

Toscotec launches breakthrough innovations for a more sustainable tissuemaking

Giulia Fabbri, Global Marketing and Communication Manager, Toscotec

INTRODUCTION:

In 2022, Toscotec has launched three breakthrough technological innovations aimed at reducing the energy consumption and carbon emissions linked to tissuemaking and at guaranteeing the highest tissue quality:

1. INGENIA, a new concept tissue machine to produce structured tissue
2. TT Induction SYD, a steel Yankee dryer that relies on electromagnetic induction instead of steam for drying
3. TT Hydrogen Burner, a new generation of burners for Yankee hoods fueled by 100% hydrogen.

1. INGENIA

Energy, sustainability, and quality are the most challenging topics in R&D and design process for papermaking today. State-of-the-art technologies for structured tissue have an undisputed high-end paper quality benchmark fixed by TAD (Through Air Drying), which is currently identified as the top process to manufacture high quality, highly absorbent and soft tissue. The market also offers other intermediate technologies that also produce a textured tissue and can lead to a reduction of energy usage, but whose final products do not compare to real structured paper. Undoubtedly, the most important leaps in tissuemaking technology are moving around the possibility to produce structured tissue similar to TAD, but with less energy need and capital investment required.

Toscotec has developed INGENIA, a new concept tissue machine to produce premium quality structured tissue paper. The quality generated by INGENIA line is substantially higher than textured tissue and close to Through Air Drying (TAD) produced paper but using 35% less energy.

Figure 2: Toscotec's INGENIA line.



Figure 1: Toscotec's headquarters in Lucca, Italy.

With INGENIA Toscotec responds to the challenge of today's paper market calling for premium quality tissue obtained with lower energy use and lower capital investment than TAD lines. INGENIA's concept is based on consolidated technologies for premium tissue, building on vast internal know-how of Toscotec's and Voith's R&D, and field data validation on TAD and structured paper systems.

Paolo Raffaelli, Toscotec Chief Technology Officer, says: "The key factor for energy reduction compared to TAD, is that INGENIA achieves significantly higher dryness through non-thermal dewatering on a structured moulding fabric. With TAD, the thermal drying starts from 24-26%, whereas INGENIA achieves a much higher dryness level without using hot air or steam. This maintains the premium quality obtained through rush transfer and structured moulding fabric, but uses much less energy."

Ultra-premium tissue quality

Through non-compressive water removal technologies and efficient fiber moulding, INGENIA produces much higher tissue quality properties than other technologies for textured or conventional DCT tissue. These properties include bulk, softness, stretch, and absorbency, which improve the tactile “hand” feel and the final paper characteristics that compete with premium segments for toilet, facial and towel tissue grades.

The specific pattern of the structured fabric and the use of a calender can further enhance the quality of end products.

Energy Efficiency through Process Innovation

The process of this new concept machine begins with a dilution profiling layered TT Headbox-ML operating on a twin-wire forming section. Like TAD machines, INGENIA operates wire rush transfer at low consistency, but its key capability is an enhanced vacuum de-watering system without pressing the paper web, which ensures that dryness is greatly increased while fibers are being supported in the same shape as they originally formed when fully water saturated.

At the end of the wet section, TT NextPress shoe press uses low loading pressure to gently stabilize the web dryness content and transfer the paper to the drying section without bulk compression. The combined action of a third-generation design TT SYD Steel Yankee Dryer and high-efficiency TT Hood achieves the final desired dryness.

The process is completed by dry creping, sheet stabilization integrated with dust removal, and precision winding using an electro-mechanical TT BulkyReel fitted with a Center Wind Assist on the primary and the secondary arms. The Center Wind Assist fully preserves bulk by reducing the nip pressure against the reel drum during the winding process.

Flexible Configuration

The new INGENIA offers top flexibility, as it can easily swing from the production of premium quality structured tissue to conventional DCT. When in conventional mode, INGENIA delivers top machine speed and production capacity.

INGENIA features widths up to 6 m, a production capacity from 100 to 250 tpd, and operating speeds up to 1,500 m/min in structured tissue mode or 2,000 m/min in conventional mode, depending on machine size and customer requirements.

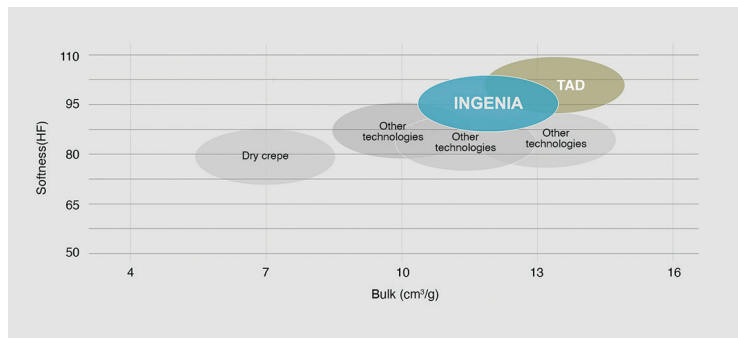


Figure 3: INGENIA-produced premium quality toilet tissue (unconverted).

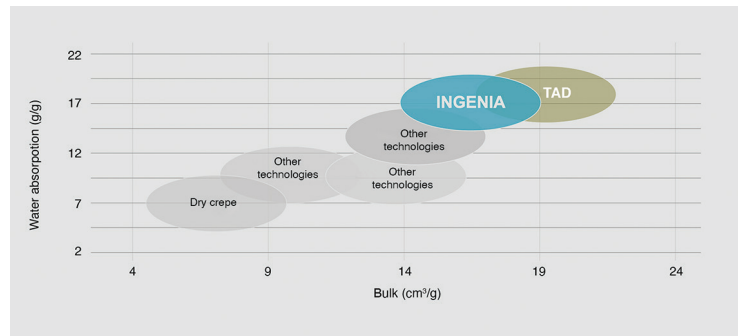


Figure 4: INGENIA-produced high absorption towel (unconverted).

2. TT Induction SYD

TT Induction SYD is a carbon-reduction breakthrough developed by Toscotec that redefines Yankee dryer technology entirely. TT Induction SYD uses electrical induction instead of steam energy to dry the paper web, thereby cutting direct greenhouse gas emissions to zero.

In 2000, Toscotec pioneered a major technological innovation, TT SYD, the first Yankee dryer entirely made of steel. Steel Yankees have since surpassed their cast-iron equivalent to become the benchmark for drying efficiency and safety in the paper industry. TT Induction SYD is now set to be the new game changer in tissue for its capability to use clean energy and slash direct carbon emissions associated with the drying process.

Figure 5: Toscotec’s TT Induction SYD



A disruptive innovation for dry crepe and TAD tissue machines

With TT Induction SYD, the internal steam distribution and steam/condensate removal systems are entirely replaced by an induction system composed of static coils installed inside the shell and electrical controls and instrumentation located outside for easy maintenance and monitoring. As a result of precise coil geometry, the induction system delivers a very fast and accurate heating effect exactly on the areas of the shell where it is required, while preventing residual circulating currents in other areas.

Steam-heated Yankees use steam energy typically generated by burning fossil fuels. TT Induction SYD uses electrical energy that can be derived from renewable energy sources while delivering the same result, i.e. uniformly heating up the Yankee's shell in contact with the paper web to achieve dryness. TT Induction SYD is suitable for installation on dry crepe as well as Through-Air-Drying (TAD) tissue lines.

Luca Ghelli, Toscotec R&D Director, says, "Sustainability is the guiding idea of TT Induction SYD's design. As a proven industrial technology, an induction system offers multiple advantages when applied to the most energy-intensive section of the tissue machine. The efficiency of this cutting-edge technology will dramatically reduce the carbon footprint of papermaking. Based on our expertise in steam-heated TT SYD and induction systems, we succeeded in developing a more efficient and sustainable steel Yankee dryer."

Substantial carbon reduction with unchanged productivity and paper quality

Normally, approximately half of the carbon dioxide emissions produced by a tissue machine originate from the operation of the Yankee dryer. By using clean energy, TT Induction SYD achieves zero direct emissions, while maintaining productivity unchanged and reducing energy consumptions because of the higher efficiency of the induction system. Due to the precise heating of the shell, it

also eliminates possible moisture profile issues related to uneven condensate removal, thereby ensuring an improvement in moisture uniformity in both cross direction (CD) and machine direction (MD).

Maximum safety, easier operation, and maintenance

TT Induction SYD was designed without any electrical, mechanical, and radiation risk to ensure maximum safety. Besides offering safe operations, it also clears all issues related to the maintenance of steam-heated Yankees, including pressure vessel's mandatory and planned controls, maintenance of condensate straw pipes against potential plugging and of special heads for steam and condensate inlet and outlet. The entire Yankee system is simplified in the absence of steam: the heads, the internal surface which is groove-less, and the steam and condensate auxiliary system disappears entirely, including the steam generator with related maintenance and controls and delicate controls for steam quality. TT Induction SYD simply requires relatively easy maintenance on the electromagnetic induction system.

3. TT Hydrogen Burner

TT Hydrogen Burner is a new generation of 100% hydrogen fueled burners especially designed and tested by Toscotec for Yankee hoods. Within the context of the energy transition from fossil-based to zero-carbon industrial operations, Toscotec developed this patented innovation to drive the conversion of paper manufacturing to clean energy.

TT Hydrogen Burner is an in-line burner featuring precisely controlled combustion and two safe operation modes. In carbon-free mode it runs on 100% hydrogen; in carbon-reduction mode it is fueled by a mixture of natural gas and hydrogen, where the percentage of hydrogen is accepted across a wide range.

Figure 6: Toscotec's TT Hydrogen Burner.

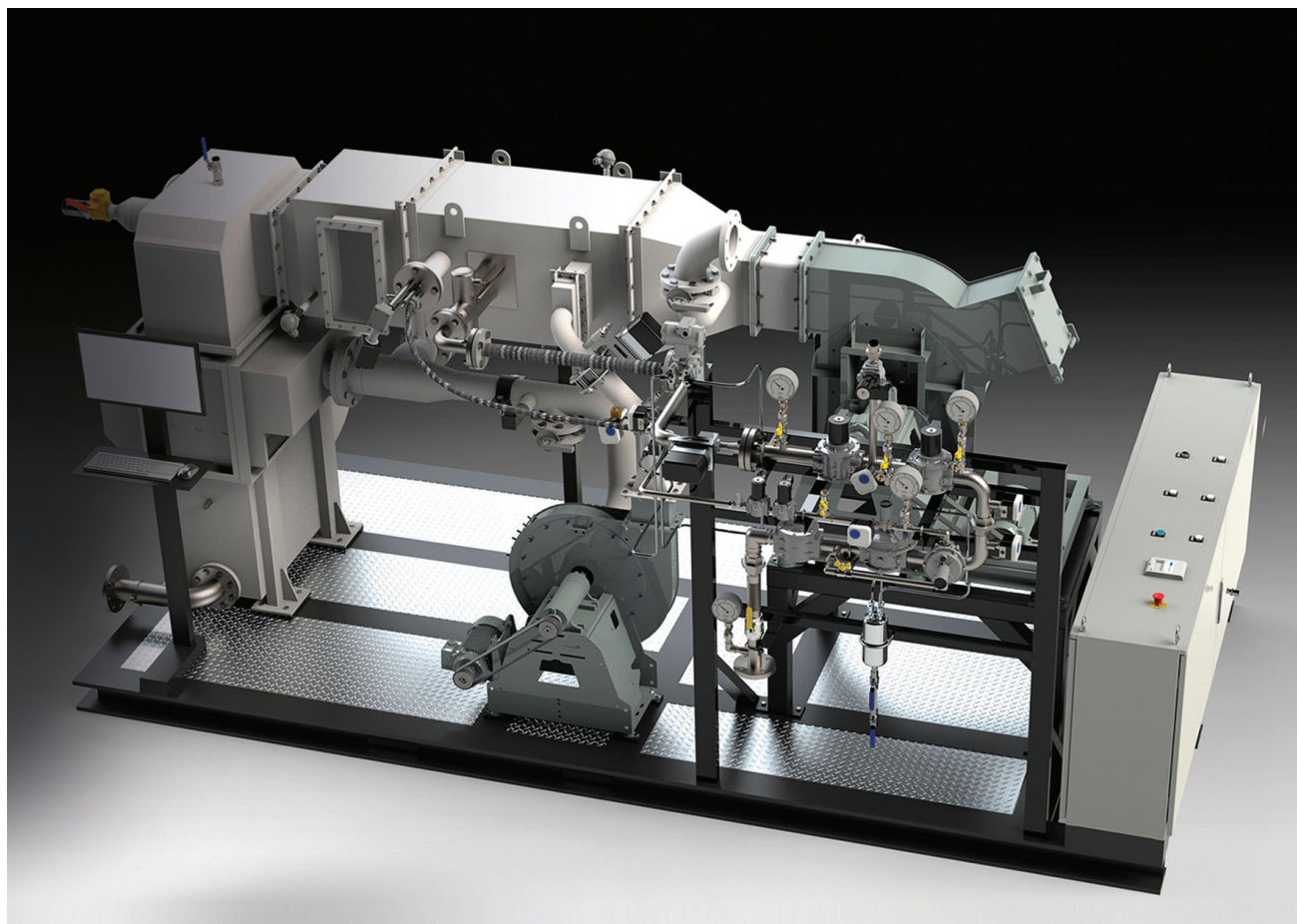




Figure 7: Toscotec's headquarters office building in Lucca, Italy.

Fossil-free fuel for a more sustainable tissuemaking

TT Hydrogen Burner entirely matches the high performance of gas-fired burners, using a carbon-free fuel. In fact, hydrogen combustion does not emit carbon dioxide into the atmosphere. The key factor in the overall energy balance is that hydrogen fuel is produced from renewable energy sources. If this is the case, in the future hydrogen may possibly replace fossil fuels in all thermal processes associated with tissuemaking, including steam production and air system burners. In terms of its infrastructure, hydrogen can be stored in pressure vessels, or injected into the existing natural gas grid.

Stefano Pecchia, Energy Technology Director at Toscotec, says, "Tissue producers are asking for technological innovations that will allow them to work in full hydrogen mode. Whether they choose to replace their existing burners or install new tissue lines, tissue producers aim to be ready for when this fuel will be widely available, cost competitive and green. In response to this demand, Toscotec has invested in building a dedicated air system test bench to ensure guaranteed results according to the specific operating requirements of paper mills".

Ready for industrial application

The design of TT Hydrogen Burner is ready for industrial scale production because it has been successfully tested to operate under the same conditions of air speed, temperature, and humidity of the actual air system of a tissue machine. TT Hydrogen Burner is suitable for immediate installation. Currently, hydrogen availability for tissue mills is limited, so the burner can be set to operate burning hydrogen mixed with natural gas in carbon-reduction mode, or even only natural gas if necessary. When hydrogen becomes readily available, in order to switch to full hydrogen mode, TT Hydrogen Burner simply requires a nozzles replacement, which is a one-day easy procedure. This will guarantee the highest possible combustion efficiency based on 100% hydrogen gas.

Turnkey projects: Full control equals maximum efficiency

Toscotec is recognized as the global leading supplier of turnkey tissue projects. In its capacity as turnkey supplier, Toscotec ensures a strong focus on energy saving across the entire plant. The magnitude of the turnkey scope allows Toscotec to push the envelope on carbon reduction by designing a new production line through the lens of energy efficiency. Turnkey projects include a fully customized engineering design which is based on available energy sources and raw materials, as well as selection of equipment for the entire plant. Therefore, turnkey operations guarantee maximum production efficiency.

Rebuilds: The highest value for a limited scope

In the space of energy and production efficiency, tissue machine rebuilds are a very effective way to optimize a section of the tissue machine with its associated processes with a relatively limited budget.

Customization is key in rebuilds. Toscotec carries out site surveys and rebuilding analysis to pinpoint the most effective targets for upgrades and process optimizing solutions. These can also serve as guidelines for tissue manufacturers to identify the technological investments that yield the highest returns.

The main targets of Toscotec's tissue rebuilds are threefold. The first is increasing the productivity of an existing machine both by boosting its drying capacity and by reducing its energy consumptions. The second is improving paper quality, which allows the mill to achieve premium quality or to produce lower basis weight, high quality tissue paper, thereby reducing raw material costs. The third is ensuring equipment safety: by upgrading outdated machinery, Toscotec guarantees maximum operation safety on the production line.

In 2022 Toscotec has managed more than 25 tissue machine rebuilds for leading manufacturers that remain confidential. The projects are located at different mills across 6 continents: Africa, North and South America, Asia, Europe, and Oceania.

Figure 8: Toscotec's headquarters in Lucca, Italy.

