

Supplementary Information

Application of PLC-Based Spectrophotometric System Nitrogen Protection Device to Automated Direct Measurement of Target Substances in Zinc Hydrometallurgy

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The supplementary materials include 9 pages.

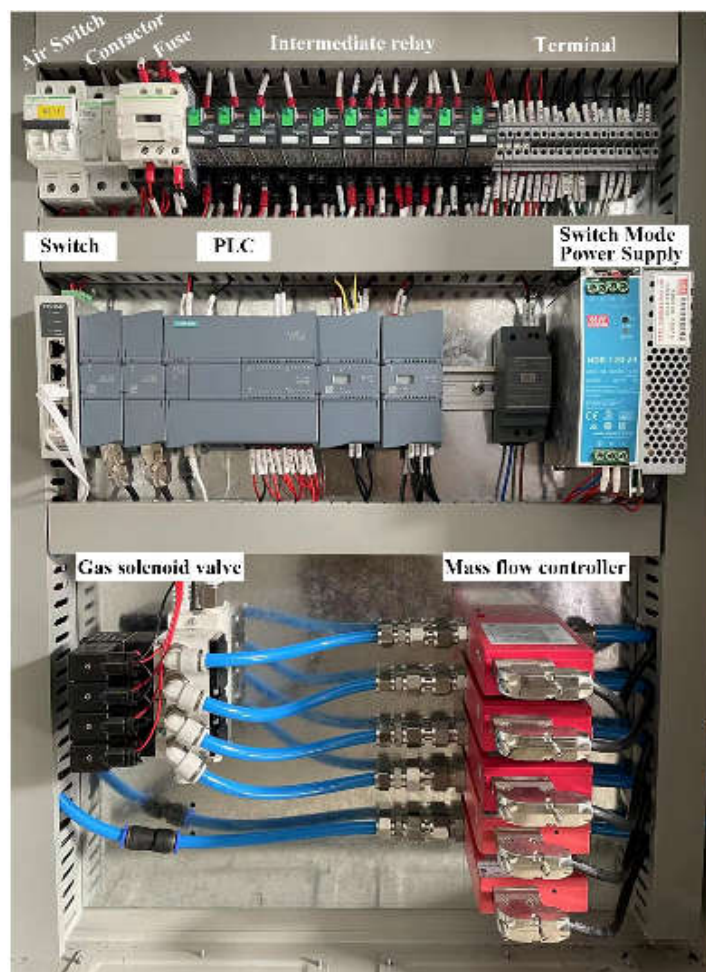


Figure S1. Internal physical picture of electric control cabinet.

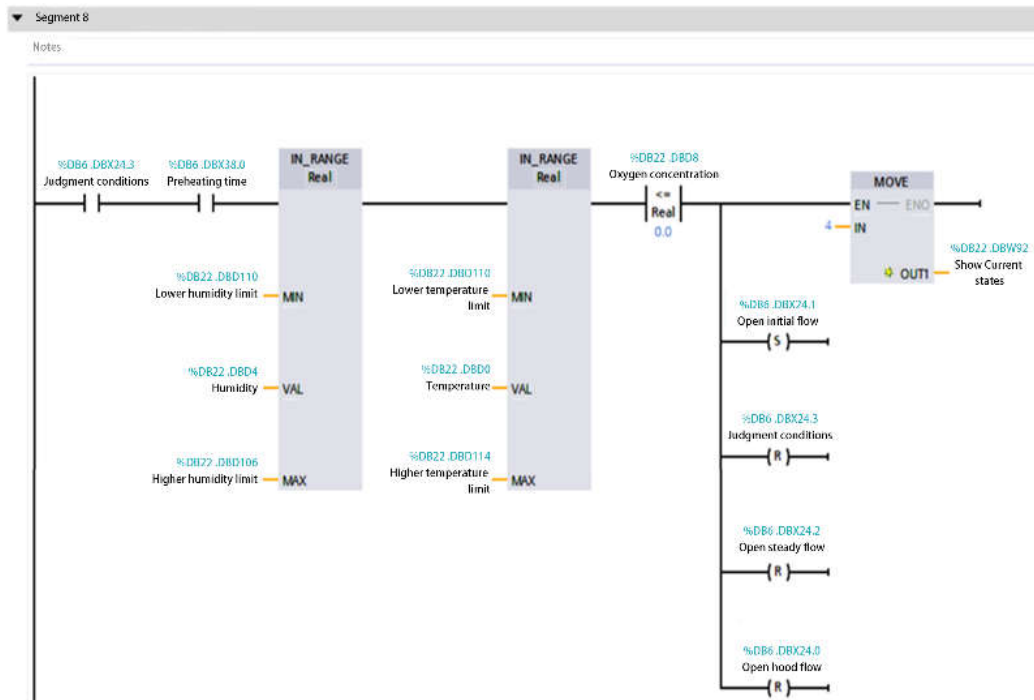


Figure S2. Current test environment detection procedure.

Monitor operation

Next

Current state: Preparing

Stop

0.0 s

Preheating remaining time

Auto

Start

Step

Waste

Recycle

Clear

Import

20 °C

11.6 %

0.0 %

L / min

6.00

2.00

3.00

0.00

11.00

Temperature

Humidity

Concentration

Light source area

Sample area

Receiving data area

Cover

Outlet

Monitor operation

Optical path

Set

Manual mode

Alarm

Close

Figure S3. Operation monitoring interface.

Optical path	Cleaning speed /r/min	Injection speed /r/min	Cleaning time /s	Injection time /s	
1	50.0	30.0	20.0	30.0	
5	50.0	30.0	23.0	32.0	
10	50.0	30.0	25.0	33.0	
50	50.0	30.0	29.0	36.0	
100	50.0	30.0	33.0	40.0	
1+5	50.0	30.0	28.0	35.0	
5+10	50.0	30.0	32.0	38.0	
1+5+10	50.0	30.0	40.0	40.0	Next
Monitor operation	Optical path	Set	Manual mode	Alarm	Close

Figure S4. Optical path selection interface.

Cleaning and flow setting

			Stable flow	Initial flow	
Preheating time	15	min	Optical system area	0.6	6.0 L/min
Cleaning times	2		Sample area	0.6	2.0 L/min
Total cleaning times	20	Clear	Data receiving area	0.6	3.0 L/min
			Cover	30	L/min

Monitor operation

Optical path

Set

Manual mode

Alarm

Close

Figure S5. Parameter setting interface.

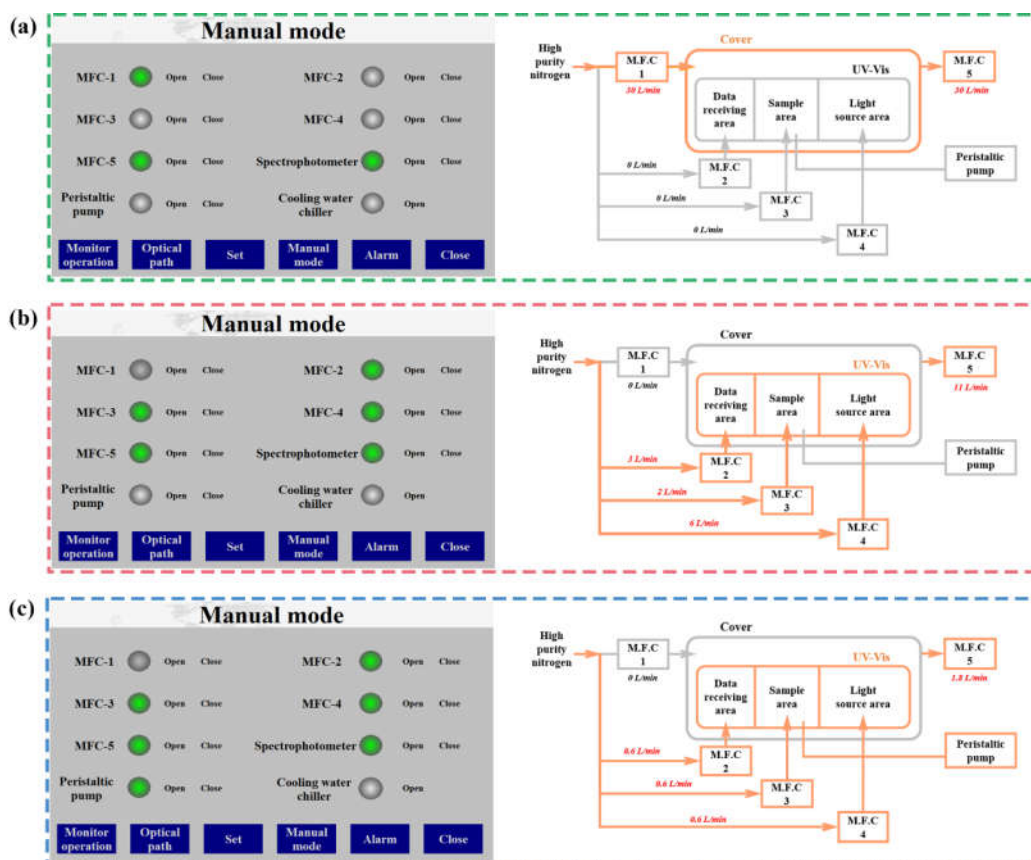


Figure S6. Manual control interface under different conditions, including: (a) nitrogen replaces the air inside the hood at a high flow rate of 30 L/min; (b) Nitrogen displaces the air inside the light source system area, sample room and data receiving area of the instrument at the optimal flow rate of 6, 2 and 3 L/min; (c) At the detection stage, the nitrogen flow is 0.6 L/min.

Alarm window

Maximum temperature

30°C

Minimum temperature

10°C

Maximum humidity

30%

Minimum humidity

0%

Maximum concentration

20.9%

Date	Time	Alarm description

Monitor operation

Optical path

Set

Manual mode

Alarm

Close

Figure S7. Alarm prompt interface.

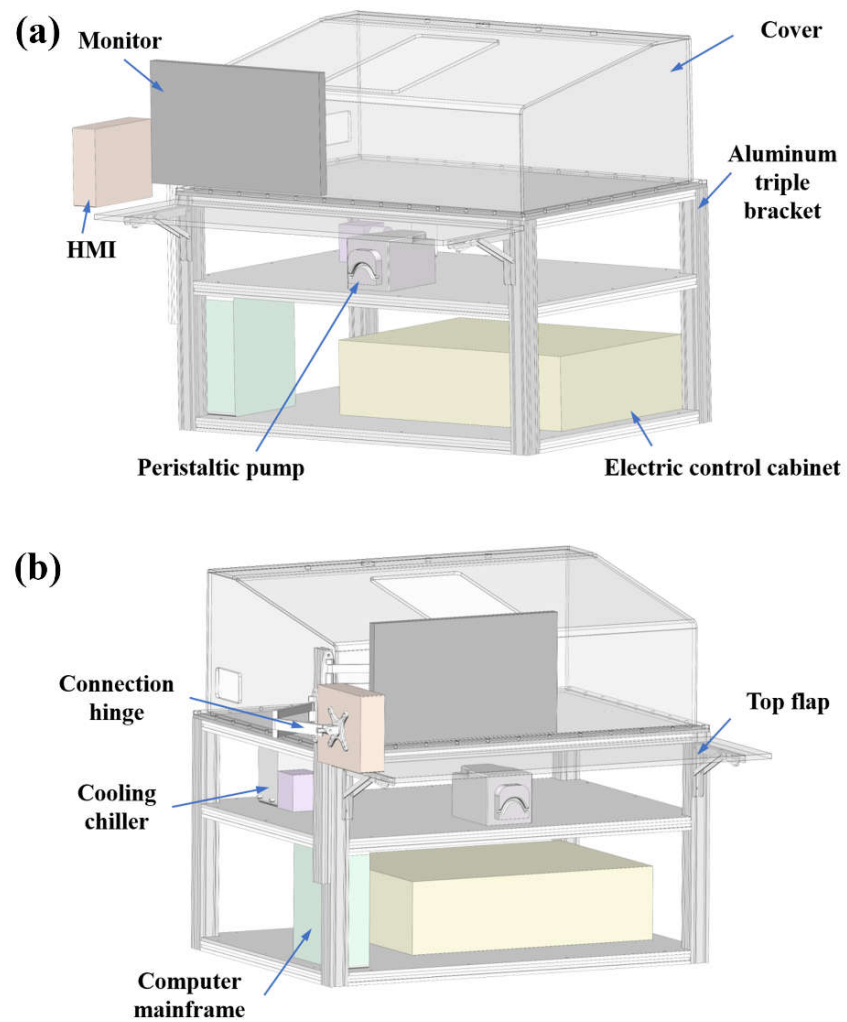


Figure S8. The system rendering of device.

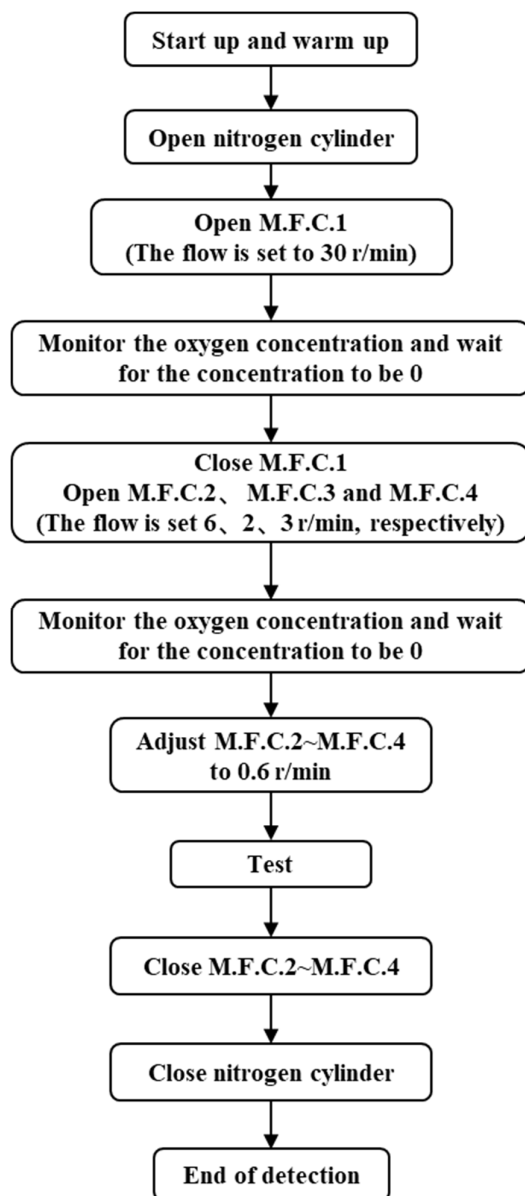


Figure S9. Upper computer program operation flow chart.