NEW INNOVATION FOR AUTOMATED PULP BALE UNIT HANDLING AND STORING CASE: METSA GROUP BIOPRODUCT MILL

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ABSTRACT

Different automated solutions for pulp bale unit handling and storing have been investigated in the past, but the fact remains that unit handling is still commonly done with clamp trucks. Metsä Group Äänekoski adopted a new way of thinking by implementing the world’s first automated handling and storing solution to their new bioproduct mill in Finland. The storing solution is based on high bay technology, which is known from paper roll handling. This solution has proven to suit to pulp bale units incredible well offering wide range of benefits in terms of storing density, handling efficiency, space usage and capacity comparing to traditional solutions.

Keywords: Pulp bale unit handling, automated storing, automated sorting, automated loading, FIFO, logistic chain

1. INTRODUCTION

Metsä Group commissioned new next-generation bioproduct mill in Äänekoski in Central Finland. It is the largest industrial investment so far to Finnish forest industry with its 1.3 million tons annual pulp production. This bioproduct mill started its’ operations in August 2017.

There is new technology in every department, but one of the true world premieres can be seen at the end of the production line in form of world’s first Automated Distribution Center (ADC) for pulp bale units, because this plant will not have storage in it’s traditional meaning at all. Plant’s production is shipped twice a day by rail road to Helsinki harbor along domestic truck shipments during the day. To enable this new thinking with the finishing logistics was needed. The logistic chain of the mill can be seen from the figure below [1]:

Figure 2: Bioproduct mill’s logistic chain
2. EXPERIMENTAL ASPECTS

Matti Alanen, Vice President of Logistics, Metsä Group [2]:

“The selection process was not just a selection between different system suppliers, but also a selection between various technical and functionally quite different storage and handling solutions. The further the preliminary survey progressed, the more the benefits of TransBale became clear.

TransBale provides an excellent chance to develop the product delivery pipeline as a whole, not just the dispatch operations at the mill. During the preliminary planning stage, the entire product delivery chain was modelled and the share of cost elements created during the different stages identified. After this, we sought a solution that would enable us to manage these material flows of 1.3 million tons in total in the most cost-efficient and reliable manner. TransBale also provided us with better tools for planning and grouping deliveries in a proactive manner, further benefiting the logistics pipeline outside the mill.

Before the selection was made, the solution was carefully investigated from the perspective of usability, among other considerations. We studied other solutions of the similar type already in use, with the primary intention of gathering other users’ experiences of the operational reliability of high-bay storages. The distribution center at the bioproduct mill is a seamless part of the mill’s production machinery, and its reliability must be top class.”

Figure 1: On the left rack erection site, on the right high-bay storage with stacker crane
2.1 An innovative approach to fill the need

The core of TransBale automated distribution center is high-bay storage with two fully automated stacker cranes. The system buffers and sorts hard and soft wood pulp bale units by product type and customer order, and controls all dispatch operations. Compared to typical high-bay storage that uses a pallet racking system with several stacker crane aisles where only two pallets can be stored in each, TransBale is deep-lane storage where six pulp bale units can be stored in each storage channel - without any need for slave pallets. This makes it possible to store larger amounts of material in a smaller space. The pulp bale units are stored on steel C profiles, and the shuttle car moves the bales from the bottom, which is gentler than the typical way of moving them by the steel wire that holds the bale units together.

Concepts main elements:

TransBale rack storage
- Rack 14 levels, 25,200 t
- Stacker cranes 2 units, capacity up to 1,000 t/h

Conveyor system
- From production in to storage
- From storage to shipping

Shipping
- Truck loading
- Train loading

Warehouse Management System (WMS)
- Functionality
- Flexibility

2.2 WMS significant role

The distribution center is equipped with the Pesmel WMS warehouse management system, due to which the warehouse inventory is real-time and fully automatic. The WMS plays a big role in the operations of the distribution center as it is connected to both the production automation system and the mill's SAP system. Based on the product and dispatch information obtained from these systems, the WMS controls automated train and truck dispatch and loading operations. With automatic loading, trucks are loaded in few minutes, and a train with 22 cars carrying 1,400 tons can be loaded in three hours. In addition to loading efficiency, automation minimizes work safety risks and damage to the equipment and products.

2.2 Bioproduct mill’s automated distribution center for pulp in numbers

Measurements: 100 meters long, 35 meters high and 30 meters wide
Handling capacity: 6 to 12 pulp bale units per crane, up to 1,000 tons per hour
Storing density: 9–10 t/m²
Total capacity: 25,000 tons in an area of 3,000 square meters

Three main distribution channels for pulp:
- 800,000 tons are transported as export units by train to Helsinki harbor to international markets,
- 400,000 tons are transported by train and trucks directly to customers mainly in Finland
- 100,000 tons are refined in different units in the mill area [3].
3. RESULTS AND DISCUSSION

After first half a year in operation, TransBale has proven its efficiency in practice. TransBale has solved the challenge of managing the material flows of 1.3 million tonnes in the most cost-effective and reliable manner.

Overall the new bioproduct mill is the most efficient pulp mill in the world in terms of produced tons per mill employee, see the figure 4 below [4]. Due to fully automated functions, TransBale does not require manpower to storing or sorting pulp bale units with it’s 1,000 tons of pulp in an hour capacity. The functionality is supervised by the mill operator. This means great reductions both in labour costs and better quality without handling damages.

Figure 4: The sum of tons per year / mil employees in pulp paper mills.

The surface area at bioproduct mill was limited, like it often is at mills, and TransBale was the best solution to this challenge with its’ storing density of 9–10 tons/m². The surface area of the storage is less than one thirds of the traditional storage’s surface area as can be seen from the figure 4 below [4]. Due to automated handling the need for fork lifts is minimized and driven kilometers substantially smaller, which automatically reduces the amount of fuel consumption.

Figure 5: The efficiency of TransBale can be seen in various different figures.
4. CONCLUSIONS

TransBale is optimal solution for any logistical node between the pulp mill and transporting vehicle, whether it is at the mill or for example in the harbor. The loading of trucks, trains of even vessels can be done automatically.

Figure 6: Train loading  Figure 7: Truck loading  Figure 8: Vessel loading

There are several benefits to utilizing the TransBale concept that make it a strong solution in many respects.

Technical features
With TransBale the handling, storing and sorting of pulp bale units is done with totally different philosophy. The new way of thinking, by handling the pulp units from the bottom enables easy handling of different unit sizes and heights. Also it is fast, but the pulp bale units are handled extremely carefully with this method.

The technical benefits of TransBale are shown in the comparison table below [5]:

<table>
<thead>
<tr>
<th>Features</th>
<th>Traditional storage</th>
<th>TransBale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storing density</td>
<td>3 tons / m2</td>
<td>10 tons / m2</td>
</tr>
<tr>
<td>Pile unit height</td>
<td>4-5 units</td>
<td>14-15 units</td>
</tr>
<tr>
<td>Handling capacity of 500 tons/h</td>
<td>4-5 clamp trucks</td>
<td>1 crane</td>
</tr>
<tr>
<td>FIFO</td>
<td>N/A</td>
<td>yes</td>
</tr>
<tr>
<td>Sorting possibility</td>
<td>N/A</td>
<td>yes</td>
</tr>
<tr>
<td>Operation</td>
<td>Manual</td>
<td>Automated</td>
</tr>
</tbody>
</table>

Figure 9: Comparison table of traditional storage and TransBale storage.

TransBale solution enables storing of 14-15 pulp bale units on top of each others (pic below) and it has automated sorting making FIFO possible.

Figure 10: Traditional clamp truck storing  Figure 11: Automated TransBale storing
Cost efficiency
The automation of the distribution center lowers operating costs significantly, because there is no need for clamp truck drivers and supervisors in loading. The functionality can be supervised by the operator at the mill. The high-bay construction enables increased production capacity without the need for additional investments in the distribution center. The high-bay concept requires less space for building, and it is easy to expand the shelving upwards if future needs dictate without substantially disturbing the operation of the facility.

The Pesmel WMS allows adjustable sorting capacity, which means that there is no longer any need for preliminary sorting, as the stacker crane and WMS keep track of the storage location of each pulp bale unit. This enables the optimal use of space, regardless of how many different grades of pulp are produced.

Reliability
The construction is a rack-supported building, which means that instead of being located inside another building, the roof and wall elements are attached to the frame of the shelving. The construction has been designed to function even in winter conditions: it is unheated and fully unmanned, with the exception of maintenance measures.

![Figure 12: TransBale can be build as a rack supported building.](image-url)

The simple construction ensures reliable operation with the integral shelving, two cranes and chain conveyors. Thanks to the real-time inventory enabled by Pesmel WMS, the delivery process is also very reliable. The orders are delivered on time and to the correct place as human errors in stock bookkeeping and dispatch have been eliminated. Also, the availability of the 24/7 HelpDesk ensures that the system operates reliably.

Safety
The fully automated dispatch center functions without clamp trucks; they are only needed in loading the cargo. The elimination of busy traffic inside the facility is a major safety factor.

Fire safety in the TransBale distribution center is exceptional compared to typical storage facilities. In a typical storage building, the sprinklers are located in the ceiling, so if a pulp bale that is located lower in the shelving starts to smolder, it is difficult to extinguish it. In TransBale, there are thousands of sprinklers integrated into the shelving, which enables effective extinguishing.

Environmental friendliness
The TransBale concept supports environmentally friendly principles. For example the reference case's system, introduced at pages 2-4, works 100% on the energy produced by the Metsä Group mills, so no fossil fuels are used. In addition, the stacker cranes store the energy that is produced when the cranes lowers. This energy is supplied to the mill's own electricity network. Also, because fewer clamp trucks are needed, less fuel is consumed. TransBale's optimized, efficient use of space minimizes the need for storage space.
REFERENCES
1. Presentation at Metsa Fibre’s media event on 7th of March 2018
2. Matti Alanen, Vice President of Logistics, Metsa Group
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