

## Why Metsä Board Äänekoski mill changed its roll packing method? 为什么这家著名的纸厂改变了纸卷的包装方式？

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Metsä Board is Europe's leading producer of fresh forest fiber carton boards, the world's leading manufacturer of coated whit-top kraftliners and a major paper supplier. Its central Finland located Äänekoski board mill is producing fully coated BCTMP board with white or coated back recommended to high-quality packing and graphics. In spring 2012 the Äänekoski BM1 line was rebuilt to increase its capacity by 30.000 t/a up to 240.000 t/a production capacity. Along this board machine rebuild also the roll finishing system (slitter winder and roll packing line) had to be moved and updated.

2012年一家欧洲著名的纸板制造商，对它位于芬兰中部的Äänekoski工厂进行了改造，产能由30,000吨/年增加到240,000吨/年。纸机改造后，纸卷完成系统（复卷和包卷机）也进行了升级改造。（注：因为纸厂名的公开未获许可，故隐去）



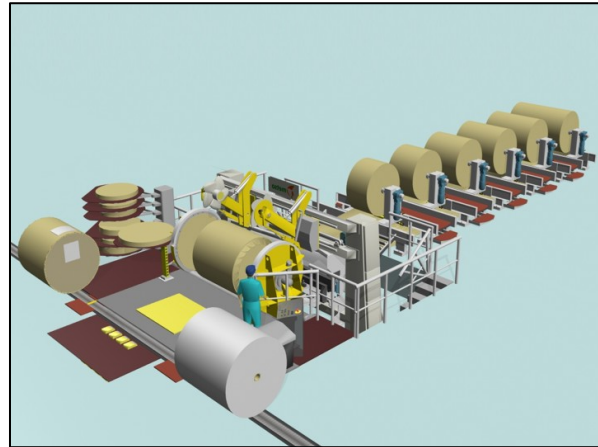
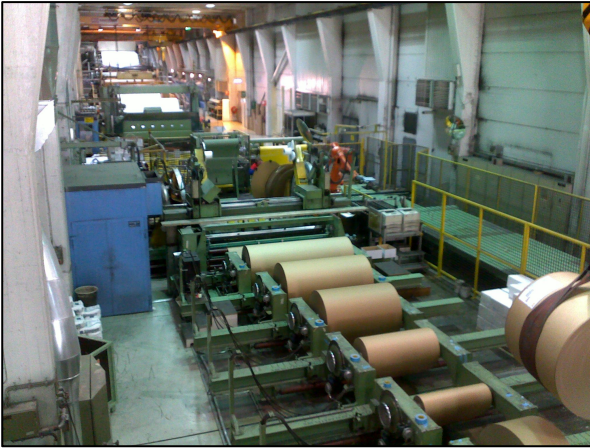
**Figure 1** Paper roll packing methods can be divided to two main categories - stretch (on the left) and kraft wrapping (on the right).  
图 1: 纸卷包装方式主要有两种—缠绕包装（左图）和牛皮纸包装（右图）

### Plan for phased production line rebuild 生产线分段改造计划

Production capacity of this 1966 started BM1 line was originally 50.000 t/a. Since those days its capacity had already been quadrupled before this rebuild by continuous process improvements and system upgrades. Nevertheless the main machine hall building had stayed with its original dimensions. With this upgrade the wrapper had to be moved backwards to make space for bigger parent reel handling and for the new slitter winder. Among the capacity increase also the full automation of the finishing operations was on the wish list to improve the operational efficiency. All this threatened to push the roll wrapper out of machine hall's back wall and cause significant jump in civil work costs. That made the payback of this capacity increase challenging to justify.

这台1966年投产的纸机原产能为50,000吨/年，到2012年春天改造前产能已经扩大到4倍，不过主厂房并没有扩大。在这次改造中，包装线必须往后移，为更大的母卷流转和新的分切机腾出空间。纸厂也希望完成整理部的运行全部自动化，以提高生产效率。所有这些计划都需要包装机移出厂外，造成土建成本的增加，使投资回报受到影响。

The used roll wrapping method had been kraft wrapping from the beginning, and the current 1988 implemented semi-automatic Valmet StreamPack kraft wrapper was now approaching respectable quarter century service age (**figure 2**). With this machine the wrapping was done in one station, wrapping phases controlled by the full time operator, who manually placed both inner and outer heads. The labeling had been automated in earlier rebuild to be done by industrial robot at the exit station front of the ramp to warehouse. 改造前纸卷的包装是Valmet StreamPack半自动牛皮纸包装机（安装于1988年），改造时运行时间已达到设计寿命。所有的包装在这一台机器上完成，包装过程由操作工控制，操作工需人工安装内端护板和外端护板，标签在之前的改造中已实现在仓库出口位置由机器人自动放置。



**Figure 2** The starting point - on the left seen the existing semi-automatic StreamPack at the end of the board machine hall. Next to it 3D illustration to clarify the one station structure.

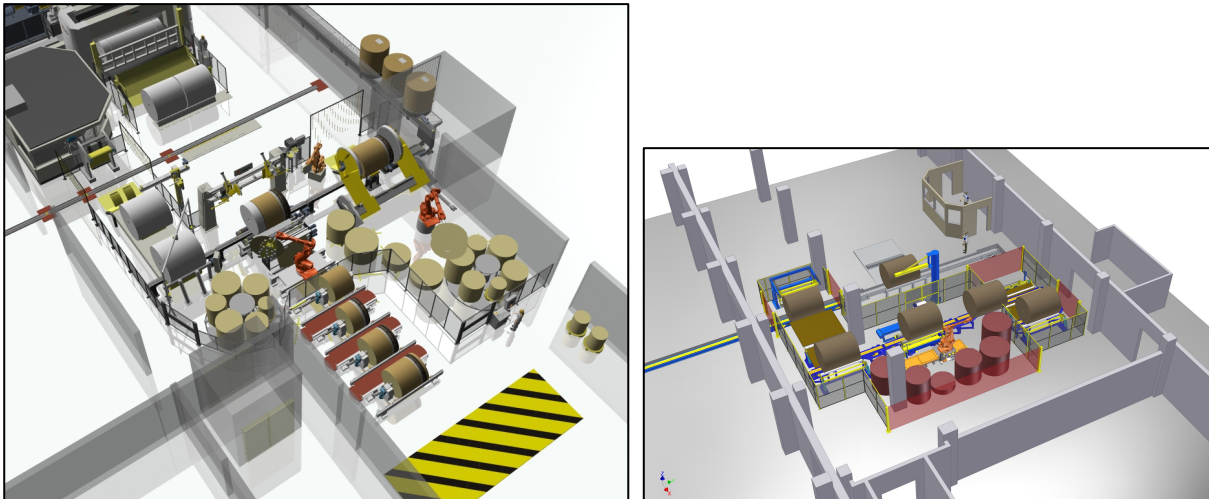
图2：开始点：左图显示现存半自动包装机位于纸机厂房末端，右图显示一站式包装机的3D图

The rebuild of this existing packing machine had been proved to be financially unjustified and operationally too complicated to execute. The finishing area modifications had to be done without disturbing the ongoing production. The plan was to start this line upgrade by installing and starting up the new wrapper behind the existing one, and convert the roll stream from old winder to it. After that the existing wrapper could be dismantled, and the new slitter winder could be installed on its place. And then in the third phase the old winder could be dismantled, and the new parent reel handling and board machine upgrade could be done in the shortest possible production stop.

对现存的包装机进行改造在经济上不合理，实施起来也非常麻烦，并且要求改造过程不能影响正常生产，所以计划是在现有包装机的后面安装一台新的包卷机，然后将卷从旧的包装机切换到新的包装机，然后在第三阶段拆除旧的复卷机，在最短停机时间内完成对新的母卷物流和纸板机的安装调试。

The old Valmet StreamPack wrapper had served extremely well, so therefore the first obvious choice for Metsä Board's project team, lead by production manager **Pentti Hyytinen**, seemed to be new fully automated Streamline kraft wrapper. But after the first layout sketches for the new finishing area were done (**figure 3**), it was noticed that the BM building needs to be extended with two column spaces (2x6m) to be able to fit in the new fully automated kraft packing line. The main reason for this was the production line's extension, but also the new kraft wrapper demanded more space. With the existing machine's manual head insertion both inner and outer heads are placed by the operator at the same station. And the head stacks are continuously replenished and organized according to the need around this one and same station. But with automated machine the head insertion is done by industrial robots, which need head stack revolver platforms to feed the right sized heads for robot to grip during the wrapping process. At this point the project team understood that they should include into their feasibility study all alternatives available today. The question was that are there acceptable alternatives, which fulfill set quality requirements and use less floor space?

之前旧的Valmet StreamPack 包装机运行非常稳定，因此纸厂项目团队决定采用新的全自动牛皮纸包装线。但在新的完成区域布置图出来后（图3），问题就显现出来：为容纳新的改造设备，纸板厂需增加两个柱距的厂房（2 x 6米），原因是新的生产线更长，新的包装机占的空间也更大。在旧的包装机上，内外端护板在同一站人工放入，端护板储备放在包装机周围。但在新的包装线上，内外端护板由机器人自动放入，需要更大的存储平台，以便机器人可以自由选取正确尺寸的材料。基于这一点，项目团队开始考虑更多的包装可能性。问题是：是否存在既满足包装质量、占地空间又少的方案呢？



**Figure 3** New slitter winder location shown with new fully automated Stremline C kraft wrapper (on the left).  
图 3.新的切纸机与新的牛皮纸包装线的布置图（左图）

**Figure 6** The Stretch film wrapper's simplicity compared to the alternative kraft wrapping layout is striking. It fitted in the existing BM hall without building extensions (on the right).  
与牛皮纸包装相比，缠绕膜包装的布置简洁明了，现有厂房即可容纳

**Alternative solutions for the packing needs**  
包装的替代方案

Paper roll packing methods can be divided to two main categories - kraft and stretch film wrapping. Kraft wrapping has been the dominant packing method with good reasons in paper mills for printing grades. And stretch film wrapping with its all variations has been the main method for tissue, fluff pulp, specialty papers and internal dust and moisture protection for rolls to be sheeted. But due to the improved packing materials, machines and handling systems along the trip from the mill to end users, the boundaries of stretch wrapping has expanded. Also the paper industries changed business environment has given extra push to find more cost effective solutions for the operations including roll wrapping and handling. Stretch wrapping tend to enable simpler space saving layouts compared to kraft wrapping.

纸卷主要有两种包装方式：牛皮纸包装和缠绕包卷。文化纸的主要包装方式是牛皮纸包装，而缠绕包装因为其灵活性特点主要应用于卫生纸、短纤浆和特种纸。因为有防潮和防尘的需求，大卷分切前的储存阶段也会用到缠绕包装。随着包装材料、包装设备及从工厂到终端用户物流链的改进，缠绕包装的应用空间也得到了延伸。并且，商业环境的变化也促使纸厂寻找更好性价比的生产方式，包括纸卷的包装和物流方式，以降低生产成本。与牛皮纸包装相比，缠绕包装且有更简洁更紧凑空间利用的优势。

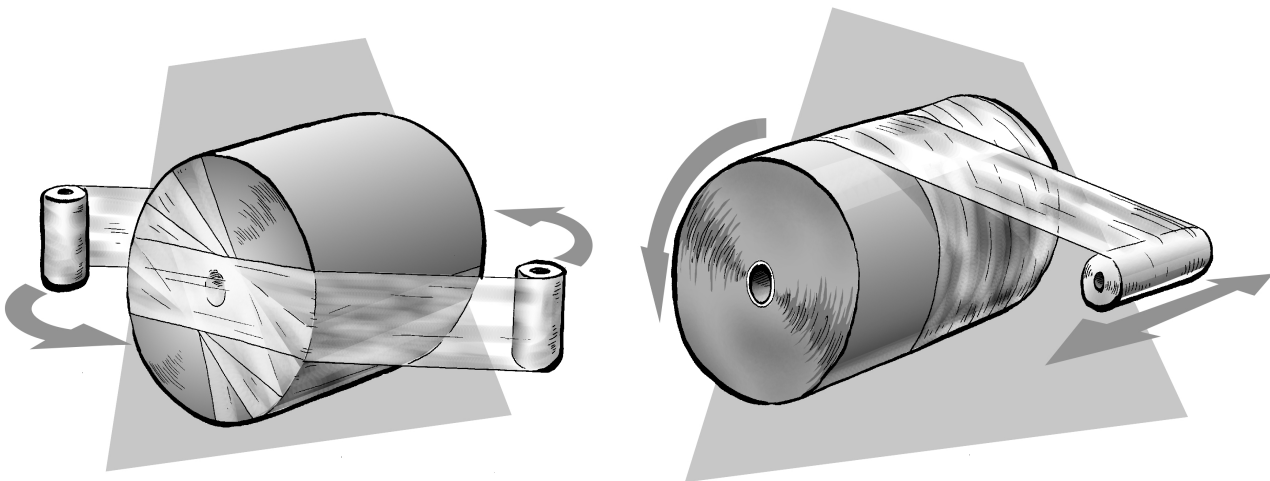
The strong bipolar “for-or-against” thinking around the stretch vs. kraft debate is outdated and unnecessary nowadays. It has been fuelled partly by the suppliers, which according their own interest push that system what they have in their repertoire. Now most of the main suppliers have both alternatives to offer, and are able to explain in detail both concept’s pros and cons for each specific case. It is clear, that kraft wrapping offers stronger mechanical protection especially for roll corners. And that the insurance companies like FM Global rates the stretch wrapped rolls to be fire protection wise the same as unwrapped rolls. But the same is they say also of steel and plastic straps comparison. And still plastic straps share in business is growing due to technical and commercial reasons. The truth is that kraft wrapping and steel strapping are reducing exfoliation, which tends to lessen the fire hazard of the lighter-grade paper rolls. This affects on fire protection and insurance costs. But altogether the core question here to be clarified is: what is the good enough protection against the specific transportation chain, and how to do that in most economical way.

围绕“是用缠绕包装还是牛皮纸包装”的争论持续了许多年，它一定程度上是源于包装机供应商为自己的利益考虑，对自有技术的应用推广。但现在大部分供应商可提供这两种解决方案，并能针对每一个项目分析每种方案的优缺点。牛皮纸包装的保护性特别是对对角的保护有更大的优势。保险公司将缠绕包装卷与未包装卷的保险费同等收取，这是缠绕膜包装的劣势。但类似的情形是：钢捆带与塑料捆带的应用，虽然塑料捆带不利于消防，但出于技术和成本的考虑，塑料捆带的市场份额还是越来越大。事实是：牛皮纸包装和钢捆带会减少轻级别纸卷的火灾隐患，有助于防火和降低保险费。结合产品运输链中对产品的保护性和经济性，哪一种包装是最好的方式呢？



The sometimes heard claim, that stretch wrapped rolls do not tolerate clamp truck handling like kraft wrapped rolls is not accurate. This myth stems from comparison of plain axial or radial wrapped rolls (**figure 4**), which are commonly used as internal moisture and dust protection for sheeter rolls on their short route to adjacent converting hall. Axial wrapping, sometimes called as cocoon wrapping, main purpose is to seal the roll ends, while the radial wrapping seals and strengthens to roll body and corner protection. With or without axial wrapping, also in stretch packing can be used corrugated heads to give protection against the roll end dents. With available stretch wrapping alternatives also combinations of stretch/kraft/foam/bubble film are possible and quite widely used in converting business side.

关于缠绕包装不如牛皮纸包装耐受抱车的传言是不准确的。这个传言源于分切前中间卷的轴向缠绕和径向缠绕包装（图4）。这种包装方式一般用于在短距离传送时保持纸卷内部的水分和防尘。轴向缠绕，有时也称之为茧形缠绕，主要目的是密封纸卷端面，同时径向缠绕密封纸卷的卷身并加固边角。无论用不用轴向缠绕，都可加上端护板对端面加强保护。缠绕包装的材料



**1. Axial (Cocoon)**

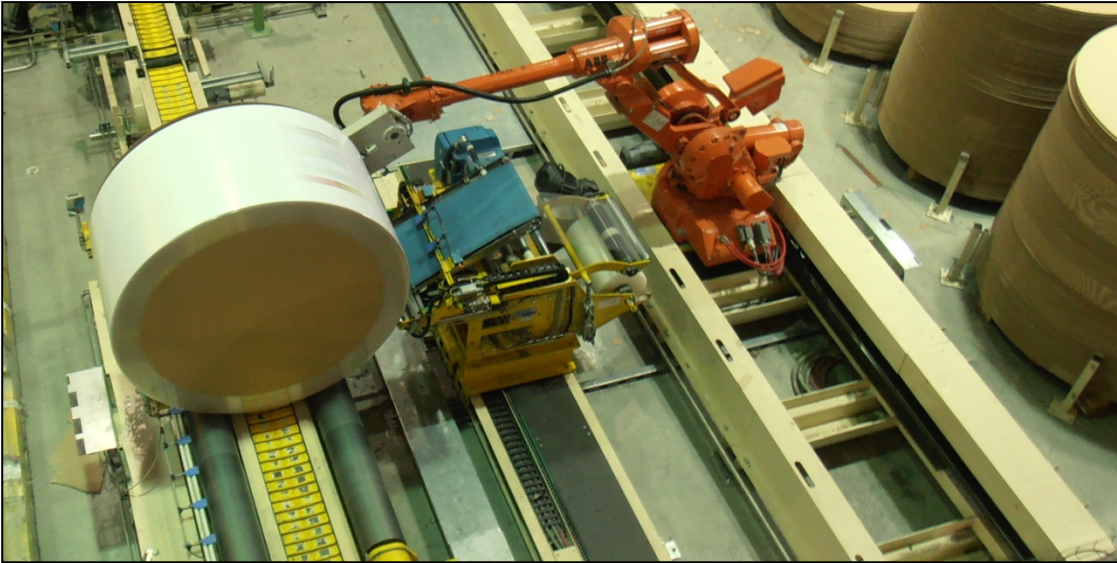
**2. Radial wrapping**

有多种可选，拉伸膜、牛皮纸、泡沫、气泡膜等，也可几种组合使用。

**Figure 4** 图 4

In Metsä Board Äänekoski case the acceptance for stretch wrapped rolls was relatively simple to get without any extra tests, because same company's Tako mill in Tampere had wrapped already for years board rolls with radial stretch combined with corrugated heads (**figure 5**). In both case the transportation chain was relatively short and fully controlled by the Metsä Board group itself. Also with Tako case the space available for the wrapper had been limited. And there the stretch concept had proved to be sufficient protection for the need with considerable lower investment costs compared to Kraft wrapping alternatives.

在Äänekoski案例中，由于有其他工厂的前期经验，缠绕包装无需额外的试验就相对容易接受，原因是归属同一集团的Tampere工厂已有缠绕包装（带端护板）使用了好几年（图5）。在两个工厂里，运输链都相对较短，完全由集团自己掌控。在Tampere工厂，也是由于空间有限才安装的缠绕包卷机。事实证明：缠绕包装投资低，保护效果好。



**Figure 5** Selected method was radial stretch film layers to protect the roll body and corrugated head disks for the roll ends. Body labels were slipped under the film during the wrapping.

图5: 选择的径向缠绕可保护纸卷周向和端护板。周向标签在缠绕过程中滑入缠绕膜下面

The weakest point with this way stretch film wrapped rolls is the roll bottom corner. But this difference is countered to a certain limit by the Z- folding feature, where the stretch feeder folds the stretch film layer three ways into Z- form for the roll corners. This not only saves with material costs, but is actually tested to be stronger compared practice to add separate thick film slip for the corner protection. This technology also helps with axial - radial wrapped rolls to be more stackable, which is limited compared to kraft wrapped due to the axial wrapping caused roll end convexity.

缠绕包装的最大弱点是它对纸卷底面的边角保护，但这个问题在某种程度上已经由Z-折特性解决——缠绕膜在端头重复缠绕三次形成Z形保护，与另外增加厚膜进行边角保护的方法相比，这不仅节约了材料成本，而且更结实。与牛皮纸包装相比，轴向缠绕的卷更易于堆垛，因为牛皮纸包装在轴向包装后会造造成纸卷端面不平。

**Reasons for the selection made**

选择缠绕包装方式的原因

In the below **figure 6** can be seen the layout done for the Äänekoski case with the selected stretch wrapping concept (corrugated heads with Radial Stretch wrap). The simplicity compared to the alternative kraft wrapping layout is striking. The required wrapping capacity for big max 1,8m diameter board rolls was 60 rolls/h. First of all, the number of needed head stacks and head robots can be split to half, because only corrugated heads are used with stretch film wrapping. With kraft wrapping needs to be used along these inner heads also flimsier outer heads to seal the package. Secondly the number of required wrap material back stands goes with ratio 1 for Stretch and 4 for Kraft. This gives savings with wrap material costs, when only one size Stretch film rolls needs to be stored compared to bigger PE- laminated kraftliner rolls which needs to be stored in sizes to cover roll widths from the smallest to the biggest. Also hot-melt glue consumption is higher with Kraft wrapping, and therefore the cost per wrapped roll will be in this case lower with Stretch wrapping. Thirdly the heavy duty head press station with ~180 °C heated press plates to heat seal the kraft wrapped package is not needed with this Stretch concept.

图6是Äänekoski工厂选用缠绕式包装后的工厂布局，相对牛皮纸包装，它简洁明了。包装产能需求是60卷/小时（最大卷径1.8m）。有三点优势：首先，由于缠绕膜包装只需要瓦楞纸端护板，端护板存储站和安装机器人只需一套，但牛皮纸包装中既要用内端护板，也要用外端护板；第二，缠绕膜的上料位只需一个，而牛皮纸的上料位有4个，以准备不同宽度的牛皮纸可以覆盖生产中可能出现的最小卷宽和最大卷宽，缠绕膜包装的热融胶用量比牛皮纸包装也少得多。第三，热封站（约180摄氏度的热压板用于热封牛皮纸包装）在缠绕包装中是不需要的。

At the end the stretch wrapper total investment costs including civil works in Metsä Board Äänekoski case ended up to be only 1/3 compared to kraft wrapper investment needs. Reason for this huge difference in costs was partly stretch wrapper's much simpler structure, which explains 50% of the cost savings. The other half of the savings is explained by the fact, that the stretch solution didn't require the building extension by two column bay widths like the kraft wrapper. It was also noticed that the total operational costs of this stretch wrap solution was estimated to half of comparable kraft wrapper life cycle costs.



最终，Äänekoski工厂缠绕包装的总投资（包括土建）是备选牛皮纸包装方案的三分之一，其中有一半的投资节省是因为缠绕包装的结构更简洁，另一半的节省则是来源于缠绕包装无需工厂扩建——牛皮纸包装需要将厂房延长两个柱距。至于运行费用，估计缠绕包装是牛皮纸包装成本的一半。

**Conclusions 结论**

So keep mind open and concentrate in your feasibility study to find out the facts related to the real protection need against the transportation and storing. Stretch wrapping is certainly not suitable for everybody, but for sure it's safe to say, that it can be used more in paper mills that it has been used so far. Especially vertically integrated finishing/converting operations can safely save significant amounts of money by protecting its rolls with stretch film instead of PE- laminated kraft wrapping. Think your needs through and do tests if needed. Challenge the suppliers to present alternatives with clearly articulated reasoning of pros and cons. The key to an optimally functioning finishing system is smartly and well engineered system layout. That demands real knowledge that you should seek for when putting together your investment plans.

保持开放的头脑，专注于寻找合适的解决方案为产品的运输和储存提供可靠的保护。缠绕包装并不适用于所有的状况，但可以自信地讲，缠绕包装已经在纸厂中得到了越来越多的应用，特别是在完成/整理区域一体化集成的情况下应用缠绕包装，可以大大减省成本。深思熟虑，试验证明，你会找到最适合的解决方案。



**Figure 6** Fully automated stretch film packing in Metsä Board Äänekoski. Corrugated heads to protect the roll ends with radial stretch wrapping for the body and corners, and plain paper labels without glue slipped under the film layer.

Äänekoski 工厂里的全自动的缠绕膜包装，瓦楞纸端护板保护纸卷端面，径向缠绕保护卷周和边角，普通的标签纸滑入缠绕膜内面