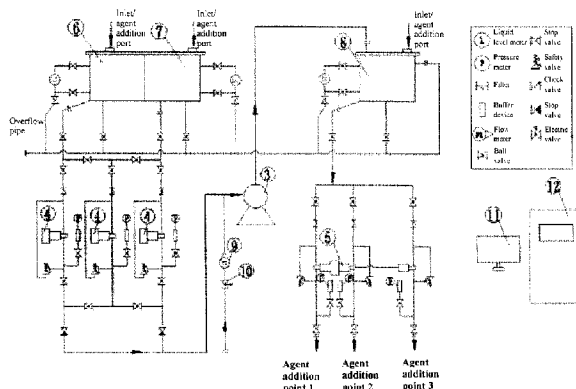




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(54) **Titre : DISPOSITIF POUR L'EMULSIFICATION ET L'ADDITION CONTROLEE D'AGENT DE FLOTTATION**
(54) **Title: DEVICE FOR EMULSIFICATION AND CONTROLLED ADDITION OF FLOTATION AGENT**



(57) **Abrégé/Abstract:**

Disclosed is a device for the emulsification and controlled addition of a flotation agent, which is applicable to the field of coal dressing. The device comprises a floatation feed flow rate and concentration detection system (13), wherein a floatation machine feed pipeline is connected to a control system (14) through a line, and the control system (14) is connected to an agent metering, emulsification and multi-point addition system and a floatation foam product monitoring system, respectively; the control system (14) comprises a PLC control cabinet (12) and an upper computer (11) connected to each other; the agent metering, emulsification and multi-point addition system comprises an agent box, a metering pump (4), an emulsification pump (3), an agent addition metering pump (5) and an agent buffering tank (8); and the floatation foam product monitoring system is a monitoring camera (17) arranged on a floatation device (16), the monitoring camera (17) being connected to the upper computer (11). The device for the emulsification and controlled addition of a flotation agent realizes automatic addition of the agent, effectively reducing the waste of the agent, and no manual agent addition is required for the floatation machine, the floatation machine is unwatched so the need for manual work is reduced, and the floatation cost is reduced.

Abstract

Disclosed is a device for the emulsification and controlled addition of a flotation agent, which is applicable to the field of coal dressing. The device comprises a flotation feed flow rate and concentration detection system (13), wherein a flotation machine feed pipeline is connected to a control system (14) through a line, and the control system (14) is connected to an agent metering, emulsification and multi-point addition system and a flotation foam product monitoring system, respectively; the control system (14) comprises a PLC control cabinet (12) and an upper computer (11) connected to each other; the agent metering, emulsification and multi-point addition system comprises an agent box, a metering pump (4), an emulsification pump (3), an agent addition metering pump (5) and an agent buffering tank (8); and the flotation foam product monitoring system is a monitoring camera (17) arranged on a flotation device (16), the monitoring camera (17) being connected to the upper computer (11). The device for the emulsification and controlled addition of a flotation agent realizes automatic addition of the agent, effectively reducing the waste of the agent, and no manual agent addition is required for the flotation machine, the flotation machine is unwatched so the need for manual work is reduced, and the flotation cost is reduced.

Description

DEVICE FOR EMULSIFICATION AND CONTROLLED ADDITION OF FLOTATION AGENT

I Technical Field

The present invention relates to a device for emulsification and controlled addition of flotation agent, in particular to a device for emulsification and controlled addition of flotation agent applicable to the coal dressing field.

II Background Art

Flotation is to separate useful minerals from useless minerals on the basis of differences in surface properties between the minerals under the action of an agent. Factors that have influence on the flotation process mainly include the amount of pulp, pulp density, size composition, regime of agent, etc. The flotation process is difficult to control owing to a large number of influencing factors. As detection techniques, control techniques, and actuators are developed rapidly in recent years, automatic flotation control techniques have also been innovated and developed.

Coal dressing plants usually use a flotation method to separate 0.5-0mm coal slime. In coking coal dressing plants and anthracite coal dressing plants, coal slime accounts for 20%~30% of the total quantity of raw coal fed for washing. In the flotation process, the product indicators are controlled by adjusting the regime of agent solely based on the production experience of the workers without any theoretical guidance and criterion. The manual adjustment approach is not accurate and timely and has direct influence on the economic benefit of coal dressing plants. To overcome the blindness of manual agent addition and hysteresis of flotation indicator control, domestic and foreign researchers have made researches on flotation process optimization to improve automation of the flotation process. In view of the complexity of flotation process control, many researchers have made researches on flotation process control from different aspects.

Manual addition of agent: the agent is added at the agent addition points manually according to the product quality, and the dosage is controlled on the basis of the valve opening degree. A main problem involved in manual addition of agent is that the addition is interfered by human factors.

Quantitative addition of agent: the agent is directly added to the agent addition points with a metering pump. This method can effectively perform statistics on the agent consumption and achieve accurate addition at the addition points, but has a problem that the amount of added agent doesn't vary with the pulp flow and concentration fluctuation, and thereby results in waste of the agent.

Quantitative addition of emulsified agent: the agent is emulsified in a certain quantity and then is directly added to the addition points. The amount of agent at the addition points relies on manual control. This method can accurately control the total quantity of the added agent, and can attain a purpose of saving the agent by means of

emulsification. However, the quantity of the added agent doesn't vary with the pulp flow and concentration fluctuation, and results in waste of the agent; the addition at the addition points relies on manual control and is inaccurate.

In the past few years, great achievements have been made in flotation agent addition and control in China. However, the flotation agent addition and control was mainly based on quantitative and emulsification addition, the amount of added agent has not been correlated with the quantity of feed material, and accurate addition at the addition points has not been realized.

III Contents of the Invention

To overcome the drawbacks in the above techniques, the present invention provides a device for emulsification and controlled addition of flotation agent, which has simple structure, has functions including foam layer monitoring, agent metering, agent emulsification and preparation, and accurate addition at the addition points, and supports addition of agent at different points under automatic control or remote control.

To attain the technical object described above, the device for emulsification and controlled addition of flotation agent provided in the present invention comprises a flotation feed flow rate and concentration detection system, which comprises a flow meter and a density meter arranged on a feed pipeline of a flotation machine, wherein: the feed pipeline of the flotation machine is connected with a control system through lines, and the control system is connected with an agent metering, emulsification, and multi-point addition system and a flotation foam product monitoring system, respectively;

The control system comprises a PLC control cabinet and an upper computer that are connected with each other;

The agent metering, emulsification, and multi-point addition system comprises an agent box, a metering pump, an emulsification pump, an agent addition metering pump, and an agent buffer tank, wherein, the agent box consists of a collecting agent tank and a foaming agent tank, the collecting agent tank and the foaming agent tank have an agent addition port in the top part of the tanks respectively, and have overflow pipes on their side surfaces respectively, a valve is arranged on each of the overflow pipes, a plurality of output pipelines of the collecting agent tank and the foaming agent tank are merged and then connected to the input end of the emulsification pump, a stop valve is arranged on the main pipeline that is merged from the plurality of output pipelines, a metering pump is arranged on each output pipeline of the collecting agent tank and the foaming agent tank, valves are arranged on the output pipelines at the two sides of the metering pump, a clean water pipeline is connected to the input end of the emulsification pump, a clean water flow meter and an electric valve are arranged respectively on the clean water pipeline, the output end of the emulsification pump is connected to the agent buffer tank via pipelines, an agent addition port and an overflow pipe with a valve are arranged respectively on the agent buffer tank, the output end of the agent buffer tank is connected to a plurality of agent addition points through pipelines respectively, an agent addition metering pump is arranged on the pipeline having plurality of agent addition points; according to the quantity of dry coal slime measured by the flotation feed flow rate and concentration detection system, the quantity of added agent per ton of raw coal and the proportion of the agent are inputted into the upper computer, the upper computer transmits a

calculation result to the PLC control cabinet, and the PLC control cabinet controls the connected metering pumps so as to control the quantity of added agent;

The flotation foam product monitoring system is a monitoring camera arranged on the flotation apparatus, and the monitoring camera is connected to the upper computer. The overflow pipes of the collecting agent tank, foaming agent tank, and agent buffer tank are connected with each other for discharge. One to three of agent addition points are arranged during the flotation process, the agent addition proportions at the agent addition points are inputted into the upper computer, and the upper computer controls the agent addition metering pumps to add the prepared agent to the agent addition points. The monitoring camera arranged on the flotation apparatus monitors the condition of the foam product in the flotation apparatus in real time, and the regime of agent addition is adjusted according to the foam condition and product indicators to control the quality of the product. A safety valve and a ball valve are arranged at the input end and the output end of each of the metering pumps and the agent addition metering pumps respectively, a filter is arranged at the input end of each of the metering pumps and the agent addition metering pumps, and the metering pumps and the agent addition metering pumps are connected with a buffer device and a pressure meter sequentially via a valve respectively.

Benefits: the amount of added agent is controlled with the flow meter, the density meter and the upper computer to overcome the drawback of blindness and inaccuracy of manual agent addition, so that the agent can be added accurately and automatically, and waste of the agent can be reduced effectively; a monitoring camera is utilized to display the quality of the flotation product online in real time, accumulating total feed quantity for flotation, and accumulating total quantity of clean coal and guide the amount of added agent according to the product quality; the quality of the flotation product is displayed online in real time, and the product quality can be adjusted at any time; the flotation machine doesn't requires manual agent addition, and can operate in an unwatched state; thus, the labor requirement and the flotation cost are decreased.

IV Brief Description of Drawings

Fig. 1 shows flotation feed detection;

Fig. 2 shows agent metering, emulsification, and multi-point addition;

Fig. 3 is a schematic diagram of flotation process parameter control.

In the figures: 1 - flow meter; 2 - density meter; 3 - emulsification pump; 4 - metering pump; 5 - agent addition metering pump; 6 - collecting agent tank; 7 - foaming agent tank; 8 - agent buffer tank; 9 - clean water flow meter; 10 - electric valve; 11 - upper computer; 12 - PLC control cabinet; 13 - detection system; 14 - control system; 15 - agent addition system; 16 - flotation apparatus; 17 - monitoring camera.

V Embodiments

Hereunder the present invention will be further detailed in embodiments with reference to the accompanying drawings.

The device for emulsification and controlled addition of flotation agent provided in the present invention comprises a flotation feed flow rate and concentration detection system 13. As shown in Fig. 1, the flotation feed flow rate and concentration detection system 13 comprises a flow meter 1 and a density meter 2 arranged on the feed

pipeline of a flotation machine, the flow Q (m^3/h) and density ρ (kg/m^3) of the feed material are detected respectively by means of flotation feed detection, and the quantity of dry coal slime $b=Q \cdot \rho/1,000$ (unit: t) in the flotation feed material can be obtained from the detection data; the feed pipeline of the flotation machine is connected with a control system 14 through lines, and the control system 14 is connected with an agent metering, emulsification, and multi-point addition system 15 and a flotation foam product monitoring system;

As shown in Figs. 2 and 3, the agent metering, emulsification, and multi-point addition system comprises an agent box, a metering pump 4, an emulsification pump 3, an agent addition metering pump 5, and an agent buffer tank 8, wherein, the agent box consists of a collecting agent tank 6 and a foaming agent tank 7, the collecting agent tank 6 and the foaming agent tank 7 have an agent addition port in the top part of the tanks respectively, and have a plurality of overflow pipes on their side surfaces respectively, a ball valve and a flow meter are arranged on each of the overflow pipes, the overflow pipes of the collecting agent tank 6, the foaming agent tank 7 and the agent buffer tank 8 are connected with each other for discharge, the output pipelines of the collecting agent tank 6 and the foaming agent tank 7 are connected to the input end of the emulsification pump 3, a plurality of metering pumps 4 that serve as backup for each other are arranged on the output pipelines of the collecting agent tank 6 and the foaming agent tank 7 respectively, the metering pumps 4 feed the collecting agent and the foaming agent to the emulsification pump 3 respectively, a clean water pipeline is connected to the input end of the emulsification pump 3, a clean water flow meter 9 and an electric valve 10 are arranged on the clean water pipeline respectively, the output end of the emulsification pump 3 is connected to the agent buffer tank 8 through a pipeline, an agent addition port and an overflow pipe with a valve are arranged on the agent buffer tank 8 respectively, the output end of the agent buffer tank 8 is connected to a plurality of agent addition points through pipelines respectively, an agent addition metering pump 5 is arranged on each of the pipelines having plurality of agent addition points, the emulsification pump feeds the emulsified agent and water to an agent storage tank 8, and the emulsified agent is added to different agent addition points through the metering pump 5;

A safety valve and a ball valve are arranged at the input end and the output end of each of the metering pump 4 and the agent addition metering pump 5 respectively, a filter is arranged at the input end of each of the metering pump 4 and the agent addition metering pump 5, and the metering pump 4 and the agent addition metering pump 5 are connected with a buffer device and a pressure meter sequentially via a valve respectively;

The concentration of the prepared emulsified agent can be controlled to be a fixed value by means of the metering pump 4 and the electric valve 10. One to three of agent addition points are arranged during the flotation process, the agent addition proportions at the agent addition points are inputted to an upper computer 11, the upper computer 11 controls the agent addition metering pump 5 to add the prepared agent to the agent addition points; the amount of added agent per ton of raw coal and the proportion of the agent are inputted to the upper computer 11 according to the quantity of dry coal slime measured by the flotation feed flow rate and concentration detection system 13, the upper computer 11 transmits the calculation result to the PLC control cabinet 12, and the PLC control cabinet 12 controls the connected metering pump 4 so as to control the amount of added agent;

The flotation foam product monitoring system is a monitoring camera 17 arranged on a flotation apparatus 16, the monitoring camera 17 is connected to the upper computer, and monitors the condition of foam product in the flotation apparatus 16 in real time, so that the regime of agent addition is adjusted according to the condition of the foam and the product indicators so as to control the quality of the product;

The control system comprises a PLC control cabinet 12 and an upper computer 11 that are connected with each other.

As shown in Fig. 3, the quantity of dry coal slime in the feed material for flotation can be used as a guide for the total quantity of added agent in the flotation process, and the quantity of reagent addition, agent addition proportion, and the amount of added agent at the agent addition points are controlled according to the quality of dry coal slime in the feed material for flotation. For the coal slime and fixed reagent in long-term production, the agent consumption rate is K (kg/t), and the proportion of the agent n is a fixed value; the quantity of water added into the emulsification pump 3 is Q_1 ; the quantity of added agent at the agent addition points can be calculated simply by inputting the agent consumption rate K , the proportion of agent n , and the ratio of agent $d_1:d_2:d_3$ among the agent addition points on a control interface. The calculation process is as follows: suppose the volume of the collecting agent added into the metering pump 4 is V_1 (L), the volume of the foaming agent is V_2 (L),

$V_1 = n \cdot V_2$, then the volumetric concentration of the emulsified agent is $c_1 = \frac{(V_1 * V_2)}{Q_1}$.

For example, in a case of three agent addition points, the ratio of agent among the agent addition points is $d_1:d_2:d_3$; the quantity of added agent calculated by the upper

computer at the agent addition points are: at the first point: $V_3 = \frac{d_1 \cdot k}{(d_1 + d_2 + d_3) \cdot c_1}$ (L);

at the second point: $V_3 = \frac{d_2 \cdot k}{(d_1 + d_2 + d_3) \cdot c_1}$ (L); at the third point:

$V_3 = \frac{d_3 \cdot k}{(d_1 + d_2 + d_3) \cdot c_1}$ (L), the PLC control cabinet 12 controls the metering pump 5 to feed reagent in corresponding volumes to the agent addition points.

A criterion must be met by the control, i.e.: C_1 is a fixed value, and $V_1 + V_2 + Q_1 = V_3 + V_4 + V_5$.

Utilizing the control method and the detection result described above, automatic detection and control can be carried out, and the system can be incorporated into a centralized control system.

When any property of the flotation coal is changed, the control system may be switched to a manual state, and manual operations may be executed, the quantity of added agent, the proportion of the agent, and the quantity of added agent at the points may be traced, to seek for an optimal regime agent to guide the automatic control of the agent.

Claims

1. A device for emulsification and controlled addition of flotation agent to a floatation machine (16) comprising a flotation feed flow rate and concentration detection system (13) including a flow meter (1) and a density meter (2) in a feed pipeline of the flotation machine, wherein the feed pipeline of the flotation machine is connected to a control system (14) including an upper computer (11) and a PLC (12) connected to the upper computer (11), the control system (14) being connected to an agent metering, emulsification, a multi-point foaming agent addition system (15) and a flotation foam product monitoring system including a monitoring camera (17) on the floatation machine (16) connected to the upper computer (11);

the agent metering, emulsification, and multi-point foaming agent addition system including an agent box consisting of a collecting agent tank (6) and a foaming agent tank (7), metering pumps (4), each having an input end and an output end, an emulsification pump (3), an agent addition metering pump (5) and an agent buffer tank (8), each of the collecting agent tank (6) and the foaming agent tank (7) having a top agent addition port and side overflow pipes, a valve in each of the overflow pipes, a plurality of output pipelines from the collecting agent tank (6) and the foaming agent tank (7) merging into a main pipeline connected to an input end of the emulsification pump (3), a stop valve located in the main pipeline merged from the plurality of output pipelines, a metering pump (4) in each output pipeline of the collecting agent tank (6) and the foaming agent tank (7), valves in output pipelines at two sides of the metering pumps (4), a clean water pipeline connected to the input end of the emulsification pump (3); a clean water flow meter (9) and

an electric valve (10) in the clean water pipeline, a pipeline connecting an output end of the emulsification pump (3) to the agent buffer tank (8), an agent addition port and an overflow pipe containing a valve on the agent buffer tank (8), pipelines connecting an output end of the agent buffer tank (8) to a plurality of agent addition points; an agent addition metering pump (5) in the pipeline having the plurality of agent addition points for feeding agent into the feed pipeline depending upon the quantity of dry coal slime measured by the flotation feed flow rate and concentration detection system (13).

2. The device for emulsification and controlled addition of flotation agent according to claim 1, wherein the overflow pipes of the collecting agent tank (6), foaming agent tank (7), and agent buffer tank (8) are connected to each other for discharge.

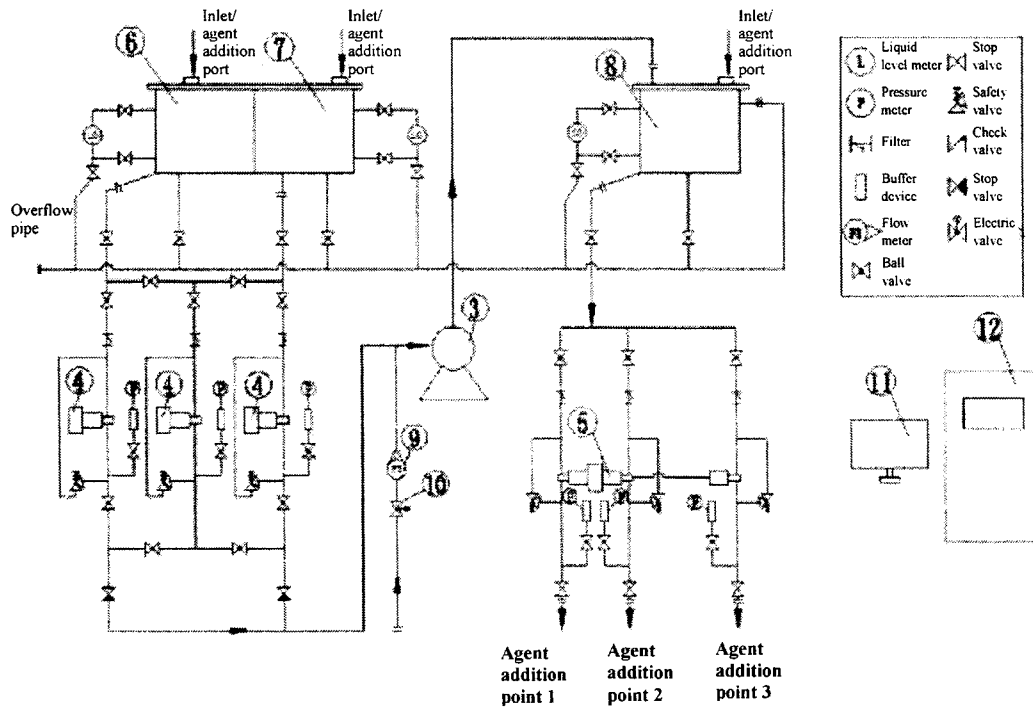
3. The device for emulsification and controlled addition of flotation agent according to claim 1 including one to three agent addition points in the pipeline.

4. The device for emulsification and controlled addition of flotation agent according to claim 1, wherein the monitoring camera (17) is adapted to monitor the condition of the foam product in the flotation apparatus (16) in real time so that a regime of agent addition can be adjusted according to the foam condition and product indicators to control the quality of the product.

5. The device for emulsification and controlled addition of flotation agent according to claim 1, including a safety valve and a ball valve at the input end and the output end of each

metering pump (4) and each agent addition metering pump (5); a filter at the input end of each metering pump (4) and each agent addition metering pump (5); and a valve connecting the metering pump (4) and the agent addition metering pump (5) to a buffer device and a pressure meter sequentially.

Drawing of Abstract



Drawings of Description

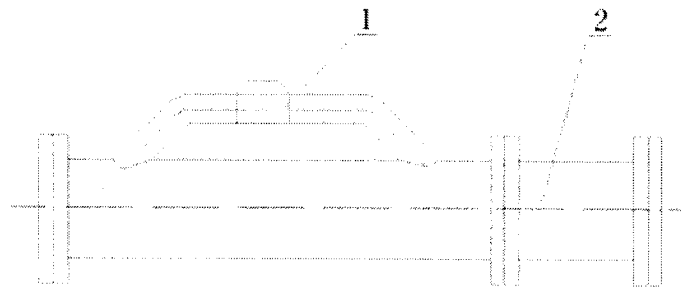


Fig. 1

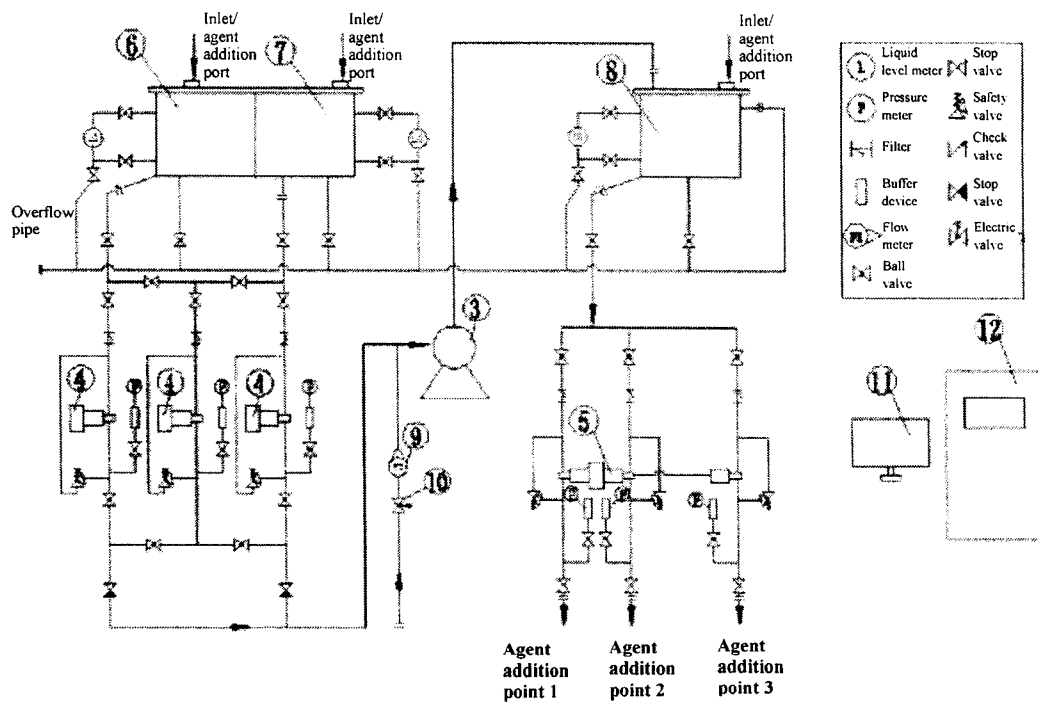


Fig. 2

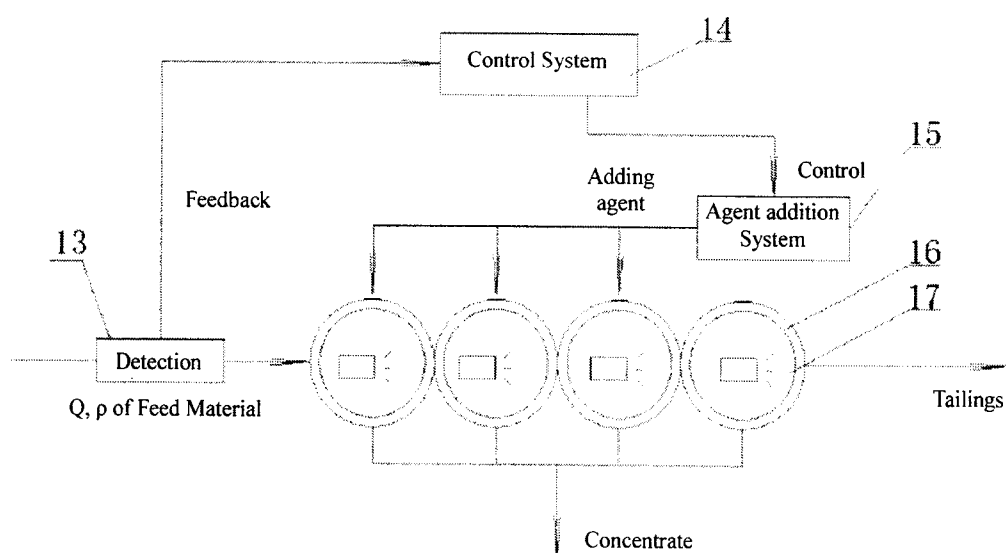
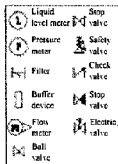
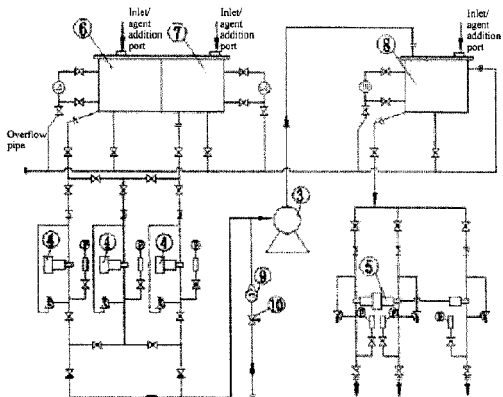


Fig. 3



Agent
addition
point 1

Agent
addition
point 2

Agent
addition
point 3

