A Concept Note for Live Drainage Analysis on Wire Part

Introduction

Drainage analysis on the wire part is important as it indicates the present operating conditions and on the basis of it, suggests to you the key areas where further improvements can be made. Papermakers often adjust vacuum levels, engage/ disengage some hydrafoils or other elements so that they are able to improve efficiency of their machine for the current grade and basis weight of paper. Often, a drainage analysis is done by experts and the report is usually submitted after several days to the concerned. Basically, for better performance, a user must be able to know the relevant information/ data in his/ her desired format, that too at a faster speed. Imagine yourself driving your car which is displaying only the speed (rpm) of wheels and wheel diameter; and you are told that you may use the two values to calculate the speed of your car in km/hr.

The present paper shows how a live drainage analysis can be used to display the wire part performance on a real time basis.

Conventional In-plant Drainage Analysis

Conventionally, the drainage analysis is done by the machine clothing suppliers, who with the help of the sophisticated tools determine the gsm of stock on wire. As water is drained out by different elements like wet and dry suction boxes, the stock GSM is reduced. Here stock GSM means the quantity of stock and water both indicated in grams per square meter of area. The instrument used is based on infrared rays transmittance and is very costly. That is why very few mills can afford to procure and use it for in-house evaluation.

In fact, this results in various problems. You decide to have a drainage analysis, you contact the supplier, and actual analysis is done after several days depending on the availability of the instrument and testing engineer. As a lot of calculation work is required, the report preparation also takes a few days, and by the time you get the report, often you lose interest in its findings.

Another problem is that such analysis can be done only for the running quality and gsm on the machine on the testing day. For a mill manufacturing different grades of paper and in different basis weight ranges, such drainage analysis is relatively less advantageous.

Fortunately, most clothing suppliers want to improve the performance of their customers and hence offer such drainage analysis free of cost, is-spite of the fact that they spend a lot on procuring good equipment and also hire the best experts available for this purpose.

Live Drainage Analysis

So, there is a strong need to have a live analysis, which is able to give instant results, or maybe in a few minutes, so that whenever you make any change in say vacuum level in a box, or anything, you get the results quickly.

In addition the system must be of such a cost that most, or at least 20%-30% of the mills can easily afford it. In the beginning, many mills may be tempted to follow the present approach where they pay nothing additional to their clothing suppliers, and clothing suppliers do the whole exercise on a free of cost basis though the results are available after a big time gap.

So, fundamentally, we need to have a customized system that is low cost, available 24X7 on the plant display monitor; so that all concerned can view the results of drainage analysis on the shop floor itself.

How Can We Do This?

If we look at any four-drinier machine, we'd agree that most of the time, the off couch dryness (almost) remains the same. In case a mill is achieving say 23.5% dryness, there might be a small variation of +/-0.2% or less after changing the vacuum level slightly. So, for the sake of study, we can take it as constant in the beginning. Having known the production rate, it is quite easy to find out the mass flow at this dryness level.

Now the water being removed from different suction boxes (or sets of suction boxes) can be measured using magnetic flow meters. In case it is not possible to have flow meters on individual box, a flow meter can be considered for a group of boxes in the beginning. For example, in place of having three flow meters for all three sections of a TriVac box; a common flow meter installed on the outlet line of the seal pit tank for the TriVac box can be considered.

Now, having known the mass flow leaving the couch roll and mass flow leaving the TriVac box, it is easy to add these to find out the mass flow rate entering the TriVac box.

The same approach can be followed backwards to find out flow rates at different positions, and rest is just a mass balance.

So, basically we need several magnetic flow meters, signals from existing PLC for GSM, machine speed, paper moisture etc., as well as a new PLC panel and a server/engineering station and an operator station.

Online Calculations

With the advancement in PLCs and PLC programming it is easy to incorporate these simple calculations and have the output information in the desired format on a dedicated computer monitor. In case you need to display consistency at different positions, dewatering from different boxes, percentage dewatering in different boxes etc., formulae can be accommodated in PLC programming and the same may be displayed.
As most of the flow values shall be available from flow meters, only the dryness after couch is taken by a sample, and can be updated on the operator station monitor. A simulation study indicates that a +/-0.2% or +/-0.3% change in dryness does not alter the calculated dryness level in earlier elements significantly.

With this scheme, however, sometimes, a particular problem may appear. Imagine the water from DuoVac & TriVac is being collected in a seal pit, and the overflow of this is being taken to another tank. A pump is installed for this, but the capacity of the pump is much higher than the water quantity to be handled. Most papermakers like to have an oversized pump to avoid any unforeseen situation. Obviously, the pump will face a problem of fluctuating feed at input and hence the flow meter reading will fluctuate too much. In last stage boxes, such fluctuation may result in significantly high variation in output readings.

This problem can be solved in two ways. First, a damping block is to be added in PLC programming to mitigate the impact of fluctuating input signals. Thanks to the rich libraries of various PLC programming languages, this is an easy task today. Second option is to integrate the input signals for some time, say 15 min, 30 min or one hour; and then perform the calculations on the basis of this accumulated data. Both of the ways mentioned above have been tried for some other applications and found working efficiently.

Conclusion

Having such a system using just a few field instruments (mainly the flow meters, a PLC panel having some analog I/O cards and PLC module) and an operator desk will dramatically help papermakers to tune their paper machine for optimum performance. Not only this, such a facility will help optimize various process parameters, for example vacuum levels in initial boxes, enabling papermakers to optimize vacuum energy consumption also.

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