high stability of data and communication.

3.1.2 人性化

3.1.3 User-friendly

● 人性化的软件界面简单明了，非常适合中国工人的操作使用。系统采用高级语言编制，多年的不断完善，有着符合本工艺的人性化界面和操作，给使用者提供了非常方便的条件，对操作人员无任何专业要求，进行简单的培训即可管理和操作。

● The user-friendly software interface is simple and clear, so it is quite suitable to operation by Chinese workers. The system is compiled with high-level language. With many years of improvement, it has realized the user-friendly interface and operation conforming to this process, therefore facilitating the user greatly. It has no professional requirements for operator, and someone after receiving a simple training may manage and operate it.

3.1.3 功能全面强大

3.1.3 Powerful function

● 参数全面精确，界面上各参数给操作工提供了很好的操作依据，参数包

括：液位，流量，压力，各参数的设定值，手自动转换按钮等。

● There are comprehensive and exact parameters, and the various parameters on the interface provide the operator with good operation basis. These parameters include: liquid level, flow rate, pressure, settings of each parameter, and manual-automatic switch button, etc.

● 完善的操作工权限管理，对各班甚至到每个人的任何操作进行了限制管理和记录，避免越权操作。

● Perfect operator's authority management, limiting and recording any operation of each shift and even each individual, to avoid unauthorized operation.

● 人性和专业的报警系统，对操作员的提醒和警告避免了现场出现任何误操作和生产安全问题

● People-oriented and professional alarming system, reminding and warning the operator to avoid any faulty operation and work safety problem on site.

3.1.4 扩展性强

3.1.4 High expansibility

3.2 试验浮选柱自控系统操作

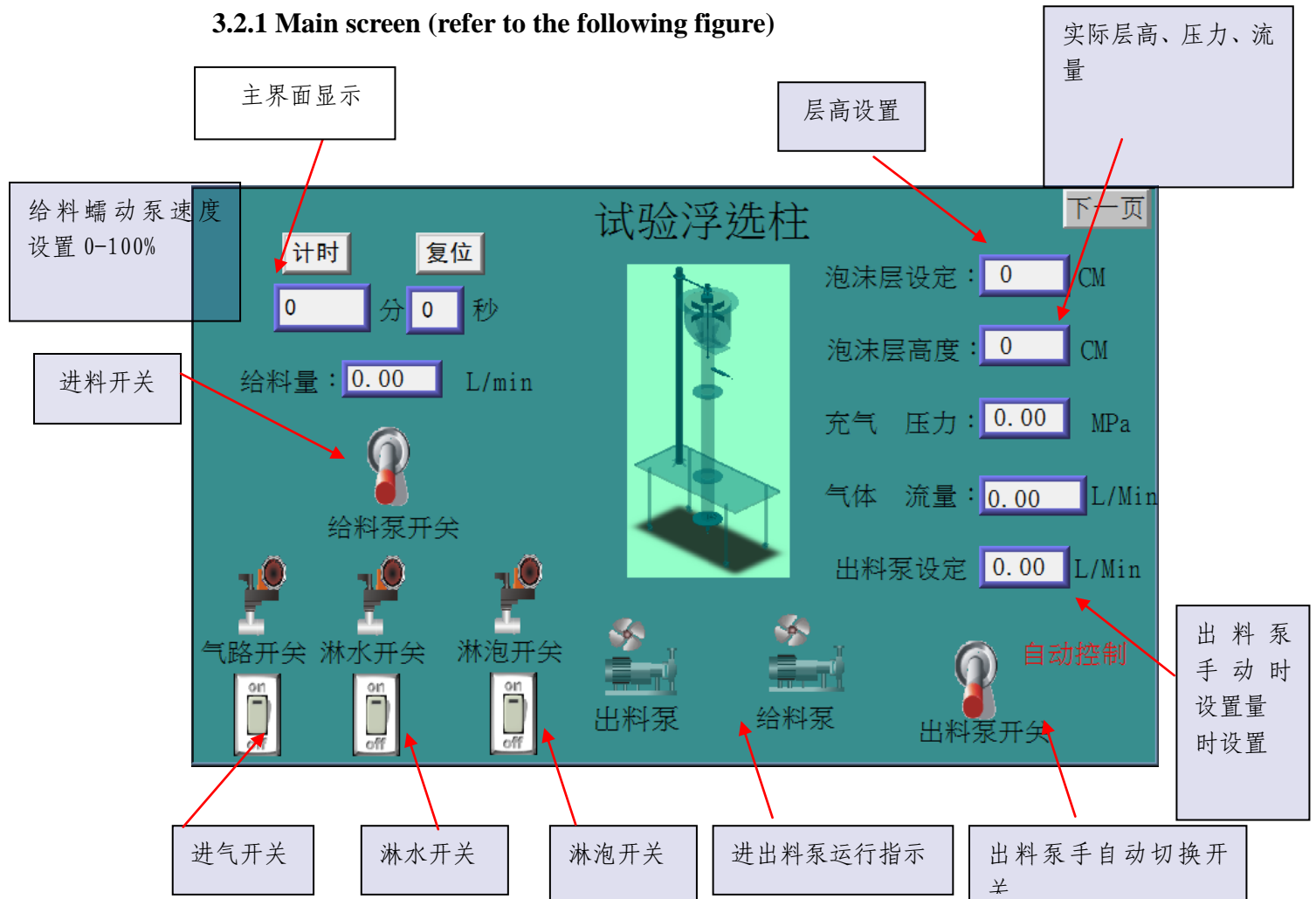
3.2 Operation of experimental flotation column auto-control system

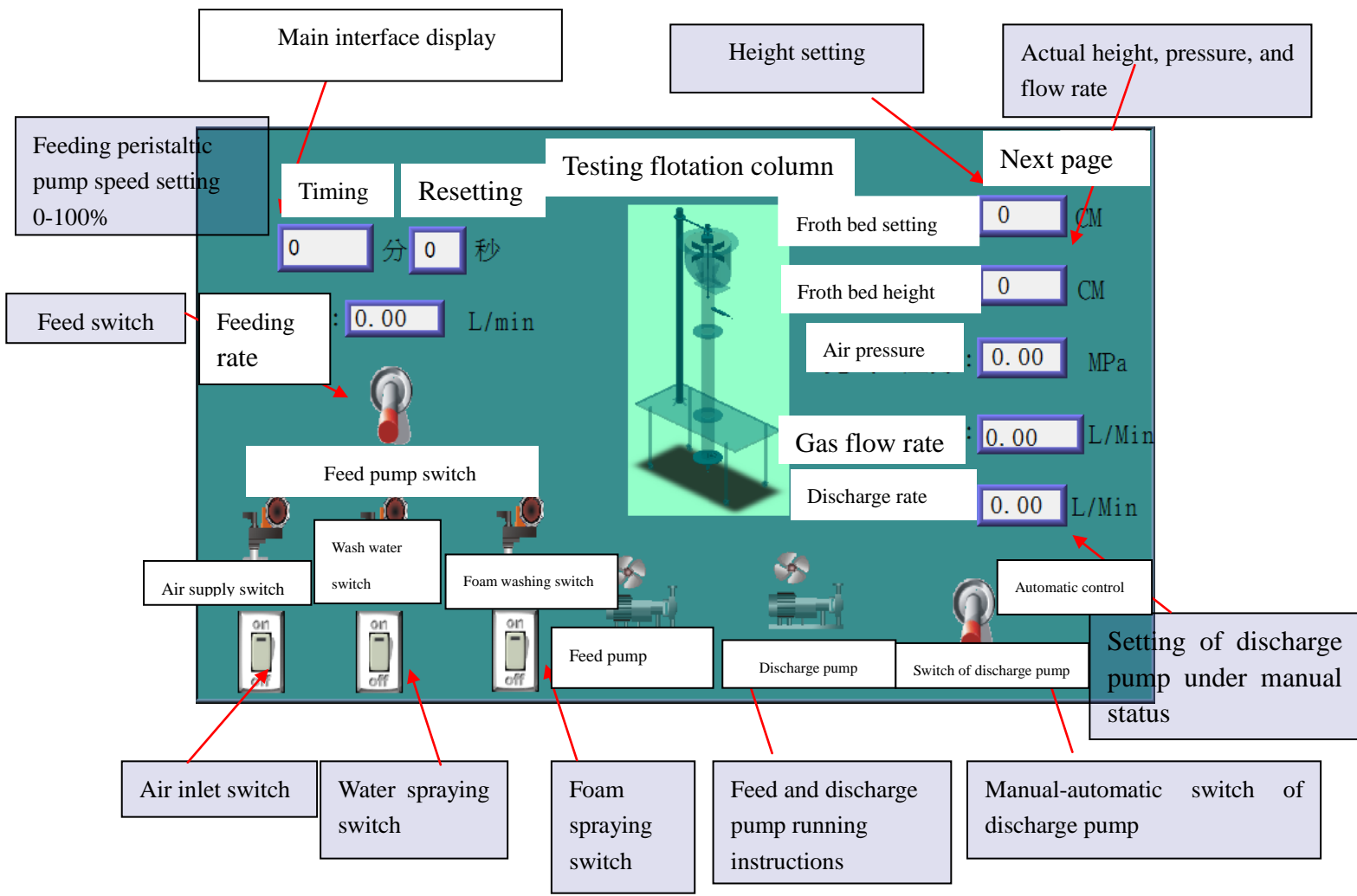
本系统由独立的PID回路构成，主要对液位信号进行精确定位控制。本手册主要为操作员的说明和规范手册，请操作员严格按照手册操作本系统。

This system is composed of independent PID circuit, mainly to precisely locate and control the liquid level signal. This manual is mainly to provide operation instructions and specifications, so the operator is required to operate the system in strict accordance with the manual.

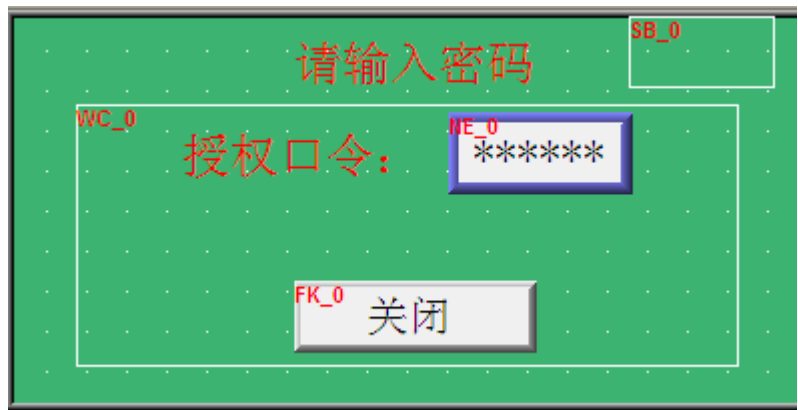
3.2.1 主画面 (参考下图)

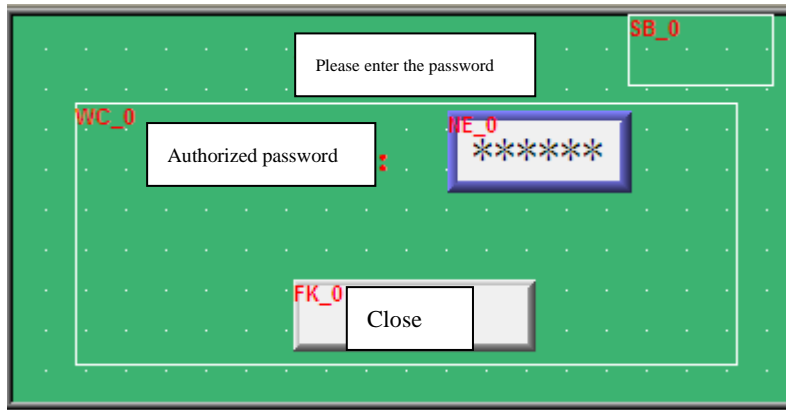
3.2.1 Main screen (refer to the following figure)





系统登录窗口
System login window





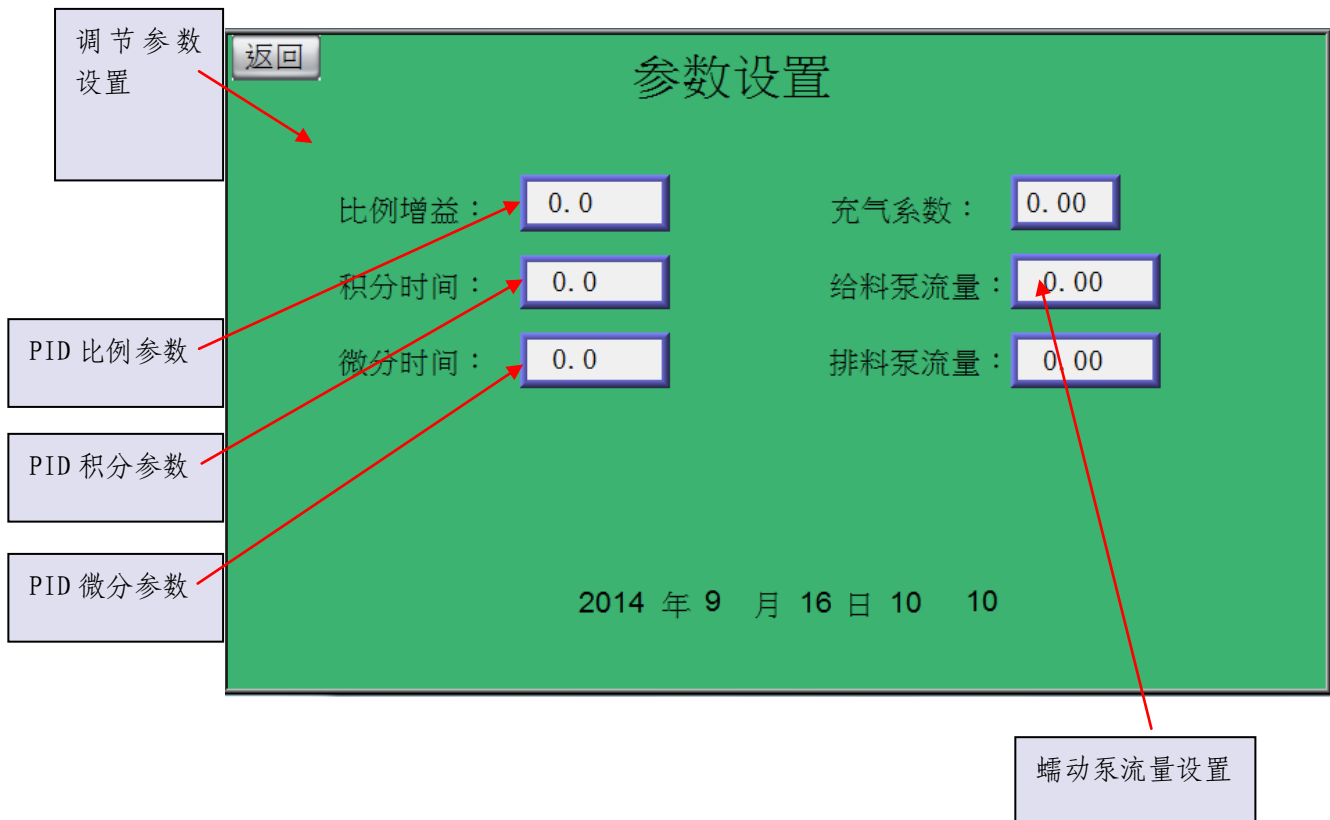
The password is 123456.

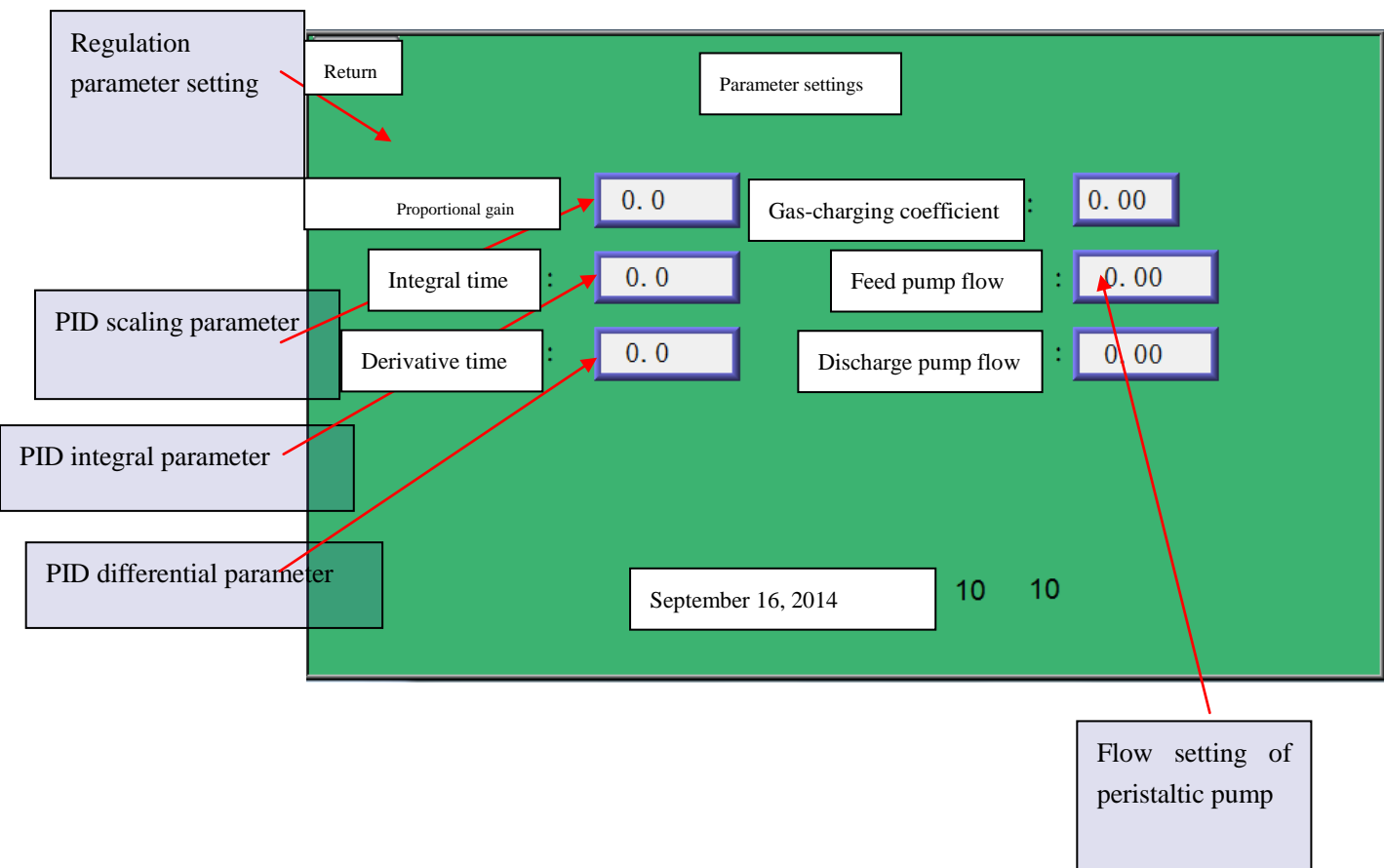
3.2.2 参数设置页面 (参考下图)

3.2.2 Page of parameter settings (refer to the following figure)

注：P, I, D 这三个参数请用户不要随便修改，这三个参数对系统的自动调节起了关键性的作用，只有对 PID 回路调节比较熟练的工程师才能适当地对其作一定的修改（系统在使用一段时间后，此三个参数有必要进行适当的修改）。

Note: P, I and D, these three parameters, are not allowed to be modified without permit. They play a key role in the automatic regulation of system. Only the engineer who is familiar with PID loop regulation can modify them appropriately (after the system is used for some time, it is recommended to modify these three parameters properly).





主画面是以人性化的界面形象地显示整个系统及其工艺流程。

The main screen gives a vivid presentation of the whole system and its process flow with a user-friendly interface.

(1) 系统在启动后，整个工艺系统自动运行。

(1) After the system is started, the whole process system will run automatically.

(2) 设定值可以在相应的位置，点触数据框即弹出键盘输入。

(2) The setting value may be in the corresponding position, and the keyboard may pop up to enter the value by touching the data box.

只有用户注册了才能对系统进行相应的操作。

Only a registered user can operate the system correspondingly.

第三章 浮选柱的操作

Chapter III Operation of flotation column

1、试验浮选浮选柱操作规程

1. Operating procedures of Experimental flotation column

1.1 开机准备

1.1 Preparations for start-up

1. 开机检查、准备

1. Inspection and preparation before start-up

① 巡视设备一周，检查各紧固件是否松动，供气供水系统是否正常。

① Check the device, and inspect whether each fastener is loosened and whether the gas supply and water supply systems are normal.

② 清洗干净浮选柱所有之前做试验的残留杂质。

② Clean all impurities remained from previous test of the flotation column.

③ 清洗所有输送泵确保入料泵和循环泵中无铁锈和异物，以免堵塞气泡发生器。

③ Clean all delivery pumps, and make sure that the feed pump and discharge pump are free of rust and foreign matter, so as not to block the bubble generator.

④ 检查各工作泵的阀门是否完好（尤其是各尾矿阀），阀门开启、关闭关系是否正确。

④ Check whether the valves of each working pump are under normal condition (especially each valve of tailings), and whether valve starting and closing relationship is correct.

⑤ 检查供电情况，泵、搅拌桶等设备是否正常供电，数显 PID（配置液位自动控制系统的浮选柱）是否正常显示，蠕动泵是否能正常工作和调整。

⑤ Check the power supply condition: whether the pumps and agitators are of normal power supply; whether the digital display PID has a normal display; and whether the peristaltic pump can work and be adjusted normally.

⑥ 检查蠕动泵的蠕动管，发现有磨损的现象，及时更换。

⑥ Check the peristaltic pipe of peristaltic pump, and replace immediately if any wearing is discovered.

⑦ 在柱内已放空的情况下，开车前往柱体内注水约 $1/2 \sim 2/3$ 柱体体积量。

⑦ When the column is emptied, inject water into the column, reaching about

1/2~2/3 of the column volume.

1.2. 开机程序

1.2 Start-up procedure

① 准备好给矿矿样和取样管路及盛样容器。

① Prepare feeding sample ore, sampling pipeline, and sample container.

② 完成开机准备操作后，打开浮选柱控制系统电源，进入操作界面。

② After completion of preparations for start-up, power up the control system of flotation column, and enter the operation interface.

③ 打开空压机送气开关，开启控制系统气量开关，开启气泡发生器前球阀。

③ Open air supply switch of air compressor, start the gas switch of control system, and start the ball valve in front of bubble generator.

④ 视试验流程的需要，放置精矿、尾矿管到指定给料搅拌桶或取样设备。

④ According to the test process needs, place concentrate and tailings tubes to the designed feed mixing barrel or sampling device.

⑤ 调整气量至合适气量（不能使柱体内矿浆翻滚），液面稳定后开始给矿。将尾矿泵打到自动控制档位。

⑤ Adjust the air flow to a proper value (not make the ore pulp in the column roll over), feed ores after the liquid level is stable.

⑥ 设定好泡沫层厚度，调整各参数至最佳。

⑥ Set the thickness of froth bed, and adjust each parameter to its optimal valve.

1.3 停机操作

1.3 Shutdown operation

① 停止给矿。

① Stop feeding.

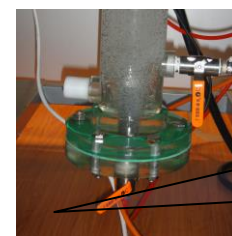
② 将尾矿泵调至手动，调高尾矿泵转速，将柱体内矿浆放空。

② Adjust the tailings pump to be under manual status, increase the rotating speed of tailings pump, and empty the ore pulp inside the column.

③ 通过给矿泵往柱体内注清水，清洗浮选柱内部、调浆桶。

③ Inject clear water into column through feed pump, to clean the inside of flotation column and mixing vessel.

④ 清洗完毕后，排空柱体积水，关闭气泡发生器球阀，关闭空压机及自控系



球阀
Ball valve

统。关闭总电源，清扫试验场地。

④ After cleaning, drain the water depositing in the column, **close the ball valve of bubble generator** as well as air compressor and automatic control system. Close the main power, and clean the test site.

注意：关机后，一定要关闭气泡发生器前球阀。

Caution: After shutdown, the ball valve in front of bubble generator shall be closed.

1.2 操作指南

1.2 Operation guide

以下所涉及的常用参数大多是经验值，要达到理想的效果必须在实际操作中加以优化。同样，以下所讨论的基本规律是基于在浮选柱处于稳定状态下改变一个变量的结果。对于非瞬间的变化可以作补偿，但是流量或高/低品位物质脉冲的快速波动都可能导致难以预料的性能下降。因此，应当尽可能地保持矿浆流量的均匀和稳定。

The common parameters involved below are mostly empirical value. To achieve an ideal effect, they shall be optimized in practical operation. Similarly, the basic rules discussed below are the result when the flotation column is under stable status, with one variable changed. As for non-instant changes, corresponding compensation may be made, but the rapid fluctuations of flow or high/low-grade material pulse may result in the unpredictable performance reduction. Therefore, it is required to keep the uniform and stability of ore pulp flow.

a. 充气量

a. Aeration rate

充气流量的增加可提升回收率（保证浮选过程平稳前提下），但在特定的空气表面速率下，气泡的特性会改变并导致降低回收率。该准确值基于气泡的大小、气泡的承载能力和矿浆的流速。通常增加空气流量，将会：

The increase of aeration flow may improve the recovery rate (under the precondition that flotation process is kept stable), but under specific air surface rate, the characteristics of bubbles will be changed and the recovery rate will be reduced. Such exact value is based on the bubble size, bubble bearing capacity, and ore pulp flowing rate. Generally, with the increase of air flow,

- 降低精矿的品位

- the concentrate grade will be reduced.
- 增加精矿的回收率到最佳值后，随后降低回收率。
- the concentrate recovery rate will be increased to the optimal value, and then the recovery rate will be reduced.
- 降低精矿的固体含量百分比
- the solid content percentage of concentrates will be reduced.

以上变化规律仅仅局限于特定的流量范围。气泡的类型最终将改变而产生不同的流动状态从而损害浮选柱的性能。过高的充气量会导致矿浆在柱体内翻滚，泡沫层变薄直至消失。

The above change rules are only limited to the specific flow range. The bubble type will be finally changed and different flow statuses will appear, therefore damaging the performance of flotation column. An excessively high aeration rate will result in the rolling of ore pulp inside the column, and thinning of foam layer until disappearing.

b. 泡沫层厚度（液面高度）

b. Foam layer thickness (liquid level height)

泡沫层厚度是决定精矿品味的重要参数，较深的泡沫层，可以使矿化泡沫二次富集作用加强，可以显著提高品位，但回收率会相应的下降。但是，泡沫层过厚不会再带来明显的好处。最深的极限是矿沫形成太重而自身破裂的地方。破裂时可以看见在矿沫区产生大量涡流。（此时的回收率将非常低）。开始时建议设定矿沫深度为 300mm。试验过程中可以在 300mm 上下调整，选择最佳厚度。增加泡沫层厚度将：

The foam layer thickness is an important parameter to decide the concentrate grade. A deeper foam layer may strengthen the secondary enrichment of mineralized bubbles, greatly improve the grade, but the recovery rate will decline correspondingly. However, an excessively thick foam layer cannot bring other obvious advantages. The deepest limit is at the place where the bubbles formed break themselves. A large number of eddy can be seen in the mineral foaming area when the bubbles break (the recovery rate at this time will be very low). At the beginning, the mineral foaming depth is recommended to be set as 300mm, and it may be adjusted around 300mm during the test process to select the best thickness. With the increase of foam layer thickness,

- 提高泡沫产品浓度
- the foam product concentration will be increased.
- 提高精矿的品位

- the concentrate grade will be increased.
- 降低回收率
- the recovery rate will be reduced.

c、给矿量

c. Feeding capacity

给矿量的增加将直接降低物料在浮选柱的滞留时间，从而降低回收率。建议给矿量在设备额定处理量之间调整，如果给矿量过大可能会造成排尾系统堵塞。增加给矿量将：

The increase of feeding capacity will directly cause the reduction of detention time of materials in flotation column, therefore reducing the recovery rate. The feeding capacity is recommended to be adjusted in the rated handling capacity of device. If the feeding capacity is excessively large, the tailings discharge system may be blocked. With the increase of feeding capacity,

- 降低浮选时间
- the flotation time will be reduced.
- 增加排尾难度
- the difficulty of tailings discharge will be increased.
- 降低回收率
- the recovery rate will be reduced.

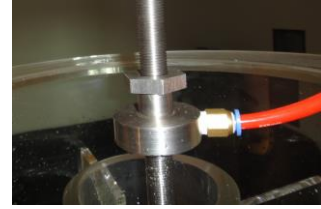
d、泡沫淋洗水

d. Foam spraying water

安装在浮选柱顶部的泡沫淋洗水装置使清水均匀的喷洒到泡沫表面，清洗泡沫夹带的矿浆，同时使泡沫产生兼并和重新生成，精矿品位得到进一步的提升。泡沫淋洗水过大可能会清洗掉泡沫携带的目的矿物，甚至可能使泡沫层完全消失，回收率骤降。所以泡沫淋洗水水量一定要调至最佳大小。增加泡沫淋洗水可能会：

The foam spraying water device installed on the top of flotation column can make the clear water evenly sprinkled to the foam surface, to clean the ore pulp entrained in the bubbles, and in the meantime, make the bubbles merged and regenerated, therefore, the concentrate grade will be further improved. Excessive foam spraying water may clean away the target minerals entrained in the bubbles and even can make the foam layer completely disappear and recovery rate sharply drop. Thus, the foam spraying water shall be adjusted to be of the best rate. With the increase of foam spraying water,

- 提高精矿品味
- the concentrate grade may be increased.
- 降低回收率
- the recovery rate may be reduced.



第四章 常见问题及处理办法

Chapter IV Common problems and solutions

序号 NO.	故障现象 FAULT	原因分析 CAUSE ANALYSIS	排除方法 ELIMINATION METHOD	备注 REMARKS
1	无气泡产生 No bubbles generated	气泡发生器开关未开启 The bubble generator is no switched on	开启空压机、控制系统、发生器球阀各开关 Open the switches of air compressor, control system, generator ball valve	
		气泡发生器损坏 The bubble generator is damaged	建议更换气泡发生器,请拨打中工矿业售后服务电话(见说明书最后联系方式) It is recommended to replace the bubble generator, and please call the after-sale service telephone of Zhonggong Mining (see the contact information in the last of the Instructions)	
2	浮选柱液面调整不到位 The liquid level of flotation column is not adjusted to be in place	浮选柱给矿不正常 The feeding of flotation column is abnormal	检查上一生产环节给矿是否正常。 Check whether the feeding of previous process is normal	
		液位计异常 Abnormal level gauge	检查液位计 Check the level gauge	
		排尾泵异常 Abnormal tailings discharge pump	检查排尾泵胶管是否损坏 Check whether the rubber hose of tailings discharge pump is damaged	建议定期检查更换胶管 It is recommended to replace the rubber hose regularly
		自动控制系统显示异常 The automatic control system has an abnormal display	检查自动控制系统显示数据与实际液面是否一致 Check whether display value of automatic control system is consistent with the actual liquid level	
3	气泡发生器气管积	检查油水分离器里是否积水	排空油水分离器积水 Evacuate the water logging in the	

	水 There is water logging in the air pipe of bubble generator	Check whether there is water logging in the oil-water separator	oil-water separator	
		储气罐积水过多 There is excessive water logging in the gas tank	排空储气罐积水 Evacuate the water logging in the gas tank	建议定期排空储气罐积水 It is recommended to evacuate the water logging in the gas tank regularly
		气泡发生器返水 There is backwater in the bubble generator	停机时关闭气泡发生器球阀 Close the ball valve of bubble generator upon shutdown	
4	浮选回收率低 The flotation recovery rate is low	浮选工艺异常 Abnormal flotation technology	检查浮选工艺各项参数是否达到要求 Check whether each parameter of flotation technology reaches the requirements	
		气泡量不够 Insufficient bubbles	检查气泡发生器开启情况 Check the opening condition of bubble generator	
			检查空压机排气气压 Check the exhaust air pressure of air compressor	
		泡沫层过厚,作业精矿品位过高 The foam layer is too thick, and the working concentrate grade is too high	调整泡沫层厚度,达到合理的精矿品位 Adjust the foam layer thickness, to reach the reasonable concentrate grade	
泡沫淋洗水过大 Excessive foam spraying water	调节泡沫淋洗水水量到合理水量 Adjust the foam spraying water to be of a reasonable rate			
5	浮选品位较低 The flotation grade is relatively low	浮选工艺异常 Abnormal flotation technology	检查浮选工艺各项参数是否达到要求 Check whether each parameter of flotation technology reaches the requirements	
		泡沫层较薄 Thinner foam layer	调整泡沫层厚度,达到合理的精矿品位 Adjust the foam layer thickness, to reach the reasonable concentrate grade	
		没有开启泡沫淋洗水或水量较小	调整泡沫淋洗水 Adjust the foam spraying water	

第五章：联系方式

Chapter V Contact Information

公司报修网址：www.zhonggongky.com

Website of repair service: www.zhonggongky.com

公司本部技术服务联系方式：0731—82849778—8014

Technical service hotline of home office: 0731—82849778—8014

公司本部售后服务联系方式：0731—82849780—8008

After-sale service hotline of home office: 0731—82849780—8008