Multiply Hydroformer - Opportunity For New Innovative Products

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ABSTRACT

Specialty Papers have worldwide a share of about 5% of the total paper production and 10% for total sales of paper.

The 2900 different paper specialty grades are divided into nine main segments. To produce these types of papers special technologies and know how are necessary.

The production locations for specialty papers are currently mainly located in Europe. It is obvious that also in Asia especiallly in China and India the production of specialities grades will become more and more an attractive opportunity in the near furture. Specialty Grades opens up new vistas for the Indian mills with a lot of value addition and value creation.

The segment of the wet lay nonwovens and filter paper covers a wide range of paper and nonwoven products.

All these grades are produced with long fibres in the range between 2mm and 40mm. Typical for the production of the wet lay products is the use of very low headbox consistencies due to the long fibers.

The Voith headbox and former for the wet-lay products has the trade name HydroFormer™. The HydroFormer™ can have a 1-, 2- or 3-ply headbox.
Typical products are filter papers like tea bag or automotive filters, or glass mat for roofing and flooring or other applications. The new multiply technology gives great opportunities for new innovative products.

Introduction:

The field of Specialty paper has a large number of paper grades with very specialized final applications and product demands. They need special technology and know how for production, and are characterized with very demanding quality requirements.

Because of the many different Specialty paper grades it is suggested to divide the various grades systematically into application segments and markets.

1. Decor and Overlay Paper
2. Label and Release Paper
3. Wet-lay nonwovens and Filter Paper
4. Photographic Base Paper & Digital Imaging Paper
5. Auto-copying base paper
6. Thermo Paper
7. Banknote and Security Paper
8. Cigarette-, Tipping-, Plug Wrap Paper
9. Thin Printing Paper and One Side Glazed Paper and other

Figure-1: Specialty Paper Segments

Voith Paper GmbH & Co KG, Betriebsstatle Duren
Sales pzsd, veldener Straβe- 52-52349 Duren (Germany)

For example label paper and release papers are focused in one application segment because they have the same market area of application, even though the quality criteria and the process of manufacturing may be different.

In total there are approx. 2900 paper grades in the area of specialty papers which Voith Paper divides into nine main segments.

The worldwide demand of specialty papers is approximately 16 million tons a year. This comprises approximately 5% of the total paper demand worldwide.

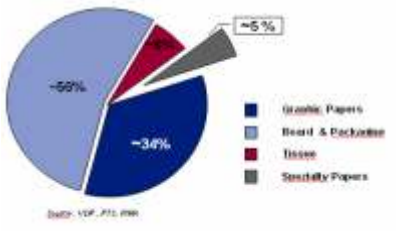


Figure-2: 5% of Worldwide Paper Production are Specialty Papers

In comparison to mass-produced papers, specialty papers have a higher added value and therefore obtain a higher price level.

Therefore the share of the worldwide turnover for specialty paper is higher than the worldwide share of its production capacity. As a result, about 5% of the paper production in the world is specialty paper which corresponds to 10% of the total paper sales.

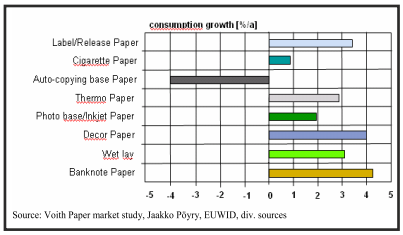


Figure-3:Consumption Growth of Specialty Paper

Most of the segments of specialty papers have a different growth ratio.

You can find, for example, an estimated growth of banknote paper of about 4.3% each year.

Only Auto-copying base paper shows an estimated negative growth.

The market leaders in specialty papers are mainly familyowned companies like Koehler and Felix Schoeller in Germany, etc. The very large paper companies play only a secondary role for these grades.

Most of the worldwide production today of Decor Paper as well as Thermo Paper is coming from Germany. The installed base of Voith specialty paper machines is large because of the long term presence as a major supplier to the paper industry.

The production locations for specialty papers are currently mainly located in Europe.

It is obvious that also in Asia especiallly in China and India the production of specialities grades will become more and more an attractive opportunity in the near furture.

Wet-lay Technology:

One of the above mentioned segments of specialty paper, the ***Wet-lay nonwovens and filter paper*** will be in the focus of this paper.

if you have long	→	*fibres (up to 40 mm)*
and you want	→	*homogene formation*
you need	→	*low consistenciey (0,01 - 0,08%)*
and that leads you to	→	*Wet-lay technology*

Figure-5:Why wet lay technology

With an inclined wire arrangement, sheet forming using long fibres to produce papers or wet-lay nonwovens was possible.

With very low headbox consistency, in the range of 0.01 to 0.08%, a good formation with long staple fibres of up to 40mm is possible.

- **very good product homogeneity**
- **versatility to produce wide range of products**
- **high production capacity**

Figure-6:Characterization of wet-lay technology

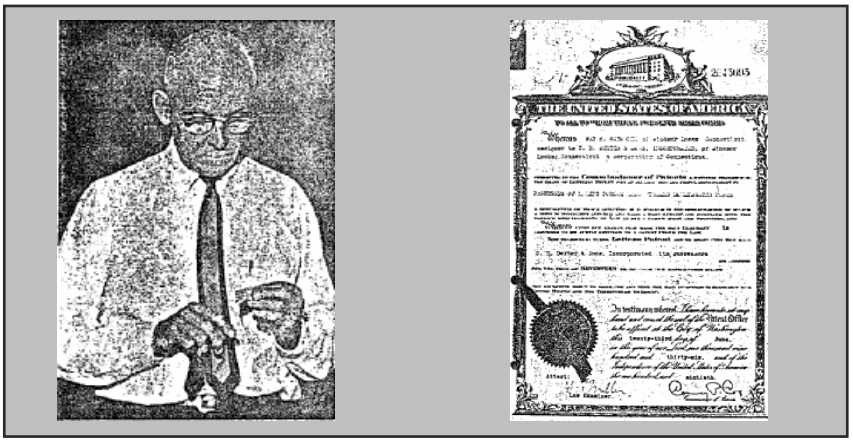


Figure-4:Fay H. Osborne, inventor of the wet lay technology

The initial development of wet-lay inclined wire technology occurred in the twenties of the last century at C.H. Dexter and Sons in Windsor Locks, Connecticut, USA. (1)

Their intent was to produce Japanese hand-made paper by continuous mechanical means. Their development work showed that a high dilution was necessary to form homogenous papers when using the very long fibers. This led to the inclined wire forming technology.

The wet lay technology can be characterised as a technology which results in a very good product homogeneity. There is a versatility to produce a wide range of different products with different fibre types. The machine have a high production capacity compared to the small market for these products.

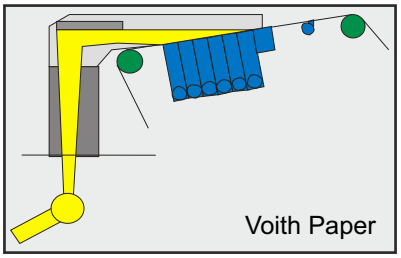


Figure-7: open headbox

The early inclined wire machines were equipped with 1-ply headboxes able to run at slow production speeds up to 50 m/min. These inclined wire formers had an open headbox and the suspension was flowing straight towards the inclined wire.

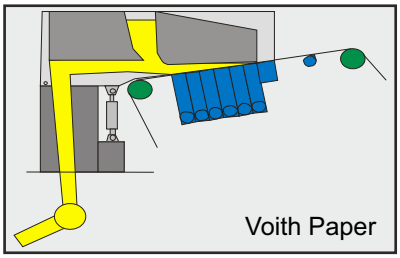


Figure-8: open headbox with front wall

Later the development went to an open headbox where the forming area was covered with a front wall. With this design the pond level could be adjusted, and production speeds up to 300 m/min were possible.

The next step in the development was to close the headbox and pressurize the stock level with an air cushion.

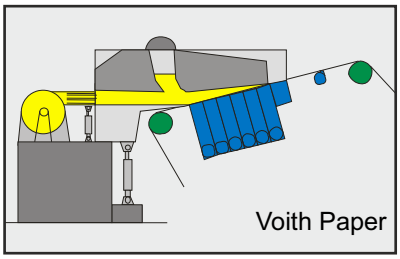


Figure-9: closed headbox with air cushion

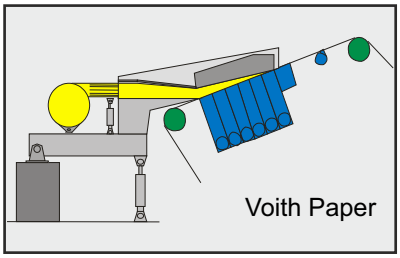


Figure-10: closed headbox with air cushion

Production speeds of up to 450m/min were then possible.
The last development step of the 1-ply headbox was the hydraulically closed headbox. There is no free liquid surface within the headbox. The fibres are prevented from floating to the surface. Today maximum production speeds of 550 m/min are possible.

The main development of 1-ply inclined wire formers took place from 1960 to 2000.

Specialty Papers	Tech. Nonwowen	Textile like Nonw.
synthetic fibre paper	glass mat for: roofing, flooring, circuit prints	surgical products
tea & coffee bag paper	battery separators	napkins
food casing paper	decorating products	bed linen
overlay paper	wall papers	towels, wipes
filter paper		hospital products
plug wrap paper		

Figure-11: Typical wet-lay products (2)

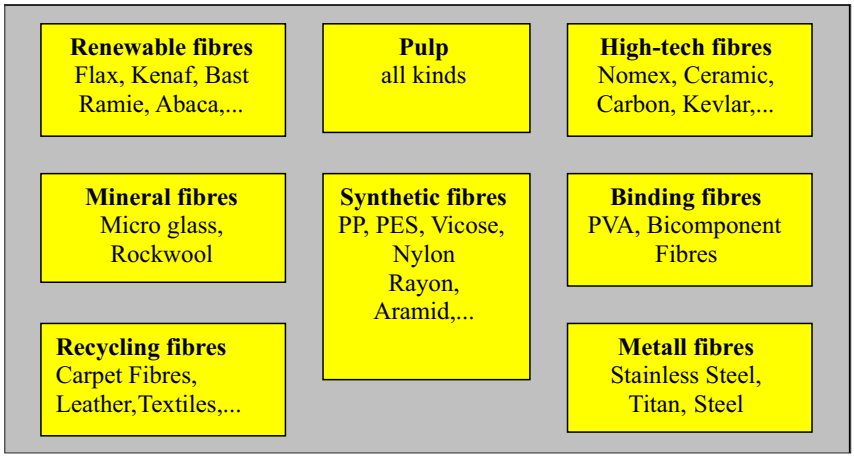


Figure-12: Fiber types (2)

In figure 11 you find typical products of the wet-lay forming technology.

On the left side are typical examples for the so-called long fibre speciality papers. These are mainly filter papers for different applications.

The big group of glass mat products belong to the technical wet-lay nonwovens. Glass mat for roofing, flooring and other applications. Also battery separator filters, decorating products and wall paper are a part of this classification.

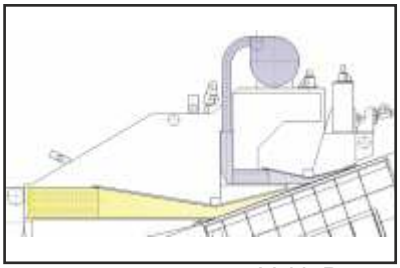
The textile like nonwovens are mainly hospital products, wipes and towels.

The wet-lay process can use all uncrimped fibres of a length of max. 40mm that are able to be dispersed in water.

And even fillers can be added if necessary.

In addition to the 1-ply products, a smaller market for 2-ply products developed. A typical 2-ply product is a heat-seal tea bag paper.

For tea bag, a main filter paper of 12 g/m² is formed as a base ply, and with the use of a secondary headbox, or a



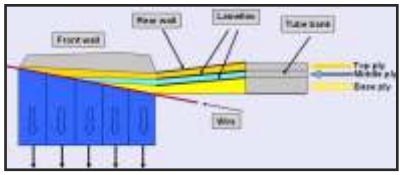
Voith Paper

Figure-13: 2-ply HydroFormer headbox

second ply of the base headbox, a sheet of approx. 4 g/m² is formed on top of the base paper. The second ply is mainly a synthetic fibre like polypropylene which allows to heat-seal the tea bag.

The older forming technology had the disadvantage that many adjustments had to be made to form a good 2-ply sheet. With small variations in pressure settings or gap adjustments the sheet was sometimes negatively influenced. To determine the correct setting was not an easy task.

To avoid the difficulties with the old multiply design, Voith has worked for some years to develop a new multiply technology.



Voith Paper

Figure-14: 3-ply HydroFormer™

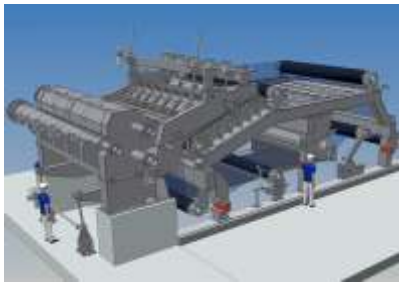
The principle of the new multiply technology is shown in Figure 14. In this arrangement three different suspensions flow through three distribution headers and tube banks into the headbox. Following the tube banks the three suspensions remain separated using flexible lamellas.

At the location where the formation process begins, the suspensions first come into contact. The base suspension forms the initial sheet. After this the middle and top ply suspensions are dewatered.

Following the dewatering, a sheet consisting of the fibres of the different suspensions is formed.

Voith Paper

Figure 15: Three suspensions in a HydroFormer™ headbox.



Voith Paper

Figure-16: 3-ply HydroFormer™

There is only a small intermixing of fibres between 2 plies. This intermixing helps to avoid a delaminating of the sheet at the boundaries of the plies.

The 3-ply HydroFormer™ is shown in figure 16. This machine is able to produce tea bag paper, overlay paper and plug wrap paper.

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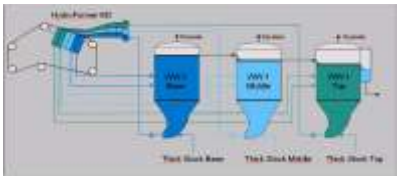
Figure-17: Photo of a Multiply HydroFormer

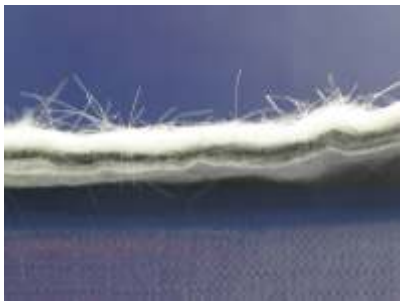
In figure-17 the first 3-ply HydroFormer™ which was manufactured by Voith Paper can be seen. This machine with a width of 3.2m and the capability to produce 1-, 2-, 3-ply products is running max. 550m/min. The capacity of this machine is 7,000 t/a.



Voith Paper

Figure-18 White-water System: 3-ply

Figure 18 shows a white-water-circulation of a 3-ply HydroFormer™. Base, middle and top ply have its own white-water-circulation system. The 3 white-water-circulation systems are not independent from each other. To be able to have a flexibility in the adjustment of the flows in the formation zone of the HydroFormer™, the white-water tanks are connected to each other. The water balance is adjusted with overflows between the white- water tanks of base, middle and top ply. There is only 1 level controlled extraction tank. The excess water in the system is taken out of this tank and goes back to the stock preparation of the machine.



Voith Paper Pilot machine

Figure-19: Product sample 3-ply product

In figure 19 a 3-ply product produced on the Voith Paper Pilot machine in Düren is shown. This handsheet of different synthetic fibres shows the layering structure of the sheet.

There are several commercial products which are already on the market. Two examples are 3-ply tea bag paper and 3-ply wear resistant overlay paper.

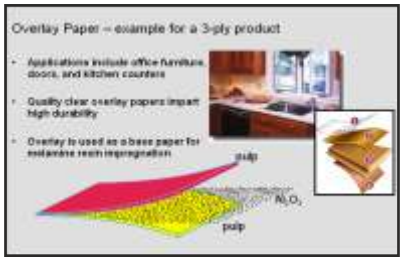


Figure-20: Overlay paper

Due to wear resistant overlay paper laminate flooring is able to resist wear. The wear resistance is due to a filler in the paper, aluminum oxide.

Using a 3-ply HydroFormer™ headbox, aluminum oxide is fed into the middle-ply. The base and top-ply of the pulp cover the middle ply which contains the aluminum oxide. This prevents aluminium oxide from falling out of the paper, and it reduces the wear that could occur in the paper machine.

With this method wear resistant overlay paper of new and higher abrasion classes can be produced. Contents of up to 50% aluminum oxide can be added to the overlay paper.

The first commercial 3-ply HydroFormer™ headbox, which I have shown you before, produces this new innovative product which easily found its way to the market.

This new multiply technology opens the opportunity to develop totally new multiply products using a large range of usable fibres. New properties of these sheets can help to find new applications for innovative products.

For example, a 1992 trade journal publication article by Kaukopaasi and Shah from Ahlstrom described this as follows:

> ***"Wet lay multilayer media could provide a new degree of freedom in tailoring filtration products to meet future needs".***

With the development of a 3-ply wet-lay paper machine we are able to provide the industry the right machine for these new products.

An estimation of all inclined wire machines worldwide results in a number of approx. 250 to 300 machines.

Up to now, only two of these 3-ply HydroFormer™, with a relatively small capacity of approx. 20,000 t/a, are installed worldwide.

We estimate that currently a worldwide capacity of approximately 50,000 to 60,000 t/a of 2-ply inclined wire machines is installed.

The rest of the inclined wire machine is producing 1-ply products with a capacity of approx. 1.5 Mio t/a.

The expectation for the development for the future market is that every other year a multiply inclined wire machine will be installed worldwide.

Wet-lay technology

- **wide range of wet-lay products**
- **new opportunities for product development**
- **small, unique market for multiply products**

Figure-21: Summary Wet lay technology

Multiply products will still be a small and unique market.

There is a wide range of wet-lay products on the market. The new multiply technology gives our customers new opportunities for product development. The market for multiply wet-lay products will remain relatively small and unique.

The market scenario is changing worldwide, and also in India. It is imperative to look for new opportunities for all Indian paper mills to stay competitive. In the face of concerns over fibre shortages in India and requirement of high capital investment for bigger plants and machineries for traditional grades, such Specialty Grades opens up new vistas for the Indian mills with a lot of value addition and value creation. Indian Paper Mills need to actively consider this aspect which will usher a new growth path to the industry.

Literature

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2. H. Pill, Dr.-Ing. K. Afflerbach, Nonwovens Fabrics, Wet lay method, Wiley-VCH, (2005)
3. Jan G. Kaukopaasi & Naresh B. Shah 01/92