

# From energy challenges to solutions: TURBAIR Vacuum Systems at the forefront

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## INTRODUCTION:

Efficient and resource-saving technology solutions play an increasingly vital role for the paper industry due to rising energy prices and growing environmental awareness. Thus, paper manufacturers are facing challenges that require them to rethink their processes. With the dewatering process being one of the most energy-intensive stages in the papermaking process, this is the focal point where paper manufacturers can achieve energy savings by installing or upgrading to a vacuum system.

In 2021, global tissue consumption reached approximately 41 million tons. Forecasts indicate a consistent annual increase in global tissue demand over the next decade, with expectations to reach 55 million tons by the year 2032. This growth can be attributed not only to population expansion but also to heightened demands associated with an increased awareness of hygiene. Simultaneously, the growing emphasis on sustainability and environmental impact underscores the importance of not only adopting eco-friendly materials but also optimizing paper production processes.

The pulp and paper sector accounted for slightly less than 2% of total industrial emissions in 2022. While there was an average annual decline in emissions intensity of nearly 3% between 2010 and 2022, paper production processes must be optimized in order to achieve a further reduction in energy requirements. The urgency is amplified by soaring energy prices, driven by factors such as the long-standing conflict between Russia and Ukraine and continuous supply chain challenges, pushing paper manufacturers to explore more efficient technological solutions.

The demand for efficiency in paper production becomes evident when considering the processes involved. Paper production requires process water, which is not always easily accessible and contributes to increased energy consumption and costs. A particularly energy-intensive stage during the paper manufacturing process is the dewatering of the paper roll, where vacuum systems account for up to 20-25% of the total electrical energy consumption. Beyond dewatering the paper sheet, the vacuum systems also transport the paper between the sections of the paper machine and clean the press felts, which remove moisture from the paper sheet. TURBAIR® vacuum systems, engineered and manufactured by MAN Energy Solutions in Zurich (Switzerland), are designed to accomplish these tasks, keeping the focus on energy efficiency and sustainability. These systems are applied in numerous new installations of board, tissue, and paper machines, progressively replacing outdated water ring pumps.

"Our TURBAIR® vacuum systems provide an eco-friendly alternative to water ring pumps, enabling board and tissue manufacturers to achieve substantial savings in water and energy consumption. As a result, our technology not only reduces CO2 emissions in paper production but also significantly cuts down on production costs", states Manfred Dobler, Head of Paper Industry at MAN Energy Solutions.



## Harnessing vacuum systems to reduce energy consumption

The vacuum level and volume required in paper production are contingent on the specific paper type in manufacturing. MAN Energy Solutions offers two versions of vacuum systems tailored to these needs: the compact single-stage radial blower achieves a vacuum level of up to 65 kPa, and the multi-stage radial blower, equipped with up to four vacuum levels, can attain a maximum of 80 kPa. Both variants are available with options for fixed or variable speed.

Utilizing these vacuum systems in paper mills brings forth a range of operational advantages for users that significantly enhance efficiency and sustainability. The vacuum blowers distinguish themselves from water ring pumps, which often experience wear and performance decline over time. In conversion projects, where old water ring pumps are replaced with TURBAIR® blowers, typical energy savings range between 40% and 60%. Furthermore, the systems achieve an absorbed energy consumption that is up to 30% lower compared to conventional water ring pumps as there are no friction losses caused by the water ring.

Efficient dewatering of paper on the machine depends on factors such as grammage, speed, and paper composition, necessitating varying air and vacuum levels. The TURBAIR® blowers are designed with a broad working range, ensuring efficient operation even under partial load conditions.



**Type RT TURBAIR® vacuum blower**

The exhaust air temperature of the blowers is between 120°C - 165°C. As a rule, approx. 70 – 80% of the drive energy of the blowers can be recuperated through the waste heat,” explains Manfred Dobler. “Combined, these advantages result in a simple ‘return on investment’ calculation, with the amortization period for such a system installed in an existing paper production plant being less than two years.”

Considering the potential savings outlined earlier, paper producers can achieve a significant reduction of up to 80% in the overall energy consumption of the vacuum system. Renowned for its durability, the technology requires no wearing parts and involves straightforward maintenance. MAN vacuum blowers installed over 70 years ago, continue to operate seamlessly, highlighting their long-lasting reliability.

**Versatile vacuum blower solutions**

Depending on the requirements of the application, single-stage RT or multi-stage RC blower types are available in different sizes:

**Single-stage RT blower with fully automatic outlet regulation:**

The RT vacuum blower, depending on its size, has a versatile range of applications, with capacities ranging from 200 to 1,450 m<sup>3</sup>/min and up to 65 kPa. Its automatic outlet regulation allows the volume flow to dynamically adapt to the specific requirements of paper machines. The control system efficiently manages volume requirements, ranging from 30% to 100%. Additionally, the RT can fine-tune vacuum levels between 35 and 65 kPa using a frequency-controlled drive.

The extensive functionality of the RT series makes it particularly well-suited for felt conditioning in tissue applications. Its simple installation and compact design on a base frame make it a convenient option for replacing existing water ring pumps with RT blowers.

This design results in an additional reduction in energy consumption of up to 30%, adding to the overall cost-effectiveness. The adoption of frequency-controlled drives allow flexible adjustments of air volume and vacuum level to match the operating conditions of the paper machine, preventing unnecessary expansion losses and, depending on process requirements, facilitating an additional energy consumption reduction of up to 20%. Furthermore, the technology eliminates the need for sealing water, ensuring both cost savings and a positive impact on the ecological footprint through the conservation of fresh water.

“TURBAIR® stands out as a vacuum system unparalleled in both efficiency and reliability, delivering optimal performance with minimal environmental impact that no other system can match. Numerous references prove energy savings of 40 to 60% of the absorbed power during conversions. This calculation does not even take into account the additional savings made possible by using a one- to three-stage heat exchanger. Utilizing the hot exhaust air from the blowers with a heat exchanger allows for even more significant energy savings.



**Type RC TURBAIR® vacuum blower**



**Automatic output regulation**

	System	Product	Absorbed power from existing vacuum system	Absorbed power from TURBAIR®	Saving
1	5.0m wide 1120m/min	180g/m <sup>2</sup> SK paper	2300 kW	1260 kW	45%
2	5.8m wide 900m/min	SC paper 120g/m <sup>2</sup>	2100 kW	800 kW	62%
3	5.6m wide 1200m/min	Tissue	1070 kW	560 kW	48%
4	4.0m wide 850m/min	Kraftliner 180g/m <sup>2</sup>	1900 kW	1100 kW	42%

**TURBAIR® technology proves its worth**

As part of the evolving landscape within the paper industry, paper manufacturers are actively modernizing their production facilities by incorporating one-stage RT blowers. The TURBAIR® technology is supplanting outdated vacuum systems in existing tissue machines. The RT 56 model stands out as the preferred choice for narrow 2.8 m tissue machines operating at speeds of up to 2,200 m/min, while the larger RT 71 model finds favor in 5.6 m tissue machines. This versatile technology accommodates various manufacturing processes, including conventional crescent former, TAD (through-air drying), and Advantage NTT technology for sanitary paper production.

Decades of consistently high customer satisfaction have led to the widespread deployment of well over 1,000 TURBAIR® vacuum systems, equipping over 470 paper machines worldwide. A few references where TURBAIR® technology replaced the existing vacuum system see table above:

“We take pride in the substantial market impact achieved by our TURBAIR® technologies, particularly in the realm of tissue and board machines, on a global scale. Our reach extends not only to countries where our vacuum systems are already widely embraced but also to emerging markets like Central and South America, as well as Asia and India, where we perceive significant potential for future growth. Moreover, our presence is strengthening in markets such as the USA, driven by the increasing significance of operating costs, efficiency, and sustainability in the decision-making process”, states Manfred Dobler. “Our customers value factors such as the availability of MAN employees for on-site visits, the robust design of their machinery, its high efficiency, low maintenance requirements, and user-friendly operation.”

**CONCLUSION**

The landscape of the global paper industry reflects a dynamic confluence of challenges and opportunities. The increase in tissue consumption, driven by factors such as population growth and increased hygiene awareness, promises significant growth in the coming decade. However, this expansion is not without consequences for the environment, which is why the industry must address its role in industrial emissions and the need to optimize energy-intensive processes.

Due to these challenges, the sector is faced with the urgency to improve the efficiency and sustainability of paper production. Rising energy prices, influenced by global events such as geopolitical conflicts, act as additional catalysts for paper manufacturers to explore more efficient technological solutions. Addressing these complexities requires a holistic approach that combines technological innovation, environmental responsibility and operational efficiency.

Addressing the challenges in the dewatering process is pivotal for paper producers, as this stage is among the most energy-intensive, with vacuum systems accounting for 20-25% of total electrical energy consumption. Replacing the water ring pumps in the paper mill with vacuum systems significantly impacts CO2 emissions in paper production. MAN's TURBAIR® vacuum systems tackle these challenges by slashing the overall energy consumption by up to 60% and minimizing water requirements. By recovering clean, hot exhaust air from the vacuum blowers and reintegrating it into the energy cycle, consumption can be further reduced by up to 80%.

The successful integration of such technology solutions will play a crucial role in shaping the future course of the paper sector and ensuring its resilience, environmental responsibility and adaptability to evolving global challenges.