Dryer Steam and Drainage Control

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SUMMARY

The Process of Paper drying is in different part of paper making. In most of Machines the drying of paper is carried out by number of dryers arranged in different groups. The dryers are usually heated by steam. Adding steam to the dryers and as well as removal of condensate from the dryers should be regulated to get optimum performance.

The paper discusses the factors and functions related to functioning of a dryer steam and drainage control. Thus to an Instrument Engineer, it gives idea about parameters which effect performance of the system and for a process-personnel, provides understanding regarding functioning of the control-system and co-relation with process-parameters and related eqnipments.

INTRODUCTION

The purpose of Dryer steam and drainage control-system is to regulate steam flow into the dryer and to help in effective removal of condensate and vapours from the Dryers, which are produced as a result of Drying Process. This regulation and effective removal results in economy of steam consumption and optimum performance of Dryers.

The process of paper drying can be divided into three zones, namely-warm-up zone; constant heating zone and falling rate zone. Thus control system designed for this task is arranged in the said order. Further the control-system should have flexibility for various conditions of drying i.e. condensing-rates-taking into aecount Moisture-variations from Presses; variation in Basis Weight; Machine-speed and grades of paper to be made.

CONTROL-VARIABLES

There are three major variables for control purpose.

TEMPERATURE. PRESSURE AND DIFFFERENTIAL PRESSURE

TEMPERATURE—The temperature inside the dryer or in the steam header supply steam to various dryers can be used to position the steam-valves of individual dryer groups. This regulates the temperature at which steam condenses, hence the heat transfer.

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PRESSURE—The Pressure inside the dryer determines the condensing temperature, thus by regulation of pressure one regulates condensing temperature and hence the rate of heat transfer. Therefore pressure can be used for positioning steam control-valves of individual groups.

PRESSURE OR TEMPERATURE CONTROLLERS — Temperature controllers when used to position steam supply valves, their performance is less satisfactory then pressure controller, due to the influence of Superheat on the temperature—pressure relationship of steam. Temperature controllers give reasonably good results, where there is little superheat in the steam. Even modest amount of super heat tends then to be inaccurate for regulating condensation temperature.

The disadvantage of temperature controller are further magnified, if main steam-supply have fluctuations in temperature or pressure. A good pressure controller compensates effect of such flactuations but a temperature controller can not.

DIFFERENTIAL-PRESSURE—There should be some difference of pressure between steam and condensate header of a particular group of dryers. This is required for effective removal of condensate from dryers and required blow-through steam for removal of non-condensables. For efficient operation of a dryer group, the differential-pressure across it should be held constant. The differential (D.P.) may be controlled by regulating amount blowing from the seperator. By increasing the amount of blowing D.P. is increased.

The dryers are heated by steam condensing on the inner surface of the wall as heat is taken away from the shell. The condensation is a constant temperature process with temperature depending on the pressure within dryer. The condensate is removed either by Bucket, Scoop or Siphon.

The non-condensable gases present in steam, accumulate in the dryer and add up a partial-pressure over the condensing pressure which ultimately results in reduced drying capacity and uniformity. In order to purge out this non-condensables, steam should be blown-through with condensate. Thus the condensate removal system should be sized to accommodate condensate flow as well as blow-through steam.

The Differential pressure required for condensate removal and non-condensables depends on the geometry of Siphon-condensate Pipe-path; on the condensate and blow-through rate through this path; on the centrifugal and gravitational forces acting on the condensate. Thus in general required D.P. is a function of Machine speed, rate of condensation, blow-through required and type of Siphon used whether stationery or rotating.

CONTROL-STRATEGIES

From steam utilization point of view dryers can be arranged in two ways. First concept uses fresh or live steam in each dryer group. In the other concept flash steam from the higher pressure group is used in preceding low-pressure group-the so called ***cascading***. The cascading of groups results in effective utilisation of flash steam and in economy of steam consumption.

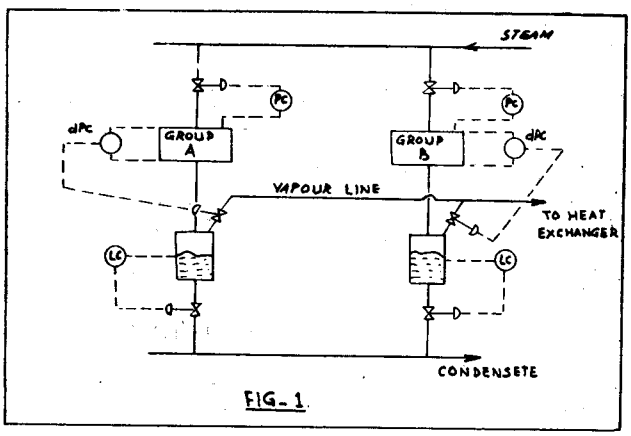

FIG-1

Figure-I shows control-system for dryer groups without cascading. The pressures in group A & B are determined by set-points of respective pressure controllers. Differential across individual-group is maintained by differential pressure controllers. Constant D.P. is maintained to ensure effective condensate removal and required blow-through.

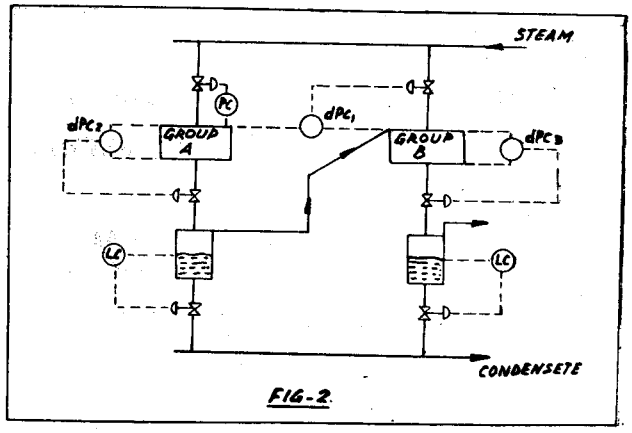

FIG-2

Figure—2 shows control-system for dryer groups with cascading arrangement. Pressure in group A is controlled by pressure-controller and is determiened by its set-point. Flash-steam from group A seperator is fed to the group B. The make-up live steam is added to the group-B, depending upon setting of DPC_1, which maintains a constant differential between group A & B. For proper operation of controls, differential between A & B should be higher than the differential of the group A itself. To ensure proper drainage, differential across individual groups A & B are maintained by DPC_2 and DPC_3

The moisture in the paper-reel can be controlled by placing set-point of pressure controllers by moisture-controller. The measurement of moisture is made at the dry-end after dryers. For better results transportation lag should be minimum and therefore groups close to the dry end should be chosen for control.

PERFORMANCE AND CONTROL ELEMENTS

The performance of the control-system depends upon careful selection of control elements such as, Pressure and Differential Pressure Controllers; D. P. Transmitters and control-valves. Added to this is the control modes in corporated with controllers and their tunning; Resolution and response of transmitters; speed of Response, Rangeability and inherent characterstic of control-valves.

The controller used for this purpose, if have proportional-mode only, then there exists offset between set-point and controlled variable. The off-set depends upon the size of disturbance. During normal operating conditions, this does not pose any problem, but during paper-break a large disturbance is introduced and proportional controller is not able to handle it effectively. Further, during paper-Break, cylinder pressure should reduce substantially, which may not be possible only with proportional controller. The situation can be met in one way by adding

integral-action to the controller. With integral-action, care should be taken for resonance, which can occur if this is not at low-level. Another way to do this is to use ON-OFF valve to shut steam to the cylinders.

The steam control-valves chosen for this purpose should have fast-response regardless of cylender pressure. Otherwise the control-loop has to be tuned for proper-stability at the pressure-level, where loop gain is maximum and at all other levels, the loop-response will be unnecessary slow.

TUNNING OF CONTROLLERS

For good performance of the control-system, the controller should be tuned properly. Properly tuned pressure controller eliminates pressure variations in the system. As under tunning of controllers effect performance, highly tuned controllers pose problem as well.

Since a paper Machine can have three or four groups in series and a control system have many control-loops, they interact in a complicated way. A disturbance in steam pressure will move from group to group towards the wet-end of the machine and the paper web then will carry the effect of such disturbance back from low to high pressure group, thereby forming a type of closed loop. Therefore resonance phenomenon in such system can easily occur.

Thus it is important that the individual loops of the control-system do not exhibit resonance and particularly two-loops in series should not show resonance at the same frequency, Further an improper design of condensate system can produce condensate oscillations and if steam controllers are tuned to resonance at the same frequency, this can lead to severe sheet moisture variations.

AUXILLERY CONTROLS

In addtion to the pressure/temperature controllers and D.P. controllers, there are some other auxilary controls which help in the performance of main control-system. The two which can be mentioned here are-condensate level control system for seperators/ Receivers and Heat Exchanger.

The function of condensate level control system is to control and maintain a minimum level inside separators/Receivers. This can be further supplemented by adding one pressure-switch to this system, to regulate condensate-transfer Pump-running. That is to say–in case of low level pump is stopped. This helps to avoid pump running dry, thus adds safety to it. Further, since a minimum condensate level is maintained, steam blow through the pump is avoided. This is very important for functioning of D. P. Controllers.

The function of Heat Exchanger in this system is to remove and condense hot vapours which are the result of blow-through from separators. The available heat is used for heating process water which can be used for various purposes. The heat exchanger is connected to a vacuum pump, which at this point removes non-condensables from the system. The removal of blow-through steam from the system by heat exchanger, adds to the performance of D. P. controllers The temperature of hot water from the heat exchanger can be varied by regulating flow of circulating water through Exchanger.

CONCLUSION

As the working of the entire control-system is concerned, both pressnre/temperature system as well as condensate-removal system should perform well. This is observed that-even excellent performance of Pressure/Temperature system is masked by Poor-performance of condensate-system and it becomes origin of trouble for the entire control system.

Further it is normally assumed that dryer-system is a *linear* system. This is not exactly true—the non linearity being function of Pressure in side cylinders. This non-linearity has to be compensated for-either by non-linear relays or by use of computer.

REFERENCE

1. Taylor Manual No. IOA 101811
2. Masoneilan Manual No. 2007.