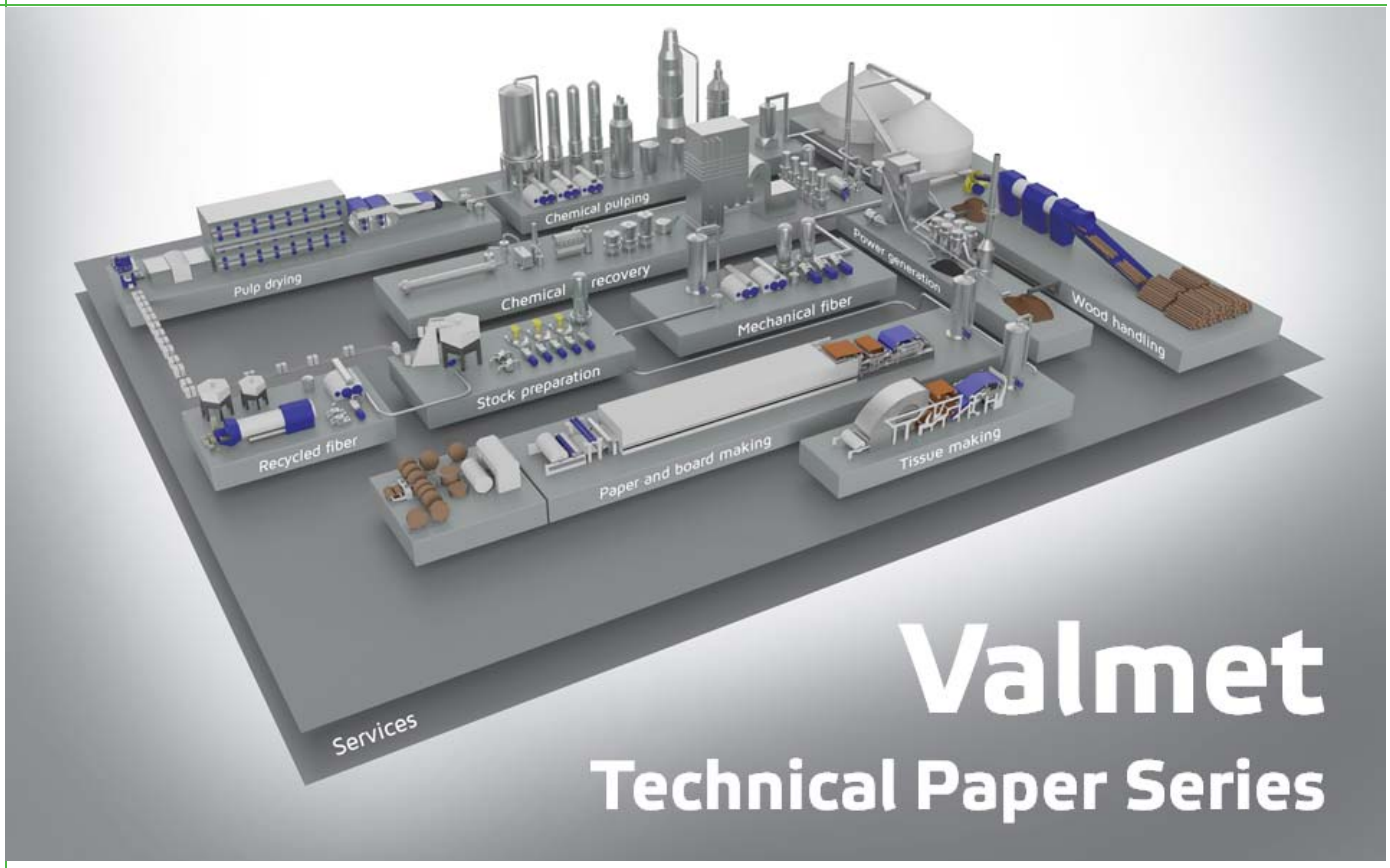


Valmet's Advantage™ NTT® Concept

Executive Summary

A radical new configuration of proven tissue and papermaking technology has been developed by Valmet. It is the Advantage NTT concept. The machine components are similar to NTT, but assembled in a different way. This new arrangement creates a textured tissue with the high bulk of TAD and the speed and energy efficiency of DCT. It also has better softness than the standard NTT process. Putting these three paper properties together also creates lower costs through fiber savings and lower energy costs.

With a simple mode change, textured or conventional tissue can be made. Increased flexibility adds to the list of positive attributes.

The Advantage NTT technology has been developed in a full scale tissue pilot machine in Valmet's Tissue Technology Center in Karlstad, Sweden. TM1 was rebuilt to run the NTT process under actual operating conditions. It is available for tissue makers to use for trial run of new NTT products.

Proven components in a new configuration

Valmet's Advantage NTT concept is based on a radical new configuration of proven tissue and papermaking technology. The machine components used in Valmet's Advantage NTT machine are all proven in the field at running conditions very similar to NTT, but they have been assembled in a new arrangement that results in a textured tissue very high in both bulk and softness. Textured tissue is seen as a completely new category of tissue (**Figure 1**), offering the high bulk of TAD (Through Air Dried) and the speed and energy efficiency of DCT (Dry Crepe Tissue).

The NTT process has been developed over the past few years by Valmet, in close cooperation with Albany International. Among the key benefits of NTT textured tissue is an increase of 50-80% in bulk and much better softness than conventional DCT. Due to the higher bulk, fiber savings of 10-30% are possible for textured tissue. At the same time, when the Advantage NTT machine is running in the textured mode, it has an even lower energy demand than DCT, since dryness going into the Yankee dryer can be up to 45%, depending on the basis weight.

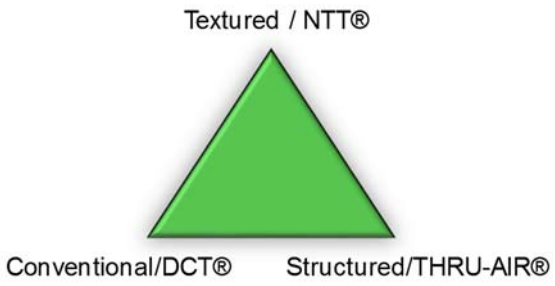


Figure 1. Textured (NTT) tissue is a completely new category of tissue

Simple mode change

A key benefit of this patented technology is that it can quickly switch modes to produce either textured tissue or conventional tissue. It involves a rather simple clothing change that takes about 3-4 hours. Thus the Advantage NTT concept offers incredible flexibility because it can meet market demand for either conventional or premium tissue.

When running in the conventional mode, the final product is the same as, or better than, DCT. But its energy demand is much lower than DCT, due to its dryness after the Yankee transfer which can be up to 48%, depending on the basis weight.

Process and sheet properties

The focus in development work has mainly been on toilet and facial tissue. Excellent products have been made in which bulk or caliper are 50-80% higher than on conventional dry crepe machines and at about the same level as on TAD machines at the same softness. **Figure 2** shows a sheet bulk vs. tensile strength index for toilet tissue with a basis weight of 18 g/m². The products were made in the NTT textured mode with a furnish consisting of 40% SW and 60% Eucalyptus.

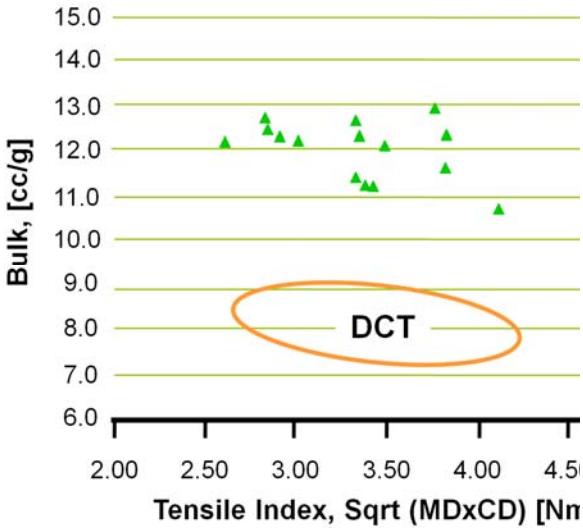


Figure 2. Bulk vs. Tensile Index (toilet tissue 18gsm)

Although towel has not been the main focus of the project, it is, of course, possible to produce towel and achieve higher bulk than with DCT. However, trials have not yet proven that it achieves the same quality as on a TAD machine. The base sheet for TAD has a bulk level of 18 cc/g compared to about 7 cc/g on a conventional dry crepe machine. The water absorbency is twice as high as for the TAD product – in other words, 16-18 g/g measured by the basket method. The preliminary trials with towel indicate that NTT falls in between with a bulk of 11-12 cc/g and a water absorbency of 10- 12 g/g.

NTT = high bulk AND high dryness

The relation between bulk and dryness is shown in **Figure 3**, when drying is started for TAD, conventional dry crepe and NTT. The bulk of NTT toilet tissue is slightly less than TAD, but it has significantly higher dryness. The data points for TAD toilet are with relatively fine TAD fabric, which gives high softness without calendering.

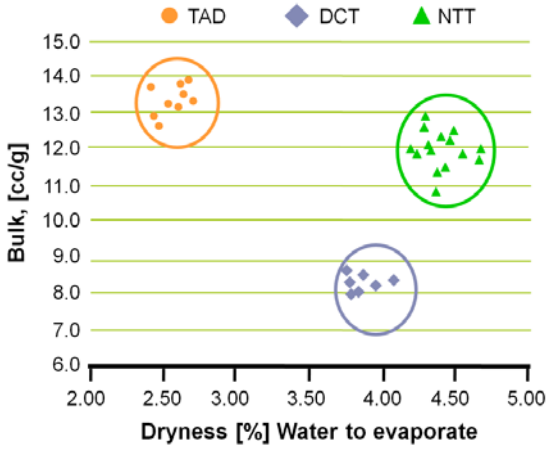


Figure 3. Bulk vs. Dryness (toilet tissue 18gsm)

When considering operating costs, high dryness after the pre-press is not the only advantage of NTT. For example, the vacuum requirement for Valmet's NTT machine is at the same level as for a DCT machine. In comparison to TAD, the vacuum consumption is less than 25% of TAD.

Pilot machine operation revealed that the requirement for refining energy for NTT is lower than for DCT. This makes it possible to run with a higher amount of HW. Less refining and more HW also reduce operating costs.

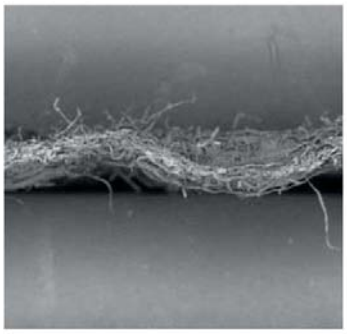
Bulk for lower weights

The high bulk of the textured mode creates possibilities of reducing the basis weight or reducing the weight of the finished product. In Europe, it is common to produce 3-ply products with a total basis weight of about 50gsm. With NTT it is possible, for example, to make a 2-ply product with a total basis

weight of 45gsm and at the same time maintain the roll firmness (hardness). In such a product the sheet count can remain the same or be reduced.

Another possibility is to maintain the basis weight in the 3-ply product. The sheet count or length of such a product has to be reduced at the same roll firmness. The fiber savings in the finished product can be at least in the range 10-20%, and may be up to 25%. This estimate is based on finished products made with base paper from the pilot machine.

Pilot demonstration gave proof



The Advantage NTT technology has been developed in a full scale process at Valmet's Tissue Technology Center in Karlstad, Sweden. The tissue pilot machine, TM1, was rebuilt to run the NTT process under authentic operating conditions.

The pilot tissue machine is now available for tissue makers to use for their trial runs of new NTT products.

A winning combination

To summarize, the key benefits of the new Advantage NTT concept are:

- Switch capability between textured and conventional dry crepe tissue.
- Textured tissue has 50-80% more bulk and better softness than DCT.
- Fiber savings of 10-30% are possible in finished products with textured tissue.
- In the textured mode, dryness after the Yankee transfer is 45%, which lowers energy consumption.
- In the conventional mode, dryness after the Yankee transfer is 48%, which significantly lowers energy consumption.
- The Advantage NTT machine is easy to operate and has high machine efficiency and high production capacity.

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.