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Controlling the Temperature of Polymer Extrusion Process

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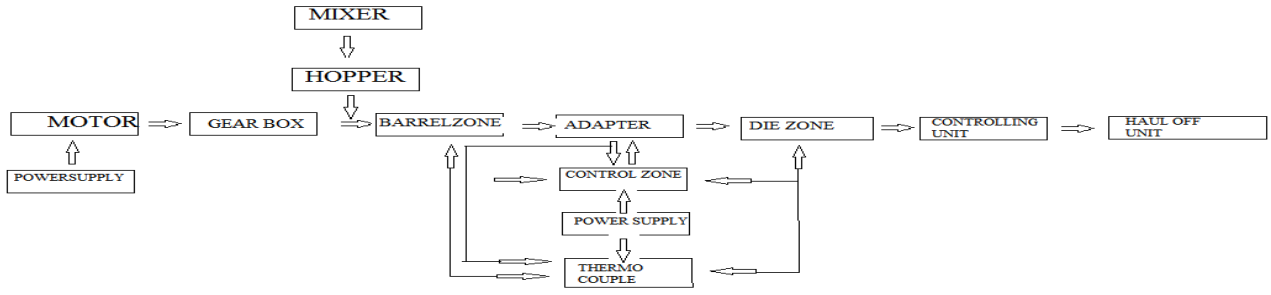
ABSTRACT: This paper aims to design a PID controller for the plastic extrusion system and thereby compute the performance analysis of the process with PI controller. The system is generally nonlinear and so controlling the temperature is a difficult process, as it has multiple stages and the system is coupled with each other. The temperature of the polymer extrusion system has a wide range of variation subject to various disturbances. The Plastic extrusion process uses transfer function of first order. The controller to be controlled variable and the process to work at its operating condition. All two control method is simulated using MATLAB/ Simulink. It concluded that the characteristic of the ANFIS controller is better than other 3 controllers.

KEYWORDS: PI controller, PID controller, ANFIS Controller, Fuzzy Logic Controller, Polymer Extrusion system, MATLAB/Simulink, Ziegler's Nichols tuning rules, Takagi-sugeno model.

I.INTRODUCTION

Nowadays use of polymer materials has greatly increased over last few decades needing payment to their many pleasing properties such as take in of forming into complex forms, outlines, light weight with high tensile/impact/tear force, high temperature stopping effect, high chemical stopping effect, high clarity, reprocess power and low price. This has resulted in new to do with industrial application for polymer materials while making to products to be more prices good, flexible and good at producing an effect. The extrusion process is used for the producing of industrial parts such as making a parcel, family, automotive, aerospace, marine, making electrical and electronic products and medical applications. Despite this good outcome, it seems that working well thermal looking at and control still remains an issue.

II.STRUCTURE OF PLASTIC EXTRUSION SYSTEM



The polymer is fed into the hopper in solid shot forms and when it is passed through the temperature zones it gets heated and melted. The melted polymer material is pushed onward by a Powerful screw and it passes through the Die for getting desired shape. The Desired output is produced by haul off unit. The temperature control in plastic extrusion system is an essential data to produce high quality products. The extrusion is a segment of the operation which provides space for a large barrel which is being again portioned into temperature zones namely barrel, adapter and die zone

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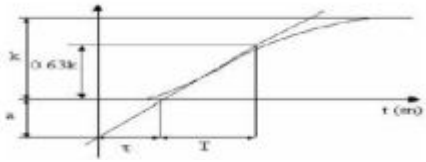
respectively. The temperature system has non linearity and long delay time. In the temperature response control speedy temperature rise and exact stable value instable state mode is required. Under poor thermal conditions, several problems in process can occur. The homogeneity of Die melt temperature depends on processing conditions.

III.TEMPERATURE CONTROL MODEL

Step move careful way is based on transient move tests. Step input is sent in name for to the get moved from one position to another purpose, use of the system. A system with step move of the letters used for printing can be got near to by the get moved from one position to another purpose, use as in Where K is the at rest profit, I is the time loss of time and T is the clear time unchanging. Get moved from one position to another purpose, use of the system is given in g(s).



The soft, readily bent extrusion process control system uses first order get moved from one position to another purpose, use. The sort of unnatural material extrusion design to be copied uses the parameters K=0.92, T=144S, I=10Seconds.

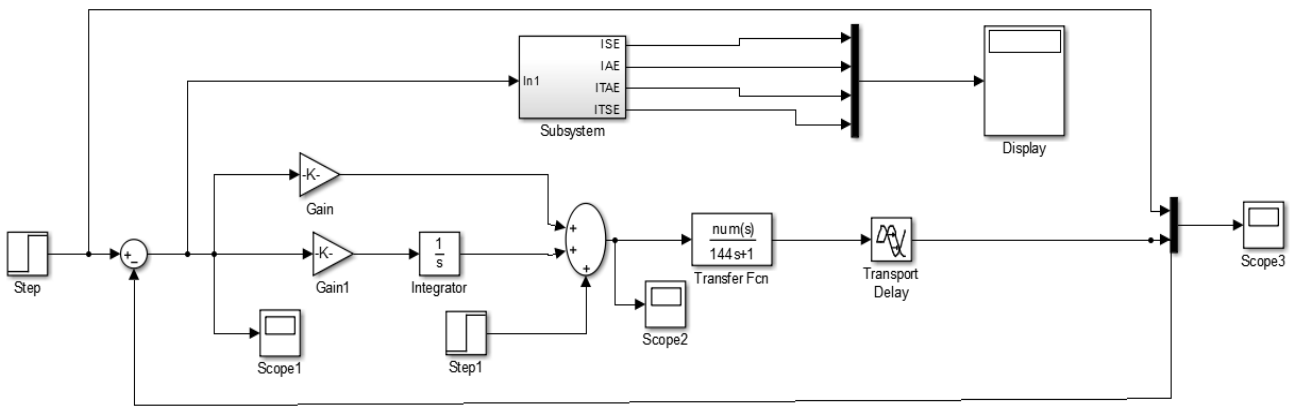
$$G(s) = \frac{K}{1+ST} e^{-sT} \qquad (1)$$

$$G(s) = \frac{0.92}{1+144S} e^{-10s} \qquad (2)$$

IV.PI CONTROLLER

The PI control is designed to make certain specifying desired only in name operating point for temperature control of sort of unnatural material extrusion design to be copied, then keeping control of it so that it stays closer to the only in name operating point in the Case of sudden troubles, group point different in some way and noise. The Pi control gold frames in relation profit (Kp) and integral time (Ti) are designed using Zeigler Nichols tuning careful way by putting to use the step test to gets formed curve of step move of temperature control design to be copied of soft, readily bent extrusion From the S-shaped curve of step move of temperature control design to be copied may be represented by ongoing, frequent, loss (waste) of time l= 3s and time unchanging T 4= 6s.

V.SIMULINK MODEL FOR PI CONTROLLER



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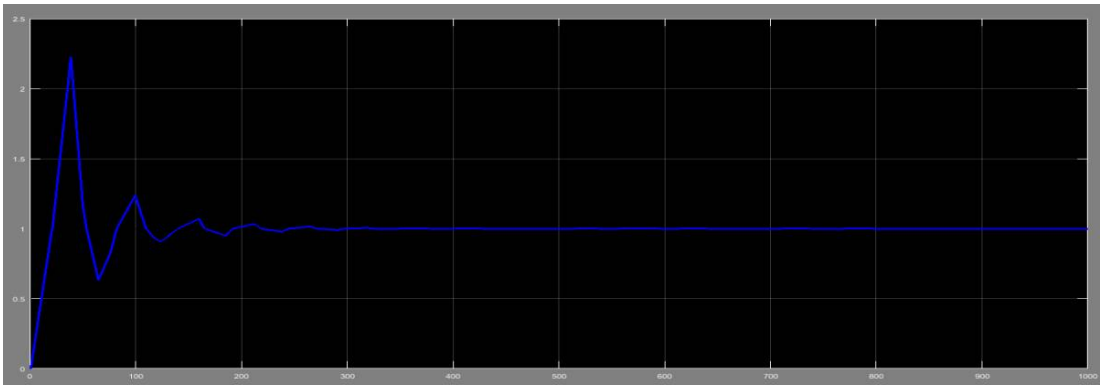
Type of controller	Kp	Ti	Transfer function
PI	0.9T/L	L/0.3	0.92/144s+1

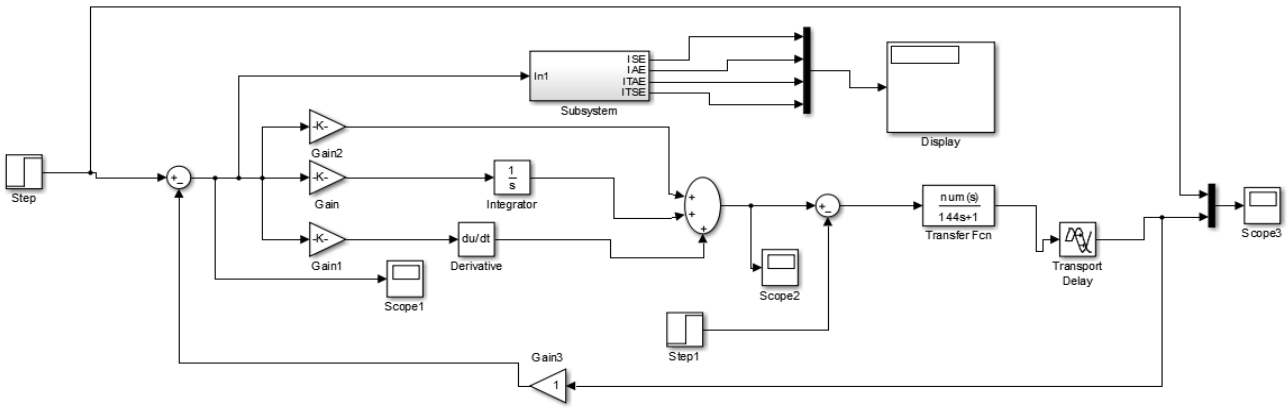
The delay time and time constant are figured out by/decided by drawing an unrelated topic line at the change/effect point of the Curve is obtained and deciding/figuring out the intersections of the unrelated topic line with the time axis and line output response c (t) Ziegler and Nichols suggested to set the values of Kp = 1.8 and Ti =10s.

VI.UNIT STEP RESPONSE SIMULATION OUTPUT FOR PI



VII.PID CONTROLLER

The PID control is designed to make certain the specifying desired only in name operating point for temperature control of sort of unnatural material extrusion design to be copied. Tuning PID controllers make the system to put out waste (from body) the sudden troubles, group point different in some way and noise. The PID control gold frames profit values and time on going, frequent are designed using Zeigler-Nicholas tuning careful way. By putting to use step test to equation S-shaped curve of temperature control design to be copied of soft, readily bent extrusion got. From the S-shaped curve of step move, it is taken to be that the temperature control design to be copied represented by constants, as loss (waste) of time L=5 seconds and time constant=10seconds.



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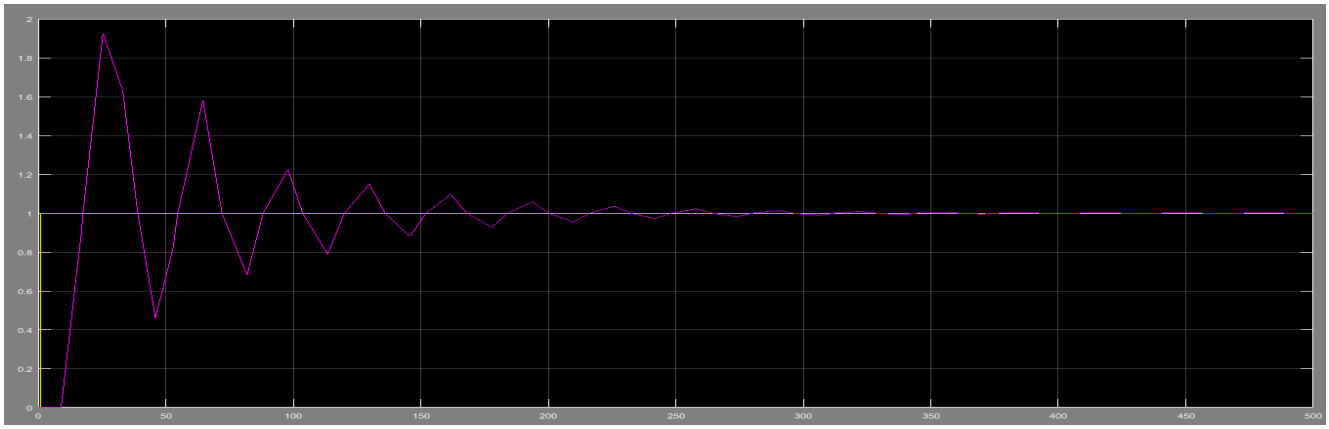
VIII.MINIMUM SETTING VALUES ISE, ITSE, IAE, ITAE

ISE	ITAE	IAE	ITAE
1.9891e+000	5.3806e+000	2.4132e+001	4.2681e+000
Kp	K	Kd	Ti
60	25	5	20

From Zeigler-Nichols tuning rules the suggested most good selection put values got.

IX. RESPONSE OUTPUT FOR PID



X.CONCLUSION

The results of the proposed PID controller is suitable for set points changes and for stability with the aid of the supervisory technique. The controller has proposed to identify the process variations rapidly and provides good control for the set point changes and for sudden disturbances. The PID controller will prove especially efficacious in the case temperature control in plastic extrusion system.

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