Executive Summary

By keeping the tissue machine air system well balanced and choosing the correct drying strategies a substantial reduction in energy consumptions may be obtained.

It has been well proven that system efficiency can be improved by measuring and adjusting air system parameters and settings. However, the question poses itself, how are these settings to be maintained? Lack of competence or insufficient information about the impact of incorrect settings can easily nullify the benefits initially obtained. Even different machine operating conditions, such as changes in production or the use of heat exchangers for hall ventilation, depending on the time of the year, can cause uncontrolled variations in air system balance, moving away from the optimal operating point.

Valmet has developed Advantage BalanceControl (ABC) to solve this problem. The Advantage BalanceControl system allows the mill to maintain - in an automatic and continuous manner - the optimal settings for the air system, such as balance and exhaust humidity level, and the best drying parameters when choosing temperature and impingement speed.
Overcoming the real-life difficulties of maintaining optimized settings

Through a personalized algorithm and a set of sensors installed on the hood and air system key points, the ABC system constantly detects and adjusts the drying parameters and the air system flow characteristics (air temperatures, pressures, volume flows and humidity values) in order to constantly maintain the lowest specific energy consumption cost required for drying. In addition to the field sensors, the system includes the installation of a Human Machine Interface (Figure 1) that is connected to the mill DCS and QCS through a bus system.

The system can be accessed both from the local net and through a safe VPN connection. It is then possible to access the ABC pages through any internet connection and from a simple web browser (Figure 2). This system collects and calculates every 15 seconds about a hundred variables which are then stored and can be used for recurring reports to be distributed to the different control levels within the tissue mill.

Basically the ABC system works such that all actions implemented by the service engineers during the energy optimization process become automated and continuous.

The system can be easily installed on new machines and those already in use for several years.

ABC can be implemented on different levels, starting from a base level to manage a single machine with access limited to some users. The implementation can range up to a corporate level - for management and benchmarking of different machines in different premises, implementing an SQL database and a SCADA data capture and supervision system.

Real-life references

The ABC system has been installed and tested with confirmed positive results. One of the reference installations is a European tissue mill producing toilet, napkin and towel tissue with basis weight between 16 and 26 gsm, from virgin and deinked pulp.
The target for the mill was to decrease energy consumption while increasing drying capacity. Mill management decided to focus future investments on two technologies: a new heat exchanger and the ABC system. This twofold change granted the mill a reduction in gas consumption - after only 5 months greater than 15% reduction has been achieved.

According to the mill director, "In the short term the system proved efficient and there is a great potential for further savings possibilities. The system works while the make-up air is almost entirely closed. A small modification will enable us to exploit the heat exchanger capacity even more for combustion air temperature and we expect a further gas consumption reduction of 1 to 2%.”

There is another advantage to the mill after the ABC system was installed. The hood and air system settings are monitored and optimized, which means that energy consumption, according to the mill director, "no longer depends on the operator’s skills, as the system performs a continuous check to find optimal conditions.”

**ABC focus: Air system balance and drying strategy**

Today a tissue machine uses about 70% of the total energy for the drying process. Most of this energy normally goes to the hood/air system (natural gas, electricity), while the rest is used by the Yankee cylinder (steam). The correct setting of the hood and air system, together with the proper dryness parameters, boosts performance improvement of both production and quality and provides remarkable energy consumption reductions.

Valmet’s constant data collection from many different tissue machines around the world has generated a vast database of energy performance information. With this valuable information we can support mills in finding the best machine settings and improving performance.

Comparing the performance of a state-of-the-art tissue machine - such as a Valmet DCT200TS - to machines with similar characteristics, reveals great improvement potential in energy performance (Figure 3). On-machine actions have proven that significant improvements can be achieved and maintained over time with correct air system settings.

**Keeping the balance**

The air system generates hot air that is blown at high velocity onto the moving sheet to accomplish most of the drying. The other essential function of the air system is to guarantee the correct exhaust of humid circulation air, as well as to replenish it by conveying low-humidity make-up air.

The system is in balance when the controlled flows of the supplied air...
(typically make-up and combustion air for the correct operation of burners) are equal to the outgoing air (exhaust) (Figure 4).

If the air supplied is more than that exhausted, then the system is in over-pressure and the excess hot and humid air is blown to the machine hall through the hood edges. On the other hand, when the outgoing air flow is higher than that supplied, the system is in under-pressure and cold air is being sucked into the hood from the machine hall.

Both circumstances can lead to abnormal and dangerous operating conditions, as well as to performance deterioration and an increase in energy consumption, therefore an increase in operating costs.

An over-pressurized system (Figure 5) can cause an increase of running (energy) costs up to 63,000 EUR/year for each kgDA/s of hot air blown into the machine hall (estimated gas cost 35 EUR/MWh), as energy contained in this wasted air is not recovered through the heat exchanger. [kgDA/s is the mass flow rate of air.]

Further problems that may be caused by a system in over-pressure are:

- Increased risk of fires around the hood
- Damage due to equipment overheating near the hood
- Felt and profile issues
- Worsening of hall ventilation control with widespread condensation problems

An under-pressurized system (Figure 6) causes an increase in running costs (up to 57,000 EUR/year for each kgDA sucked in from the hall) because the make-up air is still cold in the hall; it has not yet been pre-heated by the
heat exchanger. But there are also additional issues that can be caused by a system in under-pressure, such as:

- Cooling and humidity peaks at the paper edges
- Dust and dirt build-up at the hood edges, therefore increased fire risk
- Sucking of dust and dirt, and consequent build-up at the heat exchanger, resulting in diminished performance and higher risk of fire

**Getting rid of humid air**

Energy consumption is also strongly linked to the humidity level reached in the exhaust air. A higher humidity level in the exhaust means a lower air flow exhausted and, as a consequence, a lower make-up air flow (when the system is in balance). In turn, this means a lower air flow to be heated-up from the make-up air temperature to the impingement temperature in the hood. This translates into lower energy costs (Figure 7).

**Hood temperature or impingement speed?**

Another important aspect affecting both specific consumption levels and drying specific costs is the choice between hood temperature and impingement speed as a drying strategy. Obviously this very much depends on the machine and production type, as well as on the ratio between the specific cost for electricity and cost for gas/fuel used. If we stick to the same machine and production type, there is always a minimum level on the specific consumption curve that defines the most economical combination to be used for drying. This minimum point varies with changing specific cost ratio as shown in Figure 8.
Summary

The advantages of the Advantage BalanceControl system (Figure 9) are numerous and can be summarized as follows:

1. ABC continuously and automatically maintains the drying settings and parameters which allow the lowest energy consumption levels. This optimized set-up maintained over time brings continual savings of up to 30-40 kWh/ton of paper, corresponding to a substantial cost savings each year for a double-format machine.

2. ABC operates according to parameters measured by field sensors, allowing no variation for individual interpretation of data.

3. ABC allows local and remote access to check system status and data collection for easy and continuously updated benchmarking.

4. ABC provides a permanent optimal balance of hood flows, avoiding all problems associated with under-pressure or over-pressure systems. This in turn promotes longer equipment life near the hood (less exposed to humid blow-out air) and fewer machine shut-downs due to fires and for maintenance, etc.

5. ABC ensures a higher safety and comfort level for operators, especially when activities are performed near the hood, such as a doctor blade replacement.

6. ABC enables easy and fast remote assistance service should problems related to the hood and air system operation occur.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers - specifically, Mr. Paolo Della Negra, of Valmet’s Troubleshooting and Field Operations group in the Gorizia, Italy office.

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We are committed to moving our customers’ performance forward.