CONTROL OF ELECTRIC ARC FURNACE BASED ON FUZZY LOGIC CONTROLLER

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ABSTRACT

Electrode regulator system is a key link in electric arc furnace smelted ore metal; it's improved control solution and effectively reduce the energy consumption and physical electrode. This Self-adjusting Controller which is very close two-closed-loop Electrode-lift Regulating System for Ore Smelting Electric Arc Furnace has been implemented in this project focusing that Electric Arc Furnace being a linear as well as nonlinear system whose parameters vary with respect to time and currents being inter-coupled in three phase system, moreover desirable result could not be obtained by PID control constant current single-closed-loop Electrode-lift Regulating System when smelting the different ore materials. In this proposed system two-closed -loop system obtained by Auto-fuzzy controller with current feedback and ore forward-feedback, this can automatically adjust the fuzzy controller option and also optimize the control operation by regulating exact quantized factor, proportional factors and then two-input variables weighing of fuzzy controller is depends on input variables. In additional, the forward-feedback control makes the rise time and adjust time of the proposed system less than that of single-closed-loop Electrode-lift Regulating System. The resultant of simulating have shown that this proposed system has better dynamic characteristics and stronger suppression capacity, so the wider application prospect will be expected.

Index Terms—PID : Cascade Control; Furnace; Simulation; Matlab / Simulink.

I INTRODUCTION

An electric arc furnace steel-making is a big power consumer in national economy. One main characteristic of electric arc furnace is that it needs a lot of electric power, the capacity of a three-phase furnace transformer can be up to several thousands to tens of thousands of KVA and power required when electric arc furnace is working fluctuates sharply, the role of the electrode regulator is to regulate power by regulating the location of the electrode. therefore, choosing an optimal electrode control program turns out to be very important for shortening the time of melting, reducing energy consumption, lowering the cost per ton of steel, and optimizing power factor.

The PID control is one of the oldest and the strongest control methods. This is mainly because this control method is intuitive, easily implemented, and robust. But for time-varying and nonlinear system, usually it is difficult to tune the PID parameters to achieve an optimal status for various conditions. To control a non-linear time-varying system with strong random interference like electric arc furnace, using conventional PID regulator can hardly get a good control effect, but using fuzzy logic control to control electric arc furnace electrode can take advantage of the robust feature of fuzzy control and non-linear control to deal with the time-varying and nonlinear characteristics of electric arc furnace.

For some nonlinear control objects, such manual inaccurate, insensitive, etc. are superior to classical control approach is too precise, too sensitive, fuzzy control, it is through the accumulated experience of the control action, with a group of language expressions can be used by the imprecise qualitative description to determine the rules.

II DESIGN OF ELECTRIC ARC FURNACE

An arc furnace pouring out steel into a small ladle car. The transformer vault can be seen at the right side of the picture. For scale, note the operator standing on the platform at upper left. This is a 1941-era photograph and so does not have the extensive dust collection system that a modern installation would have, nor is the operator wearing a hard hat or dust mask. Scrap metal is delivered to a scrap bay, located next to the melt shop. Scrap generally comes in two main grades: shred (white goods, cars and other objects made of similar light-gauge steel) and heavy melt (large slabs and beams), along with some direct reduced iron (DRI) or pig iron for chemical balance. Some furnaces melt almost 100% DRI.

The scrap is loaded into large buckets called baskets, with "clamshell" doors for a base. Care is taken to layer the scrap in the basket to ensure good furnace operation; heavy melt is placed on top of a light layer of protective shred, on top of which is placed more shred. These layers should be present in the furnace after charging. After loading, the basket may pass to a scrap pre-heater, which uses hot furnace off-gases to heat the scrap and recover energy, increasing plant efficiency.