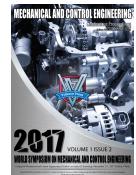




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# APPLICATION RESEARCH OF FEED-FORWARD FEEDBACK COMPOUND CONTROL IN WHITEBOARD DRY VOLUME

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## ARTICLE DETAILS

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## ABSTRACT

This paper mainly introduces the basic principle and control system of white paper feed-forward feedback composite control in the white paper dry application, combining with simulation and industrial production actual situation, analysis of the characteristics of feed-forward feedback compound control system.

## 1. Introduction

The structure of white board paper is different from the ordinary single layer paper, the white board paper is mainly composed of surface layer, lining layer, core layer and bottom layer. During the production process of white paper, white paper dry weight parameters is the comprehensive characteristics of reaction system, which once is controlled accurately, it can not only effectively guarantee the quality of white paper, but also can save the consumption of paper pulp.

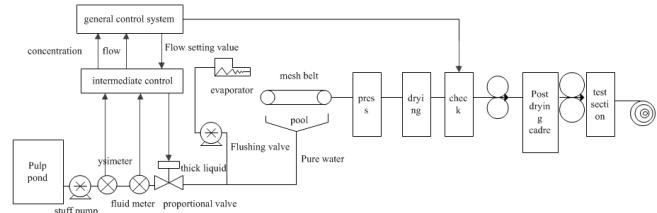
The feedback control is mainly based on deviation control system, at the same time if there is a deviation, it means that the system can't reach the ideal control requirements for the controlled object, when the object showing a large delay or receiving many disturbance, It is obviously that the system for fast response control, feedback control can't meet the requirements. Since feed-forward control is aimed at the disturbance and its variable quantity, the feed-forward control well covers the shortage in comparison with the feedback control. In the process of white board production, on account of the actual industrial environment is more complex, and it produce more disturbances. Therefore, it is very meaningful to realize the precise control of the dry volume of white board paper by using feed forward feedback compound control system.

## 2. THE BASIC PRINCIPLE OF WHITEBOARD CONTROL SYSTEM

Referring to the relevant data, it can be seen that the dry quantity of the whiteboard control system, that is, the controlled quantity, can be expressed in the following formula.

$$BD_N = 1000 * \frac{F_N * C_N * R}{W * S_N}$$

In this formula,  $BD_N$  represents the absolute dry weight of layer n ( $\text{g}/\text{m}^2$ );  $F_N$  represents the flow of layer n ( $\text{l}/\text{min}$ );  $C_N$  indicates the concentration of layer n (%);  $W$  width of paper (m);  $S_N$  express speed for layer n ( $\text{m}/\text{min}$ );  $r$  expressing retention rate. The system control principle is shown in the following picture.



**Figure 1:** Schematic diagram of system control

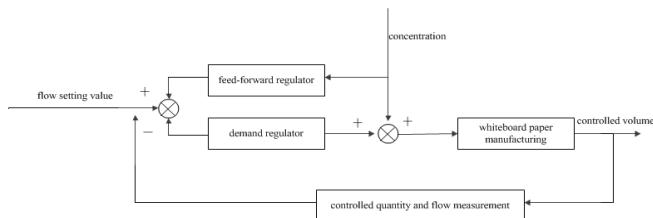
It is very important to control the dry volume accurately. Because the dry amount of white board is the parameter of the reaction system, the white paper is mainly composed of a surface layer, lining layer, core layer and bottom layer. The correspondent sizing system is mainly composed of slurry concentration meter, flow meter, fan pump and flow box. Slurry pumped from slurry pool mix or dilute with water, flowing from fan pump to head box. The level of pulp fluid keeps constant through the control of the fan pump; thereby it can maintain the normal production in the speed at about 1:1 stably.

Therefore, by controlling the flow of electric ball valve, it can control the dry amount of each layer of paper. And when layer of slurry concentration fluctuation causing the speed fluctuation of dry layer, it can control the slurry flow to keep  $F_N * C_N$  constant, the act can effectively compensate for concentration changes caused by dry weight changes.

## 3. APPLICATION OF FEED-FORWARD CASCADE COMPOUND CONTROL SYSTEM

Because of the long-time lag and the small time constant, the feed forward cascade compound control system is used in the production process of white board. Concentration is the interference source between the control system; In the production process of slurry, concentration fluctuation will cause the loss of control of the paper quantitatively affect the quality of the paper. If the fluctuation occurs in the feedback control, it is only in the pure lag time to detect the dry weight fluctuations, and then adjust the action, the process of eliminating the errors is time-consuming, it cannot effectively ensure the quality of white paper. Therefore, the concentration

feed-forward compensation control is necessary to suppress the runaway of white board paper because of the concentration.



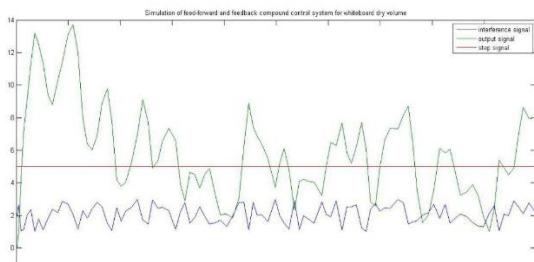
**Figure 2:** Block diagram of whiteboard dry volume control

The feed-forward feedback composite system is characterized by the use of feed-forward control to suppress the interference of the system, and the feedback control is used to suppress other disturbances. When the control system is used, the main disturbance of the system is controlled by feed-forward system, the intermediate variable is controlled by inner loop feedback, and the outer loop feedback control is used to control the system.

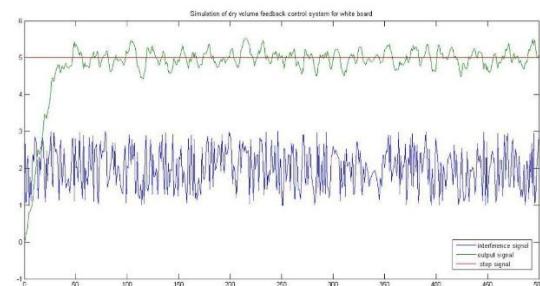
Using Simulink toolbox of MATLAB to simulate whiteboard control system, combining with the approximate transfer function of system identification to adjust feed-forward control system and analyze the feedback control system's stability control channel, and set a feedback control system.

The transfer function of the interference channel is as follows,  
 $G_f(s) = \frac{5e^{-5s}}{(8s+1)}$  The partial transfer function of the system is as follows,  
 $G_1(s) = \frac{2e^{-3s}}{5s+1}, G_2(s) = \frac{3e^{-5s}}{10s+1}$ . The feedback loop transfer function is  $H(s) = 1$ .

Using Simulink toolbox built according to a control method of the system model, the first use of the tuning parameters for constructing feedback control system, and gives the simulation results of Simulink curve as shown in Figure 3. Then the feed-forward link is added to further adjust the simulation as shown in Figure 4. Among them, the external disturbance uses the given value of 5, the interference source is 2, and the superposition amplitude is + 1 random interference signal.



**Figure 3:** Simulation of dry volume feedback control system for white board



**Figure 4:** Simulation of feed-forward and feedback compound control system for whiteboard dry volume

The simulation results show that compared with using the feedback control system can make the system more stable feed-forward feedback control system, can make a better suppression of disturbance in the random signal into the state, to further enhance the performance of the system, can be used in industrial production, it has good application value.

#### 4. CONCLUSION

After using the control function of feed-forward compensation, it effectively improve the quality of control system, referring to the relevant industry data ,it can be concluded that even when the concentration of each layer slurry has a larger fluctuation, feed-forward feedback system can accurately control the white paper dry weight, and greatly decrease rejection rate , so improve the quality of the products .

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