twogether

Paper Technology Journal

World paper market:
Quo vadis newsprint?

News from the Divisions:
Stock Preparation, Paper Machinery,
Finishing and Service.

A Scandinavian Success Story.
Notable Startups.
Orderbook Highlights.

China, changing times in
the cradle of papermaking.

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Cover picture:
Ortviken – successfull start-up
(see article on page 22).

Hans Müller,
President and CEO,
Voith Sulzer Papiertechnik GmbH

Dear customers, dear readers,

It is now two years since Voith Sulzer Paper Technology was founded – a good time to look back of what has been achieved so far. The merger of the Voith and Sulzer paper technology divisions has been a complete success, with worldwide recognition of their combined strength. Order intake, sales and income have substantially exceeded expectations despite extraordinary restructuring efforts. Our sincere thanks go to all our loyal customers both old and new for their unwavering confidence in the new Voith Sulzer Paper Technology Group.

Since one of our prime targets is complete coverage of all market areas with comprehensive local customer service, we are currently strengthening our engagement in the world's main paper producing regions. In North America medium-term business expansion of about 30 percent is planned. The same applies to Asia, the fastest growing market in our business. In China a new joint venture was signed in March 1996 with the founding of Liaoyang Voith Sulzer Paper Machines Ltd, and our new office in Jakarta has had a successful start. The world is indeed growing together – and we are growing with it. This is illustrated by two key figures from the 1995/96 business year, the second year of Voith Sulzer Paper Technology: with sales totalling 2.16 billion DM, the previous year's result was exceeded by 40%!

We are particularly proud of our new orders and start-ups in Scandinavia – the fruit of our ongoing technical innovations. The paper industry needs these innovations for continuous, cost-effective quality and productivity improvements. The printing industry in turn needs this quality to compete against the flood of electronic media – a challenge which the paper and printing industries have to face together. On page 5 you will find some interesting observations in this connection by a long-standing newspaper publisher.

As we go on tackling the challenge "twogether" with our joint innovations, we shall certainly succeed. And in this spirit I wish you all the very best for yet another year of success.

Sincerely

Hans Müller

HIGHLIGHTS

STARTUPS, ORDERS ON HAND

The following is an overview of outstanding startups from October 1, 1995 to November 30, 1996, together with main orders on hand.

STARTUPS

Stock preparation

Waste paper processing systems and subsystems for graphic papers

Dae Han Paper Co. Ltd., South Korea.
UK Paper Plc, Great Britain.
Stora Feldmühle, Belgium.
Holmen Paper AB, Sweden.
Parenco B.V., The Netherlands.
Australian Paper Mills Ltd., Australia.
Sepoong Co. Ltd., South Korea.
Halla Pulp & Paper Company Ltd., South Korea.
Hansol Paper Co. Ltd., South Korea.
Trust International Paper Corporation, Philippines.

Waste paper processing systems and subsystems for board and packaging papers

SCA De Hoop, The Netherlands.
Smurfit Townsend, Hook, Great Britain.
P.T. Indah Kiat Pulp and Paper Corporation, Indonesia.
Knauf Neg., St. Petersburg, CIS.
P.T. Indah Kiat Pulp and Paper Corporation, Indonesia.
Zülpich Papier GmbH, Germany.
Corenso United Oy Ltd., Finland.
Thai Kraft Paper Ind. Co. Ltd., Thailand.
Papeteries Emin Leydier, France.
S.A. Papeteries de Bègles, France.

Waste paper processing systems and subsystems for other types of paper
Australian Paper, Fairfield, Australia.

Chemical pulp processing systems
Hiang Seng, Thailand.

Paper machines

Graphic papers
SCA Graphic Papers AB, Ortviken, Sundsvall, Sweden.
Holmen Paper AB, Braviken Mill, Norrköping, Sweden.
Kimberly Clark, Neenah, Wisconsin, USA.
Halla Paper Co. Ltd., Korea.

Board and packaging papers
P.T. Indah Kiat Pulp and Paper, Serang, Indonesia.
Zülpich Papier GmbH, Zülpich, Germany.
Visy Paper, Australia.
Shaanxi Machinery & Equipment Import & Export Corp., Hanzong, China.
Visy Paper, USA.
VPK Oudegem, Belgium.
Thai Kraft Paper Industry Co. Ltd., Thailand.

Tissue
Al-Keena Hygienic Paper Mill Co. Ltd., Al-Keena, Jordan.
Cheng Long Co. Ltd., Tien Long, Taiwan.
Papeles Industriales, Chile.
Industria Cartaria Tronchetti, Borgo a Mozzano, Italy.

Rebuilds
Felix Schöller jr., Osnabrück, Germany.
KZP Kostrzynskie Zaklady Papiernicze S.A., Kostrzyn, Poland.
Mead Corp. Containerboard Div., Stevenson, USA.
Stora Carton Board GmbH, Arnsberg, Germany.
Schoeller & Hoesch, Gernsbach, Germany.
PWA Dekor, Unterkochen, Germany.
Consolidated Papers Inc. Biron Div., Wisconsin Rapids, USA.
United Paper Mills Ltd., Jämsänkoski, Finland.
Alberta Newsprint Co., Whitecourt, Canada.
Torraspapel S.A., Sarria de Ter, Spain.
Nippon Paper Industries, Ishinomaki, Japan.
E. Holtzmann & Cie. AG, Maxau, Germany.
Stora Uetersen GmbH, Uetersen, Germany.
Zanders Feinpapiere AG, Bergisch Gladbach, Germany.
Klingele Papierwerke GmbH & Co., Germany.
Daishowa Paper Co., Tokyo, Japan.
Honshu Paper Co. Ltd., Matsumoto, Japan.
Chuo-Paper-Board Co. Ltd., Nakatsugawa, Japan.
Rigesa, Celulose, Papel e Embalagens Ltda., Tres Barras, Brazil.
Stone Container Corp., Missoula, USA.
Hiang Seng Fibre Container Corp. Ltd., Bangkok, Thailand.
Schwäbische Zellstoff AG, Ehingen, Germany.
Papeles Bio Bio S.A., Chile.
Cia Suzano de Papel e Celulose, Suzano-S.P., Brazil.
Krkonosske Papierny A.S., Hostinne, Czech Republic.
International Paper Kwidzyn S.A., Kwidzyn, Poland.
Repap Manitoba, Manitoba, Canada.
Jiang Yin Paper Mill, Jiang Yin, China.
Igaras, Brazil.
Sguário, Brazil.
International Paper Co., Augusta, USA.
International Paper Co., Riegelwood, USA.
Westvaco Corp., Covington, USA.
Sonoco Products Co., Hartsville, USA.
Weyerhaeuser Co., Springfield, USA.
Appleton Paper, Newton Falls, USA.
International Paper, Ticonderoga, USA.
Domtar-Cornwall, ONT, Canada.
Stone Consolidated-Grand Mere, PQ, Canada.
International Paper, Jay, USA.
Torraspapel, Motril, Spain.
Roman Esteve, La Pobla de Claramunt, Spain.
Papierfabrik Hermes GmbH & Cie KG, Düsseldorf, Germany.
Smurfit Townsend Hook Papermakers, Snodland, Great Britain.

Joyce Dayton Corp., USA.
AssiDomän Frövi, Sweden.
Bataan Pulp and Paper Mills, Makati, Manila, Philippines.
Cartiere del Garda S.p.A., Riva del Garda, Italy.

Coating technology
Hansol Paper Co. Ltd., Korea.
SCA Ortviken AB, Sweden.
Hong Won Paper Mfg. Co., Ltd., Korea.
Torraspapel S.A., Sarria de Ter, Spain.
Torraspapel S.A., Motril, Spain.
Toprak Kagit Sanayii A.S., Turkey.
Hangzhou Shan Xin Paper Co., Ltd., Fu Yang Town, China.
Vorantim Celulose e Papel, Simao Jacarei, Brazil.
KNP Leykam, Gratkorn, Austria.
Kymi Paper Mills Ltd., Kuusankoski, Finland.
Veitsiluoto Oy, Kemi, Finland.
Hua Yang Technology and Trade Corp., Wuxi, Branch, China.
Machimpex, America Inc. Font Lee, China.
Genting Sanyen Paper, Singapore, Malaysia.
Kymmene Kaukas Oy, Kaukas, Finland.
Jiang Yin Paper Mill, Jiang Yin, China.
KZP Kostrziynskie Zaklady Papiernicze S.A., Kostrzyn, Poland.
International Paper, Augusta, USA.
Rhinelander Paper, Rhinelander, USA.
International Paper, Jay, USA.
Howard Paper, USA.

Winding technology
– DuoReel
SCA Graphic Papers AB, Ortviken, Sundsvall, Sweden.
Holmen Paper AB, Braviken Mill, Norrköping, Sweden.
Federal Tait, Inverurie Mill, Great Britain.
August Köhler AG, Oberkirch, Germany.
Kostrzynskie Zaklady Papiernicze, Poland.
Al-Keena, Jordan.

– Winders
Halla Engineering & Heavy Industries Ltd., Korea.
Holmen Paper AB, Sweden.
Fabricadora de Papel de Celulose S.A., Brazil.
Papeles Bio Bio S.A., Concepción, Chile.
Haindl Papier GmbH, Schongau, Germany.
Cia. Suzano de Papel e Celulose, Suzano, Brazil.
Igaras Papeis e Embalagens Ltda., Otacilio, Costa Santa Catarina, Brazil.
Yue-Li Machine Comp., Tien Long, Taiwan.
Hygienic Papermill Co., Amman, Krkonosske Papierny A.S., Hostinne, Czech Republic.
Visy Paper Pty., Ltd., Gibson Island, Australia.
Smurfit Townsend Hook, Snodland, Great Britain.

Finishing

Janus Concept
KNP Leykam Maastricht, The Netherlands.

Supercalenders
Tianjin, China.
Hansol, Korea.
Daishowa, Japan.
UPM Tervasaari, Finland.
Bosso, Italy.
Yuen Foong Yu, Taiwan.

Soft calenders
SCA Ortviken, Sweden.
Hansol, Korea.
Halla Paper, Korea.
Holmen Paper Braviken Mill, Sweden.
Kymmene Wisaforest, Finland.
Ass Domän, Sweden.
Portals, Great Britain.
Pap. Del Aralar, Spain.
IP Kwidzyn, Poland.
Serang PM 3, Indonesia.
Serang PM 4, Indonesia.
J.R. Crompton, Great Britain.
Munksjö, Sweden.
Milliani, Hungary.
Arjo Wiggins, Great Britain.
Toprak Kagit Sanayii A.S., Turkey.

Machine calenders
SCA Ortviken, Sweden.
Townsend Hook, Great Britain.
Crown Packaging, USA.
Serang PM 3, Indonesia.
Serang PM 4, Indonesia.

Rebuilds
Stora Uetersen, Germany.
Stora Kabel, Germany.
Stora Reisholz, Germany.
Cart. Toscolano, Italy.
Yuen Foong Yu, Taiwan.
Koehler, Germany.

Roll handling
Halla Paper, Korea.
Papierfabrik Scheufelen, Germany.
KNP Leykam Maastricht, The Netherlands.
Cart. del Garda, Italy.
Burgo Ardennes, Belgium.
NDI, The Netherlands.

ORDERS ON HAND

Stock preparation

Waste paper processing systems and subsystems for graphic papers
Schwäbische Zellstoff AG, Ehingen, Germany.
Papierfabrik Palm GmbH & Co, Eltmann, Germany.
Stabilimento di Avezzano, Avezzano, Italy.
Cartiere Burgo S.P.A. Verzuolo, Italy.
Stora Hylte, Hyltebruk, Sweden.
Sepoong Co., LTD., Sepoong, Korea.

Waste paper processing systems and subsystems for board and packaging papers
Europa Karton, Hoya, Germany.
Papierfabrik Tillmann, Sinzenich, Germany.
PWA Industriepapier GmbH, Aschaffenburg, Germany.
Wellpappe Wiesloch, Wiesloch, Germany.
Moritz J. Weig, Mayen, Germany.
Papierfabrik Meldorf, Tornesch, Germany.
Klingele Papierwerke GmbH & Co, Weener, Germany.
Danisco Paper A./S., Grenaa, Denmark.
Danisco Paper A./S., Grenaa, Denmark.
Papeteries Emin Leydier, Saint Vallier, France.
Papeteries Emin Leydier, Saint Vallier, France.
Kaysersberg Packaging, Kaysersberg, France.
Corenso United OY LTD., Varkaus, Finland.
Rigid Paper Produkts LTD., Selby, Great Britain.
Peterson Moss, Norway.
United Pulp & Paper Co. Inc., Philippines.

Waste paper processing systems and subsystems for other types of paper
PWA Dekor GmbH, Unterkochen, Germany.
Steinbeis Temming Papier GmbH, Glückstadt, Germany.
Papeteries de Begles, Begles, France.

Waste paper processing systems and subsystems for tissue papers
Procter & Gamble GmbH & Co., Germany.
Kimberly Clark GmbH, Flensburg, Germany.
Serla Oy, Mänttä, Finland.
LG Cable & Machinery Ltd., Dae Han, Korea.
Nampack Paper Ltd., Bellville, South Africa.

Paper machines

Graphic papers
Halla Pulp & Paper Ltd., Halla, Korea.
KNP Leykam, Gratkorn, Austria.
Malaysian Newsprint Industries Kuala Lumpur, Malaysia.
Nippon Paper Industries, Iwakuni, Japan.
Forestiers Alliance Inc., Dolbeau, Canada.
China National Technical Import & Export Corporation (CNTIC), China
Trans-National Paper Corp., Philippines.
Consolidated Papers, Stevens Point, USA.
Sinar Mas Pulp & Paper Ltd., India.

Halla Thai, Thailand.
Mazandaran Wood and Paper Industries, Iran.

Board and packaging papers
Visy Paper, New York, USA.
Guangzhou Victorgo Industry Co. Ltd., China.
Ningbo Zhonghua Paper Co. Ltd., China.
Mazandaran Wood and Paper Industries, Iran.
CMPC-Cia. Manufacturera de Papeles y Cartones S.A., Chile.

Tissue
Wepa Papierfabrik, Germany.
Thrace Papermill S.A., Greece.
Strepp GmbH & Co. KG, Germany.
Asia Pulp & Paper, Indonesia.
Papeles Industriales, Peru.
City Forest Corp., Ladysmith, USA.
Bacraft, Brazil.
CMPC, Santiago, Chile.
Consolidated Paper Inc. Stevens Point, USA.
Genting Newsprint Sdn. Bhd., Malaysia.
Guangzhou Victorgo Industries Co. Ltd., China.
International Tendering Company CNTIC, China.

Rebuilds
International Paper, Phoenix, USA.
Chuetsu Pulp, Sendai, Japan.
Papel Prensa, San Pedro, Argentina.
Mitsubishi Paper, Hachinohe, Japan.
Chuetsu Pulp, Nohmachi, Japan.
China Banknote Printing & Minting, Chengdu, China.
Volorantim-Piraciaba, Brazil.
Hokuetsu Paper, Niigata, Japan.
EDFU, Egypt.
Nippon Paper Industries, Yatsushiro, Japan.
Holmen Paper AB, Hallstavik, Sweden.
Haindl Papier GmbH, Schongau, Germany.
Stora Kabel GmbH, Hagen, Germany.
Kübler & Niethammer, Kriebethal, Germany.
Haindl Papier GmbH, Walsum, Germany.
Forestiers Alliance Inc., Dolbeau, Canada.
Papel Imprensa S.A., Pisa, Brazil.
Sczetin Skolwin S.A., Poland.
Chuetsu Pulp Co. Noumachi Mill, Nohmachi, Japan.
PWA, Hallein, Austria.
Crown Van Gelder Papierfabriken N.V., Velsen, The Netherlands.
CadiDavid, Italy.
Papierfabrik Palm GmbH & Co., Eltmann, Germany.
Carl Macher GmbH & Co. Papier- und Pappenfabrik, Hof, Germany.
Zaklady Celulozy i Papieru „Cèluloza“ S.A., Swiecie, Poland.
Felix Schöller Junior, Germany.
Hansol Paper Co. Ltd., South Korea.
SCA de Hoop B.V., The Netherlands.
Mondi Kraft, South Africa.
Assi Domän Carton AB, Sweden.
Korsnaes Aktiebolag, Sweden.
ICEC Papcel A.S., Ruzomberok, Czech Republic.
Pipsa, Chile.
Strepp GmbH & Co. KG, Germany.
Piet Retief, South Africa.
Westvaco Corp., Luke, USA.
International Paper, Jay, USA.
Appleton Paper, West Carroiton, USA.
SD Warren, Skowhegan, USA.
Longview Fibre, Longview, USA.
E.B. Eddy, New Westminster, Canada.
Stone Container, New Richmond, Canada.
Stone Container, Missoula, USA.
Stone Savannah River, Port Wentworth, USA.
Saica, Spain.
Torras Domeneck Flaça Gerona, Spain.
Daishowa Shiraoi, Japan.

Coating technology
Tianjin Paper, Tianjin, China.
Westvaco Corp., Wickliffe, USA.
KNP Leykam, Gratkorn, Austria.
Felix Schöller jun. Papierfabriken GmbH & Co KG, Osnabrück, Germany.
Guanzhou Victorgo Industry Comp., Ltd., China
Shin Ho Paper Mfg. Co. Ltd., Seoul, Korea.
Stora Hillegossen, Germany.
Consolidated Paper, USA.
Champion International Corp., USA.

Winding technology

– DuoReel
Halla Pulp & Paper Ltd., Halla, Korea.
KNP Leykam, Gratkorn, Austria.
Malaysian Newsprint Industries, Kuala Lumpur, Malaysia.
Nippon Paper Industries, Iwakuni, Japan.
Forestiers Alliance Inc., Dolbeau, Canada.
Tianjin Paper, Tianjin, China.
Shin-Ho, Daejeon, Korea.
P.T. Pindo Deli Pulp & Paper Mills, Pindo Deli, Indonesia.

– Winders
Fabryka Papieru Szczecin-Skolwin S.A., Poland.
Halla Thai, Thailand.

Finishing

Janus Concept
Lang Papier, Germany.
Shin Ho Paper, Korea.
Oji Paper, Japan.
Confidential, North America.
KNP Leykam Gratkorn, Austria.
SFI Port Hawkesbury, Canada.

Soft calenders
Ningbo PM 2, China.
Ningbo PM 3, China.
Piracicaba, Brazil.
Siam Paper, Thailand.
Ballarshah, India.
Confidential, USA.
CMPC Procart, Chile.
MNI Selangor, Malaysia.
Suzano Rio Verde, Brazil.
Alliance Dolbeau, Canada.
Sappi Blackburn, Great Britain.
Alkim Akali, Turkey
Cascades La Rochette, France.
Dae Han, Korea.
Victorgo, China.
Berghuizer Wapenveld, The Netherlands.

Machine calenders
Ningbo PM 3, China.
Ningbo PM 2, China.
Shin Dae Yang, Korea.
Dong Il, Korea.
K.C. Beech Island, USA.
J. Cropper, Great Britain.

Rebuilds
Ballarpur, India.

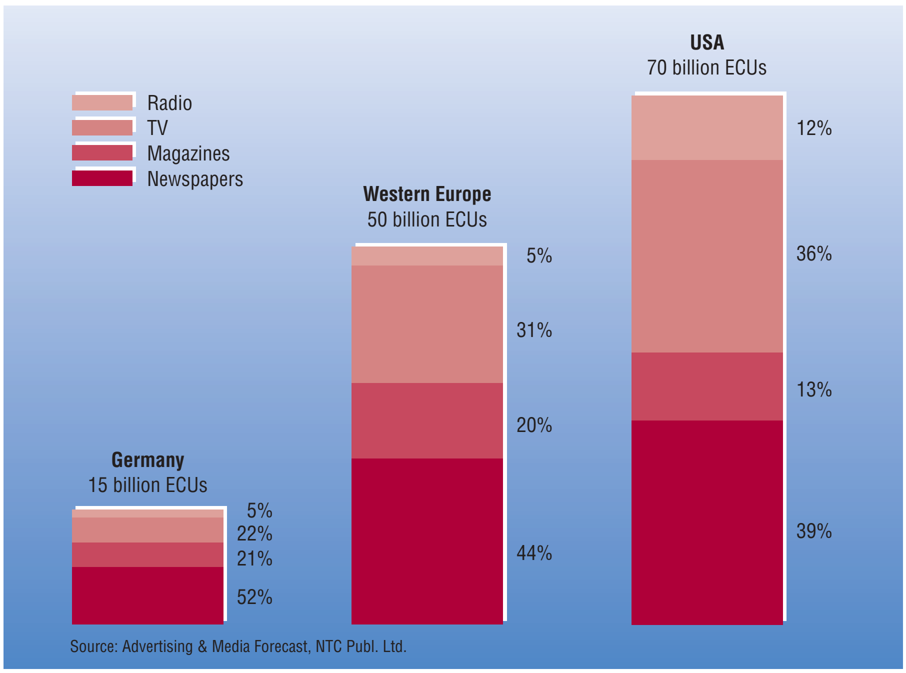
Roll handling
MNI Selangor, Malaysia.
Burgo Ardennes, Belgium.
Papierfabrik Scheufelen, Germany.
Bauer Druck, Poland.

Global paper market:

Quo vadis newspaper printing?

Media competition is increasing, and newspapers are not immune to the consequences. Although the rationalisation effects of technological development have essentially resulted in improvements to product content, various questions remain open concerning the marketing of the newspaper print medium: How are the demands of readers and advertising customers changing? Which newspaper should be aimed at which target group? Does colour play a major role for editorial contents and advertisements? What challenges do future-oriented newspaper concepts pose to technical processes – and to the paper used? Answering these questions is Bernhard Theiss, graduate engineer in printing and media technology, management partner in the “Süddeutscher Zeitungsdienst Verlagsgesellschaft m.b.H.” newspaper publishing house, co-publisher of regional newspapers and member of the German Federal Research Ministry’s “Media 2000” commission.

Fig. 1:
Distribution of total advertisement expenditure for mass media in 1994.



1

Dialogue between newspaper printers and newsprint manufacturers is progressing, albeit extremely slowly. Both sides basically agree that neither knows enough about the other's problems.

The following article is intended to give an insight into current perspectives and problems faced by the newspaper. At the forefront is the interaction between content and technology, especially where printing technology and paper come into contact. I can only touch on the publishing aspect and the wide range of development in terms of content.

The newspaper and its rivals

We live in an era of media pluralism. An increasing number of competitors are forcing their way onto the market from which newspapers make their money.

They are threatening the newspaper's reader and advertising markets. Television has robbed the print media of much of its brand product advertising. As we reach the threshold between video and print, "new" magazines make newspapers look old-fashioned. Radio has both a national and local effect on newspapers, while direct advertising is posing a challenge to the insert industry.


The author:
Bernhard Theiss, Aalen

Electronic media have not only changed people's habits in terms of reading and viewing, but also their demand for current information.

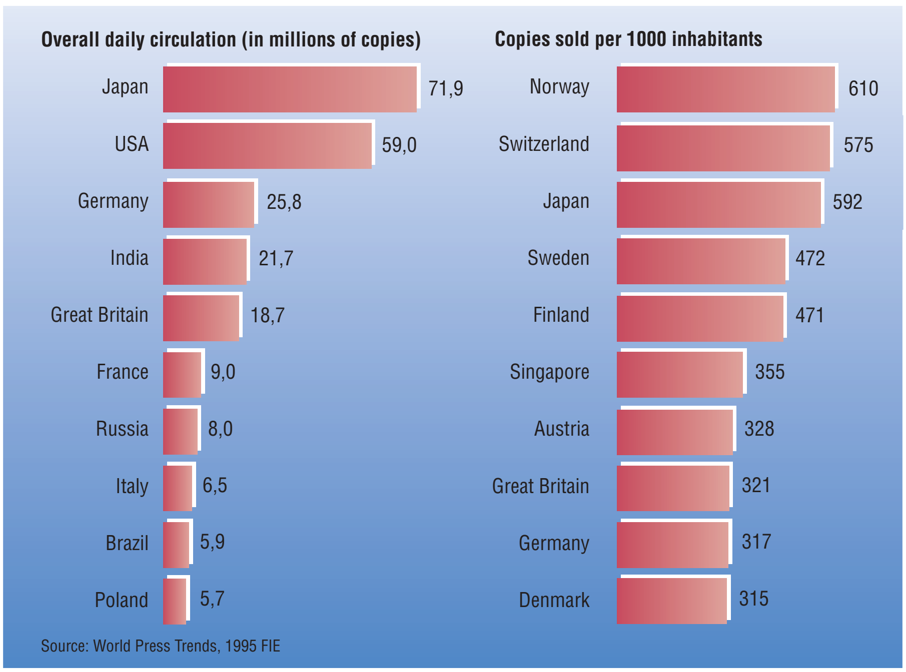
Newspapers must adapt to these changing requirements, primarily in terms of their content: they must present in-depth news with a background rather than simply reselling what appeared on TV the previous evening, and they must be written in an exciting, reader-friendly way. Secondly, they must change their image by employing colour, printing convincing photos and graphics, and offering a clear overview. The result should be a neat combination of text and pictures, laid out with the readers' interests in mind.

"The countdown has begun!" It is high time that newspaper publishers began actively participating in developments. It's true that the newspaper is still the biggest advertising medium in Germany, Western Europe and the USA, but its share of overall advertising expenditure in the mass-media sector is sinking. While daily papers in Germany expanded by a further 3.4% in 1995, total advertisement expenditure rose by 7.1%. Television even achieved a growth rate of 17.4%. In the USA, advertisement expenditure for television almost equalled that for daily newspapers *(see Fig.1)*.

Within the European Union, the newspaper's share of media advertising receipts shrunk from approximately 34 percent in 1983 to barely 28 percent in 1993.

Advertising expenditure for radio, television and print media in Germany, Europe and the USA may differ in terms

Fig. 2:
Daily papers,1994.



2

of media structure and consumption, but at the same time, there is general evidence of the growth potential for non-print media. It is not easy to define the situation in individual countries or zones, as a glance at the table for overall daily circulation and copies sold per 1000 inhabitants shows *(Fig. 2)*. Nevertheless, one thing is certain: market conditions and media competition for consumers (viewers/listeners/users) and advertising customers are similar everywhere.

A media decision is above all a decision for or against a certain media type. And in many cases, this boils down to the even simpler question: electronic or print? Those who work in the media tend to be prejudiced against daily newspapers, claiming that advertisements are difficult to plan, expensive, and often lack the brilliant colours of other media. Only gradually are newspapers beginning to offer improved service with more colour and greater quality, thereby responding to competitive pressure from other media and to the prejudices of advertising agencies and those who decide which medium to use.

The reader market

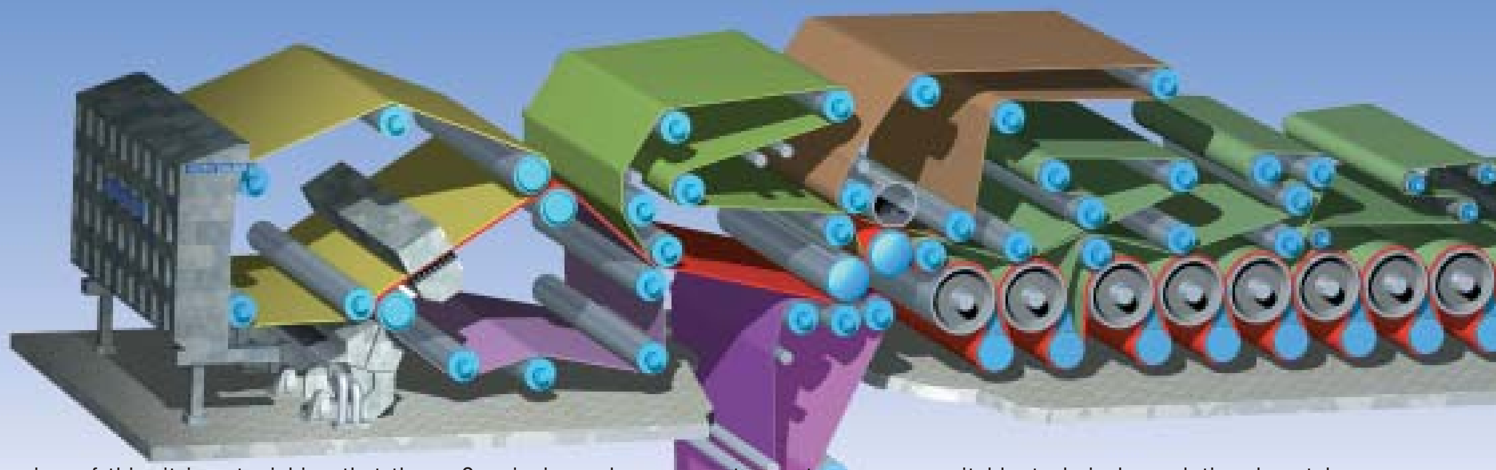
In Germany, newspaper circulation remained at roughly the same level for years. Now, it is falling slightly: 1995 saw a loss of 0.7%. In concrete figures, this represents a drop in circulation of some 200,000 copies per year, amounting to more than 10,000 tonnes of paper.

Newspapers in built-up areas have been worst hit by circulation problems. There are many reasons for this: compared with other regions, urban areas contain more single households, a greater percentage of foreign inhabitants, and an above-average number of unemployed people.

Major factors which are particularly detrimental to newspaper subscriptions in Germany and other West-European countries include the fall in the birth rate and the number of households and families being set up, and the increasing age of the population. Furthermore, media consumption by people aged below 20 has changed drastically. This category is dominated by radio, with 121 minutes of daily consumption, followed closely by television (101 minutes). The daily paper has slipped to merely 15 minutes a day. Over the years, the newspaper's audience in this age group has shrunk more than in others. On average, only every second person under 20 in Germany reads the daily press on a regular basis.

However, the euphoria surrounding radio, television and other increasingly popular media is gradually reaching its peak. According to experts, it is likely to burn itself out shortly after the turn of the century. Newspapers and magazines then have a real chance for the future, since in comparison with quality print media, electronic media reveal distinct weaknesses: consider the fact that 53 percent of all television viewers avoid advertisements by flicking their remote control.

Young people tend to escape advertisements more than elderly people. Well-educated people with high incomes also change channel more frequently when advertisements are shown.



In view of this, it is astonishing that the cost of launching a television advertisement today is almost four times greater than it was in 1980, whereas the cost of a newspaper advertisement has not even doubled in the same period. Moreover, television advertisements are far more expensive to produce than newspaper advertisements. It is now the rule more than the exception that a 20-second long TV spot costs several hundred thousand German marks to produce.

Consequently, the newspaper is a more effective advertising medium than its rivals, since its readers are more responsive to advertising. Complaints regarding excessive media advertising are directed primarily at television (98 percent of users), followed by magazines (50.3 percent), and radio (34.7 percent). For daily newspapers, the figure is only 25.2 percent. Fortunately, words such as zapping, browsing, switching and hopping are unheard of where newspapers are concerned!

The newspaper is a medium which is available everywhere. It does not require a technical infrastructure such as energy or communication networks. But one thing cannot be denied: a newspaper which is not good will not sell. And most newspapers are not yet as good as they could be.

Life is colourful, and the newspaper should reflect this by using more colour. Colour is a form of information, and a lack of it symbolises "old news"! Nobody likes to sit in front of a black-and-white television anymore.

Convincing colour concepts must arouse the readers' interest and show advertising customers what a fantastic effect colours can have in newspapers. If it is necessary to impress readers and advertisement customers purely through the product's appearance, then a little imagination is also required.

The market comes before technology. For us as technical newspaper specialists, this means giving our partners a clearer picture of the connections which exist between preliminary stage and print technology, and indeed the quality of the newsprint.

For the newspaper publisher, this means thinking in the long term and giving greater consideration to market requirements for quality, not only in terms of service, but also as regards the printed newspaper's appearance.

For the paper manufacturer, this means that the newsprint must stand up to the challenge. As a modern print medium, the newspaper must not be defeated by outdated quality standards for paper in its raw form.

What is demanded of us all is nothing less than acknowledging this home truth: the market comes before technology!

Newspaper technology

The demand for improved quality is something of a tradition in newspaper printing. And over the last 20 years, a veritable technical revolution has taken place in this sector. Until the mid-seventies, the standard practice was to use line casting machines (lead) for typesetting, zinc plates for picture reproduction and metal or plastic plates for printing. In an amazingly short time during the second half of the '70s (somewhat earlier in Great Britain and the USA), typesetting on film was introduced, followed by computer-controlled photosetting. Today, technology has reached the stage of fully digital, integrated text-picture production.

Seen against this background, it becomes clear how much of a role the ideal printing process has played in newspaper printing. It was also in this sector that offset printing processes were first introduced in the '70s, starting in medium-sized newspaper publishing houses in the USA and England.

The letterpress-printing process is now almost obsolete in Western Europe, the USA, Australia and Japan, while the Flexo print process (high printing from soft rubber moulds) continues to play a role in newspaper printing, albeit subordinate. However, it is unable to match offset printing in terms of quality. Rotogravure is not used at all in the newspaper sector.

The decisive factor in favour of the offset printing process was its ability to achieve high picture resolution (half-tone dots), even on rough paper – direct contact with the paper is no longer made by a metal printing plate, but by a rubber printing blanket. By means of film- and photosetting as intermediate stages, the light-sensitive offset printing plate has added

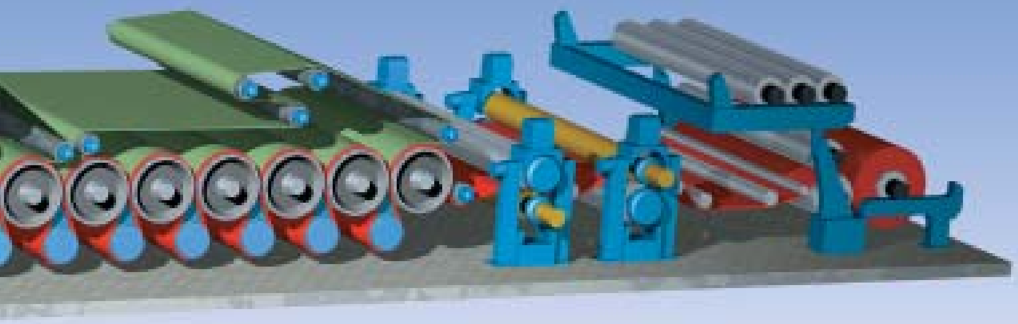


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Fig. 3:
"Braviken", the most innovative newsprint machine in the world, began work at Holmen Paper AB in Norrköping, Sweden, in mid-1996. A record holder: 1800 m/min design speed, 9650 mm wire width, outstanding runnability, perfect flatness and paper quality for brilliant colour printing.

great momentum to the digital preliminary stage. Today, this area is rapidly developing into a media-neutral data-processing system, whose information can be used for any conceivable medium.

Offset print processes and preliminary stage technologies are able to satisfy the demand for more colour. The standardization of colour-sensitive picture information has today reached a high and stable level, resulting in generally problem-free reproduction of even the highest resolutions. However, transferring this precise information from the printing plate to the paper continues to cause problems based on the process – the interaction of ink (fat), water, paper and the machine (printing blanket, inking and dampening system).

Physical dimensions of the preliminary stage

What information is transferred onto the paper? The most precise structures measurable, which must be transferred to the newsprint in a scale of 1:1, are between 30 and 40 µm (e.g. 2% of a halftone dot or spot on frequency-modulated screen). The layer of printing ink on the paper is between 1.5 µm and 2.0 µm thick.

With a scan resolution of 300 dpi (118 pixels/cm), a coloured A5-size picture (14.5 cm x 21.0 cm) requires app. 13 MB (mega bytes) of data, which must be transferred onto the printing paper as completely as possible.

Subsequent to positive initial trial runs, computer-to-plate technology (CTP) will be standardised during the coming years, with the result that previously unavoidable losses of information (and therefore of quality) will be eliminated through transfer and copying. In other words, the precise amount of information on the printing plate, which can be measured objectively, will constantly rise, and differences in the final print quality will increasingly be attributable to the combination of ink, water and paper.

Newspaper rotary printing presses

Until recently, the performance of a newspaper printing machine was judged by its ability to close editorial and advertising content as late as possible, to process large volumes in short time periods (high number of pages and print runs), and to distribute them rapidly to the reader (e.g. in the letter box by 5.45 a.m. in Germany). Nowadays, it is also judged on its ability to print decorative colours and four-colour pictures on certain pages.

Our world is colourful, and colour is information! The newspaper cannot ignore this fact. As a result, the main criterion when configuring a newspaper rotary printing press today is that it should produce as many four-colour pages as possible in a newspaper, without restriction.

The format of a newspaper is of considerable importance. Newspaper rotary printing presses have fixed formats. In Germany, the most common are the Berlin format (315 x 470 mm, web width: 1260 mm), the Rhein format (360 x 530 mm, web width: 1440 mm), and the Northern format (400 x 570 mm, web width: 1600 mm). In the USA, web widths of up to 1905 mm can be observed.

The speed of production always depends on the newspaper concept. Its size, the time at which it closes for distribution, and the area to be covered are all influential factors. The web speed of current conventional machines varies from roughly 9.0 m/s (corresponding to approximately 30,000 cylinder revolutions/hour) to a maximum of 12.5 m/s (approximately 42,000 cylinder revolutions/hour).

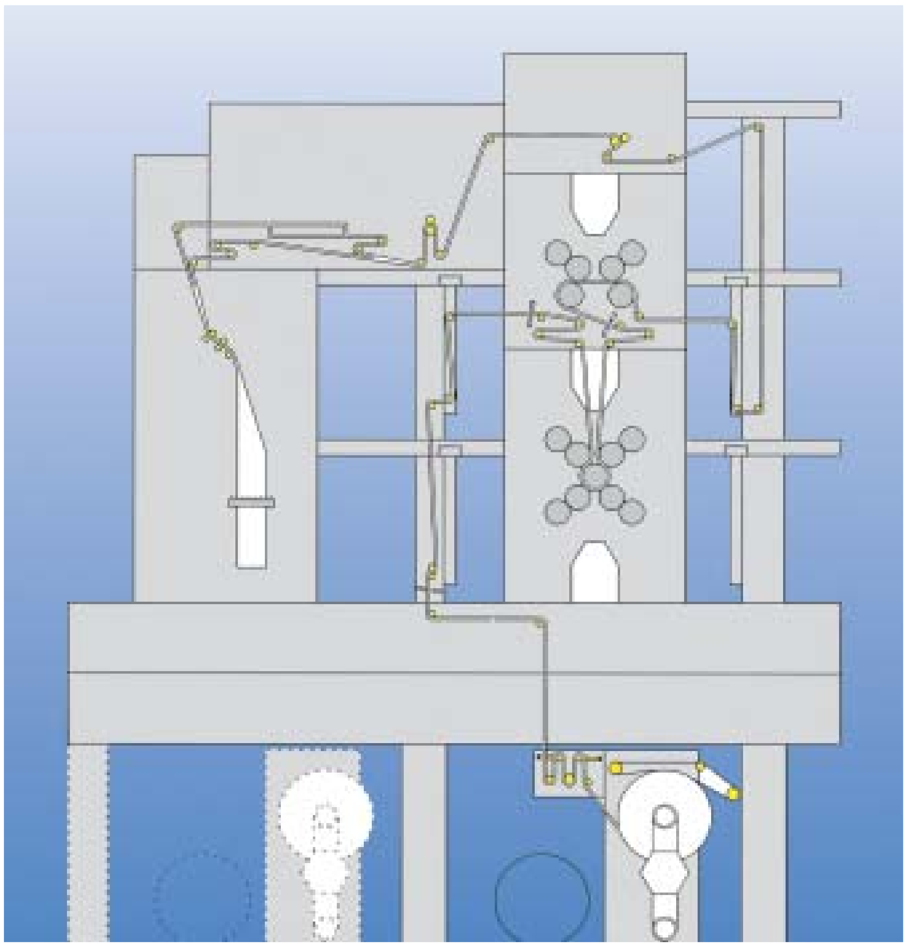
Today, the effective speed of production is mainly determined by on-line production conditions at the printing machine and further processing/dispatch. In some cases, the system's speed must be reduced, especially if large and complex inserts are to be processed.

Control station

Today, functions such as machine operation, web guiding and reel changing are carried out for the most part by automated control station technology. But despite computer-controlled inking and dampening systems, the printing process still needs to be monitored by machine staff who, as a rule, should be trained printers. The main things to be checked are print quality (register, colour intensity, effect of colour in comparison with original), the results of the interaction between paper, ink and water (smearing, emulsifying, dusting, formation of air bubbles, plate abrasion). The latter must be monitored constantly.

As a rule, the machines are fitted with paper-web feeding systems, which – depending on the product size and inking – are capable of feeding all paper webs into the printing machine.

Fig 4:
Diagram showing paper guiding in a modern newspaper offset rotary printing press, from the reel (1) over the stacked modular print units (2) to the folding and cutting device with photo-electric copy check (3).



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Reelstands now operate with exceptional precision, and work with a wide range of reel diameters above 1250 mm.

A certain problem which affects the web tension in particular is referred to as "plate-channel runout". The plate and rubber blanket are laid on or clamped to the relevant cylinder. The clamps are located in channels, which are offset by half the width of the roll. Tensioning problems faced by the web and vibrational problems faced by the machine have now been minimised by introducing tiny slots for the pressure plates, made by so-called "cylinder bearers". The tension of the rolls in relation to one another is determined by no-break metal rings at speeds of more than 35,000 roll revolutions/hour and modern bearing technology which eliminates bearing play.

Automated machine operation and high-quality print reproductions pave the way for corresponding improvements in web logistics. The paper web is first pretensioned by an adjustable stretching device, and then pulled into the printing system mainly by the rubber blanket roll. One on top of the other, the collected paper webs are driven by adjustable drawing webs in front of the folding device. Drawing webs with reversing rods on the upper section are also possible, depending on the size and complexity of the desired web mixture.

Machine configuration

Contrary to earlier, more technically-oriented decisions regarding the configuration of printing systems, the design of a newspaper rotary printing press is now greatly influenced by the newspaper publisher's product and marketing concept.

The publishing house is most concerned with the print quality achieved, the volume and print run capacity, and the machine's colour capabilities. The following list presents the printing units which are currently most popular, together with their combination into machines. Double-width machines are taken as standard, in other words 8 pages (4 wide, 2 high) per plate cylinder or 16 pages per paper web.

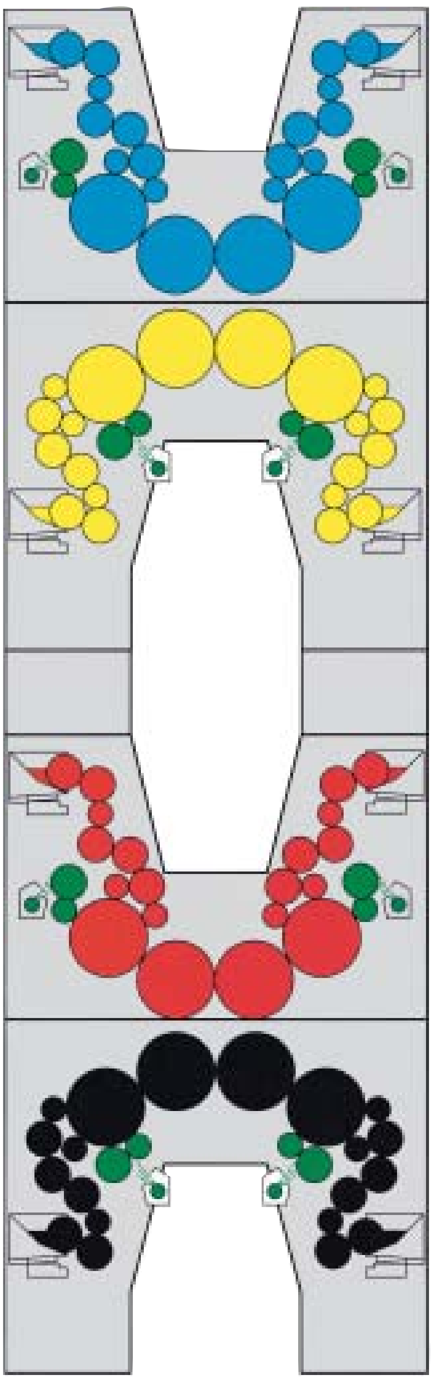
As a rule, half or three-quarter webs are suitable for the printing units as well as full webs. Quarter webs are seldom used.

9-cylinder satellite

Precise four-colour printing, since fan-out effect is practically non-existent .

Problem: complex transmissions, especially when reversing. Complex web guiding. Further printing units needed for back page.

Figs. 5 and 6:
The so-called eight-high tower – today, the most commonly-used basic configuration for four-colour offset newspaper printing. Stood one on top of the other, the H-shaped modules provide the greatest colour capacity with the shortest paper path. Each eight-high tower can print 16 four-colour pages or 32 two-colour pages. The necessary number of basic configurations are stacked in accordance with the size of the print run (paper web shown in yellow).



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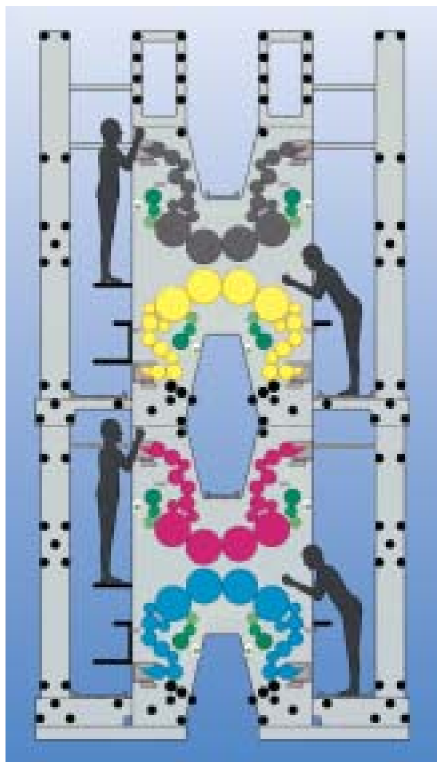

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The fan-out effect represents the change in web size which occurs due to dampening. In the case of free web guiding, the web's width may increase by as much as three millimetres if dampened several times.

10-cylinder printing unit

Problem: free web guiding for four-colour printing, resulting in fan-out effect despite high machine-technical expenditure. Complex web guiding, deviations (smearing).

H-shaped printing unit

2 basic modules, 1 upside down. Clear paper path. Short free web guiding.

Eight-high tower

2 H-shaped modules on top of one another, greatest colour capacity with shortest paper path (4/4 colour printing on both sides of web). Problem: fan-out effect caused by free web guidance between the printing areas.
According to print machine suppliers, approximately 80% of newspaper rotary printing presses supplied since 1992 were designed according to the eight-high tower configuration and delivered as such.

Further processing and dispatch

Preprinted newspaper sections and advertising inserts are often added to the printed newspaper copies, which are then counted for sales rounds, packed and dispatched in trucks.

The processing speed of the technology in the dispatch department corresponds to the production speed of the rotary printing press – in England and Australia, high-performance lines insert, count, pack and transport up to 80,000 copies an hour.

The standards which newspaper copies are expected to meet in terms of precise folding and clean arrival from the folding system are correspondingly high – not every newsprint can satisfy such specific conditions.

Paper logistics in reel handling is on the road to automisation – the continuous process chain from unloading the truck through high-bay storing, unpacking and preparation to changing the reel on the rotary printing press is already reality in some printing and publishing houses.

Fig. 7:
Rotary printing press for 16-page colour printing using the offset process: web widths from 1220 to 1680 mm, 16 pages per paper web, 70,000 copies per hour per folding system.

Printing process and product quality

The offset printing process evolved from lithography (Alois Senefelder, 1796). It is based on the chemical-physical repulsion of fat (= printing ink) and water: the hydrophobic picture areas to be printed accept ink and reject water, while the hydrophile areas not to be printed accept and absorb water. Extensive literature is already available regarding this process, and I will therefore restrict myself to briefly summarising the main details, referring in particular to the interaction of ink, water and paper.

Offset printing is capable of very high picture resolution and sharp pictures edges, even on rough paper. The problem lies in the interaction of ink and water and – especially in newspaper printing – the paper's reaction to the ink/water balance. During the actual printing process, the effects of surface tension caused by the interaction of ink and water play a decisive role, as do the boundary layers and wetting tension of the printing ink/dampening agent and picture/picture-free areas.

The water's overall hardness and its hydrogen carbonate content are of significance, since both parameters have a substantial effect on the offset process: among other things, they influence the water's PH value, which is reached through the use of specially-prepared additives in the dampening agent. For technical printing, the water should have an ideal PH value of between 4.8 and 5.3.
The sensitive printing process requires printing inks and dampening agents which are precisely matched with one another and with the printed paper.

During the printing process, impurities such as washing agents, ink binding agents, paper dust or pigment may pollute the dampening agent. Especially in the case of newspaper printing with uncoated natural paper, these impurities can upset the so-called ink/water balance. Considerable problems may also arise as a result of current development techniques for inks, e.g. through the use of plant-based fats, and the constantly increasing amount of recycled material used in newsprint.

The parameters must be redefined, and since two major components are changing at the same time (ink and paper), the situation at the moment is anything but clear and standardised. Of course, there are extensive lists of criteria for the assessment of newsprint quality. Thanks to their production protocols, paper manufacturers know much about their paper's mechanical properties: however, when presented directly with this information by the manufacturer, the printer can only turn a little of it to his advantage – e.g. weight, roughness, and perhaps the paper colouring.

Up until now at least, most of the other information available has lacked any clear and specific connection with the problems arising in the printing process.

So far, dialogue between printers and paper suppliers has established a number of practical parameters regarding the suitability of the paper for the printing machine, printability and the results of printing on certain newsprint. These are listed below:

List of parameters for newsprint:

Suitability for printing machine
Web passage (creases, wandering)

Runout/manufacturer's adhesive
Web break/wrong adhesive
Fibre design/stray dust
Washability of design

Printability
Ink acceptance
Ink requirement
Water conditions/requirements
Ink/fibre design/second impression set-off
Ink smearing/main rollers
Wave formation after printing

Printing result
Printout (full surface and screen)
Evenness (no structures)
Spot increase
Show through/strike through
Stability against wiping
Paper colouring / lightness
Sheet stiffness
Polluted areas

Further processing
Ink blotting/smearing
Set off
Behaviour in
– Conveyor belt
– Buffer (winding)
– Drum (or similar)

7

The print quality of a newspaper is assessed above all by sharp picture edges, as well as by uniform and uninterrupted areas, and high print contrast.

Repercussions occur because the ink does not dry physically in newspaper printing, but is “absorbed” into the paper. In order to achieve a brilliant, deep colour, more ink guiding is necessary. This encourages the ink to blot and smear. The result is a direct connection between certain paper properties (absorption, roughness and opacity) with print quality, enabling the newspaper to hold its own against rival media.

In contrast to heatset-web offset printing (in which the ink solvents are evaporated at temperatures of 200°C), additional handling of the printed paper web is generally avoided in newspaper-web offset printing. In some newspaper printing houses, the use of infra-red heaters achieves very good printing results on standard papers. Brilliant colours can be produced without smearing, thereby opening up new markets for newspaper printing.

Inevitably, scope for raising the quality of standard newspapers by using improved newsprint is extremely limited due to the high material costs involved.

A decisive factor for publishing houses is the newsprint’s register tolerance. Together with baggy-webs, which are frequently in evidence, and paper reels which have been wound out-of-round or slack, this plays a role above all in the context of the dampening of the paper web in offset printing.

Colour printing is increasing. Every colour means a corresponding dampening of the paper web – e.g. with 4/4 colour printing in a eight-high tower, the web comes into contact with water eight times during the print process. Electronic register control systems are able to deal with linear expansion of the web, but not with lateral expansion, which can amount to several millimetres – this is referred to as the fan-out effect.

As a result, accurate compression in the µm area is no longer possible without altering the plate positions.

The problem can be solved by using printing-plate suspension pins with divergent positions. These positions are fixed and correspond perfectly with the centre of a corridor, which has standardised left and right tolerance limits. Standard papers used for high-accuracy print products must have expansion coefficients which lie within the tolerances of this corridor. Otherwise, it is impossible to achieve a good printing result without considerable maculation. Folds in the product are a phenomenen which no longer appear on complaint lists simply because printers and publishers have given up complaining about them. Nevertheless, the paper manufacturers must solve this problem – who wants to buy a “dog-eared” book , for example?

In view of the increasingly tough media competition, the newspapers are adopting a new position – colour pages are now a top priority, as are product and print quality which can hold its own against rival media.

In both the preliminary stage and print stage, newspaper technology has made enormous efforts to achieve higher quality, and is now moving in leaps and bounds towards this goal. Progress has been so dynamic that it could be very well compared with the development of recycling paper for newsprint. This makes one thing clear above all else – paper makers (and those who supply their technology) must pay much more attention to the processing problems of their product.

Printers and publishers must show clearly where their products are heading, and in order to confront problems, they must give information about the connections they see between quality demands, printing processes and newsprint. All those involved are certainly prepared for dialogue, since it is in all their interests. One thing is for sure: if the newspaper yields to media competition, the paper industry will feel the blow too!

NEWS FROM TH

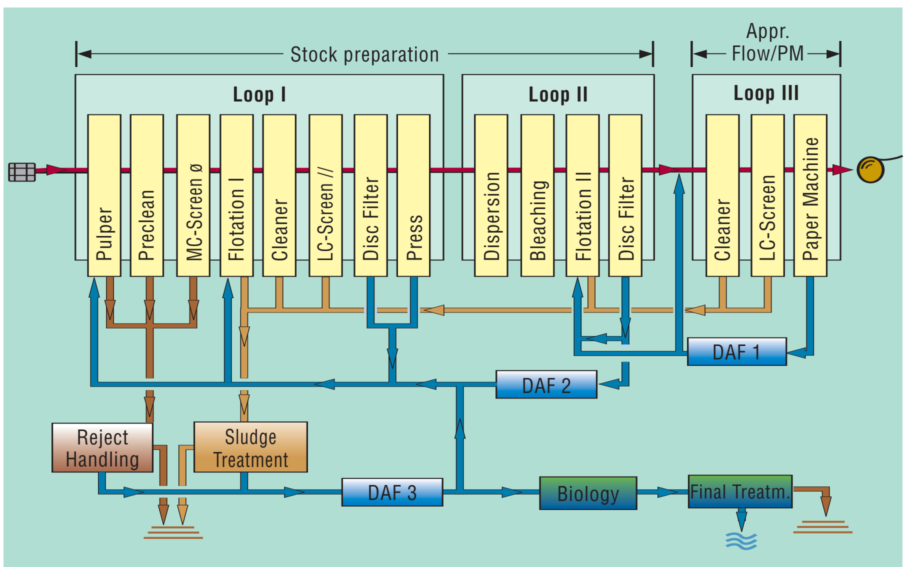
Stock Preparation Division:

Membrane technology for the further close-up of paper mill water loops

The authors:
Ralf Mönnigmann
and
Dr. Michael Schwarz,
Stock Preparation
Process Technology

Modern process technology with tailored water management demands improved water loop cleaning accordingly. Thanks to membrane technology, greater cleaning potential can be exploited likewise in conventional processing stages.

This article reports on the latest findings with selected examples of various processes and effluent conditions, thus giving some idea of the cost/ benefit situation.



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Current systems – A survey

There are basic differences between the furnish, technologies and requirements on finished paper depending on whether graphic grades or packaging papers are involved. In the following systems for white and brown grades based on the current state-of-the-art are presented.

White grades

The process diagram in *Fig. 1* shows the principle of water management for white grades. Several loops separated from one another by thickening stages enable the water to be channelled in a targeted manner in accordance with the counterflow principle. The use of fresh water in the paper machine and sequential additions to the front loops in a cascade allow the fresh water in the process to be used to maximum effect.

The degree of circuit closure normal nowadays is less than 10 l/kg. At this

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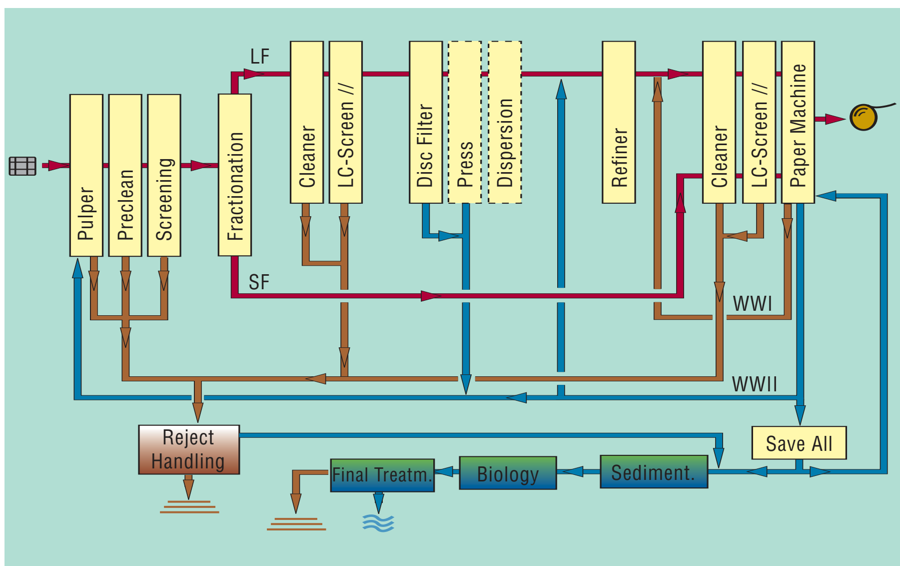
Fig. 1:
System example for white grades.

Fig. 2:
System example for brown grades.



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level, Dissolved Air Flotation (DAF) stages represent an essential component for removing disruptive fibre admixtures (anionic trash, etc.) from large volumes of water.

Each further reduction in the amount of fresh water added (and consequently the production of effluent) must be paid for in the form of more retention agents in the paper machine as well as an increased requirement for auxiliary agents in the stock preparation for flotation and bleaching. More disruptions are caused by all types of sediments. As the degree of circuit closure increases, the sulphate content also becomes a limiting criterion. The biological activity already taking place in all parts of any plant would be multiplied several times over. Precipitation of these would import an additional burden of chemicals into the system. This could cause new problems as a result of interactions with other process chemicals.

In summary, it can be said that paper mills processing waste paper and producing a range of white grades cannot reasonable reduce their specific effluent production below 7.6 l/kg.

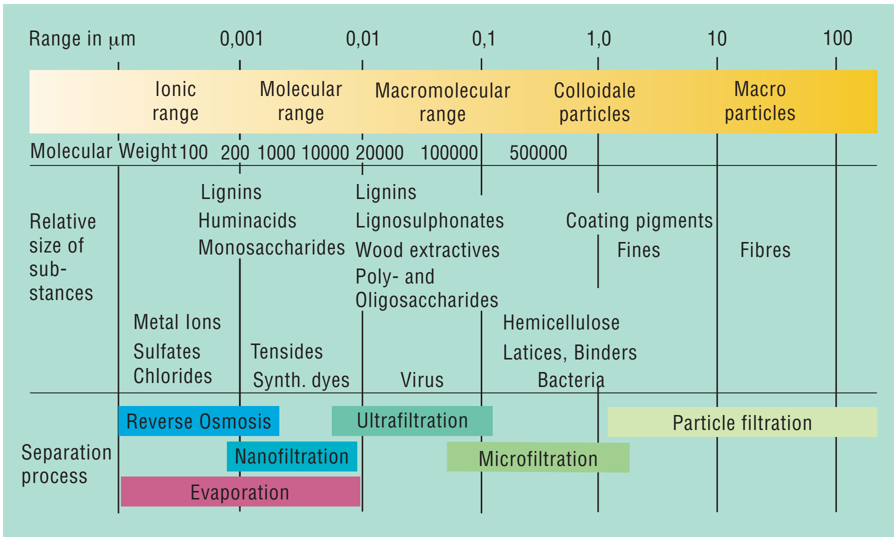
Brown grades

In principle, the configuration of systems for packaging papers is always simpler than for white grades *(Fig. 2)*. The systems are often single-loop systems and the stock consistency drops from the pulping stage to the headbox. Water management is limited to treating the shower water in the paper machine, reducing the fibre losses after reject machines and gating out the most heavily contaminated process water. The specific amount of effluent produced can be reduced to 2-4 l/kg thanks to suitable process technology for the required product qualities.

Effluent can be avoided completely if the substances contained in the filtrates from reject drainage, shower and channel wa-

Fig. 3:
Substances in the process water.

Fig. 4:
Principle of membrane filtration.



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ter are removed and the water returned to the process. It is possible to control the technique of completely enclosed circuits with these products[1,2].

However, the struggle against the negative effects of circuit closure on product quality and manufacturing technology has been going on for the same length of time. For example, even after a considerable length of time has elapsed, highly volatile substances are still liberated from the paper or are formed and lead to unacceptable odour problems. Retention problems have to be compensated for by the increased use of auxiliary agents. In addition, only periodical or spontaneous treatment with biocides can usually help against uncontrolled biological activity in the dead zones of the system.

The wellknown problem of sticky deposits in the paper machine and on other equipment like motor fans also renders the operating of the plant. These more difficult problems go right through to changed thickening factors in the cleaner system.

Corrosion problems can never be fully avoided in spite of choosing the materials for all machinery and equipment with the utmost care[3,4].

The advantage of partially opening up loops and allowing a defined effluent quantity has been shown by measures taken on several plants. It has been known for a long time that biologically purified effluent can be recirculated through the system[5,6], and in the meantime this possibility has been successfully put into practice[7].

Current limits on circuit closure

The maximum utilization of the water employed is restricted by various substances in the process water which have a disruptive effect on either the technology or the product. The concentration of these colloidal or truly solute substances, referred to as “disturbing” substances, increases at a disproportionate rate to the degree of circuit closure until reaching the specific concentration equilibrium *(Fig. 2)*.

Fig. 3 lists several of these substances which are known to be of relevance to the process. Most of them are organic substances (lignins, lignosulphonates, wood extractives, saccharides, hemicelluloses) but there are also inorganic substances such as chlorides, sulphates as well as iron and manganese ions[8,9].

The type of these constituents is basically the same in all process waters. However, their composition and quantity varies

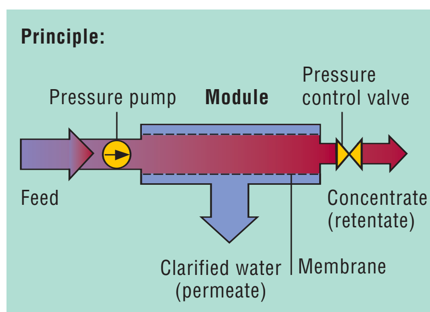

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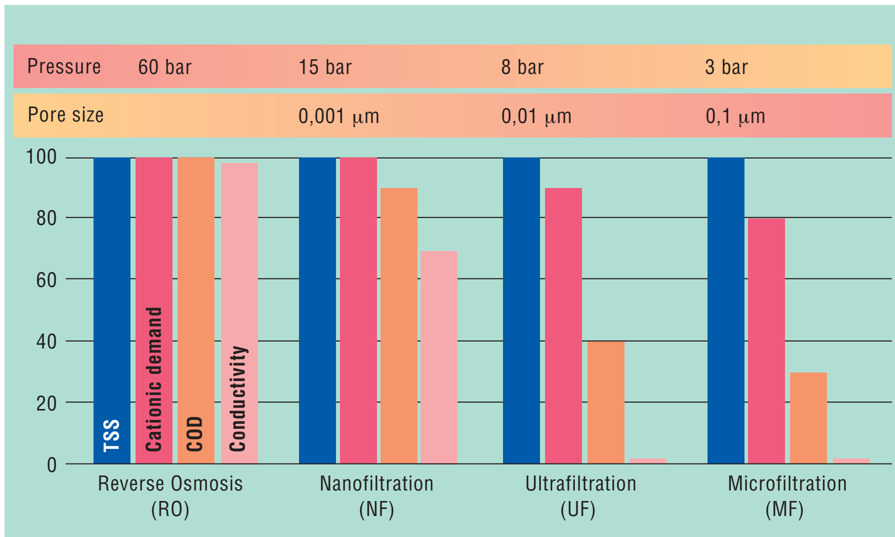
Fig. 5:
Membrane filtration processes.

Fig. 6:
Volume reduction coefficient.

greatly from system to system. Amongst many other parameters, the most important indicators for the disturbing potential are the filtered chemical oxygen demand (COD) and the cationic demand.

Technologies for further circuit water cleaning

The membrane filtration is one of the processes which have to be used in order to reduce further the limit values stated above. Membrane filtration is used in many area of effluent treatment and for concentrating process flows.



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The membrane process

In the broadest sense, a membrane can be viewed as a filter which separates the components of a mixture of substances by purely physical means *(Fig. 4).*

In this process, the feed is separated into a permeate (filtrate) and a retentate (concentrate). Membrane processes are divided into four principle methods depending on the transmembranic pressure differential and the size of particles which are to be separated out.

Fig. 5 shows the details. In addition, the figure specifies a range of separation capacities for parameters such as COD, SCD and conductivity which are relevant to the process. The flow of permeate is also used as a characteristic feature of the membrane in addition to the retention capacity.

Furthermore, there are important influencing parameters which determine the economic efficiency of the membrane separation process:

<u>Flow channelling</u>

- The inlet is parallel to the membrane so as to prevent or at least minimize the formation of a covering layer ("filter cake") on the membrane which leads to a reduction in the throughflow. This cross-flow principle guarantees maximum filtrate output over long periods.

<u>Designs of membrane modules</u>

- The core of every membrane plant is a technically expedient arrangement of membranes, referred to as the module. There are three principle designs for effluent from a paper mill:

Pipe modules are not susceptible to blockages in the inflow and can be used with suspensions containing a limited fibre content. However, they generally have a lower packing density (ratio of the membrane surface area to the module volume). Plate modules with disc-shaped flat membranes attain a considerably greater packing density. Their power consumption is

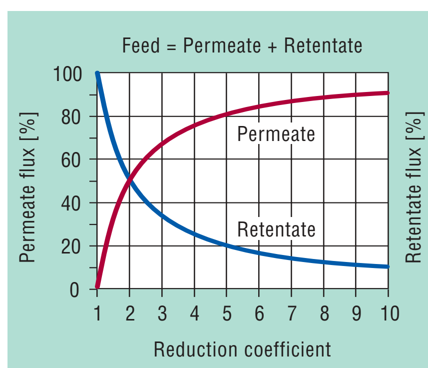

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Fig. 7:
Membrane filtration pilot plant.

Fig. 8:
Flux through membranes for paper mill effluent.

Fig. 9:
Lay out diagram for COD reduction of disk filter clear filtrate.

Fig. 10:
Retention of different tested membranes.

lower thanks to the smaller circulating volumes. There is a risk of blockages with suspensions containing fibres.

Spiral wound modules suffer from a high risk of blockage. No fibres should be allowed to enter the module. However, spiral wound modules do have the highest packing density as well as a favourable price/performance ratio.

Membrane materials

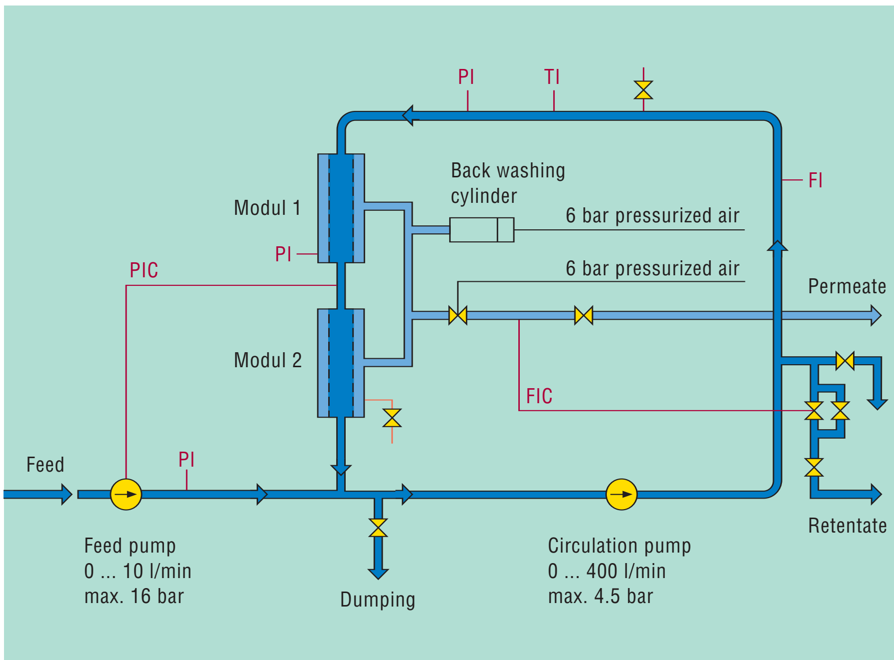
- The main division in this case is between organic and inorganic membrane materials. Inorganic membranes are temperature resistant, strong and possess a high level of chemical resistance. However, although this results in a longer service life, they are more expensive. The broad range of organic membranes are considerably cheaper. New materials can be used at temperatures up to 80°C and with high pH values. This means long service lives can usually be expected for applications in the paper industry.

Volume reduction factor

- The volume reduction factor (VRF) is often overlooked. *Fig. 6* indicates its significance.

Temperature

- A rise in temperature leads to an increase in the flow of permeate. The reason for this effect is the reduction in viscosity as the temperature rises.



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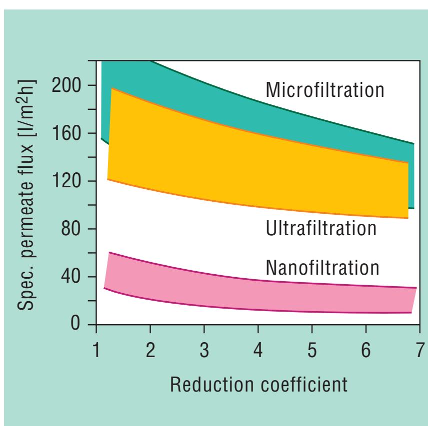

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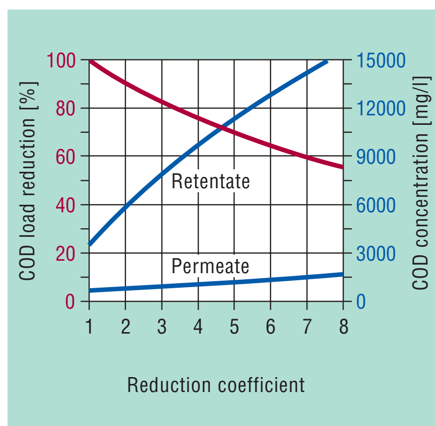

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Retention [%]	Microfiltration	Ultrafiltration	Nanofiltration
COD	20-30	45-65	75-90
Cationic demand	70-80	98	99.9
Conductivity	2-6	15-25	60-75

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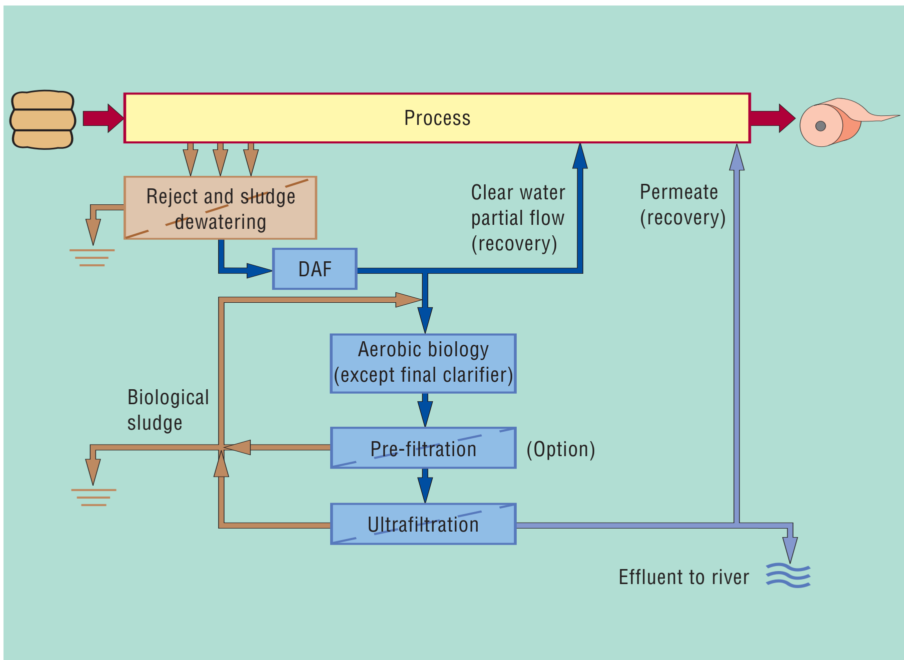
Fig. 11:
Advanced water treatment for graphic papers (1st concept).



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Possible applications and performance capability

A testing plant built specially in our company was used for testing various membranes with some selected waters from paper mills *(Fig. 7)*. The following equipment was used: ceramic microfiltration (0.1 ❍m pore width) and ultrafiltration membranes (separation limit 10,000 Dalton) as a pipe module as well as organic nanofiltration membranes (separation limit < 200 Dalton) as pipe and spiral wound modules. The test involved paper mill water types, these being in general heavily contaminated circuit waters from paper mills for brown and white grades. In addition, tests were also conducted with the run-off from biological effluent plants used in the paper industry.

Examples of the principle configuration data which were worked out are shown in the following diagrams.

Fig. 8 shows an overview of the through-flow values achieved. The bandwidth of the through-flow is explained by the constituents in the different waters. In many cases, microfiltration was unable to achieve significantly greater flux values despite the larger pore width; the membrane became blocked by extremely fine particles in the circuit water.

Fig. 9 shows an example of the retention capacity of the NF membrane. The interrelation between the reduction in conveyed substances and the volume reduction factor is a significant factor in the subsequent design of a plant and its integration into the entire system of a paper mill. A detailed presentation of all the test results would go beyond the scope of this report. *Fig. 10* shows a summarized overview of the retention capacity for the most important parameters.

A feasible system concept for graphic grades

At the start, it was explained why it is impossible to achieve a specific effluent production below approx. 7.6 l/kg using standard process technologies. This limiting value is the result of comprehensive computer-aided modelling studies and accords well with the empirical data obtained from many plants. Tests were conducted with various waters in order to prepare an optimum concept incorporating more thorough purification stages.

For purifying highly contaminated rejects effluent and sludge from white grades production, microflotation with partial recirculation to the mill water loops is state-of-the-art today. The processwater which has to be replaced due to contamination with dissolved and colloidal substances is drained off for biological treatment, where in most cases organic loading (COD) is reduced by 2-stage agitation.

Fig. 12:
Advanced water treatment for graphic papers (2nd concept).

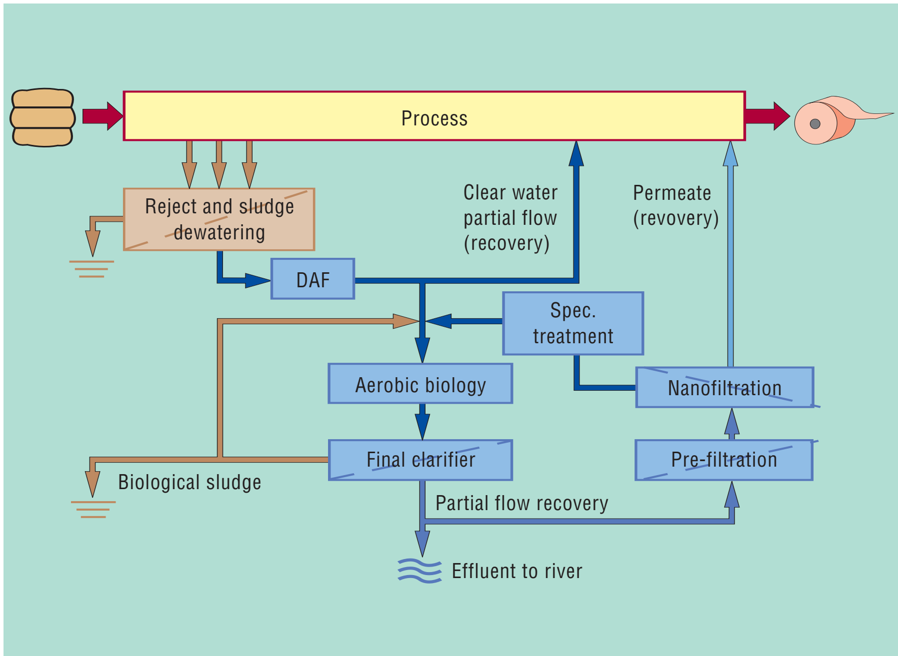
Fig. 13:
Costs for the effluent treatment..

The resultant bio-sludge is then separated out by sedimentation or sometimes flotation, and either removed from the system or returned to the agitation stage for maintaining the active sludge concentration.

In concept 1 *(Fig. 11)* biological purification can be improved by ultrafiltration to the point where the clarified water is suitable for freshwater replacement in the paper machine loops. By using tubular modules, the last sedimentation stage can be bypassed completely, with direct ultrafiltration for removing bio-sludge amongst others. By feeding back this concentrate, higher sludge concentrations (up to 1.5%) can be set in the second agitation stage, thus speeding up COD reduction.

Since production problems due to higher salt concentrations are practically unknown, and inorganic content largely depends on additives (such as aluminium sulphate), high recirculation rates are possible even with ultrafiltration.

Furthermore, part of the ultrafiltered water can be further purified in a nanofiltration stage (spiral wounded module e.g. for removing sulphates). Adding "pure" ultrafiltration permeate ensures high throughput rates and maximum service life of the nanofiltration stage. The nanofilter residue has to be separately processed by precipitation/flocculation



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	Approx. investment costs DM/m^3/h	Approx. spec. operation costs DM/m$^3_{\text{clear water}}$
State of technology		
Biological treatment +	30 000	0.4
River water treatment	11 000	0.3
(excl. buildings)		
1. Concept		
Biological treatment +	30 000	0.4
Ultrafiltration (tubular)	13 000	1.5
(incl. pre-filtration)		
2. Concept		
Biological treatment +	30 000	0.4
Nanofiltration (spiral wound)	30 000	1.5
(incl. pre-filtration)		

13

for disposal. Although the ultrafiltration module is not prone to blockage, coarse filtering is advisable if the residual fibre content in the intake is high. Another alternative *(Fig. 12)* is direct nanofiltration with spiral wounded modules, while retaining the last sedimentation stage and intermediate filtration. Thanks to the high separation capacity of the nanofiltration membrane, ongoing concentration in the

Fig. 14:
Futural aspects for the installation of a membrane filtration.

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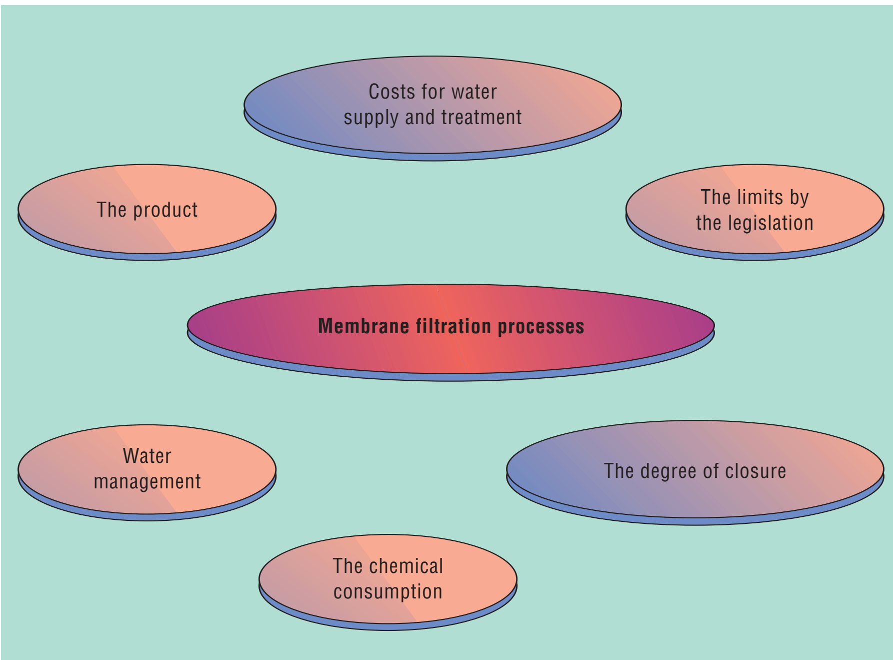

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paper mill loops – except for monovalent salts – is prevented. From the energy point of view, using low-cost spiral wounded modules with large membrane areas also allows direct nanofiltration despite low throughputs. Since these spiral wounded modules are liable to blockage, prefiltration is particularly important.

But long-term trials have shown that if the membrane filter operating parameters are carefully adjusted, no blockage will occur. The filter cleaning interval should be about 4-6 days, and here again, the nanofilter residue has to be separately processed by precipitation/ flocculation for disposal.

As shown in *Fig. 13,* both these concepts are not exactly cheap. Investment costs for concept 1 – without partial nanofiltration – amount to some 13,000 DM per m^3/h, with operating costs around 1.5 DM per m^3 of permeate. The second concept involves investment costs around 30,000 DM per m^3/h, likewise with operating costs around 1.5 DM per m^3 permeate, plus additional costs for treating the nanofiltration concentrate.

Prospects

In future, an integrated biological treatment stage will come into wide use in the manufacture of packaging papers. There are no fundamental problems involved in returning the biologically treated water, although the selection of plant components and the harmonization of individual sections will have to be undertaken very carefully. The situation is different with white grades. It is basically technically feasible to close the circuit completely. However, membrane filtration in the form of ultrafiltration or nanofiltration would be essential in order to remove micro-organisms, biological breakdown products and, in the case of nanofiltration, inorganic substances such as sulphate.

Initial results of long-term trials in paper mills have confirmed the operating reliability and good availability of membrane filtration systems.

Nevertheless, the system configuration for each individual case has to be optimized carefully, taking account of all influencing factors. Development tests must go hand in hand here with empirical data evaluation from comparable systems and computer-assisted balancing of fibre additive concepts.

In future the economical and ecological aspects of membrane filtration will be increasingly assessed for their affects on product quality and chemicals consumption *(Fig. 14).* Bearing in mind the complexity of paper mill loops, the cost-effectiveness of membrane filtration cannot be assessed simply by comparing investment outlay and energy costs with effluent treatment costs.

Paper Machinery Divisions:
Ortviken PM 4 – tomorrow's technology today

The author:
Marion Nager,
Corporate Marketing

Early 1996, SCA Graphic Paper started up their new PM 4 at Ortviken, Sweden. The goals had been set high – produce LWC paper with high opacity, high gloss, high density and high bulk using an on-line paper machine process including coating and calendering. Voith Sulzer Paper Technology of Germany is the main supplier, in an installation program that was completed in less than five months.

Reasons for the investment

SCA's twofold strategy is to produce newsprint paper in regions with a dense population and a therefore large amount of wastepaper (for example at the Aylesford mill near London), and to produce LWC papers in regions with a large fresh fiber supply. This led to the 1990 startup of SCA's first LWC machine in Ortviken. High quality results were achieved immediately, largely because of the superior properties of spruce fiber, the primary raw material. This very thin, strong, flexible and bright fiber, has proven superior to any other fiber for the production of LWC paper. "It was therefore only a question of time for SCA to take the next step and build a second LWC machine in Ortviken, the PM 4," explained Kenneth

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Eriksson, President of SCA Graphic Sundsvall.

Quality goals

Göran Nilsson, Vice President, Business Area Coated Papers, explained the reason for the investment from a marketing point of view. He sees the trend of increasing consumption of coated papers, and his market analyses showed that SCA customers were interested in a broader selection of products. It was therefore decided to create two unique new grades of LWC paper, GraphoLux and GraphoMatt, along with the already existing GraphoCote from the first machine.

GraphoLux is a paper designed for users to whom opacity and stiffness are the most important attributes. It has a high thermomechanical pulp content, which makes it bulkier than conventional LWC's. Its excellent opacity offers customers the choice of producing a magazine that feels thicker and of superior quality, or one with reduced weight, without risking a decrease in opacity (i.e., high bulk at low weight).

GraphoMatt is a matt LWC paper with an attractive combination of low paper gloss, high print gloss and very good opacity. It has been specifically developed for magazines where good readability is a must.

Asked if the quality goals have been reached with the new machine, Nilsson can only confirm, "Yes, we have reached

Fig. 2:
While old PM 4 was still producing paper, the coating and the calendering section of new PM 4 were being erected.

Fig. 3:
To shorten erection time a completely preassembled hood portion at the coating section was mounted as a whole.

all the specifications. We are now producing the promised qualities and have been able to successfully trialprint the new grades at a number of press-rooms around the world with good results. Of course a lot of optimization work was and still is required in order to get maximum productivity out of this outstanding, innovative machine."


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Machine Concept

The concept of the new machine was developed in close co-operation between Voith Sulzer Paper Technology and SCA.

According to Kenneth Eriksson, Voith Sulzer Paper Technology made a good impression during the test trials before the decision, and during the technical negotiations. "Voith Sulzer Paper Technology showed themselves as a very competent group of people. And they were well-prepared." Asked for the reason Voith Sulzer Paper Technology was chosen as the supplier, Anders Johansson, Production Development Manager, answered, "Voith Sulzer Paper Technology is ahead in technology, especially in the coating and in the calendering area." And Örjan Petterson, General Manager LWC Production, simply stated, "Voith Sulzer Paper Technology agreed to develop a new, unique product with us."

Equipment

The new machine is a complete on-line production unit, with forming, drying, coating and calendering in one process. The reasons for this design are obvious. The in-line process offers a reduction of personnel amounting to 30-50% (app. 9 persons per shift), a reduced amount of waste and a reduction of production space. PM 4 is equipped with a ModuleJet headbox, a DuoFormer CFD, a DuoCentri-2-Press with three press nips, a Combi-DuoRun pre-dryer section, a hard nip machine calender, a DuoReel with center wind, and other advanced equipment in the coating and calendering area. In addition to the machine, Voith Sulzer Paper Technology delivered complete machine-air ventilation with heat recovery, steam and condensate system, central lubrication, hydraulics/pneumatics

Fig. 4:
For the dryer section, steel framing was erected instead of concrete foundation to reduce down time.

Fig. 5:
The framing of the wet end was preassembled before being mounted by crane.

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and an extensive production monitoring system, the Technology Monitor VTM 2000.

Civil Works

Civil works for the foundation of the new paper machine started in October 1994. The fact that development work, including test trials in Heidenheim and in Krefeld, were done parallel during the design phase, sometimes made work difficult. “It wasn’t just a normal project where you knew exactly what the machine would look like in the end,” said Johansson.

Old machine still producing paper during first phase of erection

Voith Sulzer Paper Technology started erecting the new PM 4 on the 12th of July, 1995. The old newsprint machine, which was shorter than the new LWC machine, was still producing paper when the reel, calender, hot oil unit for the calender, and two cylinders were being mounted. On the 3rd of September, the old PM 4, which had been sold to the Far East, finally was shut down and dismantled in a record time. Fifty-five hundred tons of steel were carefully removed in only seven days! Less than five months later, on the 21st of January, 1996, the new paper machine started up. “I don’t think that such a huge machine has ever been erected in such a short period before,” said Kenneth Eriksson.

Uno Wallgren, project engineer for the paper machine, said the project went very

well, especially in consideration of the very short period, "It took only four and a half months, and it was in an existing building. It was really hard work for all involved due to the limited space in the building." According to Wallgren, the erection crew led by Voith Sulzer Paper Technology erection manager Alex Rieble did a very good job. "We had a lot of project meetings. We also checked the manufacturing at Voith Sulzer Paper Technology's subcontractors, and everything looked very good." The good co-operation between SCA's and Voith Sulzer Paper Technology's people helped a lot in this phase. Anders Johansson remembered that erection manager Alex Rieble and project manager Andreas Köhler "never saw a problem, always stayed cool and always found a solution. They are skilled people."

Startup

A time-schedule had been set up and steering committee meetings were held. Here problems were reviewed regularly in order to find solutions. In the beginning these meetings took place every day, they were then reduced to three times a week, and finally to once a week.

The paper machine early showed its ability to reach the forecasted quality level, whereas the new on-line coating and calendering technique took some time to get up and running. Several systems (tailthreading and drives) had to be adjusted, but because of the close co-operation, the changes were smoothly implemented. Uno Wallgren praises the

Fig. 1 (page 22) and 6:
It is done! The new PM 4 is completed and in operation.

Fig. 7:
Kenneth Eriksson, President of SCA Graphic Sundsvall AB.

Fig. 8:
Per-Olof Wedin, Production Director of SCA Graphic Sundsvall AB.

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work of the Voith Sulzer Paper Technology startup crew led by startup manager Ricardo Zorzin: "The whole staff is skilled and very open. We work very well with them." And Per-Olof Wedin, Production Director at SCA Graphic Sundsvall, says: "We appreciate the skills of Voith Sulzer Paper Technology. Especially during erection the high German standards were visible."

Today's performance

Per-Olof Wedin is satisfied with the quality results: "Quality development since the start-up was quick. We have reached our goals for brightness, opacity, bulk and gloss. Runnability and printability also seem to be superior." Wedin adds, "The paper is very good and we will soon reach a maximum production level thanks to the good co-operation with the Voith Sulzer Paper Technology team.

We remain convinced that we have made the right choice regarding the technical solution. This is without any doubt the LWC technique of the future." Eriksson confirms, "We feel very comfortable with the quality we have achieved so far and with our customers' reactions, but we will of course continue to develop the paper further."

Further SCA plans

In any case, development work at SCA will not stop, for as Wedin stated, "We want to be in the pole position when the next race starts." Well, good luck for the race!

Paper Machinery Divisions:

Latest generation of cylinder mould formers – the FloatLip former N, NO, S

The VSPT short former, widely used for the formation of individual layers of board grades, has now been superseded by the FloatLip former – very similar but offering substantial improvements.

This innovative but straightforward and practical design not only ensures better sheet formation on the cylinder mould, but also simplifies operation. One of the innovations incorporated in this new development is already revealed by its name: the FloatLip former.

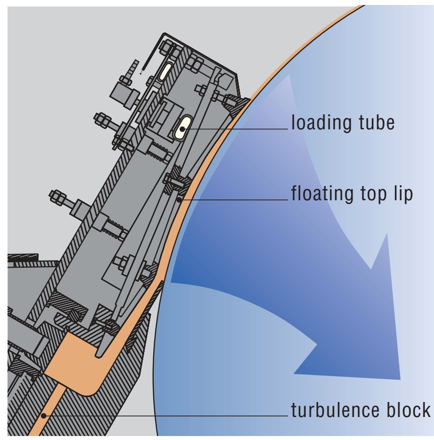
Like its predecessor, the FloatLip former consists of a cylinder mould, frame with pan and couch roll and the headbox with the supply system. While the cylinder mould and the couch roll have been taken over from the short former without any significant changes, the frame and pan of the FloatLip former now form an integral unit. The real innovation, however, lies in the completely new headbox and distribution system.

The author:
Dr. Günter Halmschlager, Paper Machine Division Board and Packaging

In conventional formers, drainage in the sheet formation zone is determined by the predetermined nozzle geometry. This makes sheet formation pressure dependent on the stock flow, the dewatering characteristics of the stock as well as the slice geometry. Variations in the degrees of refining produce changes in the dewatering pressure. Also imperfections of the cylinder moulds affect the dewatering pressure, as the clearance width changes periodically in such cases. Furthermore, the forces acting on the top lip of the headbox in conventional designs cause lip deformation over the width. Although this can be compensated, readjustments are always necessary when operating conditions change. Adjustment of the basis weight profile on a shortformer is made by conventional adjustment of the slice, so that the well-known drawback of local changes in fibre orientation negatively affects breaking length constancy and thus bending stiffness over the web width.

All these disadvantages have now been eliminated by systematic development work on the short former. Although the resulting innovations are not obvious at first sight, they are very important for product quality and operating convenience.

On the FloatLip former the top lip of the headbox is no longer rigid, but adjusted to the suspension pressure by means of a pneumatic hose. This keeps the dewatering pressure constant irrespective of fluctuations in the degree of refining. Furthermore, the top lip can follow the imperfections of the cylinder mould – the



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outlet slice remains constant. The pneumatic hose on the top lip also ensures continuous support, thus avoiding deformations due to bending. All in all, these innovations have an extremely positive effect on end product sheet uniformity (fibre orientation, breaking length ratio, formation).

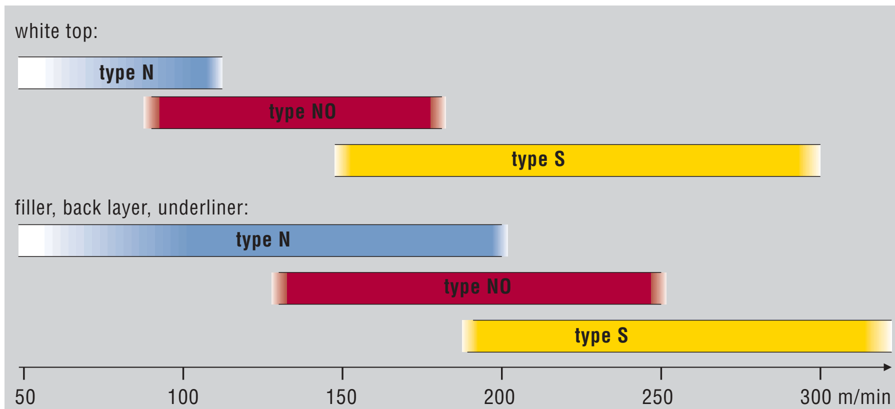
Another significant innovation comprises the supply system with dilution water control and centrifugal distributor, which supplies stock to the FloatLip former headbox through a system of hoses.

This centrifugal distributor is of similar design to the central distributor, except that the stock enters the distributor tangentially. Light-weight particles and undissolved air collect in the middle of the distributor and are removed out of the top. Compared with lateral discharge from a cross-distributor, the quantities removed are insignificant, but sufficient

Fig. 1:
FloatLip former headbox.

Fig. 2:
FloatLip former with distribution system.

Fig. 3:
FloatLip former: typical application ranges.



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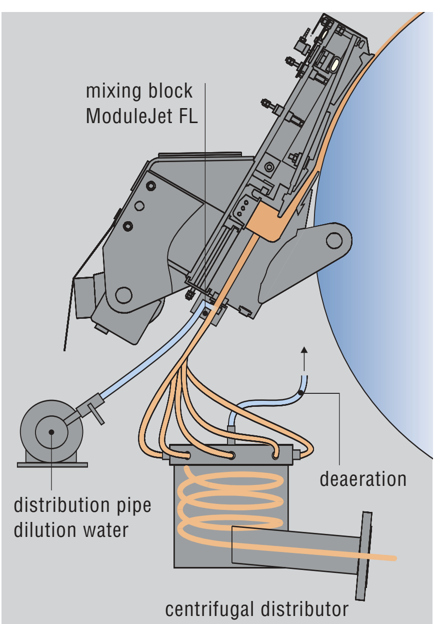
for efficient system deaeration in order to prevent pinholes and irregular sheet structuring. The centrifugal distributor not only removes the air from the system, but also eliminates the need for a cross-distributor and lateral discharge, thus saving energy in the supply system. Based on the success of the ModuleJet, the FloatLip former was equipped with a dilution water system for adjusting the CD basis weight profile. The ModuleJet FL is a greatly simplified version adapted to the needs, with manually operated dilution valves. The basis weight correction effect due to dilution is so large that only about every fifth FloatLip former requires a ModuleJet FL. The Module Jet FL allows precise adjustment of the CD basis weight profile without negative effects on fibre orientation and hence on breaking length ratio.



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Like its predecessors, the FloatLip former is available in the N, NO and S versions, type selection depending mainly on operating speed and type of furnish. FloatLip formers are best used for layers with a basis weight of 50 to 100 g/m^2, the number of formers depending on the required basis weight of the finished product.

FloatLip former sections operate at speeds between about 35 and 400 m/min, with basis weights ranging from 15 to more than 1000 g/m^2. The maximum working width is approx. 5000 mm.

The FloatLip former is an impressive demonstration of how well-tried concepts can be updated through innovations, without unreasonable outlay. Together with other state-of-the-art developments, it rounds off the Voith Sulzer Paper Technology product range to ensure a leading position on the market also in application areas where ultra-high production capacities or operating speeds are not required.

Application range of the FloatLip former

- Folding boxboard
- Grey board
- Core board
- Gypsum board

Features of the FloatLip former

- Adjustable dewatering pressure by floating top lip
- Centrifugal distributor with ModuleJet FL
- Simple operation and maintenance
- High availability

Technological advantages

- Excellent formation with low energy consumption
- Uniform thickness profile
- Good printability
- High specific bulk and CD-stiffness
- Adjustable breaking length ratio.

Paper Machinery Divisions:
Serang BM3/BM4 – the exemplary commissioning

The author:
Alexander Wassermann, Paper Machine Division Board and Packaging, Commissioning

Last year in Serang, Indonesia, a large Voith Sulzer Paper Technology order was handed over with outstanding success – a complete production line for coated folding boxboard. This comprises a multiple stock preparation line and two board machines BM3/BM4 arranged back-to-back, which apart from a few details are identical.

Plant components

The Serang board machines are supplied by a total of seven stock preparation lines for waste paper, CTMP and chemical pulp. These include all the key components of Voith Sulzer stock preparation technology, such as high consistency pulping, flotation and disperging, with additional systems for chemical additives preparation, water loop treatment and rejects processing. Maximum overall throughput is 1985 t/day oven-dry stock.

Each board machine operates with a multiply 4-wire section, all plies being equipped with step diffusor headboxes.

The press section comprises a double-felted suction press followed by large

Fig. 1:
Wire section of Serang BM3.

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diameter double and single-felted roll presses. These large roll presses may be replaced later on with shoe presses. The board sheet is prepared for coating in a hard-nip calender.

The seven coating units (four on BM4 and three on BM3) have a maximum capacity of 24 g/m^2, with precoating by stiff blade and top-coating by bent blade. Two coaters on the back side are only used for special grades, with light sizing otherwise.

After coating and the last drier stage, two softnip calenders are installed. For board grades coated on both sides, these operate with alternate soft and thermorolls. With a total of three calenders, this concept gives the same results as a machine with yankee cylinder, but with the decisive benefit of higher runnability.

This advantage mainly applies to grade changing, humidity profiles (in the machine and cross-machine directions), and paper feeding times. It also reduces investment costs and brings greater flexibility for extending existing lines.

For market reasons, the BM4 board machine mainly produces ivory board (GZ1) from bleached chemical pulp and CTMP at the present time. On BM3 duplex board is currently produced, but solid bleached board, art board and Manila board also feature on the production programme.

Fig. 2:
Partial view of Serang stock preparation system.

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Commissioning – a challenge in optimal cooperation

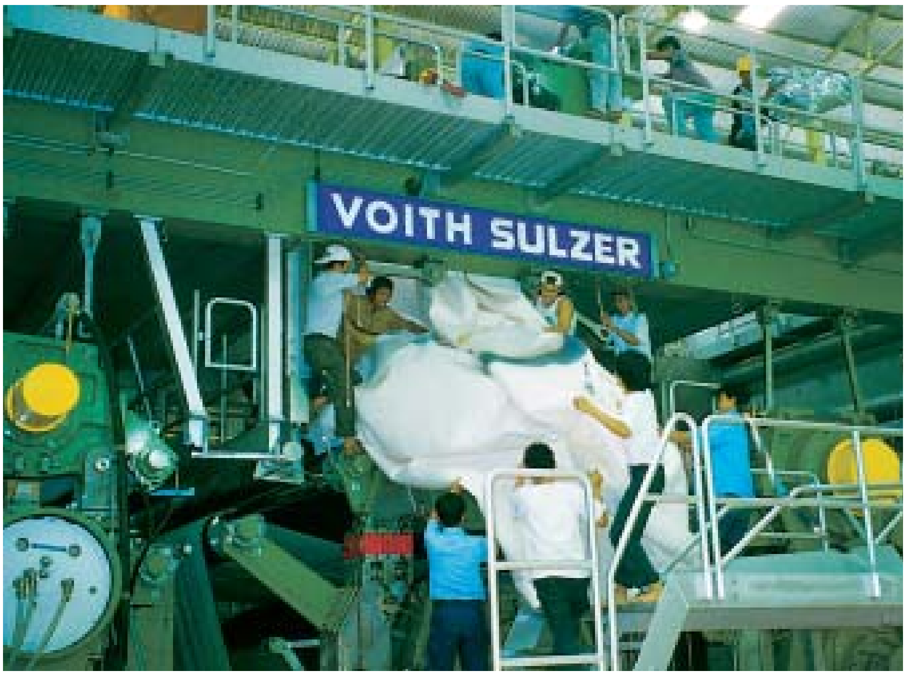
Successfully commissioning a plant of this size demands perfect on-site cooperation among all concerned. The same applies to erection and installation of instrumentation and control systems, and to the subsequent technological commissioning phase.

Cooperation between the customer's engineering and production specialists and all members of the supplier consortium was particularly noteworthy. Already during the erection phase, which is critical for smooth commissioning, customer teamwork was outstanding. The first-class workshop facilities provided by the customer also contributed a good deal toward meeting the tight commissioning schedule.

The complexities of modern measuring and control systems are not easy to master, but thanks to close cooperation with the customer's electricians and instrumentation specialists, the long checklist was successfully completed in a very short space of time. Operating personnel for the stock preparation line and board machines received training by the customer's papermaking specialists. These in turn had attended a training course in Europe prior to commissioning, where they also had the opportunity of inspect-

Fig. 3:
Felt threading on second press of BM3.

Fig. 4:
Threading of filler wire on BM3.



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ing a board mill in operation. Full preparations were thus completed for the commissioning phase, which commenced in November 1995.

Functional commissioning

At the precommissioning meeting in October 1995, a startup deadline was agreed for mid-February 1996. All checks therefore had to be completed as quickly as possible. The functional commissioning phase, which includes loop checks and dry operation tests, forms the basis for final commissioning by ensuring troublefree control and full reliability of all aggregates and machinery at startup time. This applies to all sections of the process control system as well as the machine controls.

During the loop checks, control system links to the line aggregates and viceversa were checked. With about 5000 control circuits all in all, this took up most of the time required for functional commissioning.

To give a better overview and speed up progress monitoring, check-sheets were filled out by the test engineers and handed over to the Voith Sulzer team. Any problems noted in these check sheets could thus be followed up immediately. By this time all machine motions had been checked, meaning that also the hydraulic aggregates were operational including a reliable supply of cooling water.

The stable instrumentation air supply network so important for the pneumatic systems was also ensured.

After checking all the process control circuits, each function was tested individually and in its process context. This phase provided a further check on logical sequencing of the line components.

The final stage in functional commissioning comprised startup tests on the numerous drive systems. Since more than 70 drives had to be coordinated on each board machine, this phase was extremely complex and time-consuming. Apart from drive rotation tests, checks also had to be carried out on the central oil lubrication system, steam and condensate systems. Drives in the wet section were first coordinated in the unloaded condition, since wires and felts could not be inserted until after water tests had been carried out.

Technological commissioning

The first stage in technological commissioning comprises wet testing. Both in the stock preparation lines and in the board machines themselves, all lines are first operated with water. This not only serves for flushing and leakage monitoring, but above all for initial adjustment of control parameters and stability checking of the individual systems. Pressures in the screens and cleaners are preadjusted, valve settings are made, and troubleshooting is carried out.

During the individual group startup tests, particular attention was paid to ensuring that all startup steps could be carried out by the customer's operating personnel. The water tests offered a good opportunity for training the customer's personnel in technical operating conditions on the running machines. Here again, the importance of smooth cooperation was impressively demonstrated. Since the operating personnel were divided into a field group and a process control system group, agreement between monitor display data and the process conditions was likewise an important theme.

During commissioning a recheck was al-

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Fig. 5:
Final section and reel of Serang BM4.

Fig. 6:
Great care is taken over examining the quality of a reel spool.

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so carried out on all interlocks. For example faultless operation of the refiner controls in the stock preparation line was ensured, and dependable stock supplies as a function of production regulation by the mixing centre control system. On the board machines, particular attention was paid during this phase to interlocks in the approach flow and wire section. Since the Serang board machines have multiply wire sections with 4-ply couching, interlock complexity is very high. The vacuum system in this wire section is much more sensitive than in a conventional fourdrinier machine, and was likewise checked very carefully.

Last but not least came a simulation test on the web breakage control system – extremely important for startup – and rejects processing. The light barriers were positioned carefully, since any fluctuations in tension leading to web sag must not be interpreted as web breakage. Correct functioning of each stop device also had to be ensured, as well as startup of the correct pulpers with the appropriate dilution water flow. On a line of this length, five pulpers are required for troublefree web feed and adequate flexibility in case of breakage.

Machine startup

The production schedule was agreed in good time with the customer. Initially the intention was to produce uncoated grey board (in three plies) for the customer's spool plant. After a transition to white covered duplex board, coated duplex board was finally to be produced. The production programme was adapted to current market conditions shortly before commissioning, however, in order to commence production of fresh fibre board.

This change made some adjustments necessary in the stock preparation line, but the startup deadline was still met. On February 14, 1996, the first stock arrived on the wires. Adjustments were then optimized in the wet section to ensure a stable web transfer to the dry section.

Right from the outset of production, great importance was attached to automation of the basis weight and moisture control systems. The process/operating control system supplier rapidly carried out scanner adjustments, at the same time calibrating basis weight profile regulation in the machine direction by continuous consistency measurements in each line. Particularly in the stock preparation line, a large number of consistency control devices indispensable for correct product regulation had to be calibrated. In view of the rejects produced during startup, care was taken that these were not fed back too thinly to stock preparation.

This early optimization resulted in extremely stable operation of the board machines, certainly also one of the benefits of a concept without yankee drier. After producing grey board and white covered uncoated duplex for two weeks, production was changed to coated grades. The first laboratory test results confirmed excellent product quality.

Optimization of board machine settings

The optimization work carried out during the next few weeks served on one hand to increase production output, and on the other hand to enhance board quality still further. Here again, close cooperation with the customer ensured that any adjustment changes necessary were carried out straight away, with immediate availability of results.

Machine operation was extremely smooth right from the beginning. Hardly any stoppages occurred, neither due to electrical nor mechanical causes. Only three months afterwards, web breakages were

Fig. 7:
Production manager Tsai Chuen Hsin (3rd from the left) with some members of the startup team.

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limited to about once every two days. The detailed statistics kept by the customer allowed systematic optimization of web breakage frequency.

Production was then adapted continuously to market demands, and in July 1996 the guaranteed production output of 650 t/day was exceeded for the first time. Product qualities always complied with the customer's specification.

BM3 startup

During the optimization phase on BM4, assembly work on BM3 had been completed, and loop tests and functional trials had already commenced. The unusual case of two almost identical board machines in the same line proved very advantageous here both for the erection team and test engineers. The few changes required to hardware and software were soon completed, and the revised function plan thus allowed a considerable reduction of testing time. The pre-optimized stock preparation line, already tested with water, was now started up with waste paper furnish. Of considerable benefit here was the existence in the same mill of another machine using waste paper, which during the test phase was supplied by the new stock preparation line. Stable stock supplies to the BM3 machine were therefore ensured easily.

The customer's operating personnel received excellent training on the BM4 machine, and a number of shift leaders were transferred to BM3 during startup of this machine.

These optimal conditions led to an exemplary startup of the second board machine – only 45 minutes after stock feed release, board was already being produced, which greatly impressed the customer. The outstandingly successful commissioning of the Serang board production line thus shows once again the enormous importance of first class cooperation between customer and supplier.

Gap Former Technology:
No. 26 DuoFormer CFD installation a success

Consolidated Papers, Inc.'s Biron Division's No. 26 paper machine is already manufacturing a first-line product following the installation of a DuoFormer CFD that was completed in only 18 days.

The gap former rebuild was originally scheduled to take 30 days. Effective planning and outstanding efforts by crews involved trimmed 12 days from the proposed schedule, resulting in major savings on the project. On March 7, stock was on wire and on March 8, the machine officially started up.

James R. Kolinski, Vice President, Manufacturing Consolidated Papers, Inc.

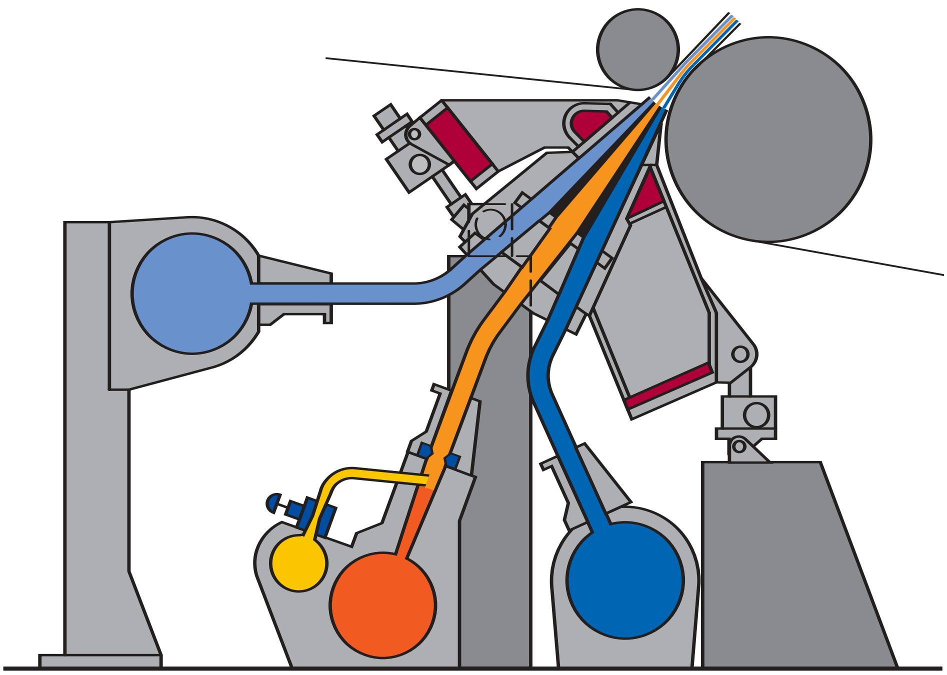
Roger L. Wangen, Division Manager Biron Division Consolidated Papers, Inc.

"It was a phenomenal job by everyone involved in the No. 26 rebuild and gap-former project, including engineers, drafting, construction, members of the yard and support departments, transfer employees, maintenance crews, No. 26 production employees, our purchasing department, vendors and suppliers, the Voith Sulzer team and contractors on site," said Jim Kolinski, vice president, manufacturing. "Other divisions sacrificed to support us with their crafts people. Thanks to everyone who had a hand in this project. It's a stellar, outstanding, world-class effort."

"The prework, installation and start-up was outstanding," noted Roger Wangen, division manager. "The entire project was a success – the first day the coaters were on, we were shipping salable paper."

The paper quality from the gap former is excellent, according to Ken Lepinski, No. 26 superintendent. There is still some fine-tuning to be done on the machine, but it is already providing great results. "The ModuleJet headbox is giving us an outstanding profile," Lepinski said. "From the start-up we've been selling the paper as a first-line product."

Paper Machinery Divisions:
New applications in multilayer technology



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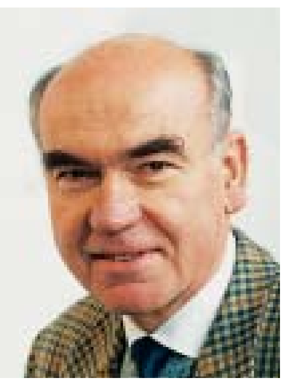
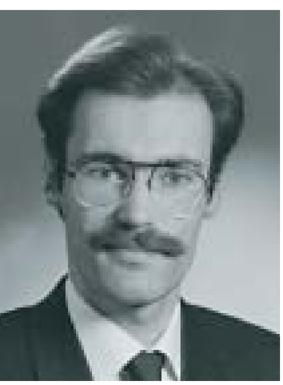




The authors:
Dr. Elmer Weisshuhn, Paper Machine Division Board and Packaging, Headboxes.
Ulrich Begemann, Paper Machine Division Graphic, Headboxes.

Multilayer formation with several headboxes and wires is state-of-the-art at the present time for board and packaging paper production.

In this connection, the intensive research work carried out by Voith Sulzer Paper Technology in close cooperation with customers has resulted in far wider applications of multilayer technology over the last few years (several pulp grades in a single headbox).

Voith Sulzer Paper Technology now markets a range of interesting new designs, suitable for a wide variety of furnishes and paper qualities as well as meeting specific customer needs.

A complete report on all these innovations would exceed the scope of this article, which is therefore limited to a basic discussion of hydrodynamics in modern multilayer headboxes.

Multilayer headbox design

Fig. 1 shows a 3-layer headbox with ModuleJet consistency control for a CFD gapformer. Up to three different pulp grades can be fed to the headbox through the large-diameter headers. If a symmetrical sheet structure is required, the two outer pipes are fed with the same kind of pulp, the lower grade pulp generally being fed through the middle pipe.

The headers are often connected to the headbox by flexible hoses. This not only makes the headbox more accessible, but also dispenses with the need for inlet and outlet compensators in the headers. Alternatively, the headers can be directly

Fig. 1:
Schematic arrangement of a 3-layer headbox.

Fig. 2:
2-layer headbox for board and packaging papers.

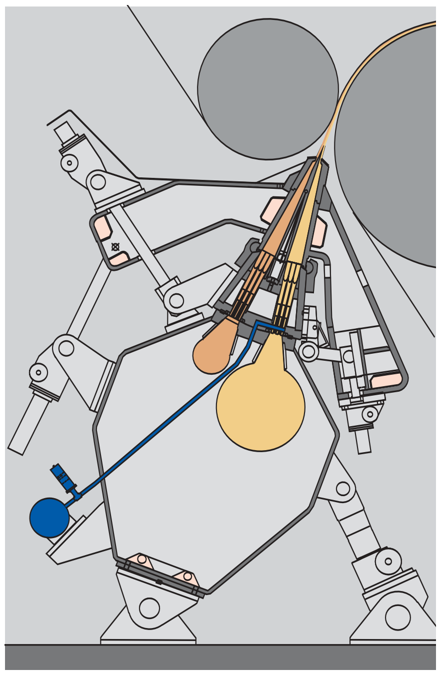
flanged to the turbulence generator, thus resulting in a very compact headbox arrangement with good accessibility.

All multilayer headboxes can be swivelled in the same way as single layer headboxes for adjusting the jet impingement angle.

At the outlet of the turbulence generator, two lamellas divide the nozzle into three separate flow channels. The end of each lamella comprises a sandwich structure made of carbon fibre reinforced plastic, with zero thermal expansion coefficient. This ensures invariable dimensional accuracy at different pulp temperatures and is essential for a stable and flat fibre orientation profile.

For board and packaging papers, the type of headbox shown in *Fig. 2* is increasingly used. The headers are installed in a rigid support structure and directly connected to the turbulence generator.

Since the basis weight of high-grade liner has to be kept as low as possible, the ModuleJet layer usually makes up at least 50% of the total basis weight. This is enough to allow optimization of the total basis weight cross-profile by varying that of one layer only. In addition to its general benefits, the use of consistency control on multilayer headboxes producers one more advantage: the uniform jet thickness for the liner, which is very impor-



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tant for good coverage, is not spoilt by slicer bar deformation due to cross profile control.

The headboxes shown here are a typical selection, taken from the wide variety of designs required for meeting all the different needs of two and three layer technology for board and packaging papers, tissue and graphic papers.

New developments in multilayer headbox design

Multilayer product quality depends far more on correct headbox design than single layer products.

Main quality criteria:

- Good coverage for a given basis weight of the liner
- Bond
- Tensile ratio
- Formation
- Stock consistency and throughput range
- Speed range

Latest achievements in multilayer headbox development:

- Significant reduction in minimum basis weight required for good coverage
- Operating speed rise of multilayer machines to about 1200 m/min
- Production at overall basis weights up to 300 g/m^2 on Gapformers

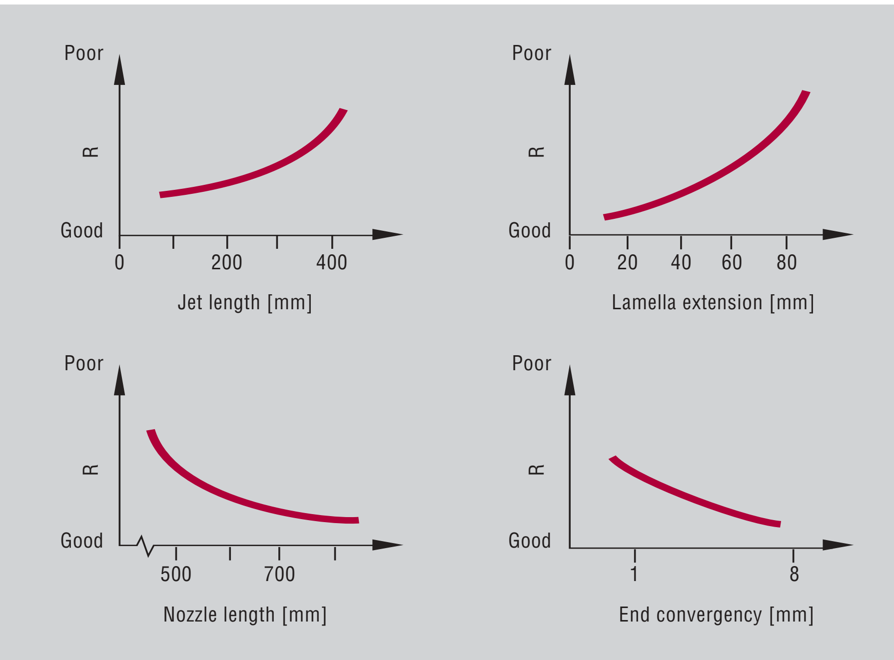
Thanks to intensive cooperation between customers and manufacturer, and simultaneous development work on several Voith Sulzer Paper Technology facilities in Ravensburg and Heidenheim, a good many product-specific solutions have been implemented in a relatively short time.

These paper machine test facilities are equipped with headboxes allowing easy modification of the type of turbulence generator, lamella and nozzle geometry. The headboxes can be operated with one, two or three layers on the Gapformer.

The first tests on 3-layer production of copying paper in March 1992 resulted in

Fig. 3:
Factors affecting jet quality R on a multilayer headbox.

Fig. 4:
Poor coverage due to unsuitable nozzle geometry.



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unsatisfactory coverage with streaks when using two different pulp grades. During the following months, parameters such as headbox consistency, jet length, nozzle length, lamella geometry and nozzle convergence were checked for their effects on formation, bond and coverage.

Fig. 3 shows the jet quality of a multilayer headbox as a function of some of these geometrical parameters.

Fig. 4 shows a 2-layer board sample with poor coverage, which was due to unsuitable nozzle geometry. Another task at that time was to develop a user-friendly headbox control system, allowing adjustment and setting of each individual basis weight irrespective of operating speed and throughput.

During this phase the advantages of consistency control, already known in single layer technology, were confirmed.

As a result, good fibre orientation and basis weight profiles were also achieved with the ModuleJet in multilayer headboxes.

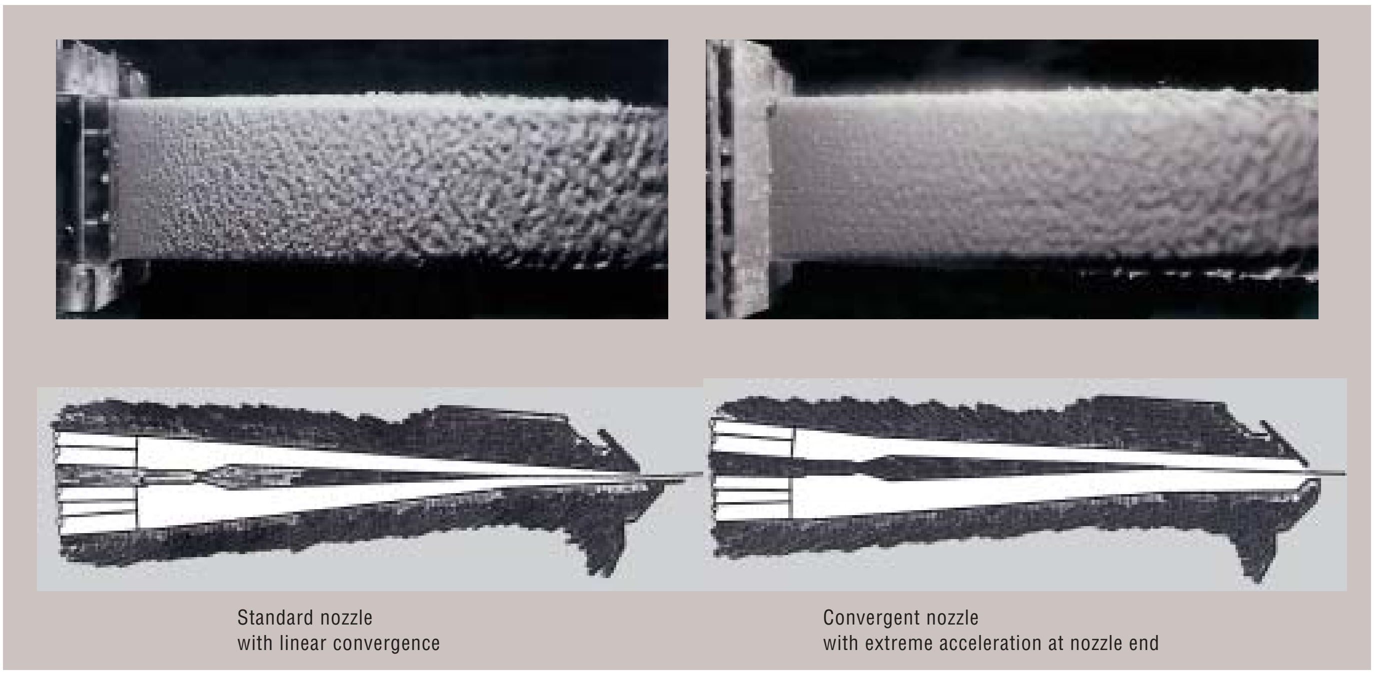
Here again, the essential prerequisite for a flat fibre orientation CD profile is an absolutely parallel gap. In other words, the flatness of the lamella ends is just as critical as that of the apron.

Since formation and coverage characteristics are often a direct function of jet surface structure, some jet pictures taken on a 120-mm-wide pilot headbox are shown here.

Fig. 5 shows the influence of nozzle convergence on jet turbulence, and *Fig. 6* that of lamella length. On the left hand side of *Fig. 6* the jet spraying effect caused by excessive wall friction is clearly visible. Increasing jet turbulence causes harder formation, and after exceeding a critical limit the result is poor coating. Long lamellas, which would otherwise seem desirable for better layer separation, are therefore not such a good idea after all.

Fig. 5:
Jet surfaces with different nozzle convergences on a test headbox.

Fig. 6:
Jet surfaces with different lamella lengths on a pilot headbox.



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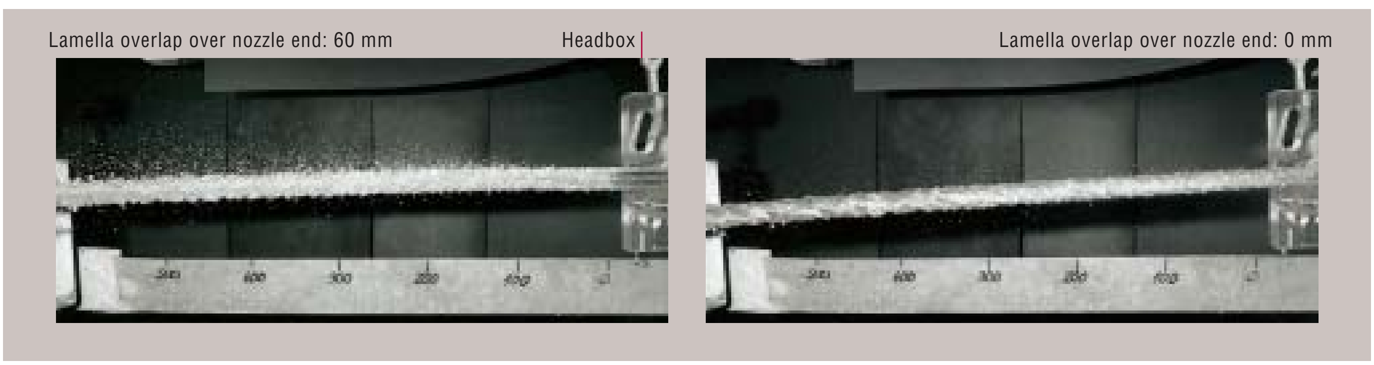

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The time exposure in *Fig. 7* shows the jet surface of a pilot headbox fitted with one lamella. The right hand side of the lamella has an optimized tip in CFRP sandwich construction, while the left-hand side has a 0.5-mm-thick tip. *Table 1* indicates the large number of Voith Sulzer Paper Technology multilayer machines commissioned during recent years alone, which also operate with multiple stock grades.

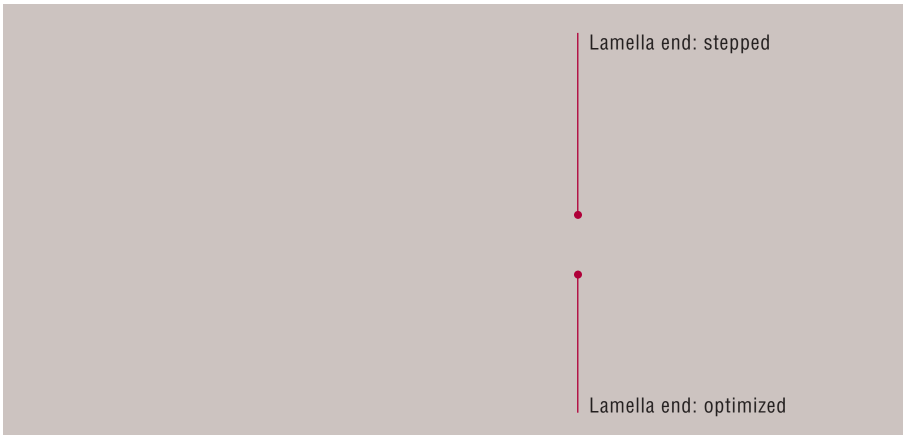
Development work has likewise been underway for some time now on the multilayer production of SCA papers, the object being to enrich the filler on the sheet surfaces. As shown in *Fig. 8,* the desired effect is much more pronounced than on single-layer sheets produced under optimal operating conditions.

Summary and prospects

Multilayer technology for board and packaging papers has now reached a high level of sophistication, and numerous

Fig. 7:
Jet surfaces with different lamella end geometries (time exposure on a pilot headbox).

Fig. 8:
Filler distribution in SCA paper produced on a multilayer headbox.



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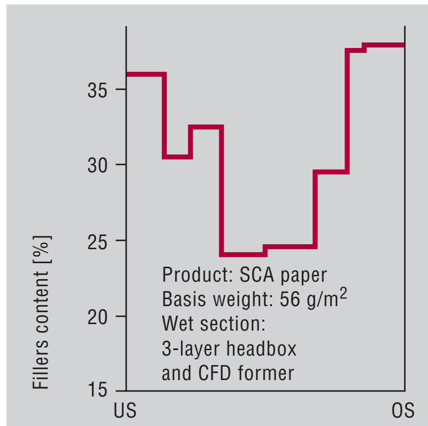

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Date commissioned	Company	Web width [m]	Paper grade
08/1994	Visy Paper Inc. Sydney 6	2.7	Liner 2-layer
01/1995	Visy Paper Inc. Conyers 12	5.4	Liner 2-layer
01/1995	Willamett Inc. Campti 2	5.4	Liner 2-layer
09/1995	Neusiedler AG Hausmening 6	4.9	Copying paper 3-layer
01/1996	Taiwan Tissue Tien Long	3.8	Tissue 2-layer
03/1996	Visy Paper Inc. Brisbane 8	3.1	Liner 2-layer
06/1996	Industria Cartoria Tronchetti Tronchetti 3	2.8	Tissue 2-layer
02/1997	Visy Paper Inc. New York	5.4	Liner 2-layer
08/1996	KNP Zülpich 2	5.4	Liner 2-layer
12/1996	Cartiera di Cadidavid Cadidavid 2	5.4	Testliner 2-layer Pulp and Paper Europe

production machines have been sold within a short space of time.

With the plants already in operation, basis weights from 80 to 300 g/m^2 can be produced on Gapformers at operating speeds up to 1200 m/min. As shown in *Figs. 9 and 10,* coverage between individual layers is good. Furthermore, investment and operating costs are significantly lower than for comparable multi-ply machines.

On the whole, basis weight and fibre orientation CD-profiles are much better. Moreover, this type of machine is as simple to operate as a single-layer machine.

For effective control of MD and CD strength characteristics, the jet/wire velocity ratio can be adjusted over a wide range.

Multilayer technology for graphic papers

Fig. 9:
Multilayer liner produced on a pilot machine with 2-layer headbox and DuoFormer CFD at 550 m/min and 126 g/m^2.
Top side: bleached chemical pulp, 56 g/m^2.
Back side: unbleached chemical pulp, 72 g/m^2.

Fig. 10:
Multilayer liner produced on a pilot machine with 2-layer headbox and DuoFormer CFD at 900 m/min and 118 g/m^2.
Top side: waste paper/chemical pulp (dyed), 46 g/m^2.
Back side: 100% waste paper, 72 g/m^2.

9

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has likewise reached maturity, but due to their lower basis weights special demands are placed on headbox flow conditions.

Although the use of multilayer headboxes for board and packaging papers, tissue and graphic papers will certainly increase over the next few years, this interesting technology is also subject to limitations, which are currently as follows:

- The minimum basis weight of top layers is around 25 g/m^2 at the present state of development. If this limit is not respected, only a network is formed, but for some applications this is sufficiant.
- Even with separate upward and downward whitewater drainage, inter-layer mixing of the fines and filler in a 2-layer headbox cannot be entirely avoided. This places limits on the maximum possible colour difference between layers.

Development potential in this relatively new field is certainly not exhausted by any means, however. It can therefore be assumed that future will open new application fields besides the classical multilayer technology. As well these applications will overcome today's limits. One example of this is filler enrichment in the surface layers of SCA grades, as mentioned above.

Paper Machines Division:
Brilliant Coating with JetFlow F – data, facts, experience

The number of renowned companies that have decided in favour of JetFlow F is steadily growing. In three Finnish paper mills, six JetFlow F's have recently gone into operation within a few weeks of each other – and all of them meet the customer's expectations in respect of quality and pro-duction. JetFlow F is simply "Brilliant Coating"! Reijo Lindholm, head of Production at Enso Publication Papers confirms: "This technology represents a significant step forwards."

The author: Bernhard Kohl, Paper Machine Division Graphic, Coating Technology

For those of you who do not yet know too much about the new process, its principle is explained briefly below.

A precisely controlled thin film of coating color is applied to the paper as a free jet. The film is pre-metered, the required coat quantity smaller and the application more uniform. Operation is cleaner, much faster, and pre-dewatering of the applied film is smoother and more uniform throughout the dwell time. The coating color arrives in a more liquid form at the blade and can be metered better, resulting in an improved coat structure.

JetFlow therefore offers brilliant advantages! What are its benefits? Below are some interesting facts based on practical experiences and opinions received from our customers.

JetFlow F – advantages at a glance

For paper quality:

- Higher gloss
- Better coverage
- Convincing printing result
- Disturbance-free coating film
- Optimum coat weight profiles

For economic efficiency:

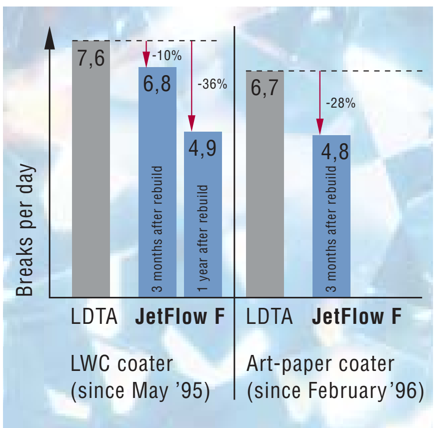
- Less breaks
- Maximum runnability
- More flexibility
- Reduced energy consumption
- Reduced coating color losses

For your production and maintenance team:

- Clean operation
- Less maintenance
- Longer blade life
- Longer roll service life
- No wear parts

What economic advantages does JetFlow F offer?

Maximum runnability
Compared with all other blade coaters, JetFlow F provides significantly higher runnability, which means the efficiency of the complete production line can be increased. With JetFlow F, speeds of 2,000 m/min (6550 ft/min) are a reality.



More flexibility
The free-jet application places no special demands on coating color rheology. The color can be optimized for the paper but does not have to be adapted to suit the applicator. JetFlow F is suitable for all customary coating colors and paper grades.

Users' experience:
"An optimization potential with regard to coating color formulation was reached due to the significantly lower color thickening and new degrees of freedom with respect to color rheology."

Fields of application...proven successfully		
Base paper		
-wood-free	g/m²	40-140
-wood-containing	g/m²	24-290
Coat weight	g/m²	4-20
Speed	m/min	330-2000
Solids content	%	45-70
Viscosity	mPa·s	600-2400
(100 rpm Brookfield)		

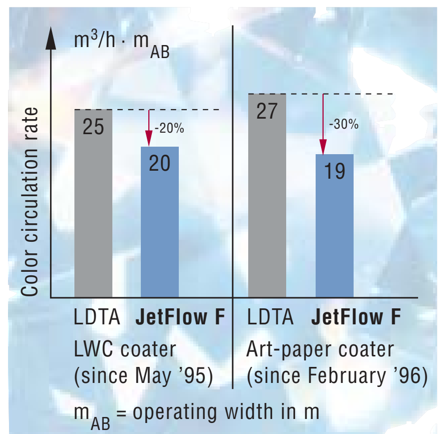
This means savings in expensive retention agents and trouble-free processing of even critical coating colors.

Reduced energy consumption
JetFlowF can operate with a higher color consistency. That saves energy. In addition, the color circulation rate is low and color thickening is reduced. JetFlow F therefore cuts operating costs.

Minimum thickening:

"Today, color thickening at Coater 1 has been reduced by 50 to 70 per cent, and at Coater 2 it is almost zero. It is therefore possible to operate with higher solids contents which is, among other things, beneficial to paper quality. In addition, the previous speed limit due to the drying limitation of the coating machine was distinctly increased for several grades."

Reduced color circulation rate:



Not only the lower color circulation rates but also the smaller color losses during cleaning reduce operating costs.

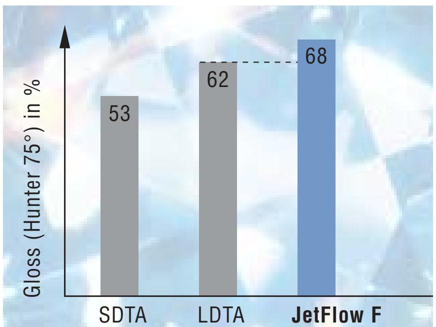
Users' experience:
"Color losses on breaks are significantly reduced. Prior to the rebuild we lost about 300 l of color with each break, emptying the color pan, whereas 100 l at the most are now lost with the nozzle applicator. Based on 5 breaks per day, this corresponds to a reduction of approx. 1 t of color loss per working day."

"The total waste water losses could be distinctly reduced due to fewer breaks and the reduced color circulation rate."

How does JetFlow F improve your paper?

Higher gloss

The free-jet application ensures a better-structured alignment of the pigments. The surface is more closed and has a higher gloss.



Results with LWC offset
40 g/m² + 2 x 10 g/m² coat application
at 1500 m/min.

Better coverage

The free-jet film provides a visibly more uniform coverage of the fibers.

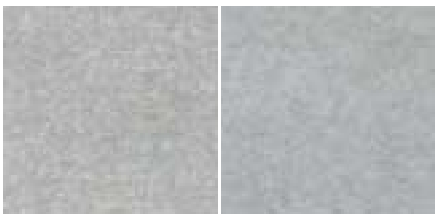
JetFlow F

LDTA

Convincing printing results

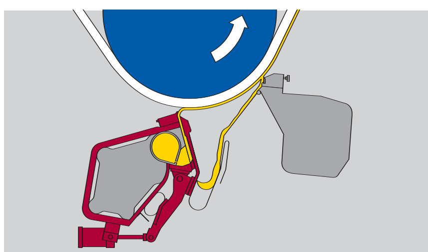
Our customers say: *"Experience with our new JetFlow F coater in the ULWC/LWC rotogravure sector shows improved printability of our high-quality papers."*

"We can save co-binder, as the JetFlow F produces an improved coating holdout."



Disturbance-free coating film

The coating color is applied without turbulence or film splitting, thus eliminating associated quality defects.

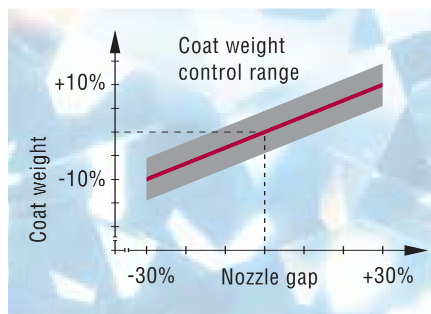


Users' experience:

"After installation of the JetFlow F, flickering streaks in the coating layer have been eliminated. The color rate setting is reproducible. Barring on the blade is a thing of the past. The result is an extremely homogeneous and uniform coat application."

Optimum coat weight profiles

Coat weight profiles can be controlled. With the innovative Profilmatic* F the profile is controlled before the coating color even reaches the paper. Something no other system can do.



As profiling is not done by the blade, the blade tip angle remains constant. Bleeding and non-uniform blade wear are reduced. This is extremely beneficial for high coat weights.

1 Jet
2 Nozzle
3 Color application
4 Color return

What are the advantages for your production team and maintenance?

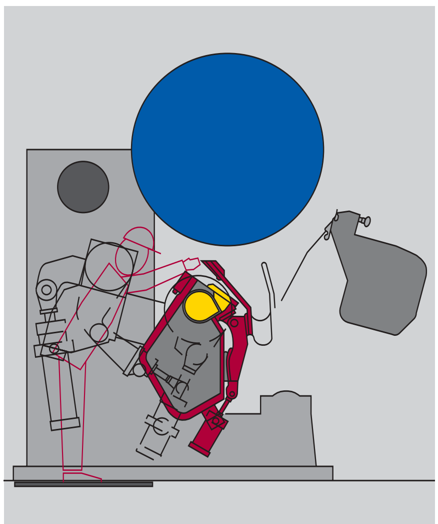
Clean operation
The compact JetFlow F nozzle produces a closed film, the coater stays clean. Splashing, misting and troublesome coating deposits are a thing of the past.

Users' experience:
"Cleaning of the system has become considerably easier and faster since the installation of the JetFlow F. Compared with the LDTA used earlier, there is no cleaning of the lead-in roll or a color pan."

"In the past, the edge deckles were very sensitive to contamination and deposits. The result were often breaks due to edge cracks, whereas the integrated edge deckles of the JetFlow F remain clean and are wear-free."

See for yourself. During a visit to a reference installation, the users of JetFlow F will certainly pass on their experience.

Less maintenance
JetFlow F has no wearing parts. Nothing has to be replaced continuously. Only the nozzle needs to be cleaned from time to time. And this is fast and easy.



The nozzle can be rotated towards the user and opened for cleaning. Experience has shown: *"The nozzle is cleaned regularly every 4 weeks."*

Longer blade life
The coating color gets to the blade in a more liquid form, reducing blade loading and increasing blade life. Advanced deckle adjusters minimize blade edge wear which also contributes to longer blade life.

A production team: *"We have never seen such a clean edge system before. The clean, exact coat edges are a great advantage. They can be adjusted remotely. The wear- and contact-free edge deckles do not stress paper web or backing roll."*

Longer roll life
The clean edge deckles inside the nozzle of JetFlow F prevent premature wear in the edge zone of the backing rolls.

Users' experience:
"After the installation of the JetFlow F, the service life of backing rolls has increased from 6 to 10 months."

Finishing Division:

Econip – a new generation of deflection compensating rolls

The author:
Nigel Ashworth,
Finishing Division

Established for over 30 years, the single zone, deflection compensating roll accepted by papermakers worldwide and known generally as the Swimming roll, has been manufactured at the Manchester, England plant of the Voith Sulzer Finishing Division.

Over 3600 of these rolls have been supplied to satisfied customers throughout the world. Without exception they all operate successfully in most sections of the paper machine including the wire part, press section, breaker stack and finishing calenders. Roll sizes and parameters produced over the years have, of course, varied tremendously with some of the more notable ones shown below *(Tab. 1)*.

During the last few years many improvements have been made to the Swimming roll offering greater flexibility, improved operation and extended service life. It is these important developments which have initiated this new generation of rolls known simply as Econip, a name which more accurately reflects their relevance to today's papermaker and which compliments the already well established NIPCO roll.

The standard Swimming roll principle is well known. This new generation of rolls has been developed from the standard design and falls into three main categories all derived from the same principle.... Econip-TC, Econip-X and Econip-L. A fourth and ultimate roll incorporates features from two of the main versions and will be marketed as Econip-LX.

Installing an Econip roll gives enormous benefits to the papermaker which become obvious once a more detailed examination of the new roll designs is made.

Table 1:

Largest diameter:	1300 mm	Press roll supplied to Tampella Espanola, Spain
Longest face width:	9550 mm	Calender roll supplied to Abitibi Paper, Iroquois Falls, Canada
Highest pressure:	1050 KN/m	Flexonip press roll supplied to ThaiKraft, Thailand
Fastest Speed:	2286 m/min	Tissue combining calender supplied to Fort Howard, USA

Econip-TC

The Twin Chamber (TC) roll is the only roll currently giving extremely accurate control in high speed, low lineforce applications. In tissue combining, where bulk loss must be kept to an absolute minimum, this is a vital consideration. These very demanding machines typically operate at speeds approaching 2300 m/min and down to virtually zero lineforce!

A conventional single zone roll is outside its design parameters under these conditions. Research has shown that controlling very low oil pressure (0.1-0.2 bar) in one zone is impractical. It was also found that as the roll speed was increased, a pressure wedge of oil formed behind one of the seals. This overcame the loading on the seal lip with a resultant loss of pressure in the zone.

The simple answer was to add a second zone. This works in the opposing direction with the differential pressure of the zones giving the required crown.

More manageable pressures can be employed which at the same time exert sufficient force on the seal to overcome the pressure wedge *(Fig.1)*.

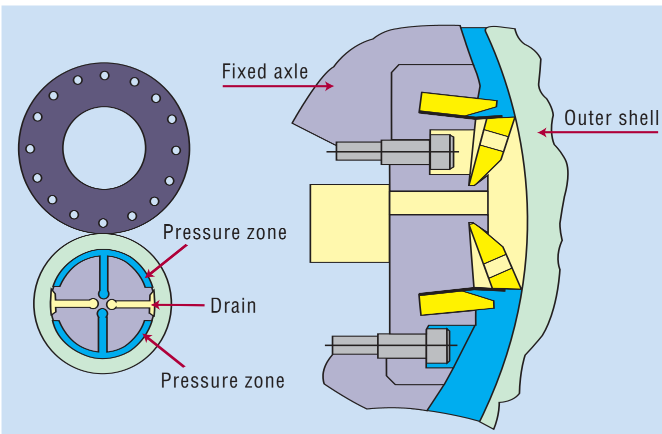
Fig. 2 clearly shows the shaft assembly with two sets of sealing elements before fitting into the roll shell. A further application of the Twin Chamber (TC) rolls in the intermediate position of newsprint

Fig. 1:
Sealing system of the Econip-TC roll.

Fig. 2:
Sealing elements of the Econip-TC.

Fig. 3:
Econip-TC roll in a newsprint calender.

Fig. 4:
Principle of the Econip-X.



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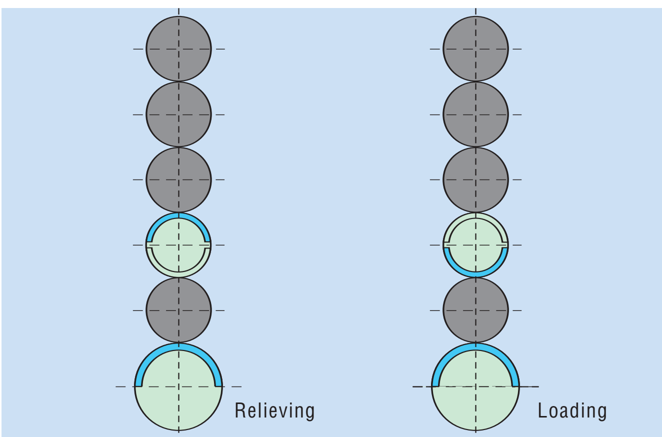

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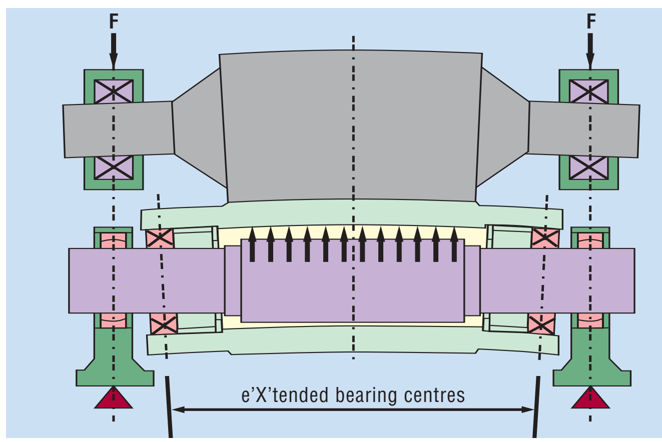

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calenders where additional loading or relieving of pressure is required *(Fig 3)*.

Econip-X

The e'X'tended roll is a simple but extremely effective design concept. By extending the shell length and positioning the internal end bearings closer to those of the opposing roll, an improved bending line of the two rotating bodies can be achieved *(Fig. 4)*.

Finite calculations show a significant improvement in lineforce distribution using an e'X'tended roll *(Fig. 5)*. This single nip example taken from a Brazilian paper mill project shows that a standard Econip roll was calculated to give a deviation of 11.2 KN/m whereas the Econip-X roll gave a deviation of only 4.01 KN/m.

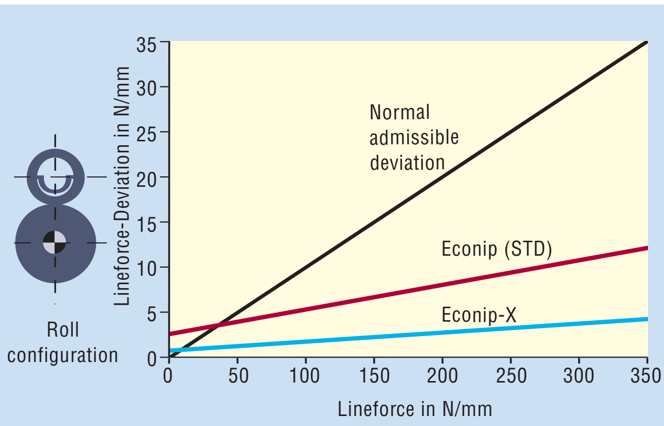
These improvements also benefit the papermaker at low lineforce levels by extending the acceptable machine operating range. These maximised benefits include a more uniform sheet finish and extended roll regrind cycles.

Econip-L

The LoadContRoll (L) is a state-of-the-art system developed for use in Janus and Supercalenders and will identify any disruptive forces arising in the calender roll stack and eliminate them by automatical-

Fig. 5:
Lineforce-Deviation of Econip rolls.

Fig. 6:
Econip application with LoadContRoll System.



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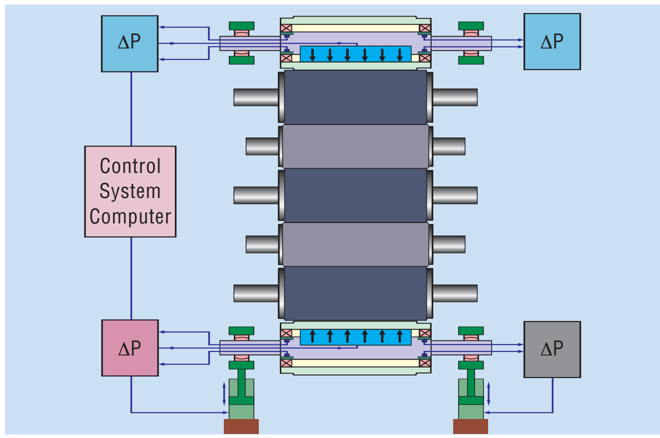

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ly regulating pressure in the Econip rolls. This concept with Econip-L rolls installed in both top and bottom positions is shown in *Fig. 6*.

Continuous monitoring also means that when rolls are changed in the stack, oil pressure in the Econip rolls is optimised for the new stack weight. Hydrostatic measuring devices situated underneath the roll shell end bearings measure the forces acting on them. The force on each bearing equals zero when the lineforce and the Econip roll oil pressure are in equilibrium. Any force disturbing the balance between the internal roll pressure and the lineforce acts as a reactive force on the roll bearings which then leads to a worsened lineforce distribution in the nip.

Excessive external loading induces a reactive force at the bearings which results in an increased compression at the roll edges. Likewise vice versa excessive internal roll oil pressure will lead to a relieving of pressure at the roll edges. Errors such as these would be compensated for by the LoadContRoll system which has a measurement range of 10% of the total nip force.

To summarise, the Econip-L roll senses disruptive forces, balances them to zero by means of the computer control system and automatically gives the optimum lineforce distribution under all operating conditions.

Econip-LX

The ultimate design combination giving the extensive benefits of both the Econip-X and Econip-L rolls is designated Econip-LX. This roll provides both improved lineforce distribution and bearing load sensing and is readily built into deflected nip Janus and Supercalenders.

General

For press section applications, the Voith patented Vibrosoft vibration dampening system can also be engineered into all Econip rolls.

A new development currently under test is the Thermo Econip roll. Further details will be available and completion is planned for the end of 1996.

This continuous programme of design and development enables the Finishing Division to offer an unrivalled range at deflection compensating rolls built to meet the ever-increasing demands repeatedly asked of technology today.

Service Division:
GR* cover – next-generation performance leader

1

In the late 70's and early 80's it was evident that the paper industry needed a replacement for their granite rolls. There were several rolls which had failed in operation, and in some cases had caused injury and death. Furthermore, the industry was beginning to use increasingly abrasive fillers in larger quantities, increasing roll wear and reducing time between grinds to an unacceptable level. Finally, higher machine speeds combined with higher loading in the presses created severe vibration and wear problems for the granite roll. These safety and operational issues were the impetus for industry to examine granite roll alternatives. In one case, a group of five Swedish paper mills formed a task force called the Granite Roll Group (GRG). This group had a goal of finding and promoting the best working and most safely reliable press rolls for large, high-speed machines. The GRG carried out several years of intensive study, with trials of various rolls conducted under operating conditions in production paper machines.

In 1990, the GRG ended their organization, but their work has been published and pre-

The author:
Paul S. Haller,
Service Division

sented on several occasions. Earlier this year, an update on the state-of-the-art in granite replacement rolls was presented by a member of the GRG, Hans M. Ericsson, former Chief Engineer at Holmen Paper in Hallsta, Sweden. Entitled “Man-made Press Rolls,” the paper was presented to the Swedish Association of Pulp and Paper Engineers in Stockholm, Sweden during SPCI-96, World Pulp & Paper Week.

In his presentation, Ericsson describes the history of both synthetic resin covers and ceramic rolls. By 1991 there were around 60 synthetic resin covers in operation among 13 surveyed mills in Europe. These rolls exhibited acceptable vibration and wear characteristics, and although several cover failures occurred, none were of catastrophic proportions. Some of the cover failures were repaired at the mills, while others required a complete roll recovering.

Wood resin, chemical additives and fines were still accumulating on some rolls, and there had been sheet release problems that could only be solved through the use of expensive release agents. Often, the synthetic resin covers were also susceptible to thermal shock, and could not be used in conjunction with a steam box. However, overall, the mills considered the difficulties minor in comparison with the danger of natural granite roll failures. Until 1991-1992, there were few ceramic rolls in operation. The ceramic roll cover’s entry into the market was made more difficult since it was being compared with the synthetic resin covers, rather than the natural granite it was intended to replace. Nevertheless, Ericsson notes that paper machines using ceramic rolls began to set speed and production records across Europe. In North America, Voith Sulzer Paper Technology’s Portland Service Center, having been in the Yankee coating business and on the leading edge of thermal spray technology for 25 years, had also been developing a ceramic press roll cover. Having developed stainless steel coatings for wet felt rolls in the 1970’s, they applied their experience in this area to develop a coating that would not only function, but survive long-term operation in a paper machine press application. The result of this intensive development was the GR® roll cover, a plasma-spray applied ceramic coating.

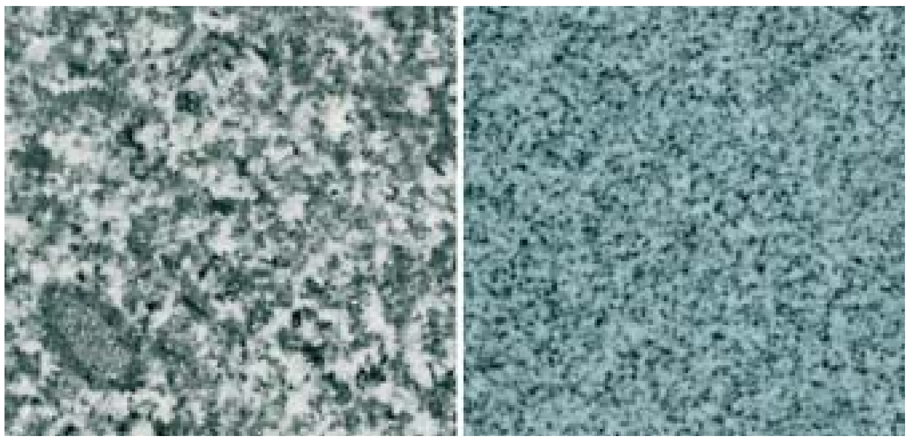

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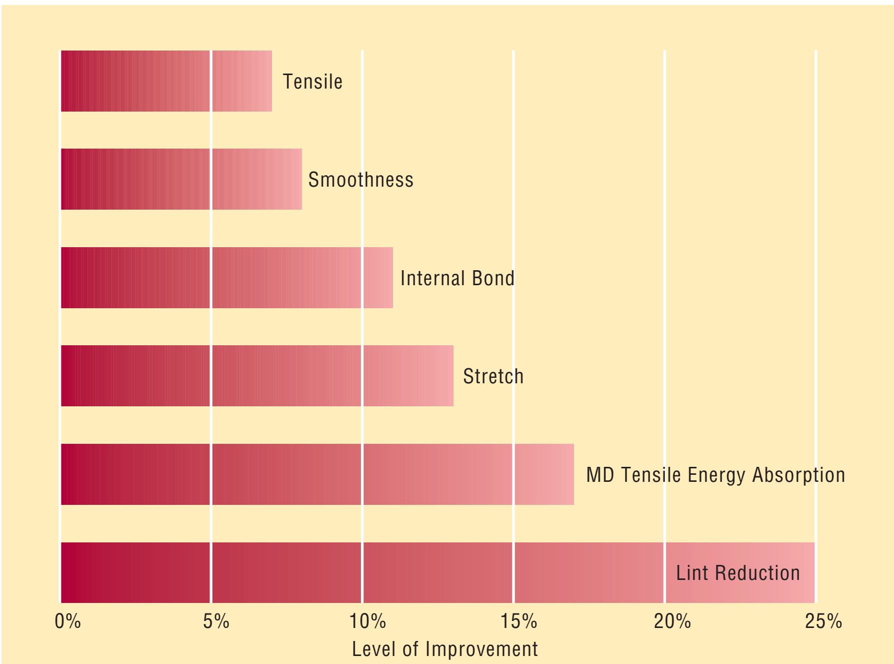
Fig. 1:
Inspection of the completed GR-Cover.*

Fig. 2:
A magnified comparison of the GR Ceramic Cover (right) and granite (left) showing GR´s uniform texture.*

Applying the cover is an exacting process. The roll body is first ground to the correct finished profile. Any locking grooves or shell imperfections are repaired prior to grinding. Once ground, the surface is cleaned and textured to the correct roughness for application of the barrier coating. This coating is then applied using special guns to create a very dense, impermeable corrosion barrier approximately .030’’ thick. This barrier layer enhances the bond characteristics of the ceramic layer while protecting the steel or iron shell from corrosion.

Ericsson notes in his paper that the single documented failure of a ceramic cover (of Japanese manufacture) was due to corrosion of the roll core beneath the applied ceramic cover. He also comments that VSPT’s GR® cover is the only roll cover to have a “corrosion barrier” base layer applied over the original core before the ceramic layer is applied. Once the

Fig. 3:
Paper Quality Improvement



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barrier coating is applied, the GR® coating is applied with a different type of plasma spray coating system to produce a very open porous coating, offering superior release characteristics. This coating is applied with a thickness of .060''.

VSPT's operating experience with the GR® roll cover is exceptional. The firm has produced the GR® cover since 1990 and has never experienced a cover failure. The rugged endurance of the GR® cover is the result of careful application of the corrosion barrier combined with a ceramic layer thicker than most competing covers. This additional cover thickness allows for crown design changes over the life of the roll, as well of the possibility to grind away cover damage resulting from objects passing through the nip. Since the cover has a minimum thickness limit of 0.10'', there is ample material for multiple regrinds. This property becomes somewhat a moot point with GR® rolls operating up to six years without a regrind. One such roll has been inspected twice during that time, once at one year and one at four years, and there were no detectable differences in diameter or profile from when it was new.

Ericsson discusses several advantages of the GR® cover over other ceramic covers in his report. One is that a single composition of applied ceramic is suitable for all positions on the paper machine and all types of paper. Because the same roll cover can be used in multiple positions, there is greater flexibility in the design of machines and a reduction in the number of spare rolls maintained by a mill. Other ceramic cover manufacturers require different grades and applications of ceramic for differing machine positions. For instance, one supplier requires one coating formulation for heated center press rolls and another for extended nip presses.

Finally, Ericsson comments that the years of experience gained at the Portland facility have been transferred to the other service centers, with VSPT now producing the GR® cover on three continents: at the Service Centers in Portland, Oregon, USA, St. Pölten, Austria, and São Paulo, Brazil. VSPT now has over 65 GR® rolls installed or on order worldwide, used in all plain press roll applications, as well as with variable crown rolls and profile rolls.

To conclude his presentation at SPCI-96, Ericsson summarizes the operating data from 1987-1995, stating that synthetic resin and ceramic covers are at the forefront of press roll technology. With one type of roll for every possible grade of paper and position on the machine, GR®'s wear resistance, durability, coating thickness and ability to withstand high temperatures make it the leader in ceramic roll cover technology.

GR* Technical data

Physical properties:

- Hardness (no nip deformation)
- Color: gray/blue
- Thickness: overall about .090''.
  GR*-layer approx. .060''
- Porosity: 5% to 6% open
  Particle hardness: Approximately 9 on a moe scale. Diamond is 10.

Comparison to granite:

- Longer life between grinds
- Lower vibration
- Reduced web tension over time in most cases
- No safety concerns
- Usable around a steam box
- Not susceptible to thermal shock
  Consistent surface and properties over time.

Comparison to other ceramic covers on the market:

- Larger porosity
- Better release
- Less susceptible to thermal shock
- More cover for changes in crown or for grinding out damage
- Consistent surface properties
- Not susceptible to corrosion or bond failure
- Usable with a steam box
- No special wash water temperature requirements.

Comparison to composite covers:

- No release chemicals required
- Usable around a steam box
- Not susceptible to thermal shock
- Consistent operation
- Surface characteristics do not change
- More durable
- Higher loading capability
- No water cooling required.

	GR
Higher Loading Capability	●
Reduced Vibration	●
Longer Life Between Grinds	●
Not Susceptible to Corrosion or Bond Failure	●
No Change in Surface Characteristics During Operation	●
Useable with a Steam Box	●

Case history one:

Paper machine:

- Fourdrinier, 276'' trim
- Twinver center press
- Two roll third press
- Third press 800 pli, single felt, granite against steel vented cover
- Off machine coaters
- Speed 3900 f/m.

Problem:

- Third press vibration
- Felt barring
- Sheet marking
- Grind frequency on press rolls
- Sheet quality
- Doctoring/holes.

Solution:

Replace the third press granite roll with a cast iron roll with a GR* cover.

Results after 28 months of continuous operation:

- No vibration at press
- Felt life up 25%
- No felt barring
- No sheet marking
- No hole problems due to doctoring
  Excellent doctor blade life (the blades last over two weeks and are changed only during scheduled outages)
- Sheet quality improvements.

Case history two:

Paper machine:

- Twin-Wire Gap Former
- Tri-nip center press
- Newsprint
- Speed 4500 f/m.

Problem:

- Center press
- Release
- Vibration
- Holes
- Breaks.

Solution:

Replace the existing cover on the center press roll with a GR* cover.

Results:

- Draws reduced
- Vibration caused by the center roll eliminated
- Holes and breaks reduced.

CORPORATE NEWS

USA/Germany:
Voith Appleton machine clothing

1

Voith Sulzer Paper Technology is the world's only paper machine manufacturer to operate its own clothing group – Voith Appleton Clothing Group – which currently incorporates five production companies.

The author: Raimund Waberski, Managing Director of Appleton-Pohl

A start was made in 1983 by taking over Appleton Mills, Appleton, USA. This company is now one of North America's leading producers of press felts, with the biggest press felt manufacturing plant in the USA.
Two years later Pohl & Co. of Düren, Germany, were taken over to become Appleton Pohl, who now make press felts and dryer screens for all grades of paper.

A special role is played by Appleton Pohl as clothing supplier for tissue machinery, a field in which the company has achieved technological leadership.

Like the other group members, Binet Feutres of Annonay, France has a long-standing company tradition. Taken over by Voith in 1988, the firm was renamed Appleton Binet in March 1996. Its products are likewise press felts and dryer screens, and this company is one of the leading manufacturers of dewatering felts in particular.

The smallest group member is Binet Sul Liri in Italy, which belongs to Appleton Binet and specializes in equipping paper machines in the narrow size range.

Lindsay Wire, Florence, USA joined Voith Appleton Clothing Group three years ago. This company manufactures forming fabrics and dryer screens and was acquired by Appleton Mills, whose name it now carries. The innovative approach of Lindsay Wire is documented by the numerous patents taken out on its products – some of them exclusive – delivered to reputed tissue manufacturers.

The group is becoming increasingly known in all markets under the common name of Appleton Mills. Together with state-of-the-art production facilities, the collective know-how of some 750 group employees meets the highest demands

Fig. 1 (page 55):
Appleton Mills, USA.

Fig. 2:
Heat setting machine for wet felts and screens.

Fig. 3:
Needling machine.


2


3

Fig. 4:
Principle of flow control felting.

Fig. 5:
Pressure characteristic in a classical roll press.

Fig. 6:
Pressure characteristic in a NipcoFlex press.

for all kinds of paper machinery worldwide.

In Kunshan, China, a new production facility is currently under construction for supplying this rapidly growing paper market with clothings. Here again, the group adopts an unwavering philosophy:

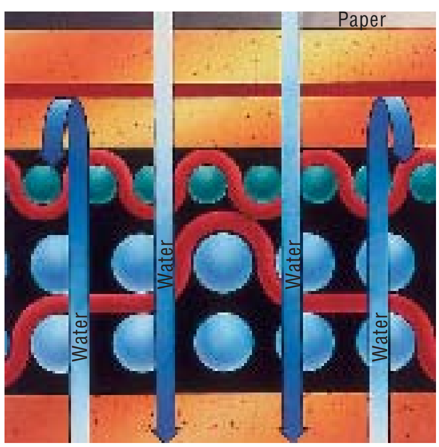
- Full integration in the Voith Corporate Identity.
- Sales responsibility is in the hands of paper engineers trained in applications technology, including specialized servicing, Scan-Tech analyses, vibration measurements and dry section investigations. In other words, sales and servicing are no longer treated as separate fields.
- Group members market the entire range of paper machine clothings, including forming fabrics, press felts and dryer screens, via a common sales organization in their respective areas. There is no competition between group members in the various markets.
- Strict compliance with the rules of total quality management, particularly with regard to environmentally friendly manufacturing methods, leading to early fulfilment of the ISO 1401 eco-audit.
- Manufacturing in each production centre is concentrated in defined phases, thus reaching the highest possible quality standards through specialization.
- R&D activities are concentrated at Appleton Mills, Wisconsin.

At the present time the group is technological leader in press felt production, particularly for tissue-making applications and for third and fourth presses. This leadership has been attained thanks to innovative flow control drainage felts which drastically reduce or prevent antirewetting effects in the press section.

The group has taken out worldwide patents on this product, whose operating principle derives from the sealing effect of a microscopic fibre membrane worked into the felt. This prevents water flow – back into paper after leaving the press nip.

In the same way as a non-return valve, this membrane releases the water when under pressure in the nip, but closes as soon as pressure is released in the press outlet.

This innovative idea was derived from nip pressing theory, according to which the paper drainage mechanism behaves in



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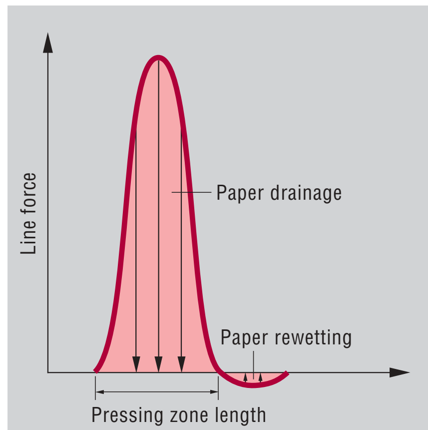
the same way as dynamic pressing in a classical roll press as shown below:



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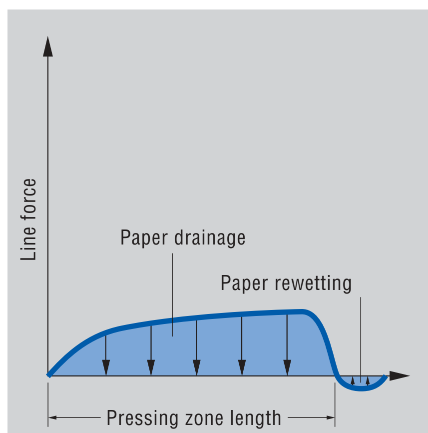
The drainage mechanism in a NipcoFlex press is as follows:



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Assuming appropriate selection of the other felt parameters, the result is without exception an increase of 0.5% to 2% in dry content, and less felt contamination.

Germany:

Board and packaging pilot paper machine upgrade – facing the future with versatility

1

Higher, better, further: these were the Olympic-sounding targets of extensions completed last September to our board and packaging pilot paper machine in the Ravensburg R&D centre.

Higher means raising the limits on customer trials and system tests, thanks to shorter setup times and greater flexibility. Better means more accurate results, and with the upgraded test facility we can now go further with our technical developments.

The main objects of this upgrade were as follows:

- To allow trials on various sheet formation concepts: single/multilayer and single/multi-ply
- Greater availability through shorter conversion and setup times
- Longer testing times, particularly with multiple furnish operation
- Higher dry content before the press section

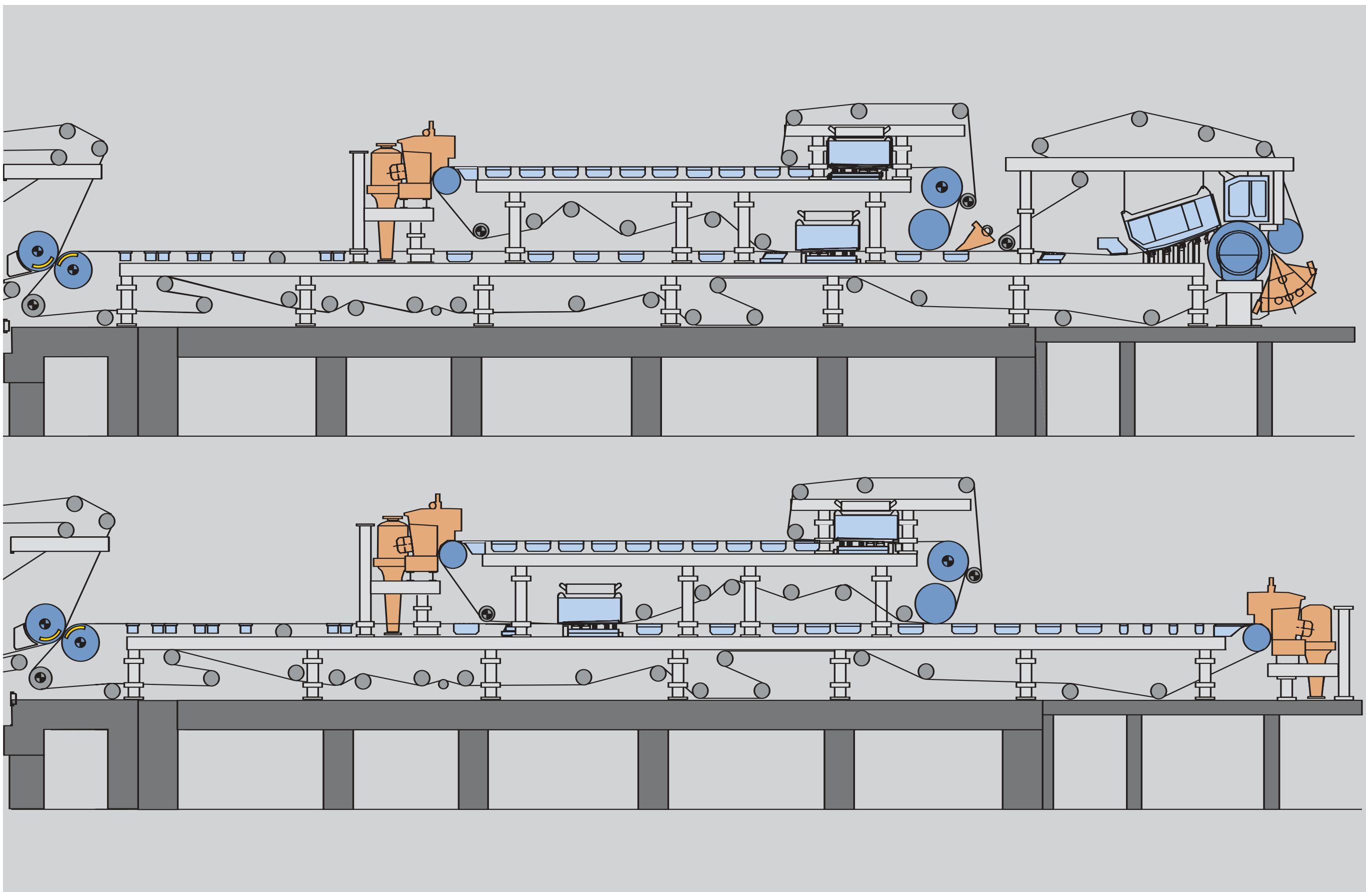
Extension work started in April 1996 by dismantling the existing wire section, after which the machine foundations were completely excavated. This made room for higher vacuum and greater capacity required to increase the dry content before the press section.

The paper machine is supplied with

The author:
Jürgen Prössl,
Paper Machine Division
Board and Packaging, R&D

Fig. 1 (page 69):
Pilot paper machine, wire section.

Fig. 2:
Pilot paper machine, wire section layout.



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stock from three approach flow systems. In the course of the extension stock capacity was increased with three new storage chests. This doubles or triples available testing time in batch operation, depending on the number of different furnishes, and with higher stock capacity, customer trials can now be carried out under even more realistic production conditions. Thanks to the link with the stock preparation division's R&D centre, up-to-date technology is available for optimizing product characteristics over the entire process, from raw materials preparation to finished paper sheet.

Incorporated in the extension is a 2-layer Step Diffusor Headbox for the DuoFormer CFD, whose design allows numerous possibilities for further optimization of all main influences on sheet structuring. These include individual layer separation, stock consistency in each layer, individual jet velocities, and geometrical parameters such as nozzle shape, lamella overlap and turbulence generation.

The new wire section was added *(Fig. 1)* – a cantilever frame design – allows the development and optimization of various different sheet formation concepts.

Fig. 2 shows two examples of possible trial arrangements in this connection:

- A DuoFormer CFD with DuoFormer DK *(top of Fig. 2)*

- A fourdrinier and DuoFormer DK *(bottom of Fig. 2)*

Fig. 3:
Pilot paper machine, press section.

3

The DuoFormer DK can be converted into a DuoFormer D, which can be installed in various positions to allow for predrainage sections of different lengths.

For operating the secondary headbox *(Fig. 2, top)* and running the bottom fourdrinier as a hybrid former *(Fig. 2, bottom),* a further DuoFormer D is available which can likewise be installed in various positions.

The press section after sheet forming allows for testing all the current press concepts applicable to board and packaging paper production. The influence of line force on dry content and technological properties can be tested under realistic conditions, for example using various types of felts. At the time of writing, a DuoCentri 2 press and a NipcoFlex press are installed *(Fig. 3).*

After the press section, the sample sheets or webs are dried on a separate dryer unit. In the up-to-date Ravensburg paper laboratory, stock and sheet samples are tested according to international methods (DIN, TAPPI, SCAN) as well as Voith Sulzer Paper Technology standards. This allows customers to check the suitability of our machinery and components for their products according to the test methods most familiar to them.

Our test recording and evaluation system enables the connection of all main machine and process control data with the respective laboratory figures. This ensures fast and reliable evaluation of test results, which are available to the customer in tabular form on modern data carrier systems.

Important technological parameters, such as plybond and compression strength of multilayer and multi-ply board and packaging papers, can now be optimized more precisely by using the customer's raw materials. Furthermore, trials can be carried out to answer some typical questions as follows:

- How to reduce cover layer basis weight as a function of raw material and formation?
- Sheet structure optimization, single and multilayer/multi-ply – how does it affect strength, properties, coverage and formation?
- How do the fourdrinier, hybrid former and gap former compare with respect to product characteristics?
- Effect of raw material on plybond in and between individual layers/plies?
- Influence of headbox stock consistency, jet/wire velocity and drainage conditions on product characteristics?

The test results supply the necessary data for drawing up guarantees, and indicate possible solutions to troubles arising in practice. In addition the pilot plant also serves as a training facility for commissioning personnel and customers' operating staff.

The substantial investments made by Voith Sulzer Paper Technology in extending the pilot plant reflect the importance we attach to board and packaging paper developments in future.

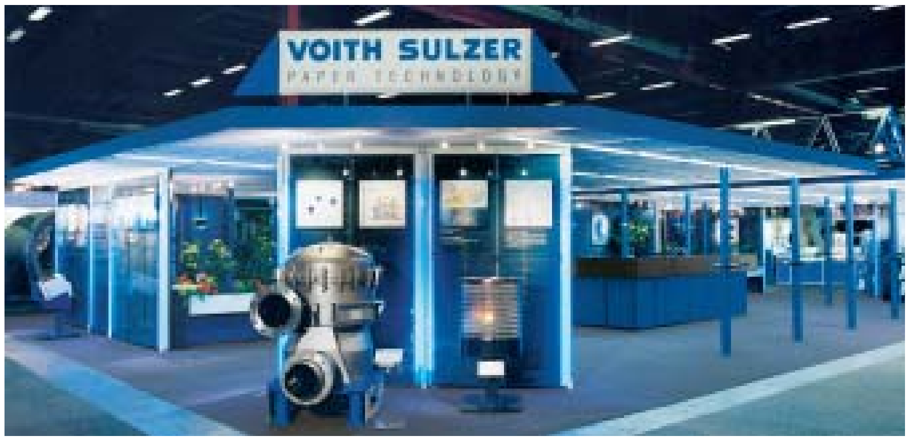
Special awards for innovation and design

Neusiedler Paper wins innovation award with a revolutionary 3-layer headbox and NipcoFlex press.

The first Pulp and Paper Europe Award was recently won by Austrian paper producer Neusiedler AG, Hausmening – for the world's first office paper machine with 3-layer headbox and shoe press.

This has introduced a new era and a completely new type of paper. The innovative technology – known as Triotec® – is the result of intensive research efforts by Neusiedler AG and Voith Sulzer Paper Technology, with more then 1000 joint tests. The new 3-layer headbox now makes it possible to produce 3-ply office stationery made of different raw materials – rather like a sandwich. Each fibre is positioned where its properties are best utilized. And the shoe press specially designed for this purpose allows bulk retention of the 3-ply structure during pressing at high production speeds.

Wolf-Dieter Baumann (left) Managing Director of the Paper Machine Division Board and Packaging, in St. Pölten, Austria, congratulates Director Josef Welsersheimb of Neusiedler AG (right).

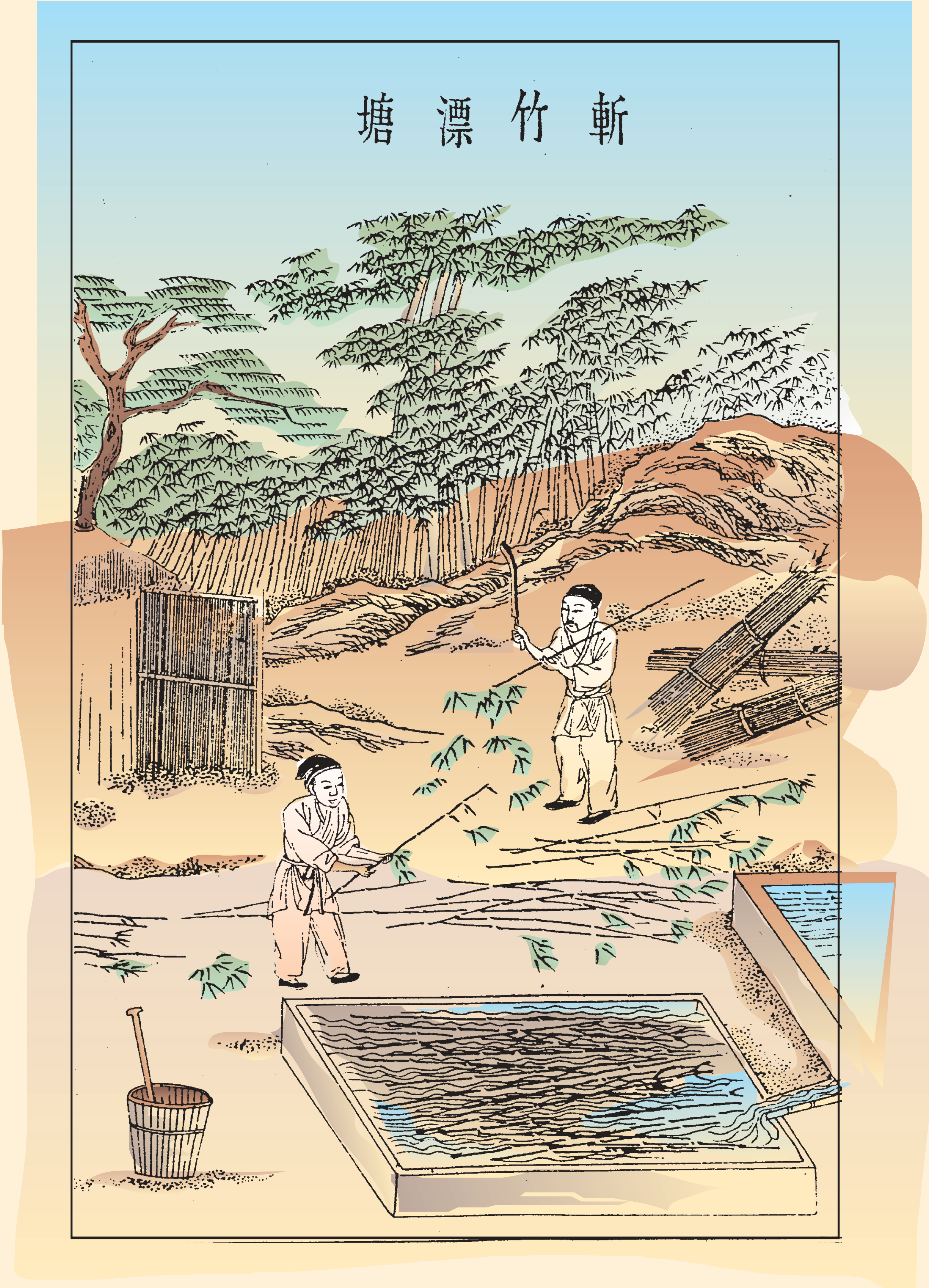


SPCI '96 – impressive presence

The exhibition organizers set two "best stand" award criteria at last year's SPCI: for the most convincing technical presentation, and for the most inviting atmosphere for visitors to discuss and exchange experience. Voith Sulzer Paper Technology's stand – in the new corporate design – met the jury's high standards as one of the best at the SPCI '96. And visitor figures confirmed this vote: the Voith Sulzer Paper Technology stand was a favourite rendezvous – much to the satisfaction of our marketing managers as well as the exhibition "backroom boys", whose design and planning work normally stays behind the scenes.

Advertisement of the year in Brazil

The Brazilian paper, pulp and carton association journal "Anave" has cited Voith Sulzer Paper Technology as best advertiser of the year for 1996. This prize was awarded for the high level of technical innovation and information incorporated in our advertising. According to a reader poll, both text and graphics gave the most convincing impression of product benefits. Edgar Horny (right) of Voith Sulzer Papiertechnik Sào Paulo, was delighted to receive the award from Claudio Vielva, "Anave" spokesman.



1

CHINA

The changing origins of paper – from hand-made to machine-made

According to the National Bureau of Statistics, total paper and paperboard production in China for the year 1995, the last year of the Eighth Five Year Plan, was 24 million metric tons[1], equivalent to a growth of 12,2% over 1994. Yet, for a population of 1211 million in the country, this amount of machine-made products, plus around 200,000 metric tons of handmade paper and an additional 3 million metric tons of imports, would mean only about 22 kilograms percapita consumption, far behind the world average of close to 48 kilograms.

It took the Chinese hundreds of years to switch over from handmade paper practices to machine-made production. And tremendous efforts had been undertaken by the Chinese papermakers, especially during the last half of this century, to keep pace with the developments in the global paper circle. It has been most gratifying for the Chinese, therefore, to have found that their efforts had at last brought the Chinese paper industry ranking third place among the major paper producing countries in the world, right after the United States and Japan.

There is no doubt that more and more paper and paperboard will be needed in the future years to satisfy the everlasting growth of the national economy. Chinese papermakers are well aware of the burden on their shoulders to meet the challenges in the coming centuryspan period.

Handmade Paper

It has been unanimously acknowledged among paper historians that the art of papermaking was originated in China[2]. Ts'ai Lun, an eunuch in the Imperial Court, was given cred it for the invention of the art of papermaking. It was said that Ts'ai Lun presented the very first sheets of paper in the world to Emperor He of the East Han Dynasty (25-220 A.D.) in the year 105 A.D. At that time, Ts'ai Lun happened to be the official in the charge of the Imperial Workshops for making almost all major necessities of the Imperial Court, from daily needs to weapons. As recorded in the history of Ancient China, Ts'ai Lun was awarded the honorary title of Marquis for this particular achievement in the art of papermaking. And, for a rather extended period of time, paper made following the method practiced by Ts'ai Lun was named by the public as "Paper of Marquis Ts'ai".

"Paper of Marquis Ts'ai" was so very much applauded by the scholars of the time that the art of papermaking began to spread to many parts of the country to satisfy the need of scholastic circle, aside from supplying the governmental officials. This eventually led to an end of writing on heavy and clumsy wooden strips and bamboo slips. Scholars at the time were very pleased to have paper available at a cheap cost, and writing on expensive silk cloth was eventually being abandoned.

In the advent of years, during the spread of the art of papermaking in the country, a number of important achievements were being claimed. Among them, there were a couple worth mentioning. The first one was the exploitation of new fibre resources other than those used in Ts'ai Lun's time. It turned out that, besides bark, flax, rags and used fishing nets exclusively used in the early days, successful attempts were reported for making paper with

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J.M. Voith Beijing Representative Office.

Fig. 1 (page 74):
Traditional Chinese papermaking with bamboo, showing how the bamboo rods are supported and soaked in pure water.

rattan, bamboo, paper mulberry and others. The second major achievement of interest was the use of bamboo screens in place of linen cloth as a dewatering medium in web forming.

Paper historians beiieve that there were several eras of prosperity in the growth of handmade paper in the country. It was said that from the later years of the fifth century to the seventh century, dyeing, sizing, surface coating, and, possibly, calendering of paper were being developed. Such historical recordings were confirmed by contemporary archaeological excavations of relics of paper, identified to be dated as far back as the later years of the East Jin Dynasty (317-420 A.D.). Tang Dynasty (618-907 A.D.) and Song Dynasty (960-1127 A.D.) were regarded as the most prosperous eras of handmade paperproduction in ancient China. It was in the early days of the Tang Dynasty when Buddhism was introduced into the country, and copying of the Buddhist Sutra was very popular.

Later on, people began to have the Buddhist Sutra carved on wooden blocks and printed on paper. The demand for paper was thus greatly increased. Then, type printing, initiated by Bi Sheng of the Song Dynasty and further improved in the subsequent years, had apparently served as another driving force in promoting handmade paper production. It was also known that in the days of the Tang and Song Dynasties, a variety of fancy paper with decorative patterns became very popular among the intellectuals, the poets in particular. Most of these fancy grades were dyed and/or surface coated with attractive coloration.

2

Fig. 2:
Tsai Lun.

Such interests and liking in fancy papers persisted through the years up to the days of the Qing Dynasty (1644-1911 A.D.).

The art of papermaking was inherited and lasted for hundreds of years without any innovative changes in its method of processing. Handmade paper managed to become a big business. It was not until the later half of the nineteenth century when Chinese handmade paper suffered its first impact from imported machine made products.

Handmade paper dealers began to realize that they were not in a position to compete with the less costly and high quality machine-made paper. The situation seemed to get worse and worse every day. A number of handmade paper workshops were forced to close down. The market for printing, writing and packaging paper was almost totally taken over by machine-made paper. It followed that handmade products were forced to confine to such traditional grades as Chinese art paper, Chinese writing paper, window paper, sanitary paper, firecracker paper, fireworks paper, spiritual paper and others. It was reported that total handmade paper production in 1949 was 120,000 metric tons. Then, in the fifties, there was a slight increase in handmade paper production. From the fifties to the eighties, handmade paper production fluctuated between 200,000 to 300,000 metric tons perannum, and seemed to have become stagnant at around 200,000 metric tons since 1988.

It goes without saying that Chinese papermakers value highly the inheritance of this art of papermaking from their forefathers. But they also realize, at the same time, that traditional manual operating process of low productivity will have to give way to highly efficient modern technologies. When machine-made paper began to flood into the market, heavy blows were being experienced by the Chinese handmade paper industry. But, lucky for the handmade paper workshops they had never lost their market in Chinese art paper. They managed to keep their foothold firmly in the Chinese artistic circle. Chinese art paper has always been favored by the Chinese painters and calligraphers. And, among the various Grades of Chinese art paper, Xuan paper bears the highest fame, not only in China proper alone but also in many other countries.

Xuan paper, normally composed of a furnish with refined rice straw pulp and wingceltis, is reputed by its persisting snow-whiteness, excellent receptivity for Chinese ink, superior dimensional stability and indisputable permanency. It has been regarded as the “Precious Rose” of handmade paper in China. It is said that since the later years of the seventeenth century, almost every piece of artistic work composed by famous painters and/or calligraphers was done on Xuan paper. This goes true with contemporary Chinese artists as well.

Presently, the production of Xuan paper is monopolized by the Xuan Paper Mill company, located at Jinxian in Anhui Province. Imitation Xuan and other grades of Chinese art paper, mostly bamboo-based, are also being produced elsewhere in the country. Chinese writing paper, primarily for penmanship classes in schools, constitutes the second major handmade grade.

Other minor handmade products still managed to have a share in the market include firecracker paper fireworks paper, and religious paper. In recent years, decorative napkins are being made in a few workshops, primarily for exportation.

Traditionally, most handmade paper workshops are located in the provinces of Zhejiang Fujian, Jiangxi, Hunan, Anhui and Sichuan, though one can always find handmade paper workshops still operating also in every province in the country.

The art of papermaking

Handmade paper had long been regarded as an important craftsmanship industry in China. It is not surprising, therefore, to notice that the art of papermaking was entered as one important chapter in the volume "Tian Gong Kai Wu", translated as "The Development of Materials and Products Through Workmanship" in English. This is an eighteen chapter volume,

3

Fig. 3: Paper made by the Tsai Lun process.

compiled by Song Xing-Xing in 1637 during the reign of the Ming Dynasty (1368-1644 A.D.). It is a comprehensive collection of written descriptions on the craftsmanship of a number of important products. The volume has been regarded as among the best manuscripts dealing with craftsmanship techniques.

Chapter Thirteen of the Volume is totally dedicated to the description of the art of papermaking. In this chapter, a general presentation of the various vegetable fibres for making paper and method of processing is given, followed by more detailed specific discussion on bamboo-based paper and bast fibre paper, accompanied by illustrations. The basic procedure for making paper, totally manual operating, can be summarized as follows as entered in the chapter.

- Retting of the vegetable fibre, with or without lime, followed by washing in a running stream and whitening under the sun.
- Pounding of the retted mass in a mortar with a wooden or stone peg.
- Dispersing of the pounded mass with water to form a dilute fibrous suspension in a vat.
- Dipping of a mould, with a bamboo screen on it, into the dilute fibrous suspension to pick up a certain amount of fibre plus water.
- Taking out of the mould, held in a horizontal position, form the fibrous suspension.
- Holding of the mould horizontally in the atmosphere and above the vat to allow dewatering from the wet web with momentary vibration of the mould to regulate fibre orientation in the web.
- Transferring of the bamboo screen from the mould to a piece of linen cloth which is previously place on a bottom wooden board, (or, alternatively, onto the top of a wet web pile formed during preceding operations).
- Taking away of the bamboo screen with the newly formed wet web left on the linen cloth. (or, onto the wet web pile).
- Repeating of steps 3 through 8 until the wet web pile reaches a certain desired height.
- Placing of another piece of linen cloth and, then, another wooden board on the top of the wet web pile.
- Loading of weights on the top wooden board to effect further dewatering of the wet webs in the pile.
- Removing of the weights, the top

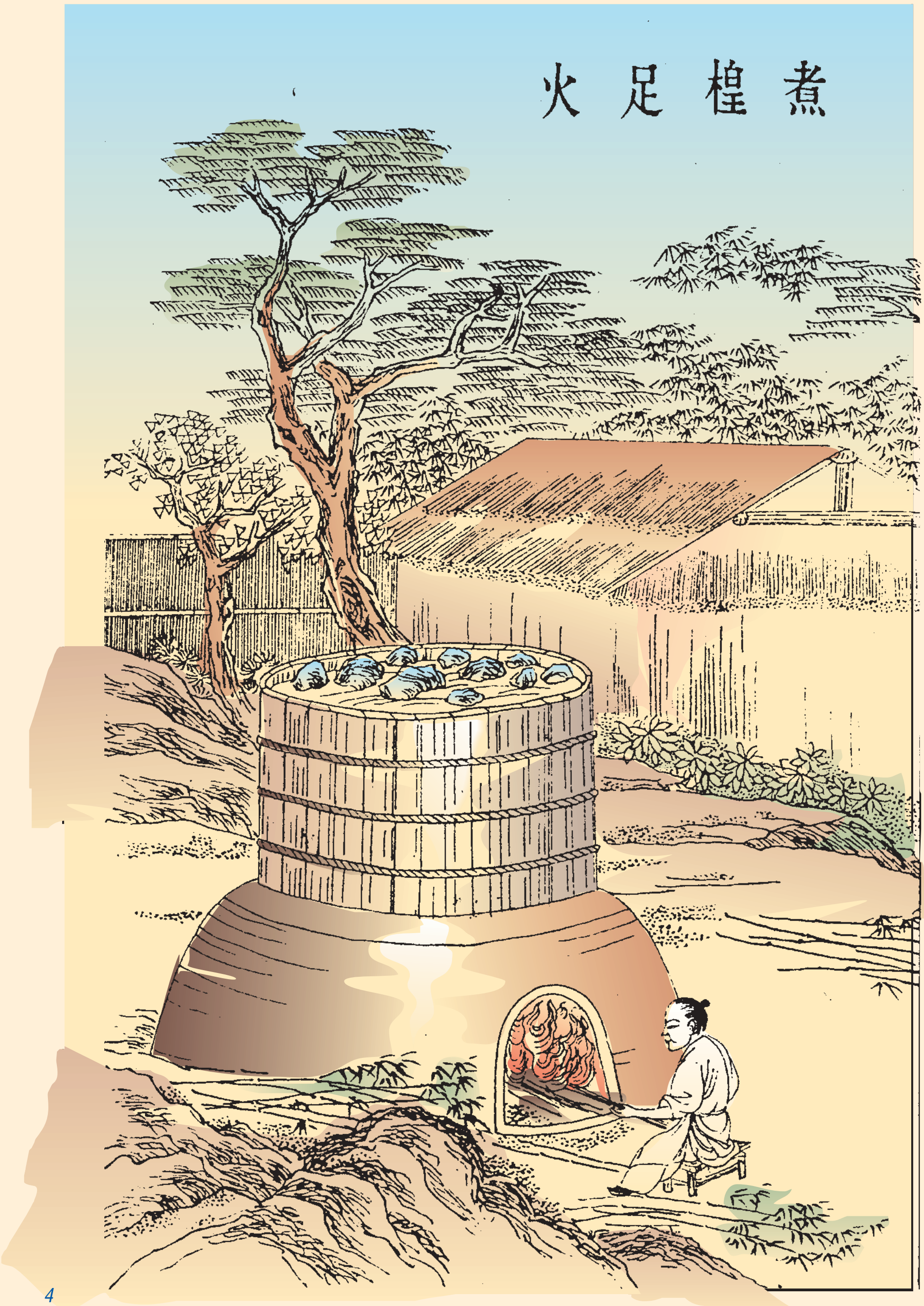

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Fig. 4:
Traditional Chinese papermaking with bamboo, showing how the bamboo rod is boiled in a mixture of pure water and slaked lime.

wooden board and the top linen cloth from wet web pile.

- Peeling off of the wet web one by one from the wet web pile.

- Brushing of the individual wet web onto the surface of a fire wall. (or, alternatively having them hung in the air for loft drying).

- Taking away of the dried sheets one by one from the surface of the fire wall (or, from the hangers) and having them stacked as a pile of finished product.

Such a general procedure for producing handmade paper has been adopted for hundreds of years without any major changes and can stili be seen practised in an number of handmade paper workshops in present day China. Most of the existing handmade paper workshops, however, have resorted to the cooking of the vegetable fibres in rotary spherical digesters instead of retting with lime. And beating in beaters has replaced pounding in mortars. But, the procedures of web formation, pressing and drying are being carried out in the traditional way.

The fundamentals of the procedure described above have even been kept quite closely in modern pulp and paper technology. Digesting has taken over the process of retting. Pounding has been replaced by beating and refining. And, web formation, pressing and drying combine into a continuous operation on a Paper machine. The essentials of the traditional art of papermaking have seemingly been sustaining through the years and everlastingly.

Machine-made paper

The art of papermaking was eventually spread eastwards to Korea and Japan as well as westwards to the Arab countries and, then, to Europe. It was in Europe where the manufacture of paper began to step over to machine-made. It was not until in the years of the late nineteenth century when machine-made operations found their way, reversibly, back to China.

China Paper Mill Company, (Huazhang Paper Mill for its Chinese name), founded in 1881 and started operation in 1884, was claimed to be the very first fully mechanized paper mill in China(3). This, presumably, was a kick-off in the history of contemporary machine-made paper industry in China. The Mill was invested by Chinese merchants and two Americans were employed to oversee the operations. Maithand served as mill manager and

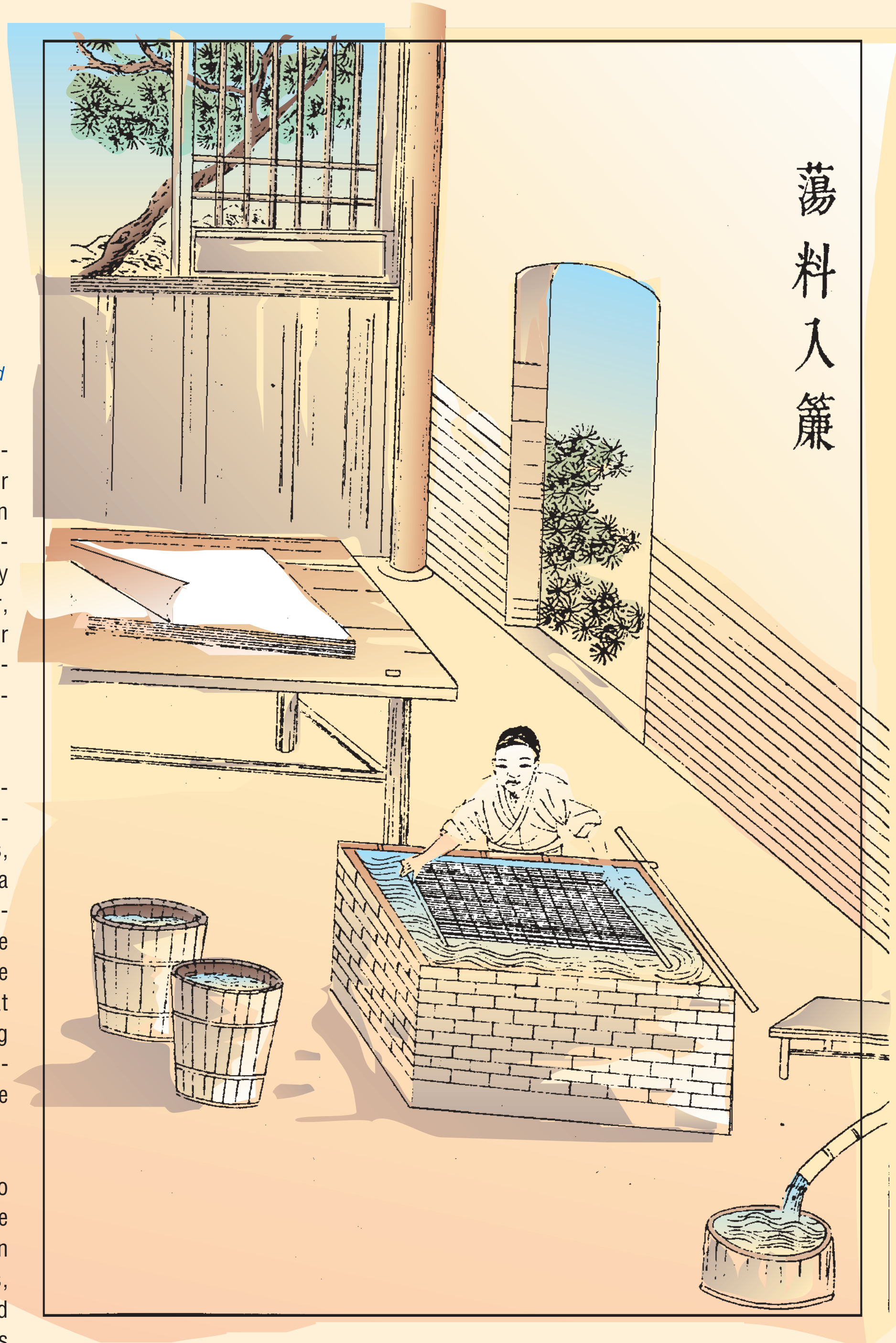

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Fig. 5:
Traditional Chinese papermaking with bamboo, showing how the sheet is formed with flexible bamboo screen out of the brickwork vat.

Fig. 6 (back cover):
Traditional Chinese papermaking with bamboo, showing how the paper sheet is dried on a heated cavity wall.

T.J. Waters as engineer. The 2 tpd capacity mill employed rags as its major fibrous raw material. Major facilities in the mill included a rag cutter with a railroad duster, a 730 cubic feet rotary digester, another cylindrical digester, seven beaters, a 96 inch fourdrinier Paper machine and a sheet cutter. Writing paper was the principal grade produced in this mill in Shanghai.

For an extended period of over one hundred years, the mill had experienced successful hours and sorrowful failures, changed hands in ownership many a time, reformed and retrofitted and managed to survive to the present day as the oldest contemporary paper mill in the country, still operating energetically at the original old site. Tianzhang Recording Paper Mill, the present name of this hundred year old mill, is now devoted to the production of special coated grades.

For a period of 30 years from 1881 to 1911, a total of around 32 machine-made paper mills were reported to have been built. They were all located in cities, including Shanghai, Yanbo, Tianjin and Hankuo. The capacities of these mills were all very small, mostly around 2 tpd. Longzhang Paper Mill, in Shanghai, producing 13 tpd writing paper, was said to be the largest mill in those days. No statistical figures are available for the paper production in those years. Not any more than 200,000 tpd may possibly be a good guess.

Almost all of the 32 paper mills were using rags for making their paper. Eventually, rag supply became so very acute that searches for alternative fibrous raw materiale were undertaken by several mills. And, in 1901-1903, Shanghai Paper Company, (Huachang Paper Mill in Chinese), initiated the production of bleached rice straw pulp on their own. It may be interesting to note that this Shanghai Paper Company happened to be the first joint venture paper mill in China. The mill was financed by American, French and Chinese merchants. Another innovation of the time was the manufacture of newsprint with groundwood made in a three pocket grinder purchased from the United States. This happened in the East Branch of the Tianzhang Paper Mill in Shanghai. In 1921, presumably, this was the first time the Chinese ever made groundwood and newsprint on their own.

After the downfall of the feudalistic Qing Dynasty in 1911, civil war persisted for quite some years. Moves toward national industrialization were very much held up. Nevertheless, the Chinese paper industry managed to move ahead, rather slowly though. 89,000 metric tons of paper

Table 1: Total Paper and Paperboard Production (1949-1995)

Year	Total Machine-made + Hand-made	Machine-made Amount	Machine-made % Share	Hand-made Amount	Hand-made % Share
1949	228	108	47.50	120	52.60
1950	380	141	37.10	239	62.90
1960	2037	1801	88.50	235	11.50
1970	2637	2414	91.65	220	8.35
1980	5626	5346	95.01	280	4.98
1990	13530	13330	98.50	200	1.50
1991	14989	14789	98.67	200	1.33
1992	17451	17251	98.85	200	1.15
1993	18879	18679	98.94	200	1.06
1994	21554	21354	99.07	200	0.98
1995	23200	24000	99.17	200	0.83

Source: 1996 Almanac of China's Paper Industry, China Technical Association of the Paper Industry, Beijing P.R. China (In Print).

Table 2: Average Annual Growth Rate (1950-1995)

Year Span	Average Annual Growth Rate %			
	Machine-made	Hand-made	Machine-made	Hand-made
1950-1960	22.60	6.84		
1961-1970	9.75	3.24		
1971-1980	8.84	2.93		
1981-1985			10.65	−6.20
1986-1990			8.89	1.56
1991-1995			12.50	0

(machine-made) were reported for the year 1936, the year before the outbreak of the Sino-Japanese War 1937.

It was some hard time for the Chinese economy during the years of the Second World War. The Chinese paper industry, both machine-made and handmade, suffered heavy blows. The year of maximum paper production was reported to be 1943, when 165,000 metric tons of machine-made paper were claimed. It should be pointed out, though, that this figure had taken into account the manufacture of paper in Japanese occupied areas. The situation was not much changed in the subsequent years after the War. And, total paper and paperboard production dropped to 108,000 metric tons in 1949.

The leaps and bounds in the development of the Chinese paper industry did not begin until the later help of the fifties of this century *(Table 1).* It took the Chinese papermakers quite some effort to arrive at the current production level. During the past decades, the Chinese paper industry managed to develop at a comparatively high rate of growth, averaging around 10% perannum *(Table 2).*

To meet the everlasting growth in demand, a preliminary goal of 30 million metric tons of paper and paperboard production has been set for the turn of the century. This would mean an average increases of 1.2 million metric tons capacity every year in the next five years, equivalent to an average annual growth of around 8%. Evidently, much strenuous efforts will have to be undertaken by the Chinese papermakers to reach this goal.

Chinese papermakers are well aware of the challenging confrontations they are facing. The Chinese paper industry has been non-wood based for many a year. Over 80% of the current production are made from reed and its homologues, wheat straw bagasse, bamboo and other cereal stalks, usually with woodpulp as a supplement in the furnish. It has been realized that for upgrading papermachine speed and for quality product production, more woodpulp should be used in the furnish. Therefore, for the healthy growth of the industry, more and more woodpulp will be needed. This would call for the better management of the government owned forestry plots such that the problem of pulpwood availability can be better tackled. It should also be noted that over 50% of the current production comes from contributions by small pulp and paper mills. Yet, admittedly, small enterprises are actually operating with deficient cost-effectiveness and are heavy pollutant contributors, since they are mostly running with out-dated facilities and traditional technologies. Furthermore, most of the small pulps are operating without any chemical recovery. True enough, the small enterprises did contribute greatly in the past years in easing up the local demand, especially in the provincial level in many cases. However, more stringent environmental regulation enforcement will eventually bring about pressure on small pulp mills operating without chemical recovery. And, it is going to be unavoidable that small mill managers will, one of these days, find themselves noncompetitive in the market. Merging of small pulp mill to form into one sizable enough to warrant the economical feasibility of incorporating some sort of chemical recovery appears to be a logical approach for the future years. Being sizable would also mean better chances in competing in the market, both in selling price and in product quality. It would be unavoidable that some small enterprises will have to close down and thousands of employees will find themselves disemployed. Appropriate measures will have to be taken to have such a problem of unemployment solved.

It has been known, recently, that any greenfield projects submitted for approval must not have less than 15,000 tpy capacity and must be accompanied by some sort of chemical recovery. Construction of sizable wood-based pulp mills will be greatly encouraged. As a matter of fact, this has been carried out in the past years. This includes the Hexian Pulp Mill in Guangxi, and Qingzhou Paper Mill (expansion project) in Fujian, both being on stream since late 1994. New projects under construction are Nanning Pulp and Paper Mill in Guangxi, Siamo Paper Mill in Yunnan, Guangning Paper Mill in Guangdong, Yueyang Paper Mill (expansion project) in Hunan etc.

On the environmental side, recent reports have disclosed the immediate closing of over a hundred small pulp mills along the banks of the Huaihe (river Huai) and in the regions upstream of the Three Gorges on the Yantze River (Changjiang). An overall dredging of the Huaihe, a major tributary of the Yellow river, calls for a general clean-up of all pollutant contributing enterprises along its banks. The three Gorges Project, which involves the construction of a huge water dam and a hydraulic power station, requests the elimination of all polluting sources upstream. Small pulp mills are facing the fate of shutting down, and, many small mill managers are now talking about merging together at some new site.

A number of greenfield and expansion projects have been proposed for the Ninth Five Year Plan period (1996-2000). Most of them are seeking for the needed capital investment. Obviously, most mill managers will feel contended if they can get foreign loans, soft loans in particular. And, of course, joint venture partners will be most welcomed.

J.M. Voith AG and the Chinese Paper Industry

There is no doubt whatsoever that the development of the Chinese paper industry before the turn of the century as well as in the first years of the twenty-first century, will include a number of sizable greenfield and/or expansion projects. Needless to say, it is going to be a challenge not only to the Chinese alone but also to suppliers all over the world. Evidently, the Chinese market for advanced equipment and innovative technologies will be highly competitive. And, to get oneself into a more advantageous position, one needs to understand better the oriental mentality. Make your company known to the average Chinese papermaker, the managers and young engineers in particular. True enough, you may find yourself handicapped by a language barrier. But, do not worry too much about this, you can always find some English speaking Chinese willing to help you. Furthermore, there is always the international engineering language there (engineering drawing) at hand. It is a fact that most Chinese papermakers have come across the name of Voith at one time or another. Most young engineers learned about the specific features of the Voith beater. As a matter of fact, there are still a number of Voith beaters operating in many small mills in the country. Voith has been engaged in business dealing with the Chinese for many a year, especially during the last half of the century. And, most Chinese papermakers are convinced of the performances and reliability of Voith equipment. For instance, the Voith Duoformer has been running smoothly with reed furnish at the Jincheng Paper Mill in Liaoning province.

Voith, undoubtedly, will be involved, one way or another, in some of the projects drawn for the development of the Chinese paper industry in the years to come. There will be much for Voith to do in the competitive Chinese market.

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