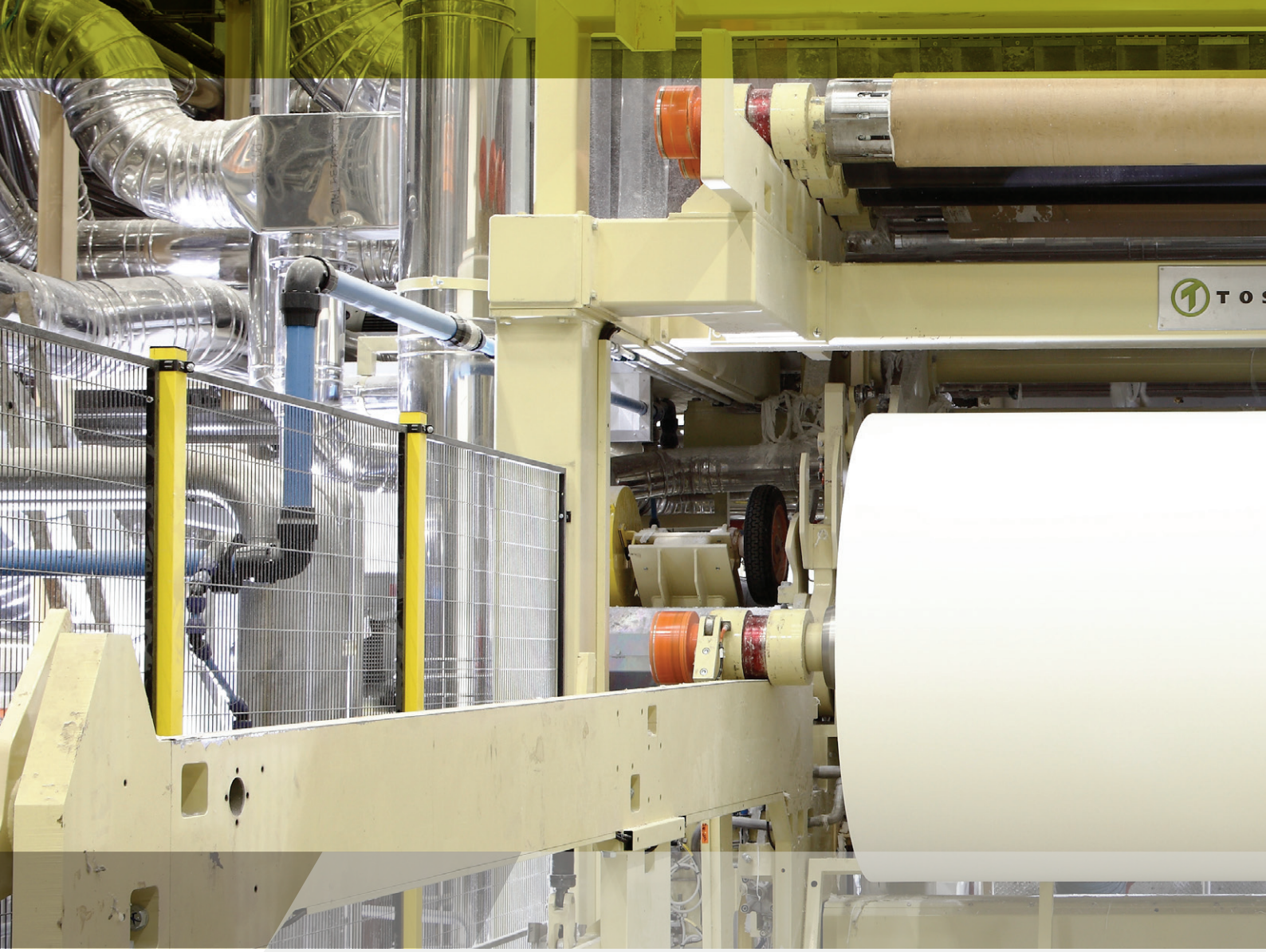


ALL IN THE PREPARATION

The pulp and water processes in a tissue line offer considerable potential for energy saving, through intelligent, tailored design.

By Cristina Brocchini, Technical Manager, Process & Project Engineering Department, Toscotec

The use of raw materials in the production of tissue has evolved over the last few years in favor of short and recycled fibers and there are distinct regional variations in raw materials usage as well. With this in mind, stock preparation has taken on more significance than ever before in ensuring high quality standards and tissue machine runnability.

But alongside these issues, the energy factor has come into sharp focus for both environmental and economic reasons, and our research and development activities have uncovered significant new opportunities for stock preparation to contribute to overall production efficiency.

Except where stated otherwise, all the technologies described are now in operation in real mill situations based on TT SAF (Short Approach Flow) technology (patent pending). Whether the producer is using dry pulp bales, slush pulp or waste paper, many of the same principles apply.

Compact, not compromise

As you might expect, the story starts with the pulper. The design is compact, but without compromising capacity thanks to increased working consistency. A redesigned impeller minimizes batch timing (batch time should be a consistent priority through any pulper optimization) and improves performance thanks to superior slushing.

The bottom line is that efficient mixing at a higher consistency – in other words the same quantity of fiber processed with less water – also brings significant reduction in specific power consumption. In refining, probably the essential design initiative is the new pattern designs on refiner disks. These have been developed to respond better to the different types of pulp which mills are handling, particularly the increase in short fiber, and to maximize the flow rate over the disk size. In the approach flow, one of the central innovations is the replacement of the mixing tank, agitator and discharge pump with a simple concept which

performs the functions of all these elements (the TT Mix). The principle is very simple and is based on a mixing funnel. The key is to introduce the substances to be mixed in the correct way and then leave it to the extremely efficient vortex action of the funnel to provide effective mixing while reducing space required and energy consumption. The machine stand tank provides another opportunity for upgrade. By keeping this as small as possible through thorough analysis of the individual mill situation, one can ensure the quickest possible grade and color changes at minimum energy consumption, but without risking the pressure pulsations and variations in consistency and color which can result when the machine tank is eliminated altogether.

Reduce volumes, speed up cleaning, improve efficiency

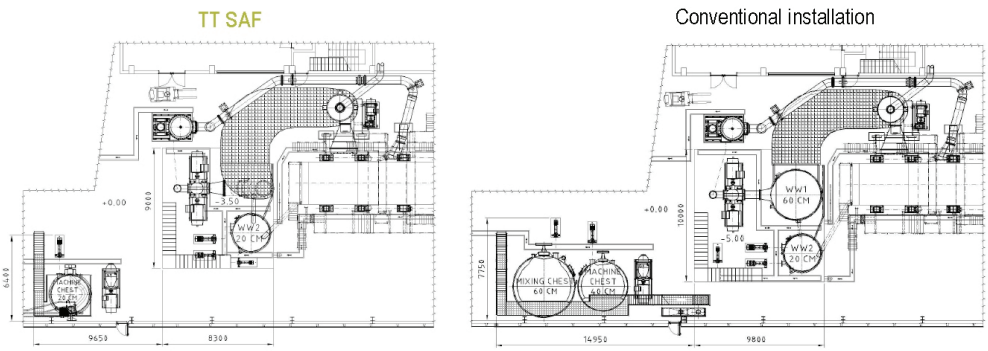
Of course all volume reductions help to speed up routine cleaning procedures, which any mill would welcome. Static mixers have a reputation for gathering a build-up of fibers, but this can be avoided using the solution already described which does away with the mixing tank (TT Mix has no inserts and no moving parts – the elimination of moving parts is another key focus of our research, because of its positive implications for maintenance and energy saving). Automatic cleaning sequences further rationalize the management of the line and create more efficiencies.

Screens provide an excellent opportunity to improve operational efficiency. We have found that stringing and deposits can be avoided by careful selection of foil rotor/basket combinations, basket size and type and rotor speed. Selection of a multi-foil rotor helps to minimize hydraulic pulsations.

The re-engineering of the screen has been focused on the fluid dynamics and ease of maintenance. Overall, such carefully-considered screen design ensures a constant speed of stock through the basket, saves energy and ensures high deflocculation.

Another area in which time savings and therefore energy savings can be achieved is in control loops. Research and experience have shown that control loops dead time can be minimized by reducing volumes without affecting outcomes, but with the benefit that the line can respond more quickly to changes in production parameters.

This adds to the gains already made in the mixing, machine and white water tanks. Equally, attention paid to first pass retention will always be rewarded.



61,76 m² at TM level
74,7 m² in the pit

136,46 m² total

More than 36% savings on building dimensions

115,86 m² at TM level
98 m² in the pit

213,86 m² total

This measure of the percentage of useful fiber which makes it through to the tissue machine in the first pass through the approach flow system is aided by efficient flume and deaerator design. Overall, the higher the first pass retention, the less pumping energy is required. The TT Deaerator itself has no moving parts which require maintenance and it uses centrifugal forces to reduce entrained air.

Customized sizing in terms of dimensions and open area ensure optimal performance and energy saving. It also allows a reduction in the flume size and length and elimination of the white water silo. On this point, management of air in the system is of course critical, as entrained air can cause loss of machine performance and sheet breaks.

Consider your pumping options

Pumping is another major source of energy consumption in the tissue mill and therefore provides an ideal opportunity for energy saving. Minimizing the pumping energy required through intelligent mill layout and accurate piping design is the first obvious step, but there are technology issues to contend with, too. For process pumps attention should be paid to ensure selection of the most efficient solution in terms of impeller design and shaft sealing type. Within the vacuum system there is the option of the tradition system with liquid ring pumps or the more recent applications of turbines and turbo blowers. We work with all these technologies, but it is worth considering the costs and benefits of each. Even the tissue market has moved towards the turbines that in the past were mainly used on large paper machines because of their capacity. While they operate at higher speeds than liquid ring pumps and therefore require more frequent and specialized maintenance, one turbine can typically do the work of several liquid ring pumps.

The downside of this is that if the turbine needs maintenance, it is far more likely to cause a complete shutdown of the system, whereas, as an example, two out of three liquid ring pumps could still keep the show on the road, albeit at reduced output. Enter the turbo blower, which can also do the work of several liquid ring pumps, but operates at slower speeds and can be specified in even smaller sizes than turbines. The caveat is that while maintenance might be less frequent, it can still be very expensive. They have been used in paper and board, but hardly at all in tissue. This could change as knowledge of their attributes becomes more widespread. So how about the energy requirements for these vacuum system options?

The installed power for each solution is similar, but turbines and turbo blowers offer viable heat recovery, unlike liquid ring pumps, so energy savings are possible. The energy saving potential is greater for turbines, but this can be offset in the case that the turbo blower assures more reliability and reduced maintenance. So far, turbines and turbo blowers tend to favor larger installations, but the technology is under development, and the balance of benefits and drawbacks for each solution is likely to change. Of course it is not just about the components, but also the way they are engineered into the system as a whole.

If liquid ring pumps are chosen, note that fresh water consumption can be minimized thanks to the use of a closed loop water circuit over a cooling tower.

And this type of installation would also ensure energy saving thanks to the use of colder water for the vacuum pumps ring.

Headbox carries on the good work

This particular story goes as far as the headbox. It has proved possible to redesign the headbox screen to boost cleaning efficiency and reduce energy consumption while maintaining the high deflocculation and other benefits of the original.

The focus in the TT Headbox itself has been to ensure quick response to product changes – after all, you can have the most nimble stock preparation system in the world, but if the headbox's response is lethargic then all benefits are lost.

Management of turbulence is the key, thus avoiding unhelpful pressure drops which entail unnecessary extra power consumption.

Easy maintenance is ensured by lateral access doors which make cleaning of all parts a simple task. The headbox translates the hard work done in stock preparation into stable paper quality, with consistent formation, CD and MD profile

and tensile strength.

From an energy point of view, the main target has been to reduce the installed power on the fan pump, while maintaining high output and quality.

And the flexibility of the headbox also allows this goal to be achieved by playing with operating consistencies and increasing them as much as possible without compromising paper quality.

All efforts to optimize the size of stock preparation and approach flow elements, from TT Mix and flume design to piping layout, help to minimize the footprint of the whole installation. Beyond the energy and time savings to be gained from such attention to detail, there will also be a reduction in necessary civil works, which helps to keep down the cost of initial investment. Recent projects have proved that it is possible to achieve nearly a 50 percent reduction in approach flow installation footprint compared with a conventional installation. This results in meaningful savings.

The next steps

Evolution never stops, and the current focus is on the water cycle, and technologies to minimize power consumption in the process of mixing air and water for the flotation process. Once again we should emphasize the need to optimize layout to reduce the power required for pumping. Elimination of unnecessary tanks and reduction of tank volumes has already yielded strong results. The desire to reduce cemical use still further also continues to inspire research, with hydraulic mixing being a key focus of our attention. And of course stock preparation is part of a complete project, with numerous energy saving opportunities which we are working on constantly, but which could provide material for several articles.

Today, it is only really as a turn key supplier with expertise throughout the tissue making process, that it is possible to optimize production from an energy perspective, and indeed from all perspectives. At the root of all successful R&D and its application in the real world is detailed knowledge of worldwide market needs.

The experience of working in different countries with various raw material mixes and energy sources (steam, natural gas, LPG, fuel oil, diesel etc), yields not only the best solutions for specific local conditions, but results in a cross-fertilization of ideas from one situation to another. This is brain storming at its most effective.

	TT SAF	CONVENTIONAL INSTALLATION
Mixing tank agitator	Not existing	17,6 kW (60 m^3 tank)
Mixing tank discharge pump	Not existing	6,4 kW
Machine chest agitator	6 kW (20 m^3 tank)	8,8 kW (40 m^3 tank)
Fan pump	590 kW	620 kW
Total	**596 kW**	**652,8 kW**

Average reduction of energy consumption around 9%

Data written in the tables represent the absorbed power and are referred to a TM production of 100 ton/day.

	TT SAF	CONVENTIONAL INSTALLATION
Mixing tank	Not existing	30 - 60 m^3
TT Mix	0,5 m^3	Not existing
Machine chest	6 - 20 m^3	30 - 40 m^3
Flume & Silo	Not existing	90 m^3
Flume & Stand Pipe	40 m^3	Not existing
Total	**46,5 – 60,5 m^3**	**150 – 190 m^3**

Average reduction of storage volumes in approach flow system up to 75%