How to start improving energy efficiency, reduce CO2 emissions and optimize production?

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INTRODUCTION:

Papermakers have different reasons for ordering a survey to be carried out on their machine. For example, energy efficiency in the drying part is poor or there is a lack of drying capacity. There can also be problems with dewatering, poor pocket ventilation, sheet moisture profile issues, moisture peaks or problems with sheet runnability and tail threading. The machine hall can suffer from ventilation issues, condensation or corrosion. The performance of ventilation equipment deteriorates slowly, and often malfunctions are noticed only when the issues cause serious enough problems in production or operating conditions.

Routine service and system audits are an important part of keeping any process running smoothly. Comprehensive, on-site machine audits can help identify inconsistencies in performance as well as evaluate the potential for failure. In addition to extending the life of a machine, audits can also play a vital role in helping operators identify opportunities to improve the process, energy and machine efficiency.

Runtech Systems offers a number of audits, ranging from full system to component specific, which can help to evaluate a range of factors. These can range from performance and efficiency evaluations to general troubleshooting. Each audit comes with a full written report, including a summary of the results as well as a detailed analysis with recommendations tailored to your process and equipment. We also provide you with insights on how to get the most from your equipment.

Vacuum system and dewatering audits

As we know, vacuum demand varies with different paper grades, felts and machine speeds. Therefore, a tailor-made solution with flexible and variable capacity can balance the supply and demand, resulting in both optimized dewatering and minimized power consumption. To achieve these results, Runtech performs professional vacuum system and dewatering audits.

Runtech and Nash engineers have performed thousands of vacuum system audits and dewatering studies at paper mills over the last 20 years. Those studies and audits enable Runtech to benchmark the effectiveness of existing vacuum systems, dewatering equipment, suction elements, fabrics and felts. All of this information comes together in an often step-by-step rebuild and upgrade plan that results in minimized operational expenses coupled with production increase and/or runnability improvements.

A vacuum system audit is used to document and benchmark the overall effectiveness of a vacuum system and sheet dewatering process, highlighting problem areas and opportunities to reduce operational costs.

During a basic vacuum system survey, vacuum levels are studied to identify the real vacuum connections. Paper machine vacuum levels are measured at the vacuum pumps and blowers to identify problem areas. The dewatering elements – flat boxes, save-all pans and uhle boxes – are also reviewed. Specialists study pressure and bleed losses to analyze the energy consumption and evaluate if the vacuum levels are too high. Energy savings are calculated based on the EP Turbo Blower speed control technology, and recommendations and proposals are made.

In addition, we can design new pipeline connection diagrams and provide engineering drawings as well as new vacuum pump specifications, if necessary. ROI calculations and reporting always come as part of the package.

Figure 1: Vacuum system audit is a tool to document and benchmark the vacuum system and sheet dewatering effectiveness, to highlight problem areas and illustrate options to reduce operational cost associated with the vacuum system.

Rebuilding a vacuum system with RunEco Turbo Blowers can decrease the energy consumption by 30-70%.

When the existing vacuum pump or blower reaches the end of life, there are several options for how to go forward. Units can be replaced with new ones or be upgraded to the latest or a different model, depending on the process requirements. In some cases, a complete rebuild is needed to gain better energy efficiency or cut down on water consumption. We are the only company in the world that can supply both liquid ring pumps and dry vacuum systems, or a combination of them, for a so-called hybrid system. In addition, we offer doctors and save-alls, making our offering complete for paper machine dewatering. With this unique portfolio, we can always find a perfect fit for our customer's demands, needs and budget.

At Smurfit Kappa Ania in Italy, both its PM2 and PM3 have been rebuilt after Runtech audits. Total energy savings in the vacuum system alone have amounted to 9 GWh per year, equaling EUR 700,000 in electricity savings annually. Additionally, as production increased by 2%, the payback time was approximately one year. According to Mill Manager Massimiliano Listi, it was shocking to learn how much vacuum they had been using for nothing. For example, the suction couch roll vacuum was removed after the forming section optimization. EcoFlows now provide a window to the process.

The next step is replacing the remaining water ring pumps with an EP Turbo Blower. This rebuild will bring the PM2 to a world record level in the specific energy consumption (SEC) of the vacuum systems.

Forming and press section audits

Forming section audits analyze and troubleshoot the machine's forming section. They specifically seek to optimize energy consumption and cleanliness. A forming section audit would typically consist of a dewatering analysis and exhaust air measurements. The cleanliness of the wet end is inspected and reasons for any dirt buildups are uncovered. The audit also includes the optimization of high-pressure and low-pressure showers and an edge trimming survey.

Press section audits analyze a variety of elements, such as doctoring and save-alls, to optimize the dewatering of the press section. Press section audits normally focus on analyzing the operation of the save-alls and doctoring equipment. Dewatering profile measurements are taken and machine cleanliness and runnability are inspected.

Both audits aim to optimize the dry content.

CASE: Forming section and wet end ventilation on a board machine

Kartonsan Karton Sanayi ve Ticaret A.S., Turkey, suffered from excess mist and flooding of the shower water back to the wire on their BM2. A study revealed that the existing exhaust system was insufficient and out of order. The type of existing fans and water separators were not optimal. The wet-end fan did not create adequate vacuum or air flow. The dry-end fan was not even running.

To correct the situation, Runtech proposed an exhaust ventilation system for the forming section, including exhaust below the breast rolls/below the headboxes to the suction stocks across the wire where the showers are installed and to the area of high-pressure showers where mist catchers need to be installed.

The new exhaust system proposed included centrifugal fans, ductworks, mist catchers, water separators with cleaning hatches and manual dampers. New fans were installed on the foundations of the old fans. Also, ducting routes were reused whenever suitable to minimize dismantling and installation work.

Today, there is clearly less mist inside the wires, and it does not spread out from the forming section. Mist coming from the low-pressure and high-pressure showers does not reach the hall ceiling or spread out to the hall anymore. This project had a major effect on operator safety and working conditions – it is easy to breathe the air in the machine hall again, and the floor is not wet or slippery anymore.

Figure 2 and 3: The machine hall before and after forming section and wet end ventilation at Kartonsan BM2.

Find the bottlenecks and machine potential

Good runnability means continuous machine operation with minimal web breaks, while machine productivity and the amount of waste stay at the desired level.

Papermakers are often faced with various runnability issues. These include a high number of web breaks or problems with tail threading or end product quality. Or perhaps there is a need to increase the machine speed but no knowledge of how to eliminate possible runnability issues in the dryer section. Or the speed has already increased, but there are now too many web breaks on the machine.

Runnability issues can be solved. The very first step to improve machine runnability is to extensively analyze the process factors from the wet end to the reel. A comprehensive runnability and efficiency audit performed by Runtech professionals can help you identify your machine bottlenecks as well as discover much needed improvement potential.

The aim of a drying section audit is to analyze and effectively decrease energy consumption while improving drying capacity and runnability. The audit consists of pocket humidity and temperature measurements, cylinder surface and sheet temperature measurements, the calculation of drying parameters, hood air system analysis, mechanical checking and heat recovery efficiency measurements.

A tail threading audit can identify tail threading issues as well as help operators improve safety and shorten tail threading time. This audit can be conducted on a single specific area/component, multiple areas/components or on the whole machine.

Figure 4: Pocket humidity levels are measured as a part of the drying section audit.

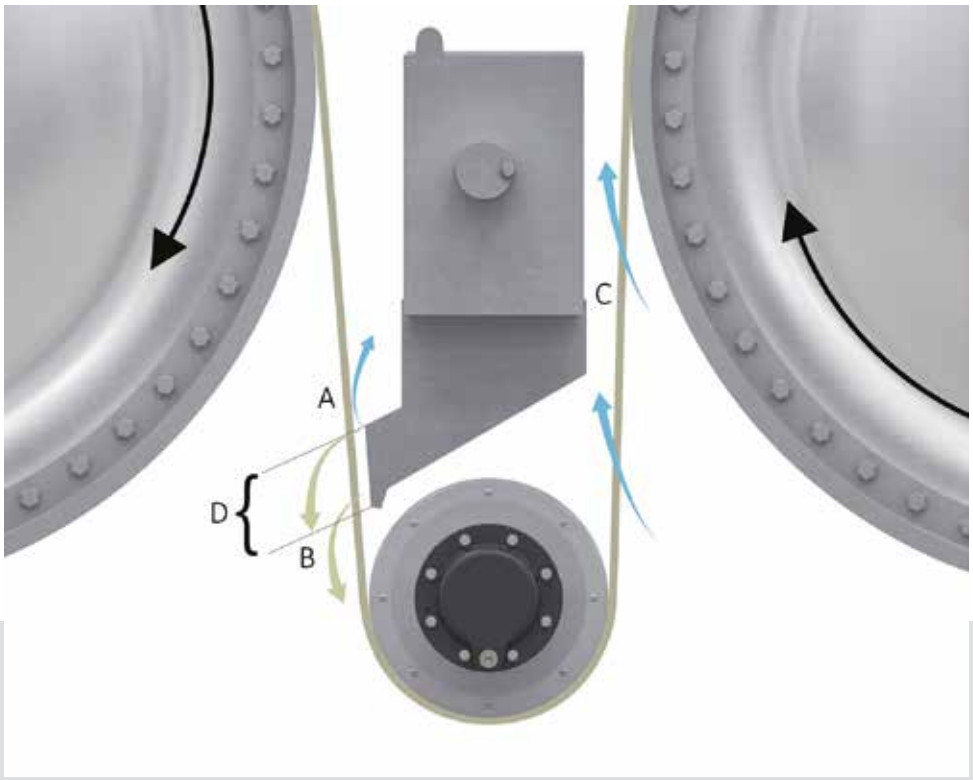

Figure 5: With correct pocket ventilation the pocket is kept hot and dry to maximize drying efficiency, lower drying costs and increase production. Upper nozzle prevents humid air flow entering the pocket (A) and lower nozzle blows dry supply air into the pocket (B). Humid air exits the pocket (C).

Upper nozzle – lower nozzle (D) form a long distance overpressure area to provide sufficient air flow to the pockets. All air from pocket ventilators is blowing to the pockets.

CASE: Dryer section rebuild reduced web breaks

Paper machine A targeted improved runnability and enhanced production. During breaks, the time tail threading took was causing production losses.

Traditional runnability control with an increased draw not only reduces sheet strength and quality but easily causes breaks in the dryer section. A high draw difference means additional raw material costs, as more chemical pulp is required to improve sheet strength.

Reducing the draw provides the potential to increase machine speed and optimize furnish. The RunPro EasyOne web stabilizer optimizes the web release with a special high-vacuum system during the critical sheet release between the upper cylinder and the vacuum roll. It prevents the web from following the upper cylinder, resulting in fewer breaks and defects.

Runtech Systems conducted a study at the mill and proposed several improvements for the process. The dryer section rebuild included a new vacuum Press Run roll, EasyOne stabilizers for the 1st dryer, TailVac drilling for the 2nd group and Gardner Denver compressors. In addition, tail threading was converted to be ropeless for the single- and double-felted sections. A Runshooter F was installed to bypass the Yankee cylinder.

At paper mill A, with the installation of EasyOne stabilizers, the draw reduction between the press and dryer section decreased about 30%. After the rebuild, break frequency was fewer than 1 per week. In addition, the mill has been able to reduce the share of long fibers by approximately 8–10%.

Ropeless tail threading improves operator safety significantly while also shortening tail threading time during web breaks by up to 80% to increase production. In many cases, the technology enables mills to increase machine speed. The tail threading time over the modified area is under 60 seconds – from press to after dryer – and it is possible to run at full speed. Earlier, a speed reduction of 200 m/min during tail threading was necessary in some situations.

Machine data
Special papers 140,000 t/a, from 58 to 78,5 gr/m²
Machine speed max 1,100 m/min, trim 4,6 m
Results after the modification
Draw reduction between the press and dryer section from 3.2% to 2.2%
After rebuild, fewer than 1 break per week
Possibility to reduce long fibers approximately 8-10%
Tail threading time over the modified area <60 s
Tail threading is possible at full speed. Earlier speed reduction was -200 m/min

Sheet moisture profile survey

A sheet moisture profile survey aims to improve quality by pinpointing where existing moisture profile problems are generated. It analyzes machine and cross-directional measurements, sheet moisture profile measurements, cylinder surface temperature profile measurements, cylinder surface cleanliness, pocket humidity and temperature profile measurements as well as evenness of the zero level.

Hood air balance / zero level

Hood zero level describes the over pressure versus under pressure inside the hood. The top part of the hood is always in an overpressure state, and the lower part and basement of the hood is in an underpressure state. Therefore, humid air tends to exhaust out from the hood through the upper part, while leakage air enters the hood from the basement.

The height in which the pressure is in balance, in other words, the even pressure between the machine hall and inside the hood, is called zero level. The level should be located where the largest openings are in the hood construction, for example, where the paper web enters and exits the hood. Typically, it is at about a 2-meter height from the operation level. The zero level is set by adjusting the hood exhaust and supply air ratio. When exhaust air increases or supply air decreases, the zero level rises.

Paper machine drying hood and heat recovery improvements

Runtech analyzes the current state of the paper machine's hall and dryer hood ventilation to gain insight on how to improve system ventilation and to enhance the machine's ambient and working climate. The findings are also used to reduce mold and corrosion.

The measurements include air flows and leakages, humidity levels and temperature profiles. Based on the findings, we provide recommendations and solutions, ranging from new closed dryer hoods, heat recovery systems to dryer section exhaust and supply air systems, steam batteries, pocket ventilation, web stabilizers or full dryer section modifications. The final solutions are always tailored to customer-specific needs.

Machine hall ventilation audit

The general purpose of hall ventilation is to prevent moisture from damaging the building or process equipment as well as to remove exhaust heat, moisture loads and airborne impurities. During the winter season, the building is heated with the machine hall ventilation to prevent any damage to buildings and equipment caused by condensation and freezing. The hall ventilation also enables a healthy and comfortable working climate for the operators.

A typical way to ventilate the machine hall is to supply clean air to the working zones at low speed. The supply air ventilates working zones without a draught. Due to the thermal loads from the process and its equipment, the supply air temperature increases, rising up toward the machine hall ceiling from where it is released. Temperature, humidity and concentration of impurities are always higher at the upper parts of the machine hall than the lower parts.

The audit focuses on air and water balance measurements, machine hall temperature and humidity levels, misting around the paper machine's wet end, hood air and water balance calculations, hood zero level along with the water and humidity load to the machine hall. Fans, hoods, ducts, valves, hatches, heat recovery systems and auxiliary equipment are all visually inspected.

Machine hall humidity levels

Air humidity (x, water content) inside the machine hall compared to the supply air humidity gives a quick and clear picture about how the machine hall ventilation is functioning.

When the ventilation system is correctly designed and functioning properly, humidity in the working zones should not be more than 5 gH2O/kg of dry air above the supply air humidity.

To minimize the risk of condensation in the upper parts of the machine hall and ceiling constructions, the air humidity should be less than 25 gH2O/kg of dry air above the supply air humidity. However, the value depends heavily on the heat insulation capability of the construction as well as the temperatures both inside and outside the machine hall.

Figure 6: During machine hall ventilation audit air humidity is measured in the paper machine hall.

High humidity loads, leakages and cold bridges cause condensation to the machine hall. Due to the condensation, metal frames corrode, concrete blemishes and bricks darken, among other things.

CASE: Increased speed and improved working conditions

In an example case, the Runtech Survey Team carried out a ventilation survey on two machines – PMA and PMB – located at the same site. The survey consisted of a machine hall ventilation, hood ventilation and heat recovery survey. One main target was to check the machine hall ventilation functioning and the air climate inside the machine hall. The drying section operation and influence on the machine hall were measured.

The outside temperature varied a lot during the survey. Some days were rainy and windy, which affected the air conditioning in the hall.

The mill's future target is to increase the maximum speed of PMA to 1,100 m/min and get 10% more production with all grades. Higher production causes a disadvantage for the machine hall air climate, which is already relatively poor. For this reason, the machine room ventilation was checked and measured as well as the ventilation of both drying hoods on PMA and PMB. When increasing production rates, the machine hall climate gets worse without improving the machine hall ventilation. Increasing production requires an investigation on how to get a complete balance on the PMA and a good working climate and proper conditions for the machine and the operators all year round. The big issues are insufficient ventilation, moisture and working climate. Runtech studied the machine hall ventilation and balance of the process air flows into and out from the hood as well as other processing equipment.

The main reason for the survey was to clarify the machine hall operation and drying section ventilation system and to check the sufficiency. The climate in the machine hall was not at an optimal level. The temperature and humidity of the hall were high, causing condensation to the structures in the winter season. The situation will worsen with a higher production rate.

The adequacy of drying capacity and runnability for targeted speed and production increase were checked.

After the study, Runtech recommended several improvements for the drying. On the PMA's hood, exhaust capacity could increase by replacing the existing exhaust fans. This would result in a higher zero level, lower hood exhaust humidity and less leaking from the hood to the machine room. New pocket ventilators would increase the drying capacity. A humidity sensor could monitor and control the hood ventilation system and leakages. In addition, the air system's runnability components should be serviced to ensure that sheet runnability and hood removable roof sealings are repaired.

To improve PMA's and PMB's machine hall ventilation, the existing room ventilation system would need maintenance and repair. Secondly, the machine room air balance could be equalized by increasing the machine room supply air amount. As a third step, evacuation hatches should be closed.

By implementing the proposed changes, the mill would be able to increase machine speed and thus gain greater production. The grades with limited drying capacity would benefit the most. Another main benefit is better air quality in the machine hall, thanks to eliminating the moisture load coming in from the drying section. Machine operators would benefit from improved working conditions. Increasing the hood's exhaust air enables a larger amount of replacement air for the drying section, which means that all pocket ventilation boxes would have sized air volume, thus maximizing drying capacity.

Figure 7: Hood exhaust fan assembly on site. Modifications to existing machine hall ventilation systems can be done by installing additional ventilation units, both supply and exhaust air units, locating them in positions where they give the best benefit.

CASE: Increased production and energy savings

Runtech Systems conducted a hood ventilation measurement and machine audit on a board machine. This mill targeted increased production while decreasing steam consumption, thus gaining energy savings. At the same time, the moisture level in the machine hall should be lowered.

As a result of the survey, Runtech suggested several improvements, which were approved to carry out in phases. As a first step, hood supply fans for hood basement blowing were installed. The fans were designed keeping in mind the pocket ventilators that were installed later. Fresh steam consumption in the supply air heating has been decreased with the new condenser coils supplied by Runtech. With this first step, steam consumption was reduced, resulting in energy savings.

The humidity of the hood exhaust air attained a satisfactory level in the second step when hood exhaust fans were installed. Also, the zero level for the hood reached the right height. Humidity and temperature in the machine hall were decreased, providing good working conditions for the mill operators.

In the last phase, pocket ventilation was installed. Delivery included sheet stabilizers, a supply fan and an air duct set from the new fan to sheet stabilizer for the first drying group. For the second to fifth drying group, tens of pocket ventilators were installed, including an air duct modification.

With these modifications and upgrades, the machine has been able to increase production by 4%.

After this project, the same customer ordered a major step-by-step ventilation rebuild on their other paper machine. The rebuild includes new hood exhausts, heat recovery towers, pocket fans and pocket ventilators as well as a machine hall ventilation enhancement.

Trust the experts

At Runtech, we understand the causes and effects in the papermaking process. With the experience of thousands of audits and studies at paper mills, we are able to benchmark the effectiveness of existing systems and equipment. All information comes together in an often step-by-step rebuild or upgrade plan that results in minimized operational expenses coupled with a production increase and/or runnability improvements.

This experience and expertise allows us to work with our customers to help them get the most from their systems, while ensuring they achieve both their operational and process goals.