

Valmet

Technical Paper Series

Savings in the Air

Executive Summary

Energy costs represent an area of savings, regardless of the fluctuation in energy rate at any given time; every mill is looking for ways to save.

Valmet's portfolio of air products provides an opportunity to improve machine runnability, efficiency, drying energy performance, and ultimately, profitability. Our family of air products (Process Air, Air Drying, Steam and Condensate, Dust and Tissue, Runnability and Process Engineering) provide unique solutions to some of today's most challenging paper process obstacles; helping mills reach the next level of performance and sustainability.

Start with an audit to better understand where the hot air is going. Determine if it can be reused, redirected or how it can be reduced. Examine the technology currently being used. Can it be upgraded or totally replaced because of improvements made? A four-step process for improving air systems performance and reducing cost is presented.

There are savings in the air

In paper and board making, resources such as raw materials, water and energy must be used in an efficient way. As energy will continue to be a significant factor influencing overall production costs, any improvement in lowering energy consumption will immediately pay back as a more profitable operation.

The good news is that there is a lot of potential for saving energy. Machine air systems provide excellent opportunities for reducing costs and increasing profitability. However, these opportunities need to be investigated – simply because the systems are running, i.e. making paper, they are not necessarily running efficiently. You have to look for the opportunities – they are there!



Figure 1. The drying process

Valmet Air lifts your mill's profitability – step by step

With over 50 years' experience in the air business, Valmet has the right solutions - unique air product families based on application requirements, technologies and performance. Valmet offers air technology and services that will allow you to reduce your energy, and therefore your environmental footprint in a clear, step-by-step manner.

In the first step, we evaluate where you are – the condition of your air systems equipment and the function and efficiency of your process. Quick scans, process surveys and energy analysis allow us to lay out a best plan forward. By this process, we now have a focus on the best operational parameters with your present equipment and a foundation for future energy saving projects.

In the second step, we ensure your process keeps running at its optimal performance level. This is typically handled through effectively planning necessary maintenance and repair. The goal here is to maintain and manage the best performance possible with your existing equipment.



Figure 2. Valmet provides a comprehensive portfolio of air systems services.

Step 3 focuses on updating your air system processes to your mill's present market demands through rebuilds and upgrades to existing equipment. Once accomplished, you begin to realize the performance benefits that result from equipment optimized to current environmental and efficiency levels of technology.

And finally, in step 4 we ramp up performance and efficiency by incorporating the very latest solutions available on the market. These new technologies deliver significant improvements with viable payback times.

Through a concentrated focus on the energy efficiency needs of our industry, Valmet set out to develop an air systems organizational strategy that combines leading edge process air technology with a product management team dedicated to bringing these solutions to your mill. Let's take an in-depth look at the six areas of air systems and learn what Valmet has to offer.

Process Air - Air management efficiency

Valmet Air can provide customized solutions for any specific installation requirement. Usually there is a need to heat hood supply air, process water, white water and circulation water for machine room heating. Energy efficiency of air dryers and impingement drying is significantly enhanced utilizing heat recovery. Valmet Air offers efficient heat exchangers for both air and water heating. Our compact heat recovery stack design provides easy and quick installation. Although based on standardized modules, each system is optimized to provide the best possible pay-back time.

Valmet developed the most compact and well defined air systems available for modern paper machines. We have combined several necessary air system functions to reduce the amount of equipment, building space, energy and operational costs. By placing the fans before the effective heat recovery system, we can return the fan energy to the air flow, while at the same time reducing the noise level outside the mill. A well-insulated and air-tight, high dew point hood contains the heat, humidity and noise.

Mills experience more savings through better operation. To achieve the best drying results with the lowest energy consumption some actions and supporting systems are needed. The Valmet XT Control system ensures complete control of ventilation air flows. It helps operators run the machine with best practices.



Figure 3. If the dryer section of the paper machine is provided with a ventilation control system, the dry solids content of the press section can be calculated.

Through maintenance, further savings follow. Preventive regular maintenance is needed to keep the system efficiency high. It is important to find the right operational values to get the best out of your machine. Mill audits, regular visits by Valmet experts or a remote computer connection with consultation help you to maintain the best operational levels.

Process Air Management

- Machine Hoods – Canopy, Conventional, High Humidity
- Exhaust Systems – Hood, Former, VacRoll, Machine room
- Heat Recovery Systems – Air, Water, Process
- Building Ventilation Systems
- Trim Conveying Systems / Broke Conveying Systems
- False Ceilings and Exhaust
- Ventilation Systems – Sizers, Calenders, Winders
- Motor Cooling / Electronic Room Cooling / CTH Systems
- Sound Attenuation

Example: Heat Recovery

Heat recovery is an essential element of an efficient air system. Almost all the energy from the drying section leaves with the hood exhaust air. Therefore, it is an excellent source for heat recovery. Valmet heat recovery provides significant savings in energy and – the payback times for a heat recovery system is usually less than one year.

With effective heat recovery mills experience more savings through better operation. Up to 50 or 60% of the energy in hood exhaust air can be economically recovered. Water can be heated up to 50 or 60 °C, without additional steam heating. The hood supply air can be heated to approximately 55-60 °C and, if need be, to over 100 °C with flash steam and/or condensate. In colder climates, the machine room ventilation air can be heated almost entirely with recovered heat.

Here again, maintenance brings further savings. In order to maintain constant maximum energy efficiency, it is important to keep the heat exchangers clean. With Valmet heat recovery, this is easy. An automatic cleaning system takes care of the daily cleaning.

The PM1 Production Manager at UPM Changshu had this to say about their Valmet Air Systems heat recovery system; "The Valmet heat recovery system is well designed and effectively meets our requirements. The combination of Valmet's high humidity hood and heat recovery equipment recovers

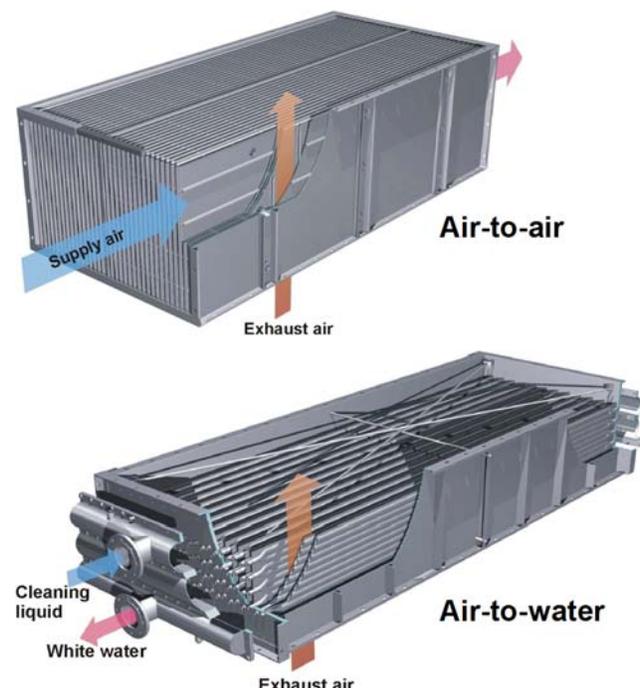


Figure 4. Not all heat recovery is created equal. Air-to-air (top) is custom designed with wide plate spacing, minimal pressure drop and high efficiency. Air-to-water (bottom) is a squat design using individual tubes and minimal welds for a modular approach.

the waste heat very efficiently. We use the recovered heat for hood supply air, process water, white water and circulation water. The heated circulation water gives us the ability to warm up the machine hall during the winter season. We save a lot of energy with [our new] heat recovery system. The total heat recovery is up to 40 MW.

The main difference compared to a traditional heat recovery system is in the air-to-water heat recovery equipment for white water heating. This way we are able to reduce the use of steam by 5 MW. We are very happy with Valmet's heat recovery [technology and] expertise. They worked with us to evaluate our needs and implemented the systems accordingly."

Air Dryer Systems – for profitability and paper quality

Air drying systems are, unquestionably, the best choice when compared with IR drying, related to drying results, sheet quality, energy savings and reduced impact on the environment. Air dryers provide over 50% energy savings, which also has a direct impact on lowering carbon dioxide emissions and environmental load.

Valmet has a long history in Air drying systems research and development concentrating on two areas: high-efficiency air dryer nozzles and paper quality following high-efficiency air drying. Common to all Valmet air dryers is PowerFloat Plus nozzle technology which provides high evaporation efficiency and excellent web runnability to the dryers.

Impingement drying is a new, very efficient way of drying the paper web. The drying medium of impingement drying is air. Very efficient drying is obtained by blowing hot, high velocity air onto the sheet and circulating the air back to the dryer. The air is normally heated up by gas burners, which causes less CO₂ emissions than e.g. combustion of coal. This method, used in the OptiDry family of impingement dryers, yields considerably higher specific evaporation rates than conventional cylinder drying. The evaporation rate of cylinder drying, 20-40 kg H₂O/m²h (according to TAPPI), increases to a level of about 100 kg H₂O/m²h (per dryer area). Thus, several times higher evaporation rates than those of the conventional cylinder drying are achieved.

Impingement drying technology is especially efficient at the beginning of the dryer section where the cold web easily attaches to the hot cylinder surface, which causes runnability problems. In this area the best results of impingement drying are achieved. Impingement drying offers an advanced and sophisticated way to increase machine production, efficiency and end product quality, in an energy-efficient way, on both new and rebuilt paper or board machines.

Air Dryer Systems

- Air impingement dryers – OptiDry, TurnDry, PowerDry
- Sheet coolers
- Nozzle upgrades and dryer rebuilds



Figure 5. The OptiDry Twin impingement drying unit is designed to increase the dry content, and temperature, of paper at the beginning of the dryer section. This prevents sticking, strengthens the web and enables high speed.

Example: PowerDry and TurnDry air dryers

In coating drying, air drying technology is the superior choice, when compared to IR drying, in terms of drying results, saving energy and impact on the environment. Air drying provides 50% greater energy savings compared to IR drying and has a direct impact on lowering carbon dioxide emissions and environmental load.

The operating cost of coating drying is affected by two factors: specific energy consumption and the price of energy. When comparing different dryer types, air dryers have by far the highest energy efficiency. The energy efficiency of our air dryer is typically 70 to 75%, while for gas or electrically heated infrared dryers, it is only 25 to 35%. This means that an air dryer requires only half the heating energy required by an infrared dryer for the same amount of evaporation. With heat recovery it is possible to reach over 80% energy efficiency with an air dryer.

There are very few wearing parts in air dryers. Maintenance costs are therefore much lower than in IR drying, where emitters or lamps must be changed every few years, requiring frequent investments and shutdowns. Existing air dryers with old and less efficient nozzles of the foil or float design can be upgraded by installing Valmet's PowerFloat Plus nozzles. These advanced nozzles can be easily installed in Valmet's air dryers or in air dryers supplied by other manufacturers without changing the drying layout.

Example: PowerFloat Plus nozzles at Sappi Kirkniemi CM2 and PM1

All six double-sided air dryers in the Sappi Kirkniemi CM2 LWC off-machine coater in Finland were upgraded with new PowerFloat Plus nozzle technology during the years 2005-2008. The machine's production speed is typically around 1300 m/min.

The Production Manager of both CM2 and PM1 said this; "The nozzle upgrades, together with improvements in coating profiling, made it possible to get rid of the electrical infrared dryers and their high operating costs. In the rebuilds, the drying capacity was transferred from the electrical IR dryers to air dryers and two rows of IR dryers were removed from the machine. Since the price of electricity is high and the air dryers' energy economy is excellent, the upgrade improved our mill's profitability."

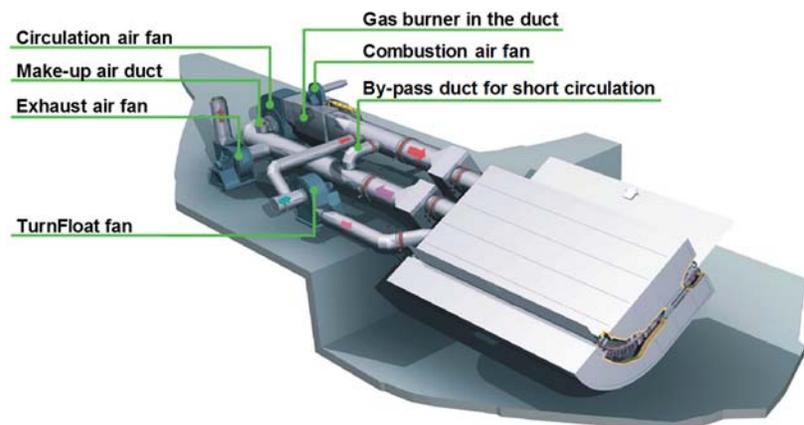


Figure 6. Valmet's TurnDry contactless dryer combines the TurnFloat air turn with the PowerDry air dryer to create a shorter drying layout and better runnability for coating machines. TurnDry air dryers simultaneously turn and dry the web during the sizing or coating drying process without touching the web itself.

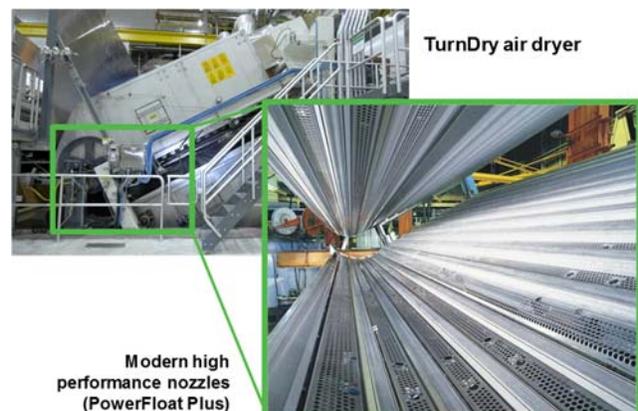


Figure 7. Valmet's patented PowerFloat Plus nozzles aren't just for new dryers such as the TurnDry shown here, but are also suitable as nozzle upgrades for old air dryers.

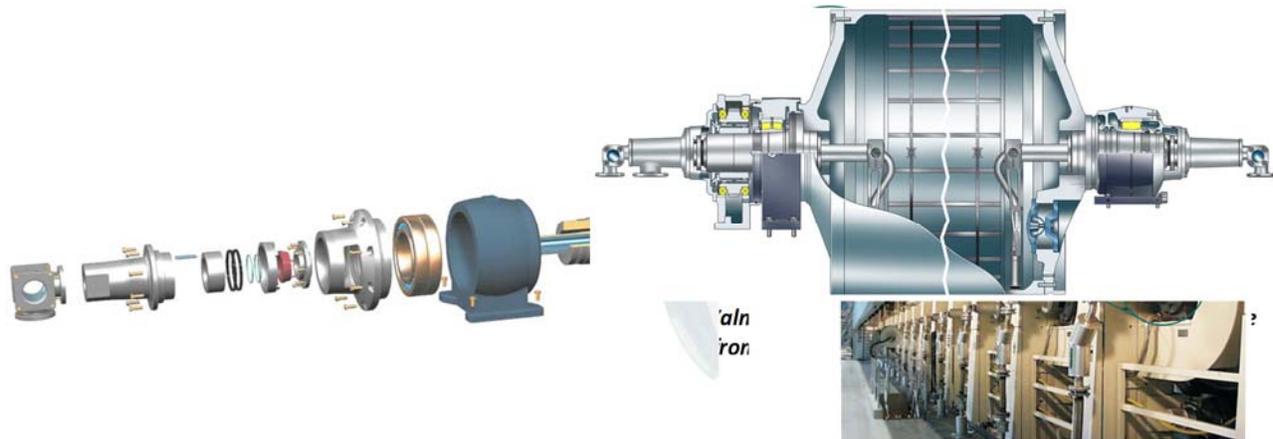


Figure 8. Valmet Steam and Condensate Unit L & S maintenance kits include a boxed set of all required seals, screws, washers, pins and mounting grease for Valmet Steam and Condensate Unit L & S steam and condensate joints.

Steam & Condensate Systems - Key to energy savings in the drying process

Drying is the part of the paper making process where most thermal energy is consumed. Thus, the dryer section holds great possibilities for saving energy – and the environment in a wider context. In most traditional dryer sections, there are ample possibilities to improve energy efficiency and gain significant savings with proper design and adjustment of the Steam & Condensate system.

The objective of the steam and condensate system in the paper machine is to provide the steam for the drying. In the dryer part the moisture is evaporated as the sheet is pressed between a fabric and the hot drying cylinder.

Past the press section, the paper sheet has a water content of about 60 %. The final drying is achieved in the drying section. This is achieved by means of steam heated dryers (cylinders) driven in groups. The temperature of each of the dryer surfaces must be exactly controlled. In the first group this might be 70 °C (160 °F) and rise then slowly to 105 °C (220 °F) in the later groups at the dry end.

In the dryer, the incoming steam turns partly to condensate. The differential pressure over the dryer is the main figure in the system design. This must be maintained to evacuate the condensate in a proper manner and amount. The condensate rate must be in balance with the amount of the "blow-through" steam flow. The "blow-through" steam is normally used in the cylinders of lower temperature.

Valmet provides a total process control approach with unique and complete capabilities to simultaneously or separately optimize; Air, Sheet Runnability and Steam & Condensate Systems in the paper drying process.

Steam & Condensate Systems

- Machine steam systems – cascade, thermocompressor, steam box supply, pulp dryers
- Yankee steam systems
- Glycol & calender heating systems
- Syphons, joints, dryer bars, separators, tanks
- Energy management & automated control systems & services
- Remote diagnostics & operations assistance

Example: Maintaining dryer cylinder internal components

High and uniform surface temperature, energy efficiency and good runnability are the three key requirements commonly placed on dryer cylinders. Having delivered several thousand dryer cylinders, Valmet is uniquely qualified to provide products that meet all of these demands.

Accurate dimensioning, high-quality cast iron materials and precision manufacturing ensure the excellent runnability of all Valmet cylinders. Valmet can supply appropriate dryer cylinders for any machine size and speed. Valmet is also the OEM parts supplier for Beloit dryer cylinders.

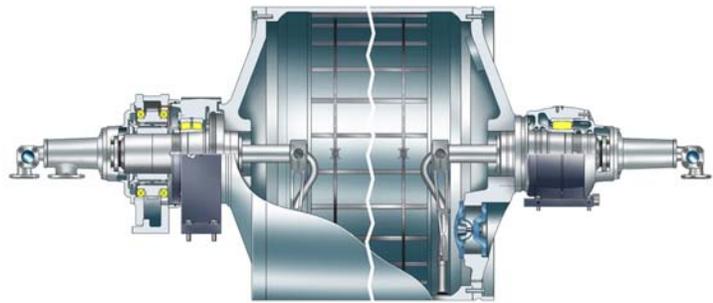


Figure 9. Valmet dryer internal view. Condensate removal can be arranged from one or both ends depending on cylinder size.

Valmet Dryer Cylinder Bars for improved heat transfer

If you require more drying capacity, savings in energy or a better moisture profile - Valmet Dryer Cylinder Bars represent a great improvement. Valmet Dryer Cylinder Bars are U-profiled low-carbon steel bars that are fixed to the inside surface of the cylinder shell using special mounting straps designed to permit thermal expansion. The length of the bars is optimized to provide the most even surface temperature.

Valmet Dryer Cylinder Bars improve the transfer of heat through the shell by breaking up the film of condensate forming inside the cylinder shell. Valmet Dryer Cylinder Bars boost the energy efficiency of dryer cylinders and also improve sheet moisture profiles through more uniform dryer surface temperatures.

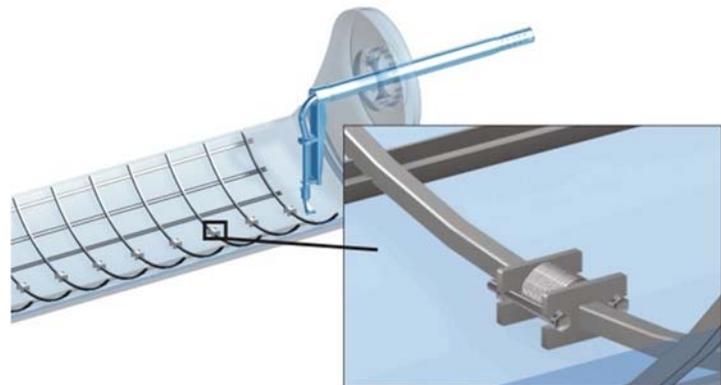


Figure 10. Valmet Dryer Cylinder Bars effectively break up the condensate layer inside the cylinder and produce a better heat transfer into the dryer shell.

In addition to improving dryer cylinder surface temperature profiles, Valmet Dryer Cylinder Bars deliver the following benefits:

- More even moisture profile
- Possibility to increase drying capacity
- Savings in drying energy
- Improved runnability
- Better control of the steam and condensate system
- Maintenance free
- Easy on-site installation
- No mechanical attachments to the shell

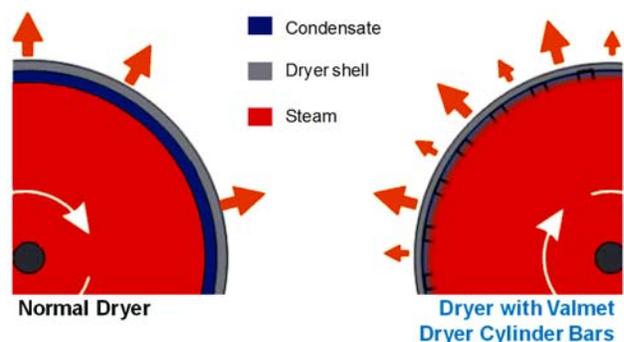


Figure 11. Comparison of heat flow through dryer shell (normal vs. Valmet Dryer Cylinder Bars).

Simplex and Duplex Steamfits and Syphons

Continuous Service (CS) simplex and duplex and bellows duplex steamfit and syphon assemblies that are properly maintained result in more productive drying time. They also substantially reduce downtime for carbon changes and other common maintenance.

One of the more important components in the total drying process is the cylinder dryer steamfit / syphon assembly. Often forgotten because of their obscure locations, they become 'critical parts' from a parts replacement standpoint, absolutely critical to uninterrupted operations. It becomes very important then, to ensure that they are properly maintained with Valmet OEM replacement parts to avoid crisis equipment operation interruptions.

The benefits of using OEM parts for maintaining your steamfits and syphons include:

- Reduced risk of failure
- Less chance for unplanned downtime
- Correct part fit - the first time
- Fast shipment - most parts are stock items

Figure 12 identifies recommended replacement spare parts for one possible steamfit - a Continuous Service duplex steamfit with stationary syphon.

1. Journal adaptor plate
2. Steamfit body
3. Carbon
4. Seal plate
5. Spring
6. O-rings
7. Insulating sleeve
8. Long sweep elbow
9. Syphon hopper

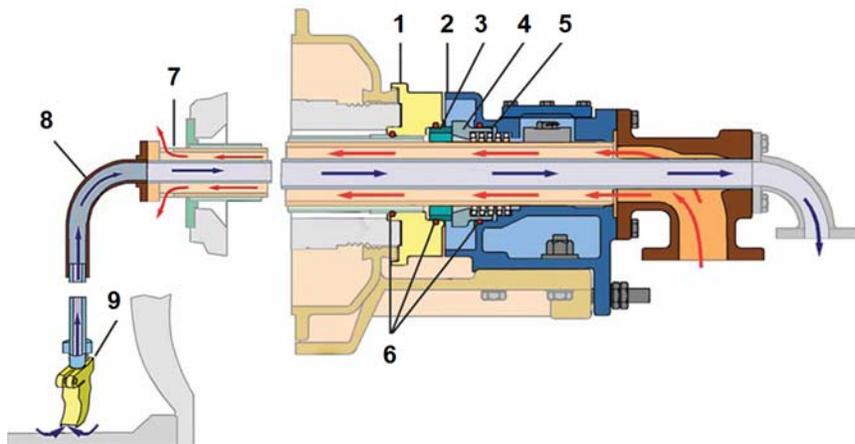


Figure 12. Spare parts for Beloit CS duplex steamfit with stationary syphon

Recommended Replacement Part Kits

The task of maintaining steamfits can be simplified by purchasing specific pre-assembled and normal wear parts, as maintenance part kits. The part kits (**Figure 13, next page**) will not only save maintenance time, but will insure that you have the correct parts when they are needed.

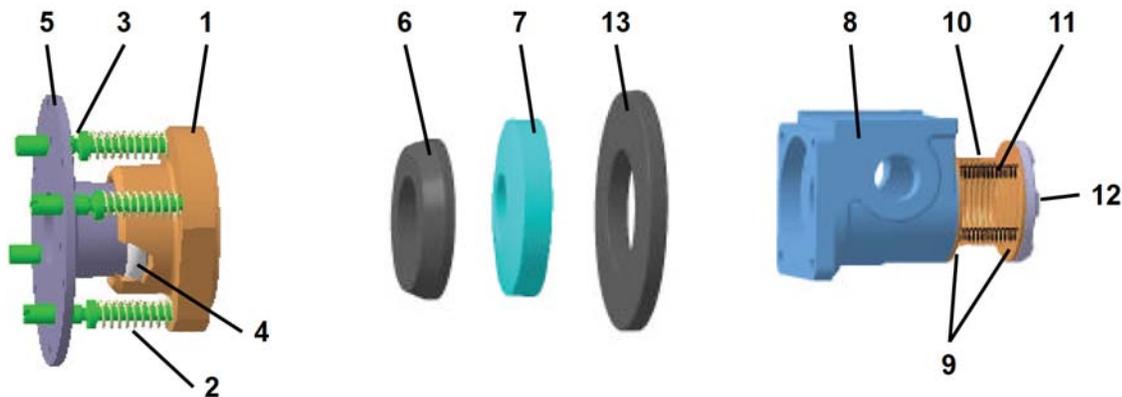


Figure 13. Replacement part kits for Beloit bellows duplex steamfit/syphon

- | | | |
|--------------------|-------------------|---------------------|
| 1. Retainer | 6. Carbon - outer | 11. Springs - inner |
| 2. Springs - outer | 7. Carbon support | 12. Flange |
| 3. Pins | 8. Steamfit body | 13. Carbon - inner |
| 4. Packing ring | 9. Clamp plates | |
| 5. Seat | 10. Bellows | |

Genuine OEM parts provide value. Each part is made to exacting dimensional and material specifications, to perform like original parts. Valmet stocks many of these steamfit system replacement spare parts.

Dust Control & Tissue Systems - Safety and a healthy working environment

Valmet has a long history of development of tissue making technology. We have installed more than 150 tissue machines worldwide since 1974. The Advantage DCT[®], Advantage NTT[®] and Advantage ThruAir[®] TAD concept machine lines combine customer's needs with our extensive technical experience and expertise into one world-class product. Valmet has cost and energy efficient solutions for any tissue making operation.

Valmet's new generation of scrubbers, glue containment and web support products offer new opportunities in the Tissue Industry in terms of unparalleled machine efficiency, emission control, safety and profitability.

The Advantage Run, non-contacting airborne sheet transfer technology, gives you control over web transfer and can thereby eliminate web flutter and ballooning problems. Advantage Run helps you to produce more even, high quality jumbo rolls, reduce web breaks and improve converting.

Dust control and Tissue Systems

- Tissue Process Air Systems
 - Advantage Run
 - Advantage Reel Nip Blow Box
- Primary & Secondary Dust Control Systems
 - WetDust
 - Pulper Exhaust
- Glue/Mist Containment Systems

- Sheet Support Systems
- Tertiary Dust Control Systems
- Web Cleaning (WCH, WCC, WCA)
- Scrubbers & Separators

Example: Advantage WetDust

Valmet's innovative Advantage WetDust concept links proven dust abatement technology with tissue machine safety. Advantage WetDust makes use of a fully wetted system, eliminating typical issues of plugging and dust fires associated with 'dry systems.'

The WetDust system is designed to capture dust where it is created by encapsulating it in water, to contain it near the source and to prevent it from migrating to the tissue machine hall. The equipment provides a healthy, safe and comfortable working environment for tissue machine operators and minimizes manual cleaning, thus reducing machine downtime.

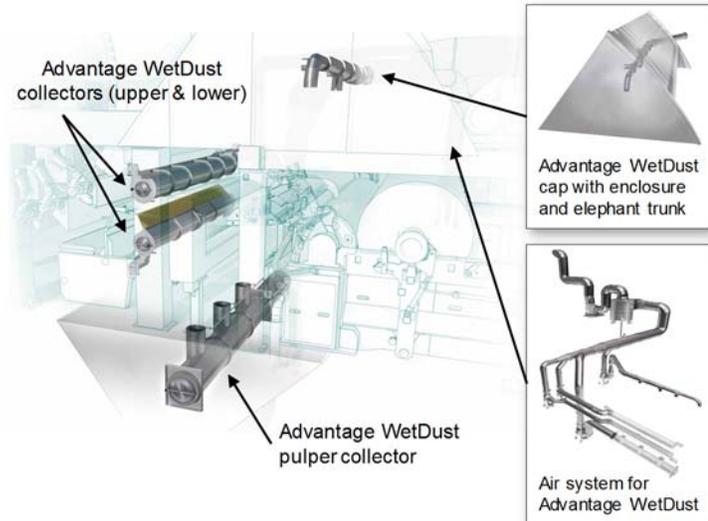


Figure 14. The Advantage WetDust innovative patented concept makes use of a fully wet system, eliminating typical issues associated with 'dry systems' (fires and plugging).

Runnability Systems - Keep your web on the machine and stable

A primary use for air, that can influence the entire process and machine performance, is as an aid to production line runnability.

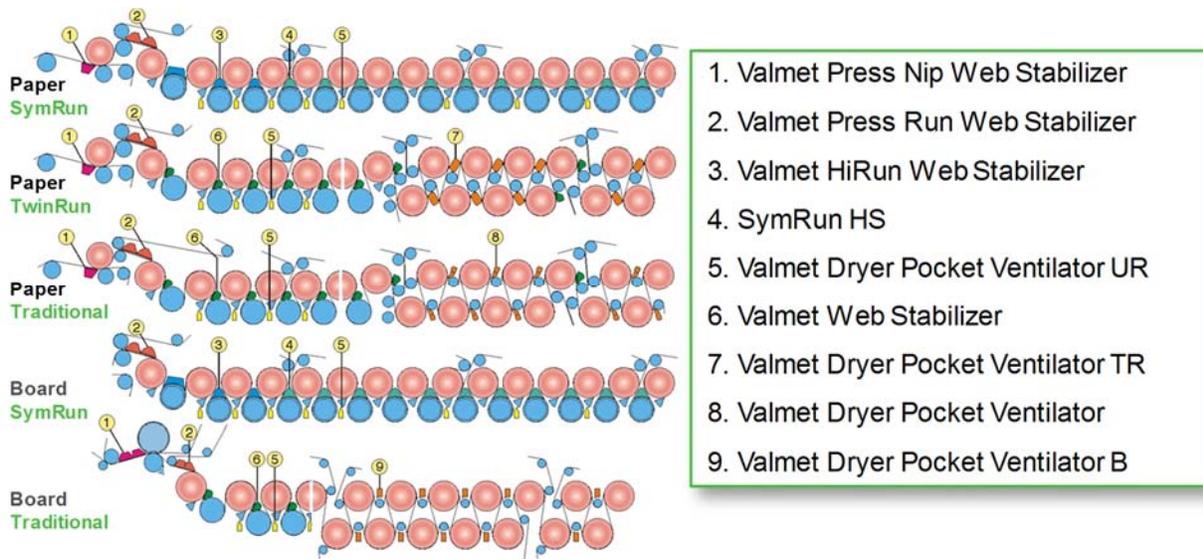


Figure 15. Blow boxes are a fundamental web runnability component. Their application must be custom designed for each individual machine line and grade, and frequently requires a combination of area-specific components.

Runnability through the press and dryer sections has always been an important issue for papermakers. Air flow and boundary layer disturbances reveal themselves in many different types of runnability problems. A paper sheet can break easily if the papermaking process is unstable or if there are excessive vibrations or pressure pulsations in the forming section, press section, dryers or in any location where the sheet passes between roll nips. Some common problems that are observed are:

- Sheet blowing at the press nip, especially during the startup of new press felt
- Edge drop-off or sheet drop-off as the sheet transfers between the press and the dryer
- Cross-machine and machine direction wrinkles caused by air trapped between the fabric and the sheet
- Edge flip from cross-machine air flows or boundary layers of air
- Curling or edge flutter caused by strong air currents entering across the machine
- Difficult tail threading caused by undesirable air flows
- Edge flutter in double-felted areas due to unbalanced pocket air flows
- Bad moisture profiles due to uneven pocket humidities
- Low drying rate due to high pocket humidity levels

Development towards more sustainable paper production is a continuous process. Valmet's runnability systems allow mills to run more efficiently at higher speeds, utilizing lower draws which translates to more productivity using half the energy of earlier technologies.

Additional savings are possible through use of runnability components including, potential savings in furnish (e.g. fiber, fillers, additives), reduced threading times, less maintenance and manpower savings.



Figure 16. Careful selection and application of runnability components such as the Valmet Press Run Web Stabilizer and Valmet Web Stabilizer SR blow boxes and Valmet Dryer Pocket Ventilator can improve web stability while decreasing energy consumption.

Runnability Systems

- Blow Box (BB) Systems – Valmet Press Nip Web Stabilizer, Valmet Press Run Web Stabilizer, Valmet Hirun Web Stabilizer, Valmet Web Stabilizer SR, Valmet Dryer Pocket Ventilator TR
- Pocket Ventilation – Valmet Dryer Pocket Ventilator, Valmet Web Stabilizer UR
- Service – Valmet Dryer Vac Roll cleaning, blow box service and optimization

Example: Valmet Hirun Web Stabilizer and Valmet Web Stabilizer SR blow boxes

Runnability systems are used for improving sheet support for the single-tier dryer groups of high- and middle-speed paper and board machines. At the moment there are over 1,500 Valmet Hirun Web Stabilizer and Valmet Web Stabilizer SR blow boxes in over 100 paper and board machines, and runnability systems upgrades have been applied to more than 150 blow boxes around the world. Sometimes the target has been improved performance, and sometimes energy savings. In the best cases both targets have been gained at the same time.

The latest blow box design includes features that improve performance and decrease energy consumption. These technical improvements are now also available as an easy upgrade package for existing Valmet Hirun Web Stabilizer and Valmet Web Stabilizer SR and older SymRun blow boxes. These upgrade services can be carried out at mills concurrently with the regular blow box overhaul. Valmet's runnability system rebuilds and upgrades enable higher machine speeds, lower draws and better efficiency, and this means more productivity using significantly less energy.

Valmet Hirun Web Stabilizer and Valmet Web Stabilizer SR runnability systems are now available for all kinds of drying section configurations; for example perforated bottom rolls without external air system.

The energy consumed in runnability system operation is the electricity needed for the fans. Upgraded blow box designs consume only half of the energy of the old type blow box design. The way the system is run and operates also has an effect: adjusting the vacuum level that is needed instead of running maximum vacuums from the wet end to the dry end of the machine can result in remarkable savings.

Maintenance of runnability systems is essential. Dirt, grease and dust are the main reasons for runnability problems and increased energy consumption. A fan energy-saving of up to 70% has been gained by complete runnability system maintenance and runnability system upgrade carried out at the same shut down. The payback time for such an investment has been less than one year from the savings in electrical energy. On top of that many other benefits like improved tail threading, increased speed and fewer breaks shorten the payback time.

Process Engineering and Customer Support Services - Wring out even more saving

Valmet has acquired substantial benchmarking data on energy and machine efficiency in the drying process from decades of studies and analysis work. Stable runnability is a combination of many factors that operate smoothly together. Maintaining even stability and keeping the process at an

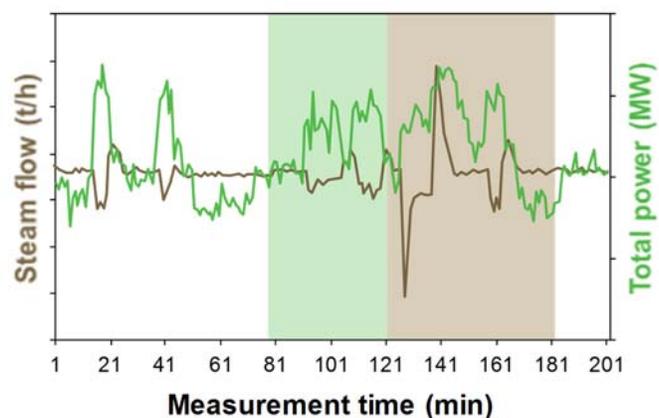


Figure 17. Energy efficiency analyses performed onsite can determine energy consumption at a paper machine, in this case total steam and electricity consumption.

optimum level requires regular analyses and the right actions.

These air system support services are more than just analytical studies of existing systems. Efficiency Audits and Runnability Studies provided by Valmet pinpoint immediate corrective action items and clear suggestions for future energy management and cost savings projects. Among other areas, we review your production and maintenance procedures, process parameters as well as runnability and quality issues.

Through these types of studies and analysis, we continuously collect benchmarking data on energy efficiency. Valmet's papermaking energy efficiency analysis offers an essential tool for decision-making. It helps to reveal a production line's energy gluttons and its improvement opportunities.

The scope of energy efficiency analysis is tailored to each mill's specific requirements and can cover either the entire production line or only particular sub processes. Also individual specialist visits to identify savings potential are available.

Efficiency audits and runnability studies provided by Valmet are tools to help you identify ways to reach your efficiency targets. These analyses determine how well your machinery functions and how it is operated and maintained. Among others, we review your production and maintenance procedures, process parameters as well as runnability and quality issues.

Process Engineering and Customer Support Services

- Dryer Performance, Hood, S&C Studies
- System Performance Optimization Packages
- Building Environment Control Studies
- Coater & Pulp Dryer Studies
- Energy & Benchmarking Studies
- Dust Level Testing
- Training

Meet the Valmet experts

Valmet Air is uniquely capable to deliver the most advanced air handling systems today - and tomorrow. Drawing from over 50 years' experience and development, our Air products and services are based on application, latest technologies and best performance. But it takes more ...it takes the right people.

At Valmet, we have the right people – people with the knowledge and experience to find efficiency and energy savings opportunities that optimize your machine operation, reduce costs and increase profitability.

Air systems case studies

The following sections present a series of representative case histories wherein mills recognized significant process improvements and cost reduction by reviewing and upgrading their air systems.

Enhanced energy efficiency through subprocess analyses

An energy efficiency analysis pilot study was carried out on the forming and press sections of PM3 at the Stora Enso Varkaus mill in Finland in the spring of 2008. In addition to information on the distribution of energy consumption between the subprocesses studied, the mill also received a list of recommended energy efficiency measures as a result of the analysis.

Rising production costs have heightened the importance of energy efficiency as a competitive factor. Energy efficiency is therefore already included in the ongoing improvement programs of many mills.

Valmet has developed a number of supporting subprocess analyses that delve deeper into areas identified through line-level and mill-wide energy consumption analyses.

Forming and press section electricity consumption

The forming and press section typically account for roughly one-quarter of total paper machine electricity consumption, which is the reason why these specific subprocesses were selected for the Varkaus PM3 pilot study.

The Varkaus energy efficiency analysis pilot included limited data extraction from the machine's automation system, required manual measurement taking, as well as observations and interviews. This approach is sufficient for subprocess analyses, but in the case of line-level energy efficiency it is useful to collect as long time series as possible for a larger set of measurement signals.

Line drive power and vacuum power expectedly dominate forming and press section energy consumption analyses. As these are very difficult and costly to control directly, changes in operating approaches occupy a central role in the case of both subprocesses in terms of potential efficiency measures.

Quick energy efficiency improvements through operational changes

In addition to energy consumption distribution information the analysis also yielded a list of recommended improvement measures and related payback periods. Some of these measures involved simple operating approach changes with very short payback times while others called for additional analysis. The production manager for Varkaus PM3 notes that energy efficiency is a key competitive factor that will take on an increasingly important role in the future.

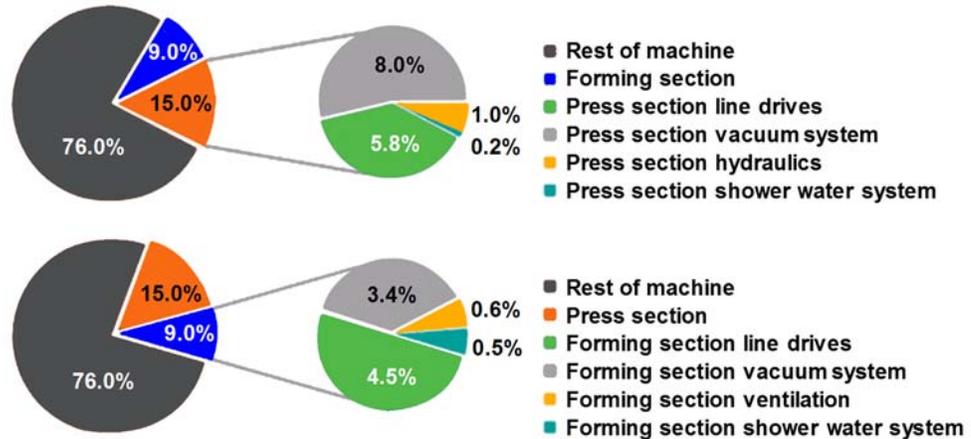


Figure 18. Varkaus forming and press section electricity consumption by subprocess.

The pilot study carried out on PM3 was very interesting and fully met the expectations placed on it, according to the production manager. He was also pleased with the recommendations provided particularly because they did not require any new investment in machinery or equipment.

Mill personnel believe that further analyses of the type conducted on PM3 are also needed in the future if cost-effectiveness is to be kept at the levels required by ever-growing competitive demands. Although potential efficiency measures are continually considered in-house, they feel that an outside perspective is also very important.

"Energy consumption was well in hand at Varkaus overall. This was evident in very low specific electricity consumption, for example. The most critical energy consumers were also known," noted Valmet's product development engineer, in charge of executing the analysis project.

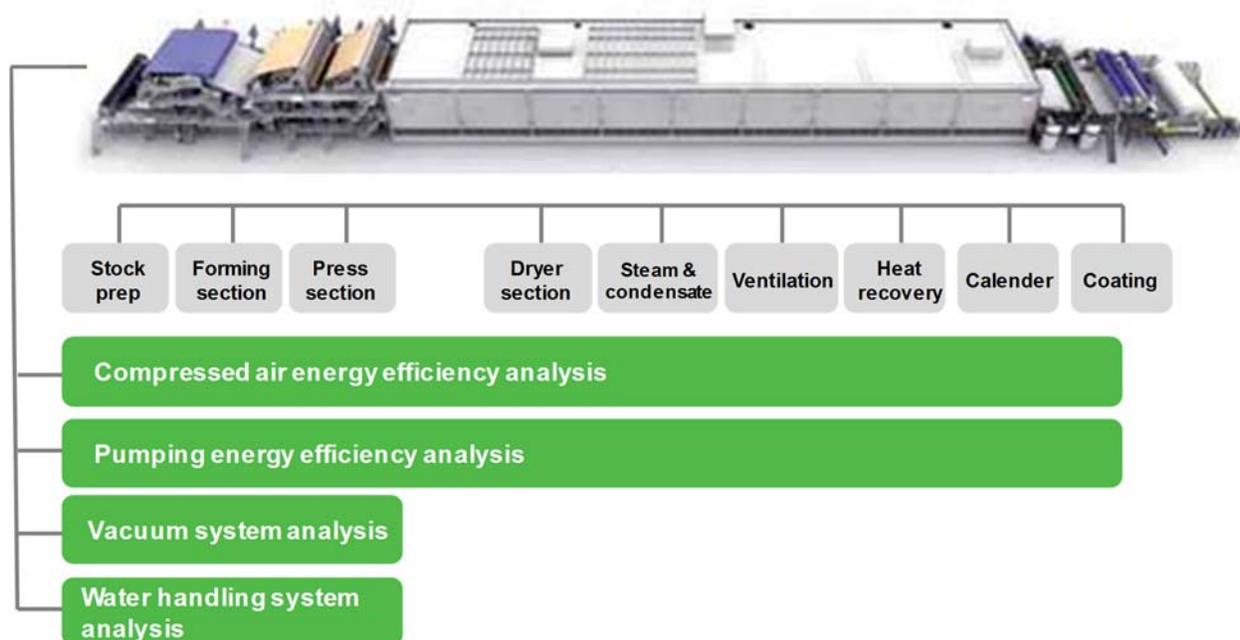


Figure 19. Example of paper machine energy efficiency analysis module.

Growing energy costs have increased mills' interest in energy efficiency services and they are now clearly in demand. Valmet's particular strength in this type of energy efficiency analysis is its solid process know-how, which also facilitates the proper consideration of production and paper quality variables. In other words, the big picture and individual properties of the process studied are always appropriately considered in energy efficiency analyses.

Dryer section heat recovery saves money

The largest part of energy leaves the dryer section with the exhaust air. As a consequence, this is an excellent source of heat recovery. By utilizing the excess heat in the dryer section, a significant amount of energy – and thus money – can be saved.

In many cases, however, the original heat recovery equipment in a machine may not be designed to perform optimally in the present situation: production, machine configuration, and heating requirements may have changed. The mechanical condition of the equipment may also be poor after several years of operation.

Investments in heat recovery rebuilds usually have a very short payback time. This story from Theresienthal is one of the examples of successful rebuilds.

Theresienthal PM6

The PM6 at Neusiedler AG, Werk Theresienthal, in Austria, is a fine paper machine with an annual production of about 198,000 tons of uncoated wood-free paper.

The machine was originally started up in 1969. Several rebuilds, aiming both at increasing production and improving paper quality, had been made throughout the years, but the process ventilation systems, including the dryer section heat recovery, had not seen any substantial rebuilds.

The original heat recovery system consisted of two stages. In the first stage, supply air to the dryer section was heated in an air-to-air heat exchanger by the exhaust air from the hood. In the second stage, outside air was heated, also in an air-to-air heat exchanger, and used as ventilation air for the machine room.

After being in operation for many years, the equipment had deteriorated and needed frequent repairs. The

leakage in the heat exchanger for the hood supply air led to the exhaust air being re-circulated back to the hood system, increasing the moisture content of the supply air leading to the pocket ventilators. This reduced the drying capacity, but also created an unnecessary moisture load for the hood exhaust system.

The original machine room ventilation system, based on bringing large amounts of air through the heat recovery stack, demanded large ducts which took up a lot of the space on the mezzanine level, making maintenance difficult.

When evaluating solutions for these problems, and when defining the scope for the rebuild, a clear potential for increased heat recovery was also found. The existing equipment, even if repaired, could not fulfill current demands regarding heat recovery performance.

After analyzing the situation at the machine, the following actions were included into the rebuild:

- The heat exchangers for the hood supply air were replaced with new CHR air-to-air units. This eliminated leakage from the exhaust side to the supply side, but the units are also designed for an increased rate of heat recovery to the hood system, thus reducing steam consumption.
- The machine room ventilation units were replaced with another type of system. Instead of directly heating the large amounts of air in the heat recovery stack, the new AHR system is based on circulating water. The water is heated by exhaust air in AHR air-to-water heat exchangers and pumped into air coils situated directly at the large openings in the wall. After heating the incoming air, the water is returned to the heat exchangers.

Thus, the large ducts for the ventilation air on the mezzanine level were no longer required.

Rebuild improved heat recovery performance

Due to their compact and modular design, the new heat recovery units could easily be fit into the existing heat recovery stacks, between the sump and the sound attenuator. Cleaning showers with automatic washing sequences were also installed for each separate unit in order to keep the heat surfaces free from fibers and other deposits.

The complete rebuild, including dismantling of the original equipment, was done during a three-day shutdown.

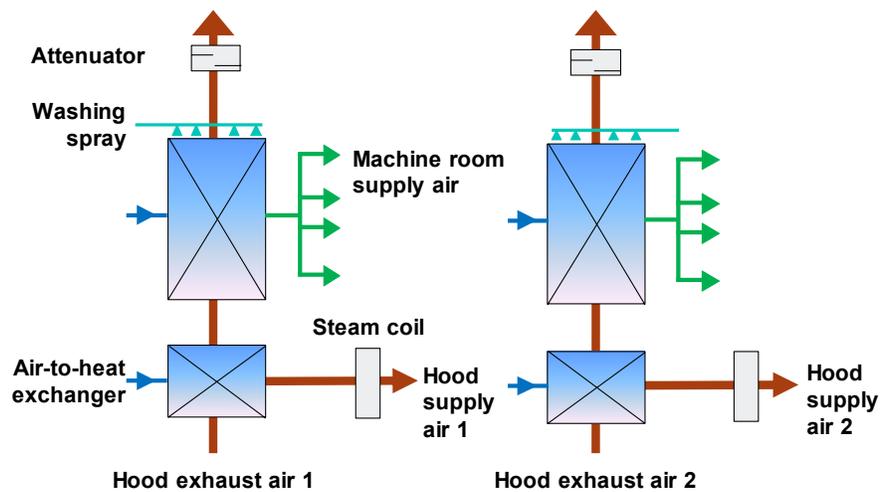


Figure 20. Flow sheet of the original Theresienthal heat recovery process.

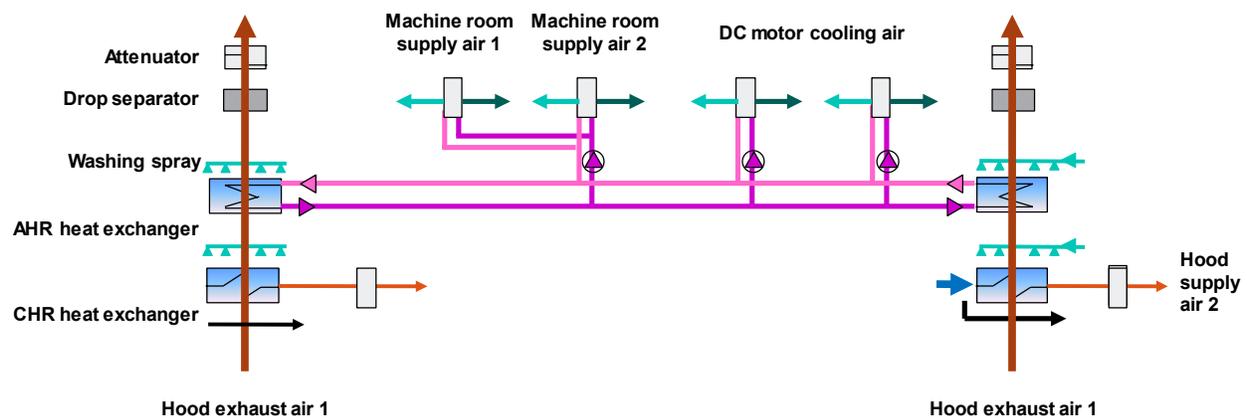


Figure 21. Flow sheet of the new Theresienthal heat recovery system.

As mentioned, the rebuild also resulted in better performance of the heat recovery system. The heat recovery to the hood supply air increased by about 20% and heat was also recovered by the DC motor cooling air.

The decreased moisture level of the hood supply air was immediately seen as a reduction of the steam consumption in the dryer section.

In other words, the rebuild was a success in every way. Sometime after the start-up of this system, the same company made a repeat order for a similar heat recovery rebuild at another of its mills, convinced of Valmet's capacity to make the right solutions for this kind of task.

Valmet Hirun Web Stabilizer improved paper quality on UPM Stracel's PM1

The main target of the runnability system investment was to positively influence the quality properties of the paper. The idea was to achieve this by improving sheet stability at the beginning of the dryer section, an area that seemed to be a bottleneck in the process.

Based on experience gained at other UPM mills, and several other mills as well, it was clear for the mill that the Valmet Hirun Web Stabilizer was the tool with the most potential to reach the targets set for this kind of dryer section modification. The high vacuums offered by the Valmet Hirun Web Stabilizer blow boxes would make it possible to lower the press-to-dryer draw and thus affect the paper quality properties. Additionally, the better sheet stability at the beginning of the dryer section would obviously lead to higher speed potential and fewer sheet breaks at the dryer section.

Valmet Hirun Web Stabilizer 2 boxes were chosen as the solution to meet the targets set for this rebuild. The delivery included five Valmet Hirun Web Stabilizer 2 blow boxes for the two first dryer groups.

According to the mill's Process Development Manager, the project with Valmet went well and in a spirit of good co-operation. He was very pleased with the progress; the documentation and training were well carried out and the schedules were kept exactly. Nothing unexpected came up during the entire rebuild project.

Lower draw gives many benefits

The Process Development Manager stated that all targets were achieved and even exceeded: "Our process has really changed in a very positive way. The machine is running well and the number of sheet breaks in the dryer section has decreased by as much as 75 %. This is due to the fact that we can now run the

machine with a significantly lower press-to-dryer draw. Actually, the draw has come down from 2.5 % to 2.0 %, which is a very big change. The influence of the lower draw is clearly reflected in the strength properties of the paper."

"The targets of the investment were reached and we are really pleased with this HiRun delivery and the co-operation with Valmet," he continued, "[Valmet Hirun Web Stabilizer] is a tool not only for improved runnability, but also for improved paper quality!"

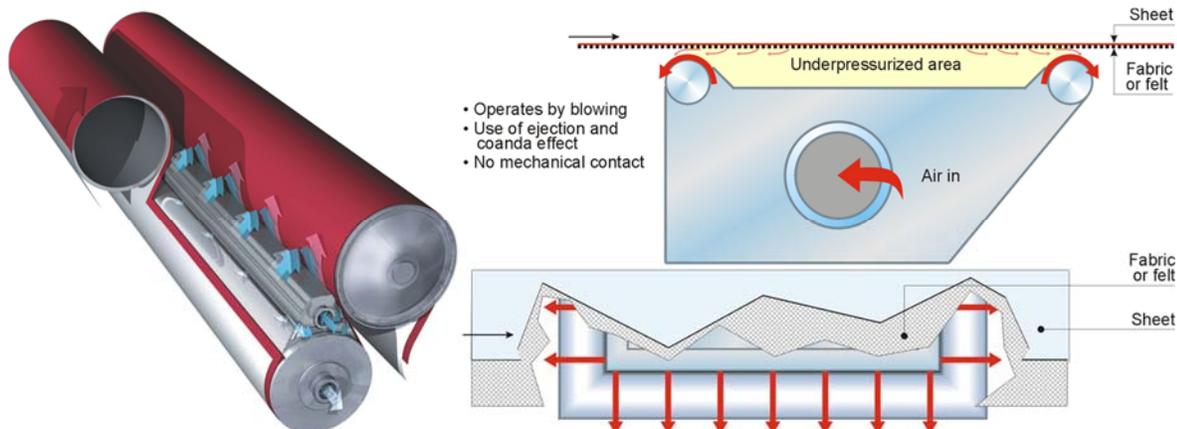


Figure 22. The Valmet Hirun Web Stabilizer blow box (left) operates without mechanical contact between the blow box and machine clothing.

Summary

Valmet would be happy to discuss efficiency and energy saving opportunities with you, at any time, to see how our Air Systems products and services can assist in optimizing and improving your machine operation, reduce costs and increase the profitability of your operation.

This white paper combines technical information obtained from Valmet personnel and published Valmet articles and papers.

Valmet provides competitive technologies and services to the pulp, energy and paper industries. Valmet's pulp, paper and power professionals specialize in processes, machinery, equipment, services, paper machine clothing and filter fabrics. Our offering and experience cover the entire process life cycle including new production lines, rebuilds and services.

We are committed to moving our customers' performance forward.