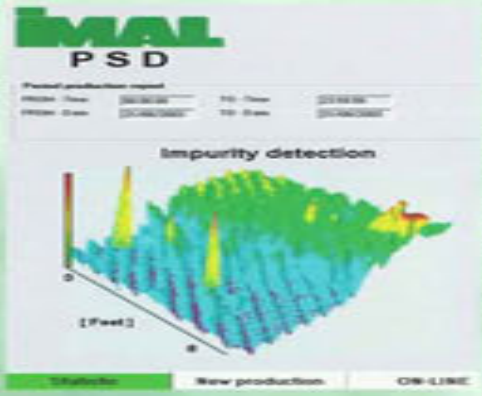
MDF YEARBOOK 2005/6

Sample pages from MDF Yearbook 2005/2006

PSD IMAL

Press Security Device

- On line steel belt protection (0.8mm resolution)
- On line mat weight per area control



The PSD Press security device is able to detect, high density extraneous impurities, such as glue lumps, fiber balls, metallic and non-metallic parts, and stones in particleboard, fibre and OSB mats.

The PSD is also able to provide a continuous and high resolution measurement of mat weight distribution over the entire width of the formed mat.

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MDF Yearbook 2005/6

Subscription details:
MDF Yearbook is a technical, marketing & management review. It is available at a cost of £75 (€130).

MDF YEARBOOK CELEBRATES 40 YEARS OF MDF

In this the special 10th year anniversary edition of the MDF YEARBOOK we bring to our readers an update on markets information, company news, technology, product and equipment developments, together with highlights in the MDF industry over the past 40 years. We thank all contributing authors for their articles.

Founding Editor of MDF Magazine And Yearbook Sets up Valuable Repository of Panel Technology

"Ye Old Editor" back in his native forest area of western Oregon, where he was educated at the College of Forestry, Oregon State University.

Ward Williams, who recently celebrated his 80th birthday, has been associated with the MDF Magazine & Yearbook since they were launched 20 years ago He has donated his entire collection of these publications to the World Forestry Centre in Forest Park, Portland, Oregon, USA. These journals will be available to researchers, scholars, historians and industry members. Interested persons may contact Mr Williams at willvan@verizon.net or the World Forestry Center, 4033 SW Canyon Road, Portland, Oregon 97221, USA.

Following a career in forest industries journalism spanning half a century on a worldwide basis, he continues to operate as an independent writer and consultant out of his Global Forest Products office and residence in Tigard, Oregon, USA. He maintains contacts with members of the MFD/panelboard industries, visiting in Europe, US and Canada. He also contributes mill and supplier reports to several publications in Europe, North America and Asia.

Along with Publisher Robert Higham of the UK, Mr. Williams was instrumental in establishing MDF Magazine, MDF Yearbook, Panel Industry Monitor Newsletter and Panel Production & Management. Prior to editing MDF, he was a founding editor of Wood Based Panels International and visited mills around the world during the "explosion" of that sector of the composite panel industry.

In response to the MDF Yearbook's current editor's request for an update on his current activities,

Ward sends "Good Wishes" to his many old friends around the world.

Siempelkamp & MDF: 'An Inseperable Success Story'

"The history of the wood-based material MDF is practically inseparable from the name of Siempelkamp, a leading machinery and engineering development company that has been closely associated with the success story of this panel material for over 40 years and was present at the beginning."

In 1965 Miller-Hofft erected the first plant for Allied Chemical in Deposit/New York. Owing to its homogeneity, MDF produced in a dry process achieved rapid popularity throughout the North American furniture industry. As early as 1968, Miller-Hofft, together with Siempelkamp, set up only the second plant in the world for Basset Furniture.

Camsan

In 1981 Camsan of Turkey ordered the first multi-daylight press with 10 openings from Siempelkamp. 1985 saw the use of a ContiRoll® continuous press for the production of MDF for the first time. Louisiana Pacific bought three presses from Siempelkamp in that year, following trial runs in the R&D division in Krefeld. The MDF ContiRoll® in Germany was handed over two years later to Glunz, Meppen.

Louisiana Pacific MDF ContiRoll

Glunz, Meppen

Development of the ContiRoll®

With the introduction of continuous press technology there was nothing more to stop the global success story of MDF. In the first 20 years Siempelkamp sold 20 plants, whereas over the next 20 years it has sold 102 plants, to date.

Of course, this level of company success also had much to do with the rapid developments in the diverse applications of MDF. The early years of the 1990s for example saw the first thin board line put into operation for Homanit, Herzberg. Thin MDF was used for back panels for furniture and base panels in drawers, becoming an indispensable component in furniture production. However, an even bigger driver to MDF demand turned out to be the rapidly growing market for laminate flooring.

To be commercially viable, thin board lines have to be especially fast. The first lines were therefore designed with infeed speeds of 800 mm/s. Further technical modifications to the infeed area of the ContiRoll® in the form of the flexible infeed mouth brought the infeed rate up to 1500 mm/s with board thicknesses of as thin as 1.8 mm

Sunchang ContiRoll.

Flexible Infeed section of the ContiRoll

Siempelkamp is still in the process of further refining the ContiRoll® technology. Infeed speeds of 2000 mm/s with board thicknesses of 1 - 3 mm are currently being worked on, made possible in part by improved pressure distribution and thermodynamics. ContiRoll® technology is available in three sizes of between 4 and 12 feet and up to 70 m in length.

Peripheral Equipment

Siempelkamp has not only concentrated in making further developments in press technology over the years but in the making of other machines which are absolutely indispensable for the optimization of production. Of particular importance is the process of *gluing*. **"**Reducing the amount of glue used is always one of the top requests of plant operators, and not jut because of cost." Hence the development at the Krefeld R&D center of the "Dry Blowline", a glue applicator for the dried fibres in a fallshaft.

This promises savings on glue along with other advantages associated with glue application, which comes after the drier. The prototype is currently being erected at a German customer's works in a plant for the production of fibre insulation materials.

New gluing device

This new gluing technology in turn requires adaptations to the *drying technology*. This is being worked on by Siempelkamp's Büttner subsidiary. Büttner has sold more than 45 fibre driers since 1995 and has played a major role in the development of drying technology. The ever increasing fibre throughput rates have led to the diameters of the drier pipes being increased from 800 mm to 3,100 mm – and even bigger diameters are currently being planned.

Fibre dryer

The way in which the *fibre sifters* work has also been adapted to meet requirements for production which is as homogeneous as possible in all ambient conditions. Sifting today is carried out with temperature stabilized air which permits a mat to be fed into the press which has been uniformly warmed throughout.

A particular focus of Siempelkamp's development work has likewise been directed to *forming systems*. This is the critical point, especially for thin boards, which determines whether a high-quality product results or not.

StarFormer to form the MDF mat

The StarFormer has been improved: The new matforming head consists of a bed of counter-rotating toothed rollers, which ensure that the fibre is distributed uniformly over the mat forming belt in transverse and

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longitudinal direction. Both the angle of tilt and height of the forming head are adjustable. Downstream is a levelling head. Its function is to produce a uniform mat with constant weight per unit area independent of the mat height and bulk density. High mat forming precision and optimal distribution of weight are the result.

Another innovation in which Siempelkamp has had a major influence thanks to its investment in research and development is the *MDF pre-heating system ContiTherm*. This is based on a flexibly adjustable air/steam mix which heats the mat and thereby permits the economic production of thick MDF boards. A number of these units have now been delivered.

ContiTherm pre-heater

With plants getting ever faster and the desire for greater flexibility, new solutions have also needed to be developed such as in *finishing equipment*. Whereas a double diagonal saw used to be sufficient for cutting boards-to-length following the press, nowadays no less than 3, or even 4 saws are used. This also reflects the desire for shorter boards. In general terms it is apparent that the increase in the number of cycles has led to increased requirements in terms of the diversity of formats and in tolerances. For example, the warehouse is now a logistics center to which more than one requisitioner has access.

Finishing line

All these developments in the mechanical elements would have been inconceivable without advances in electrical engineering. Nowadays, for example, the latest high-performance PLCs with high signal processing are used, which come with corresponding monitor visual systems for controlling complete plants and lines.

With its innovative *production management system*, (Prod-IQ) Siempelkamp has also been able to meet requirements in terms of production management, quality controls, maintenance and repair. The benefits are numerous and range from improved cost transparency and resource savings to increased plant availability and reduced production costs.

State-of-the-art technology for Fantoni

Lesonit D.O.O. in Slovenia, a subsidiary of the Italian firm Fantoni, has placed an order with Siempelkamp Maschinen- und Anlagenbau in Krefeld for a forming and press line for the production of MDF. The core of the line will be an 8.5’ x 23.84m ContiRoll® press specially designed for the production of thin MDF boards, the limit being 1.8 mm.

To enable commercially viable production the press will be equipped for a higher speed, with boards being produced at a rate of 1,750 mm/s – a new record for continuous presses. This performance level is made possible by the ContiRoll® infeed with its S-shaped modular upper hot platen which guarantees the trouble-free ventilation of the mat even at the highest speed. As a consequence the daily capacity of the plant all adds up to 635 m^3 of boards for thicknesses of 2.5 mm.

To guarantee high quality in spite of the speed and the thinness of the boards the press has been further optimised in terms of pressure distribution. Six cylinders in each row and special pressure plates provide for a homogeneous pressure profile.

Specially adapted finishing equipment supplied by SHS then enables vast quantities of boards to be processed further following on from the press. With three double diagonal saws even short board sizes can be cut at full speed, and these are followed by a laboratory board pickup unit and an automatic boardbraker. Stacking equipment, interim storage facilities and a high-speed sanding line with protection board handling and a book saw for lengthwise and crosswise cutting are also to be delivered, plus a complete packaging line with automatic squared timber laying unit. Construction starts in Slovenia in mid-2006.

40 Years MDF and 30 Years GreCon

Spark Extinguishing Systems and Measuring Systems

BY WILFRIED HENZE

"The first online measuring devices from GreCon, also for MDF production, were systems for the continuous measurement of the panel thickness after the multi-opening presses that were usual at that time. "These measuring devices were also often installed in sanding lines for final thickness inspection."

Soon after, there were ultrasound bond analysers, moisture analysers and even weight per unit area gauges. With few exceptions, the same measuring methods could be used in the MDF process as had been developed for particleboard production.

Even 40 years ago, appropriate fire protection facilities were important and indispensable for a trouble-free production. Just as in particleboard factories, the spark extinguishing system, developed by GreCon in 1974, was a welcome instrument for preventive fire protection in MDF plants also.

Both production fields – measuring technology and spark extinguishing systems – were progressed at GreCon parallel to the panel industry. This applies, of course, to the volume, and, above all, to the technology. The first online measuring devices have now become modern online measuring systems which, for the most part, surpass their original task, as for example, the ultrasound bond analyser:

The first systems came from the US and were very rigid objects and only able to detect relatively big panel defects (blisters), which meant that such systems did not gain acceptance in Europe. GreCon in turn responded down the line of selective channel arrangement, being a technology that quickly enabled small, hidden blisters to be detected and to mark the defective panels (UPU 919). Later, such defects themselves could be exactly marked in systems used mainly for final inspection and were also often used in sanding lines.

The next generation of such measuring systems incorporated a PC, and it was possible to inspect the panels in such a way that production could react to signal changes. A blister almost announced itself so early that counter-measures could be taken so that the quantity of rejected panels could be minimised. This generation rang in the era of the early bond analyser UPU 2000.

With the next generation, UPU 3000, GreCon gathered all these advantages and refined them, such that the operator is now able to read a trend, utilising the availability of a wide colour spectrum. "With this tool, he not only has an early bond analyser, but a blister prevention system as well – we call it bond quality measurement."

New ct-frame: calibration, maintenance, service during running production

Many factors can change the ultrasonic pattern. On the basis of these changes, a plant operator, who is fully conversant with his plant, can take early counter-measures so that almost no blisters are produced. A decisive factor however, is the final step, i.e., the arrangement of the ultrasound channels on a measuring frame that can be moved sideways out of the production line for calibration and inspection purposes. With this feature, it is possible for the first time to run a production line exactly to its operating limit, so that not only can blisters be avoided, but productivity can be increased, since safety reserves can be reduced by permanent, precise monitoring.

"Our example shows that new solutions are possible with traditional measuring systems by using up-to-date computer technology and courageously tackling a problem. Besides the advantages previously mentioned regarding the measurement technology, the new measuring system, called bond quality measuring system UPU 3000 is, above all, of robust construction. This is important to ensure a long, trouble-free operation especially after continuous presses."

Meanwhile, more measuring systems continue to arrive in the MDF panel production, such as the new x-ray system Dieffensor that offers complete monitoring of the fibre mat before the continuous presses. This system enables mat forming to be monitored in the cross- and longitudinal-directions. The mat weight is permanently divided in small squares and evaluated at 50 x 50 mm. Thus, a forming machine can be optimally adjusted with the option of automatic regulation. The entire spreading machine structure will change by means of this new measuring system.

DIEFFENSOR: protects press steel belts and optimises the spreading quality

With such fine a resolution, those foreign bodies that do not belong within the mat, are quickly recognised. Such items may be of metallic or non-metallic origin. If a foreign body is detected, the "contaminated" part of the mat can be automatically removed, damage to the steel belts is avoided and the life of the steel belts is considerably increased. This advantage is especially beneficial with the production of thin panels.

GreCon can also report further progress in the development of moisture analysers. Besides the known infrared systems, there are now systems available based on microwave technology which can, by means of special measuring facilities, also be installed in drop chutes, e.g., after fibre dryers. Furthermore, the microwave system is successfully used for the quick moisture measurement in the laboratory. Prior to the density profile analysis, the 50 x 50 mm samples are used for a quick test of the panel moisture. Duration of the measurement: a few seconds. A similar method can also be used online, e.g., in the star cooler.

"In the near future, there will be a new system for easy measurement of the fibre size. A first prototype already installed by the company very precisely measures the fibres in dry condition using specially developed software. As hardware, customary computers and scanners are used."

An additional "pioneering innovation" is the new GreCon spark extinguishing system using the control console technology of the company's 7000 series. "For the first time, it is possible to store events exactly to the millisecond. This advantage offers the operator the possibility to locate the source of interference in case of an alarm and to take sustained measures to avoid ignition sources in future."

"In the past 30 years, GreCon has developed into a leader of the world market in the area of online measuring systems for the panel industry and preventive fire and explosion protection systems. Proven features are maintained, good features are improved and new features are developed. We at GreCon are only satisfied when our customers are thrilled by us."

GreCon factory, listed monument, built in 1911 by Walter Gropius (founder of the Bauhaus style)

Cosevco MDF Successful Commissioning of MDF Line in Vietnam

The MDF line for Cosevco MDF in Dong Ha in the Quang Tri province of Vietnam with a daily output of 220 cu m was officially inaugurated by the Vietnamese Vice-President after speedy and successful commissioning in the middle of September, 2005.

The line has operated at full capacity to satisfy the increasing demand for high-quality MDF in Vietnam. The requirement was for a suitable press type which would produce a thickness spectrum ranging from 6 to 50mm. Furthermore, the economic efficiency of the single daylight presses in comparison with multi-daylight presses for small-scale line capacities suited the customer.

Dieffenbacher took the responsibility for overall plant engineering as well as control and automation. Other delivery items included the complete process equipment: chopper line, chip cleaning, defibration, glue preparation, chipper, forming station, forming line, with continuous prepress and steel belt loading system, single-daylight press, finishing line with dividing saws, sanding line, complete power generation equipment, mechanical and pneumatic conveying and handling equipment, filter systems, safety equipment, laboratory equipment, process and line automation.

h07e.o

Cost-effective panel production lines

Dieffenbacher designs, builds and supplies wood based panel production lines with all major components including driers, forming equipment, presses and finishing lines. Electronic control systems are also developed and manufactured within the Dieffenbacher group for complete integration.
Our comprehensive service package with highly skilled specialists provides competent support ensuring customer satisfaction.

Our dependable services:

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- Competent counseling focusing on specific requirements
- Flexible, future-oriented plant engineering
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- Economical resource management
- State-of-the-art modular process management and automated equipment
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Sandvik Steel Belts – "At the heart of MDF production for 40 years"

"As a company, we're delighted at the fantastic success that MDF board has experienced during its relative short life," a Sandvik spokesperson told MDF YEARBOOK, "and we're proud of our contribution to its success through the supply of the component that is at the heart of every manufacturing process."

It may be 40 years since the first MDF panels rolled off the presses, but 2006 marks an even more impressive anniversary for one company that has played a leading role in the success of this remarkable material. For it is now 105 years since Sandvik created the wood-based industry's first steel belt.

Installed at a saw mill in Sweden, this strip steel belt was used as a conveyor, transporting residuals (saw dust and ribs) when turning logs into planks. Since then, Sandvik steel belts have helped open the door to a whole range of different conveying, processing and pressing possibilities, not least being the manufacture of wood based panels (WBP).

Given the close relationship between Sandvik, press manufacturers and WBP producers, it is not surprising that the company claims to have been at the forefront of technological developments ever since Bison invented the first single opening press in the mid 50s.

This expertise has also resulted in a close involvement in all subsequent developments including the first successful continuous rotation press, the so called Mende-type, of the early 1970s, and the continuous double-belt presses of the late 1970s. Indeed, the influence that Sandvik has had on the industry is reflected in the fact that, of all the double-belt presses in operation around the globe today, approaching 170, more than half are running with press belts made by Sandvik.

The company's well earned reputation has been achieved through constant investment in the development of steel belt grades to suit specific applications and Sandvik is now able to offer a range of belt types for both single opening presses and to cope with the high belt-speeds and pressures of today's continuous presses.

Sandvik's influence on the overall MDF market was further extended in 2000 following its merger with well-known German firm Hindrichs-Auffermann, one of the leading producers of smooth and textured press plates and endless press belts for the production of laminates and melamine coating of wood based panels.

While Sandvik belts are used to produce MDF itself, Hindrichs-Auffermann's press plates and endless press belts are used to create the surface texture, or finish, that is applied to the board, either by direct lamination, or as a separate laminate to be applied later. This is a highly specialised process, involving close cooperation with décor paper producers to ensure natural, realistic looking surfaces. The merger with Sandvik was a natural progression with Hindrichs-Auffermann's products and skills filling a gap within Sandvik that now enables the company to serve the MDF industry at both levels.

Alongside the supply of first class press belts and plates, Sandvik's other major focus is the development of tools and techniques to maximise the efficiency of belt installation, maintenance and repair, both by customers' in-house teams and also through a network of service technicians that covers all major markets where MDF is produced.

Berndorf Band – Traditional Partner but Innovative Supplier

The steel belt is often said to be at the "heart" of the processing system in the wood based products industry. Accordingly, Berndorf Band, an acknowledged leader in the manufacturer of high quality process belts, takes a major role in the development of MDF-production. Over the past 40 years Berndorf has enhanced its company, and together with the important press manufacturers, has created an extensive product base.

In the early years of the 20th century Berndorf Band started with the development and the production of endless steel belts. In 1973 Berndorf produced its first endless steel belt for the new generation of continuous presses. The first continuous double belt press for wood based panels was installed together with Kuesters at Spano in Oostrozebeke/Belgium and this partnership still remains firm having been confirmed last year by celebrating 30 years of cooperation.

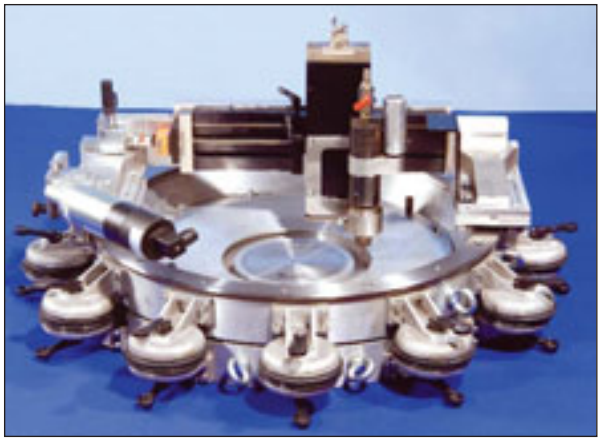
Based on such know-how, Kuesters provided Nelson Pine with the first continuous double belt press for MDF. At that time, Berndorf Band and Nelson Pine Industries Ltd. became partners, which led to the purchase of the 50th press belt in 2005.

Handing over of a commemorative related to the 50th belt purchase Persons from left to right: Gary Fredricksen, Berndorf Band Sales Rep, New Zealand; Cedrick Magic, Nelson Pine Prod. Mgr. LVL; Helmut Baresch, Exec. VP Berndorf Band; Murray Sturgeon, Man. Dir. Nelson Pine; Franz Viehboeck, Pres. Berndorf Band; Chris Turner Gen. Mgr Nelson Pine; George McMahon, Maintenance Mgr Nelson Pine and Heinrich Garherr, Bus. Dev. Mgr Berndorf Band.

"Looking back on this long-term partnership there were some remarkable milestones. For instance the period marked the first time throughout the world that Berndorf Band introduced its high tensile strength stainless steel grade Nicro 52.6 to a double belt press for MDF. Further improvements like increasing belt thickness have contributed to achieve a better life time of steel belts and higher quality in MDF production."

"The close partnership with various experienced press manufacturers and MDF producers allows us to improve the whole production process through steady development, innovative manufacturing methods and new materials for our steel belts. Since 1973 until present day, requirements regarding the performance of presses and steel belts were not the only business areas to develop. Maintenance and Service played an important part in proving ourselves as a reliable partner."

Preventive service strongly influences the life-time of a belt as is well proven by a record belt at Spanolux, which has been in continuous use since 1997. "The special, patented tools used by our company and its service organisations are steadily being improved in our Berndorf Service-Centre. Hence they can be easily adapted to the special needs and requirements a customer may have."



The new Patching Tool PT 3000

The company's latest development is the 'Patching Tool 3000', which is the third generation of this tool, that allows the repair of cracks and deformations (maybe caused by roller or chain breakings) by inserting a patch. Repairs can now be carried out by a single service technician within a very short time. "This leads to a reduction of repair costs and furthermore patches can be made on site, using spare belt material. High-quality products, minimised downtime resulting from immediate repairs as well as increased personal motivation of in-house technicians are the result."

As during the past 40 years, Berndorf Band says its company aims to remain a traditional, experienced partner but also an innovative supplier to the MDF-Industry.

Carter Holt Harvey Rises To Global 7th in MDF

Chinese MDF production has expanded rapidly during the past decade and while most new MDF plants are owned by local private companies and state-owned enterprises, a number of foreign companies have been attracted by the sector's large growth potential. Carter Holt Harvey (CHH) is one of the best known foreign companies to have invested in China, having taken over two mainland MDF factories less than two years ago and in consequence having risen to become the world's seventh largest MDF manufacturer.

Listed in Australia and New Zealand, CHH produces MDF, particleboard, pulp and paper, and owns around 330,000 ha of forest. In June 2004 the company announced it had signed an agreement to purchase Plantation Timber Products Group (PTP), one of China's leading suppliers of thin MDF, for US$134 million.

Buying PTP boosted CHH's global ranking by increasing its total MDF production capacity by over 50% and increasing the company's focus on speciality MDF products. The acquisition provided CHH with MDF production facilities close to important existing customers in China, which the company had supplied with timber products, logs, pulp and paper exported from Australia and New Zealand since the early 1980s.

Plantation Timber Products was founded in 1993 by two private individuals - Laurence Moh and Daniel Spitzer. The following year the International Finance Corporation (IFC), the World Bank's private investment window, agreed to invest in Plantation Timber Products Leshan Ltd, a joint venture of Plantation Timber Products Group and Sichuan Chuannan Forestry Bureau set up to produce MDF and floorboard.

PTP soon afterwards started preparations to expand its MDF production operations by setting up Plantation Timber Products Hubei in a joint venture with Hubei Forestry Bureau to make MDF board in Shishou in Hubei Province. Apart from IFC, foreign shareholders in both PTP's joint ventures included ING Baring, Deutsches Bank, FMO along with the founders Laurence Moh and Daniel Spitzer.

CHH bought an 85% stake in PTP in June 2004, buying out the foreign banks and private shareholders to acquire the majority shareholding. The remaining shares are held by the original local forestry partners Sichuan Chuannan Forestry Bureau and Hubei Forestry Bureau, which are responsible for ensuring continuity of the company's plantation timber supplies.

PTP has a reputation for quality products and a strong market presence with strong brands and access to more than 770 PTP brand MDF flooring retail outlets. Following CHH's takeover, PTP has continued to trade as a stand-alone company led by the same management team.

"PTP's headquarters are in the commercial city of Shanghai and there are a lot of business contacts here. Our customers are located countrywide," commented PTP marketing director Judith Lu, "We have six branch offices close to our customer base in Beijing, Shanghai, Guangzhou, Wuhan, Chengdu and Xi'an. Also, a Shenyang representative office and 26 warehouses in 20 provinces countrywide to support our sales programme."

Judith Lu, CHH's marketing director, China

PTP Leshan is located in Leshan in Sichuan Province in western China, about 100km from the provincial capital Chengdu. Designed to produce 120,000 cu m/yr of MDF, the plant produced its first MDF board in November 1996 and started commercial production in 1997. PTP later installed three short cycle laminating lines and machinery to produce door skins in the Leshan plant as part of plans to develop downstream processing. The factory currently is operating at full production capacity.

Dieffenbacher supplied the Leshan plant's 8ft by 19m forming line and continuous press, which can produce panel thicknesses of 2mm to 27mm. The plant's maximum line speed is 1,000mm per second while the plant capacity is 490 cu m/day. Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. Dieffenbacher also supplied the glue mixing and mat forming equipment, while Schenkmann & Piel supplied the drying and sifting equipment.

Most of the MDF board produced at Leshan measures 4 by 8ft, although board also is made to buyers' size

specifications."Some 3 by 7ft board is ordered," Lu noted, "We get more money for supplying different size boards."

PTP then built a second MDF plant at Shishou in Hubei Province, about 300km from the provincial capital Wuhan. The plant is installed with two MDF lines totalling 230,000 cu m/yr in capacity and is operating at full production capability producing mainly standard 4 by 8ft MDF panels.

Dieffenbacher supplied the first continuous press in 1998 which is capable of producing 120,000 cu m of MDF a year. The Shishou plant produced the first MDF board on its new line in October 1998 and started commercial production the following year. Dieffenbacher supplied the 8 ft by 19m forming line and continuous press which can produce panel thicknesses of 2mm to 40mm. The maximum line speed is 1,000 mm per second while the plant capacity is 490 cu m/day.

Dieffenbacher likewise supplied raw board handling equipment, the sanding line and the cut-to-size line along with the glue mixing, while Metso supplied the mat forming equipment and Schenkmann & Piel supplied the drying and sifting equipment.

Mende supplied a second 110,000 cu m/yr MDF line in 2001 that is operating at full production capacity producing mostly thin panel MDF.

"Our Leshan plant makes MDF raw board and flooring, while the Shishou plant produces raw board only, mostly thin board," Lu said, "Leshan makes thick and thin MDF to meet local needs as most is sold in western China and not nationally, while Leshan's MDF floor board is sold nationally. Most of our Shishou Hubei plant's MDF is sold nationally."

"Hubei Province is on the Yangtze River and centrally located in China, so it is a good place for distribution logistics and is close to timber wood resources. Our factory is located on the Yangtze River. Some MDF we supply by river barge, some by train and some by container truck. We can supply MDF to customers within a 500km radius which includes Beijing, Shanghai and Guangdong Province."

PTP sells MDF floorboard through more than 770 showrooms and sales outlets nationally. Many outlets are joint ventures in which PTP has invested with local partners. In addition, PTP also runs a large chain of wholly-owned MDF floor board outlets using a business model that joint venture and other showroom operators are encouraged to copy. To support the flooring sales drive, PTP organises a programme of frequent scheduled training sessions for showroom operators and staff.

CHH believes that China's MDF market still offers considerable sales growth potential. The company recently has launched a business review looking at possible business opportunities that could help the company hit its target of achieving a 500% growth in business during the next five years.

"We are looking for sustainable growth," Lu commented, "We have a raw MDF board business and a laminated floor business, but we are thinking more downstream as we have a lot of customer information, such as details of those who make high quality products and those items that sell. For example, such items include board with laminated paper for home furniture and laminated melamine for office furniture, also wood veneer lamination for high class office furniture. We are still studying business models for PTP as this is too large an operation to get into small fragmented downstream businesses."

The rapid recent expansion of China's MDF market is one result of the current property development boom in many major cities as MDF is widely used to make furniture and interior decoration fittings used in the office and the home. CHH estimates that about 90% of MDF produced in China is for the office and residential market for flooring, wall panels, kitchen cabinets and other uses.

MDF also has a growing number of other uses including printed circuit boards used by the electronics industry, shoe heels, arts and crafts, and to make presentation packaging for a wide range of gifts including Moon cakes, the traditional gift for the Chinese Mid-Autumn Festival.

Thin MDF panels from 2.7mm to 3mm thick are used to make Moon cake presentation boxes, CD cases, Chinese tea caddy boxes, traditional Chinese Baijiu rice wine presentation boxes and gift boxes for belts, braces and many other items. Many of these items previously were packed in corrugated cartons that have been partly replaced by MDF due to competitive pricing and the attractive appearance of MDF packaging.

"We supply the raw MDF board. Our marketing department tells customers about business opportunities making new products. We give them business ideas.

Foreign customers also give them ideas," Lu said, "There is usually a cluster of family owned companies making CD cases, cigarette cases, gift boxes and other items. Each company completes a different part of the manufacturing process such as printing, laminating, cutting, the fittings and final assembly."

PTP produces MDF in thicknesses ranging from 2.7mm to 18mm. About 90% of the total 350,000 cu m/yr produced at both the Leshan and Shishou plants is 3mm or less in thickness.

According to Lu, about 30% of the total board produced at both plants is used for furniture production while in-house production of floorboard uses a further 16% of the company's MDF board output. Interior decoration uses about 30% of PTP's MDF output. Typical applications include mounting thin MDF on particleboard for interior wall panels and to fit out cabinets.

Other important MDF uses include the production of crafts and packaging including gift boxes for which MDF provides a stronger protective board than paperboard or corrugated board. Crafts and packaging account for about 20% of the company's total MDF sales.

While 90% of PTP's MDF production is 3mm or less in thickness, MDF board is produced in various other thicknesses including 4.75mm thick board for furniture, 6mm board for men's shoe heels and 9mm for furniture. Lu noted that some customers glue 4.75mm and 9mm thick board panels together to produce 14.75mm board to make furniture.

PTP's floorboard is made of MDF laminated with three layers consisting of a decorative paper base covered with melamine and finished with a wear resistant top surface. All floorboard is made to a tongue and groove pattern. Most panels are a standard size measuring 120cm long and 24cm wide.

All PTP's flooring and MDF board products conform with ISO quality, safety and environmental standards. In recognition of the company's high production standards, the Chinese government has awarded PTP a non-inspection licence for its flooring products.

"We are looking more and more at thinner board because thin board is more profitable. Our strategy is to specialise in product differentiation," Lu commented, "We have trained production teams who can produce the best board. Our advantage is that we know how to make better quality thin board at a better price. We are always one step ahead."

"There is more price competition so technical capability is an important weapon. We offer our customers a total solution. We have a lot of niche markets that our competitors do not have. So we are thinking to leverage our market knowledge and customer resources to develop our business further. But first we will look at selling more of our existing products such as MDF floorboard to our existing customers."

PTP was one of the first companies to manufacture MDF using imported continuous presses in China and has since had an important impact on the development of the country's MDF industry. In the early 1990s blockboard, plywood and low quality particleboard were the main types of panel board available. Until the arrival of MDF, low standard local particleboard production had tarnished the wooden panel board industry with an overall low quality image.

"When PTP set up MDF production people saw a better panel board option than particleboard. PTP made money, so everyone decided to make MDF and there was a big investment in MDF production from 2000 to 2003," Lu said, "Particleboard use is similar to MDF which is more expensive, so particleboard is competitive in price, but there is not a sufficient supply. But because the MDF industry is overcapacity by about 10% already, there is fierce competition in the MDF market."

"Particleboard is used to make kitchen cabinet furniture. In future we expect that 12mm to 15mm thick particleboard will be laminated with 2.7mm thick MDF panels on both sides to make cheaper furniture."

China's total MDF production capacity is about 18 million cubic metres a year of which 4 million cubic metres consists of high quality made on imported equipment lines. Consequently PTP's total production capacity of 350,000 cu m/yr accounts for 7% of China's high quality MDF capacity.

PTP is the second largest operator of imported MDF lines after the Shanghai-listed Dare Group, which has installed Siempelkamp machinery with an estimated production capacity of 600,000 cu m of MDF per year.

CHH at WoodMac China 2005

Meanwhile, PTP is looking for business growth at a time when MDF production overcapacity and a timber shortage already are affecting some of China's weaker MDF producers. Further growth in China's MDF

capacity seems likely which will increase competition for scarce timber resources while MDF prices seem likely to come down in 2006 and into 2007 as MDF producers try to maintain their sales. "Some new MDF capacity will be installed but we are not sure how much or where it is going to be installed. Definitely there is a 10% MDF oversupply. The timber supply shortage is another issue," Lu commented, "We also expect more investment in particleboard production, but the issue is forestry resources which already are a problem. We use both popular and pine timber. We are keeping our two provincial forest bureau shareholders as strategic resource partners, but we are looking for other resources as well."

PTP believes its strategy of working closely with customers and providing ideas for new product development also will help develop future sales while many other MDF producers do not enjoy such close relations with MDF end users.

"A lot of MDF is sold via trading companies, so the MDF manufacturers have no knowledge of who is using their MDF and there is no product development for clients and the market," Lu said, "But we have an MDF product development team to work with our customers and to develop high priced items made from MDF. We are on track for healthy business growth."

IPL (Indirect Print Laminates)

NEW OPPORTUNITIES FOR THE PANEL INDUSTRY

By Ali Vahlhaus, Treffert Group

IPL is a combination of the (in-) direct printing process with so-called High Performance Coatings (HPC). HPC are typically applied as multi-layer systems by roller coating technology and cured by ultra violet (UV) energy. The coatings are either micro- and/or nano-particle modified acrylated resins, which yield extreme hardness resulting in high mechanical resistance to scratch, impact and abrasion. Depending on the degree of mechanical, chemical and thermal resistance required, HPC offers vast application possibilities in the wood-based panels industry, in particular for Laminate Flooring. The advantages of HPC are superb technical surface properties at optimum production and material cost in combination with the possibility of product differentiation. – A clear competitive edge over so-called dry finishing technologies.

Introduction

The wood based panels industry has undergone major changes and limited resources of natural timber have caused a steady substitution of solid wood panels (including plywood and block boards) with composite materials such as MDF, particleboard and OSB. Whereas the latter material is mostly used in the construction industry, MDF and particle board have obtained significant market share in the furniture, joinery and flooring industry. In these application areas, such composite materials have successfully substituted solid wood in the core construction. To achieve the optical appearance of any wood species, surface finishing technologies are used, such as impregnated décor paper, vinyl foils (PVC), direct printing or natural veneer. The total layer thickness commonly ranges from 0.15mm to 0.25mm for paper and PVC, with coating layers for the direct printing process measuring 0.05 – 0.12mm.

Substantial improvement in the dimensional accuracy and surface properties of wood-based panels, the precision of electronically controlled (in-) direct printing machines and the development of HPC have made (in-) direct printing a competitive finishing technology for high-end decorative panel products. The need to use an additional substrate (paper or PVC) had to be re-assessed economically and technically.

What Are High Performance Coatings?

High Performance Coatings are a mixture of acrylated resins (polymers), additives, metal oxides and/or silica crystals, which are dispersed under extreme shear rates in special purpose mixing tanks.

Special purpose mixing tanks at Treffert's wood coating plant in Germany

Such coatings are commonly applied by roller technology and cured by either ultra violet (UV) energy or by electron beams (EB). While the materials are delivered and applied in liquid form, these coatings have a solid content of >99%. In other words, 99% of the applied wet film weight remains on the substrate after drying. Typically, high performance coatings are applied as multilayer systems consisting of anti-abrasive sealers and anti-scratch topcoats.

Anti-abrasive Sealers, for instance, contain up to 23% Aluminium Oxide (Al_2O_3 or Korundum), the second hardest metal oxide following platinum. Al_2O_3 is added during the dispersion process in the form of micro-particles. With the support of mechanical shear and chemical processes, the micro particles are homogeneously distributed and stabilised in the liquid coating. They are being encapsulated by the polymer chains when the coating is drying, practically converting the coating film into a thin metal sheet. It's resistance to mechanical impacts and to abrasion are thus vastly enhanced. Hence, the film is not reparable (sand-able). For instance, in order to boost the abrasion resistance according to the EN13329 (Taber Abrader Test with S42 Abrasive Paper) by 1000 cycles, about 30g/m² of HPC Sealer are required.

High performance coatings under strict surveillance at Trefert's laboratories

a) The taber test according to EN438-2.6 and EN13329

b) The scratch test according to EN438-2.14

In contrast to metal however, the elasticity and flexibility of the film can be maintained depending on the base polymer used - two crucial properties for wood coatings in order to avoid excessive surface tension during climatic changes, which are leading to dimensional movements (expansion or contraction) of the substrate. Surface tension between film and substrate commonly results in adhesion failure and/or hair line cracking.

Anti-Scratch Topcoats, in turn, should not contain Al_2O_3 in order to maintain minimum sand-ability for repair and renovation purposes. These products are modified with silica-based nano-particles. Again, the particles become part of the polymerized film, thus almost doubling its hardness and resistance to scratching. If a standard UV-finish achieves a scratch resistance of 1.5 – 2.0 Newton according to EN438-2.14, that of Anti-Scratch topcoats would read about 3.0–4.0 Newton on the same substrate following the same application procedure.

Application Areas & End User Markets for High Performance Coating Systems in Combination with (In-) Direct Printing

As mentioned above, application areas for high performance coatings are best defined according to: the degree of solid wood substitution with MDF, HDF or Particle Board and the degree of chemical, mechanical and thermal resistance required

HDF (High Density Fibreboard) based flooring products fit into this definition.

Since the introduction of HDF based flooring panels (Laminate and Veneer Flooring), the market has shown enormous growth. In 1990, world production for HDF-based flooring panels amounted to 10 mio m^2. Market surveys in 2004 stipulate 730 mio m^2, of which 60% are produced in Europe, 23% in Asia and 7% in America.

World Production of Wood Flooring Panels

(in mio m^2)

	2000	2002	2004
HDF based Flooring	340	528	730*

* ca. 3 mio. m^2 IPL (Indirect Print Laminate)

Up to the year 2003 HDF flooring panels were divided into two types:

- **Laminate Flooring (LPM, DPL and HPL)**
- **Veneer Flooring**

The layer construction for LPM **(**Low Pressure Laminate) and DPL (Direct Pressure Laminate) flooring consists of a melamine impregnated décor paper and an anti-abrasive overlay paper for the face layer. The bottom is simultaneously laminated with an UF or phenolic-impregnated balancing or backing paper. HPL (High Pressure Laminate) flooring differs merely in the face layer construction. The melamine impregnated décor paper is supported by a number of phenolic impregnated core papers. HPL constructions are predominantly used for "softer" substrates (HDF with a density < 870kg/m^3 or Particle Board) and for special application areas.

The irreparability of such flooring elements caused manufacturers to feature extreme durability of the protective overlays. As no international quality standards had yet been defined, a mad race for abrasion values, impact strength and scratch resistance began. None of these values were comparable, however, as they were independently derived. Finally, in 1997, the Commission for the European Norm (CEN) drafted a norm for Laminate Flooring under the reference CEN TC 134 S2. The draft was officially ratified in late 1999 under the reference EN 13329. It is the first norm that stipulates clear methods and minimum quality standards for Laminate Flooring to be sold into different End User Segments – or referred to as Stress Classifications.

The stress classifications and their labels are defined in the EN 685; for residential areas with light, medium or heavy traffic (Classes 21-23) and for commercial areas with light, medium or heavy traffic (Classes 31-33).

A few years ago, HDF based Veneer Floors were launched. Typically, the veneer has a strength of approximately 0.6–0.7 mm and is protected with a high performance coating system. The layer construction of the high performance coating system consists of a PU-

UV Barrier Coat, an elastic UV Sealer and an HPC Topcoat. As for LPM flooring, impregnated Kraft paper or veneer is used for balancing and moisture protection on the bottom side of the panel. The backing paper and face veneer are simultaneously laminated onto the HDF substrate. The advantage of Veneer Flooring lies in the so-called soft-factors such as optical appeal, warmth, touch and sound. Simply, they are the closest re-production of Parquet.

The EN14354 details the technical product requirements and testing methods. The most striking difference is the assessment of the product's abrasion resistance (Annex D). Moreover, the wording for Impact Class has changed to Elasticity Class (Annex C) and for Abrasion Class to Wear Resistance. For determining the Wear Resistance of a surface, the Skandinavian Grit Feeder (or Falling Sand) method is specified. The Elasticity Class is measured in accordance with the EN13329 method.

Despite these differences, the EN14354 also refers to the EN685 Classification of flooring grades for various end-use segments. While the very same symbols and stress classifications are labelled on the finished product, the requirements to meet these classes differ significantly.

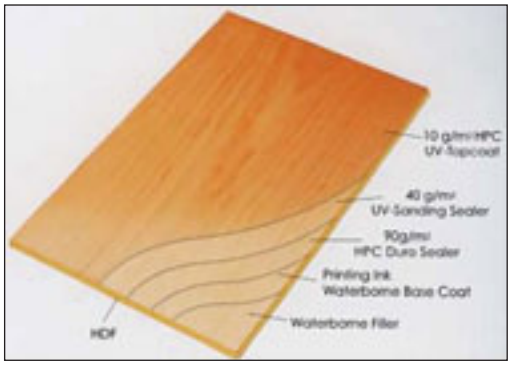
IPL (indirect Printed Laminate) Flooring

IPL products were launched in 1997 on the Interzum Trade Show by TREFFERT Coatings. Subsequently, Egger introduced IPL Flooring under the brand name "VIVO" to the market. The product failed to compete with Laminate Flooring both optically and technically, due to its inferior print and surface coating quality. Substantial improvement of (in-) direct print technology in combination with the development of HPC induced a successful renaissance of IPL Flooring in 2004. One year later, the EPLF Association has officially sub-summarized IPL under the term Laminate Flooring. Apart from equivalent technical properties, IPL offers the manufacturer benefits in the process chain, lower production costs and the possibility for product differentiation via so-called soft factors (appeal, surface effects, etc.).

Production Process

IPL Flooring is produced in continuous coating lines consisting of roller coaters, filler- and printing machines followed by thermal or radiation curing equipment. The line velocity may vary between 40 – 120m/min at a maximum width of 2450 mm. At an average capacity utilization rate of 75%, a production output of 13,230m²/h is realistic.

The substrate (HDF) does not require any specific pre-treatment. Instead of using décor-paper, the wood-pattern is directly printed onto the substrate by using a filler coat (10gm²), a backing primer (20g/m²), a base colour (40g/m²) and approximately 3g/m² of ink per printing cylinder used. Subsequent to the direct print, the high performance finish is applied consisting of the HPC Sealer (90g/m² for AC3), a UV Sanding Sealer (40g/m²) and a Topcoat (10g/m²), in order to meet the required technical specifications. All materials are virtually VOC free and do not require special care for transport and storage.



Layer Construction of IPL-Flooring

Opposed to the décor paper industry, multi color print effects in the (in-)direct printing process are frequently induced through base color variations. Hence, the use of 2 or maximum 3 printing cylinders is sufficient for the re-production of wood patterns.

Implications for the Process Chain

Thanks to the shorter process chain, IPL allows for higher flexibility at lower production cost when being compared to LPM/DPL/HPL flooring production. The production of commercial samples or small lots is easier and more economical. A set of printing cylinders typically yields the production of 14 running decors, which are being produced at least once every quarter year. For a small production, only the amount of color required can be easily prepared, thus avoiding costly overstocking of impregnated décor paper and the risk of financial write-offs.

Shorter re-conditioning time of the HDF panel subsequent to the coating process and prior to the profiling (T & G) operation contributes notably to less space and working capital requirements. IPL panels can be processed after 24h opposed to the 48h – 73h re-conditioning time needed for DPL products.

Attainable line speeds of the continuous printing process significantly outpace the productivity of a discontinuous short cycle press operation at equal capital cost, thus reducing depreciation/m² by up to 75%.

Technical Properties

As mentioned earlier, all technical requirements imposed by the EN13329 for Laminate Flooring are met by IPL products. Thus far, stress classes 21-23

(residential flooring) and 31-32 (commercial flooring) have been successfully produced and sold. The production process remains unchanged for all classes. The technical surface quality for the different stress classifications is merely controlled via the application weight of the HPC Sealer. Since HPC exercise only little tension, modifying the application weight of the Sealer does not lead to a warping effect.

Summary of features: HDF Based Flooring Panel Technologies (DPL-, Veneer- and IPL-Flooring)

	DPL Flooring	Veneer Flooring	IPL Flooring
Stress Class (EN 685)			
Impact Resistance	IC 1	EC 2	IC 1
Abrasion Resistance	AC 3	WR 2	AC 3
Scratch Resistance	>2.5N	n.a.	>2.5N
Stain Resistance	5	5	5
Light Fastness	5-6	5-6	5-6
Anti-Static	+++	+++	+++
Anti Allergic	+++	+++	+++
Anti Bacteria	+++	+++	+++
Optical Appeal	+	+++	+
Physical Appeal	+	+++	+++
Tool Wear	high	low	high
Material Cost	medium	high	low
Production Cost	medium	high	low
Sales Value	low	high	low

Product Differentiation

Due to chemistry and process related differences, IPL offers ample opportunities for product differentiation. For instance, the synchronized pore effect can be produced without diminishing productivity with an HPC Print Coat that is applied in a synchronized printing module. Despite applying only 5-10g/m^2, the pore effect sustains the required 25,000 cycles in the castor chair test according to the EN 425. Highly elastic coatings allow the production of a "soft-feel" effect for so-called "barefoot markets." A variety of other surface effects, which are provoked through functional coatings (e.g: anti-slip, lotus effect, illuminating, anti-stick, anti-graffiti, etc.), allow the development of high end niche products.

Author's Comment

"The text above gives only some examples for the vast application possibilities of IPL. There is no doubt that the trend towards more ecological use of natural resources and constant cost reduction will prevail in the wood working industry. Consequently, any surface overlay or finishing system will have to perform quantum-leaps in terms of providing optimum protection at minimum cost. With the introduction of IPL technology, it appears that TREFFERT has been able to provide its customers a competitive edge over so-called dry finishing technologies (melamine paper, furniture foil, vinyl foil, etc.). It is up to us, however, to stay alert in order to be prepared for tomorrow's challenges."

MDF in China: Through the Eyes of a Leading German Machinery Maker

ASSOCIATE EDITOR, DAVID HAYES REPORTS ON HIS LATEST VISIT TO CHINA FOR THE MDF YEARBOOK.

The rapid expansion of China's MDF industry during the past five years has made the country one of the world's fastest growing markets for MDF continuous press lines. The increase in demand for MDF to produce furniture and kitchen cabinets has attracted a wide variety of investors looking to diversify their business activities. Government support with financial incentives has been an important factor in encouraging such investment.

As Chinese machinery companies only produce single and multiple opening presses at present, all continuous press line installed in China are supplied by foreign MDF machinery manufacturers. Dieffenbacher is the largest supplier of continuous presses to China, which has developed into an important market for the German company as demand for thin board MDF has grown. Between 2000 to 2003 China is estimated to have accounted for more than 15% of Dieffenbacher's MDF machinery global sales while equipment orders from Europe and the United States fell due to the economic downturn that followed the 9/11 terrorist attack on New York.

Since 2000 Dieffenbacher has signed contracts to supply 13 MDF lines and one particleboard line to China. The company signed its most recent order in October 2005 to supply Shengda Flooring Co Ltd of Chengdu, capital of Sichuan Province with a 150,000 cu m/yr capacity continuous press that will be used to produce MDF mainly for floor boards. Dieffenbacher's previous order was signed in December 2004 with the Weihua Group for a 100,000 cu m/yr MDF plant in Taishan in Guangdong Province that will begin commercial production this year.

"Eight companies that have bought continuous MDF presses from us are using them to make thin board less than 4mm thick," noted Liu Shouhua, Dieffenbacher's chief representative in China, "The Weihua Guangdong and Shengda of Chengdu MDF lines are not in production yet. The Guangdong plant will start up early in 2006 and the Shengda Chengdu plant at the end of 2005."

"We have mixed customers. Some are state-owned enterprises, some are foreign owned and some are private. Most customers are private or state-owned. Our customers usually have started in the MDF business with a small local MDF machine. They make money and then want to install our machine as they can make more profit."

Although the majority of customers in China buy Dieffenbacher MDF machines to make thin board, most of the MDF lines supplied are capable of producing board from 2mm to 40mm thick. Machines supplied until now vary in capacity from 100,000 cu m to 250,000 cu m/yr. Daily production capacity of the models supplied so far ranges from 380 to 850 cu m/day. Most machines are designed to produce board at 1,200mm per second though machines with production speeds of 1,000 mm per second to 1,300 mm per second have been sold to Chinese clients.

The average continuous press forming line supplied to China is 23.2 metres though the shortest line supplied is 20.4 metres while the longest is 42 metres which has since been extended to 46 metres. Most continuous press lines are designed to produce 8ft wide MDF boards though Dieffenbacher also has supplied several lines designed to produce 8.5 and 9ft wide board.

During the 12 month period from July 2003 to August 2004 Dieffenbacher installed and commissioned eight greenfield MDF plants in China. Liu noted that the unusual situation of having a large number of MDF plants to install in one country in a short period of time allowed the company to make maximum use of its various specialised staff and engineers who were rotated among the various plant project sites to minimise travel and installation times.

Dieffenbacher's oldest MDF continuous press customer in China is Plantation Timber Products, which was bought by Carter Holt Harvey of Australia in 2004 and owns two MDF plants in Sichuan and Hubei provinces. Established in 1993, Plantation Timber Products (PTP) built its first plant at Leshan City in Sichuan Province in western China. Designed to produce 120,000 cu m/yr, the plant produced its first MDF board in November

1996 and started commercial production in 1997. PTP later installed three short cycle laminating lines and machinery to produce door skins as part of plans to develop downstream processing.

Dieffenbacher supplied the Leshan plant's 8ft by 19 metres forming line and continuous press which can produce panel thicknesses of 2mm to 27mm. The plant's maximum line speed is 1,000mm per second while the plant capacity is 490 cu m/day. Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. Dieffenbacher also supplied the glue mixing and mat forming equipment, while Schenkmann & Piel supplied the drying and sifting equipment.

PTP built its second MDF plant at Shishou in Hubei Province which now is installed with two MDF lines. Dieffenbacher supplied the first continuous press in 1998 while Metso supplied a second MDF line in 2001. The Shishou plant produced its first MDF board on the Dieffenbacher line in October 1998 and started commercial production in 1999. Dieffenbacher supplied the 8ft by 19 metre forming line and continuous press which can produce panel thicknesses of 2mm to 40mm. The maximum line speed is 1,000 mm per second while the plant capacity is 490 cu m/day.

Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. Dieffenbacher also supplied the glue mixing, while Metso received an order for the mat forming equipment and Schenkmann & Piel supplied the drying and sifting equipment.

PTP has been an important showcase for Dieffenbacher's MDF production technology in China. "Dieffenbacher is doing well in China because our client Carter Holt Harvey who bought PTP is a good reference for thin board MDF use," Liu commented, "Our reputation is excellent. The other reason is Dieffenbacher's support service in China. We stock spare parts in Beijing and have service engineers in China. We can guarantee the customer fast assistance if they are in trouble."

Dieffenbacher's other customers in China include state-owned Sunway Forest Products Co Ltd of Wuzhou in Guangxi Province which has installed what is believed to be the largest MDF line in Asia. Founded in the 1950s as a pencil factory, in 1988 Sunway Forest Products imported its first particleboard line from Sunds capable of producing 30,000 cu m/yr. The company later started up MDF production in 1996 after importing its first MDF line from Sunds/Kusters with the capacity to produce 100,000 cu m/yr.

MDF production was expanded further in 2002 when Sunway Forest Products commissioned two locally supplied MDF lines at a new plant in Chengxi in Guangxi Province. The same year the company decided to install what is believed to be the largest MDF plant in Asia and ordered a 250,000 cubic metre per year continuous press from Dieffenbacher to install in Wuzhou in Guangxi.

The Wuzhou plant produced its first MDF board on the Dieffenbacher line in December 2003 and started commercial production in mid-2004. Metso supplied the forming line and completed the project design and planning while Dieffenbacher supplied the 9 ft by 42 metre forming line and continuous press which can produce panel thicknesses of 2.5mm to 38mm. Liu noted that the continuous press has since been extended to 48 metres. The maximum line speed is 1,200 mm per second while the plant capacity is 900 cu m/day.

Sichuan Guodong Co Ltd, a listed company based in Sichuan Province, has installed Dieffenbacher's second largest MDF line in China. After developing business interests in the glass coating and construction industries, Sichuan Guodong diversified into panel board manufacturing in 1998. The company initially purchased a 50,000 cu m/yr single opening press straw board line from Metso which it installed in a plant in Shuangliu City in Sichuan Province.

After importing two Dieffenbacher short cycle press lines to produce laminate flooring, Sichuan Guodong ordered a 220,000 cu m/yr line to produce HDF and THDF. Installed in Chengdu, capital of Sichuan, the line produced its first board in May 2005 and is believed to have started full commercial production very recently.

Dieffenbacher supplied the 8.5 ft by 40.6 metre forming line and continuous press which can produce panel thicknesses of 2mm to 40mm. The maximum line speed is 1,200 mm per second while the plant capacity is 850 cu m/day. Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. The German company also supplied the glue mixing and mat forming equipment, while Schenkmann & Piel Engineering received the order for drying and sifting equipment, and Pallmann the refiner.

Some of Dieffenbacher's Chinese clients have developed a large panel production capacity installing locally made MDF machinery before deciding to purchase an imported line to make thinner grade MDF. The Liren Group established Lishui OAK Co Ltd in early 1990s to produce wet process fibreboard. After installing a production line at its plant in Lishiu City in Zhejiang Province, the company modified the line in 1992 to produce 30,000 cubic metres a year of MDF. Over the next 10 years the Liren Group installed seven other locally made MDF lines in various plants in South China increasing its MDF capacity to about 570,000 cu m/yr.

In 2003 Lishui OAK awarded Dieffenbacher a contract to install a 130,000 cu m/yr continuous press line in its Lishui plant to produce thin HDF board of 2mm to 6mm thickness. The Lishui plant produced its first MDF board on the line in August 2003 and started commercial production in 2004.

Lishui OAK

Dieffenbacher supplied the 8 ft by 23.2 metre forming line and continuous press which can produce panel thicknesses of 2mm to 40mm. The maximum line speed is 1,200 mm per second while the plant capacity is 500 cu m/day. Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. The Germany company also supplied the glue mixing and mat forming equipment while Schenkmann & Piel installed the drying and sifting equipment. Since installing the Dieffenbacher line, the Liren Group has increased its total installed MDF capacity to 700,000 cu m/yr.

Apart from MDF panel board lines, Dieffenbacher has supplied equipment to produce MDF moulded door skins to China where Canadian-backed Innovative Board Technologies (IBT) Shendor produces MDF moulded door skins in Shenyang, capital of Liaoning Province. The plant is equipped with a Dieffenbacher 8-opening press line with the designed capacity to produce 7 million door skins a year.

IBT Shendor produced its first MDF doorskin on the Dieffenbacher line in 2002 and started commercial production in 2004. Dieffenbacher supplied the forming line and press which operates at 66 cycles per hour and has a total pressing force of 33,000kN.

Singapore-backed Asia Dekor (Heyuan) Co Ltd is another of Dieffenbacher's foreign customers. The company was established in the mid-1990s and started up producing HDF laminated flooring at its plant in Heyuan in Guangdong Province. In 2000 Asia Dekor placed an order with Dieffenbacher for a high capacity short cycle press line to produce HDF flooring in a new plant in Shenzhen in Guangdong, bordering Hong Kong.

At the start of 2003 Asia Dekor placed the order with Dieffenbacher for a 200,000 cu m/yr MDF line to be installed in Heyuan. The new plant produced its first MDF board in June 2004 and started commercial production at the year end. Dieffenbacher supplied the forming line and 8.5 ft by 31.3 metre continuous press which can produce panel thicknesses of 2mm to 35mm. The maximum line speed is 1,300 mm per second while the plant capacity is 780 cu m/day. Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. Dieffenbacher also supplied the glue mixing and mat forming equipment, while Schenkmann & Piel Engineering received an order for the drying and sifting equipment.

The rapid increase in demand for MDF to produce furniture and kitchen cabinets has attracted a wide variety of investors looking to diversify the business activities. One company that started MDF production as a new venture is the Weihua Group Co Ltd of Guangdong Province. Established in 1992 as a construction company with involvement in hydro power generation and water supply activities, the company diversified its business interests further in 1997 when a decision was taken to purchase a locally made 30,000 cu m/yr MDF line to be installed in a plant in Meizhou in Guangdong.

Weihua expanded its MDF manufacturing activities in 1997 when the company bought a second locally made line. This time the 50,000 cu m/yr line was installed in a plant in Zhengchen City in Guangdong. In 2003 Weihua decided to enter the thin HDF market and ordered 170,000 cu m/yr turnkey plant from Dieffenbacher to install in a new factory in Qingyuan City in Guangdong. The major product is thin HDF which is made in various thicknesses from 2mm to 9mm thick.

Weihua's Qingyuan plant produced its first MDF board in June 2004 and started commercial production near the end of the year. Dieffenbacher supplied the forming line and 9 ft by 28.5 metre continuous press which can produce panel thicknesses of 2mm to 40mm. The maximum line speed is 1,200 mm per second while the plant capacity is 650 cu m/day. Dieffenbacher supplied raw board handling equipment, the sanding line and the cut to size line. Dieffenbacher also supplied the glue mixing and mat forming equipment while Schenkmann & Piel Engineering installed the drying and sifting equipment.

The Weihua Group also has selected Dieffenbacher to install a 100,000 cu m/yr MDF line in its newest factory in Taishan in Guangdong. The factory is owned by Weihua Group member Taishan Weilibang Co Ltd which plans to manufacture thin HDF.

Taishan Weilibang's plant is due to produce its first MDF board early in 2006 and will start up commercial production about mid-year. Dieffenbacher supplied the forming line and 8 ft by 18.2 metre continuous press

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China MDF Machinery Market Overview

IN ADDITION TO OVERSEAS MACHINERY SUPPLIERS, THERE ARE 10 OR MORE CHINESE COMPANIES THAT ALSO PRODUCE MDF LINES.

The dramatic development of China's MDF industry has made the mainland one of the world's largest markets for MDF production machinery during the past decade as MDF factories have sprung up across the country to supply the growing number of furniture and interior fittings manufacturers that have boomed due to the current housing and office building construction expansion.

Chinese MDF machinery suppliers bagged most of the orders for MDF lines as prices for their less technically advanced equipment remain much lower than the cost of imported state-of-the-art MDF lines. Chinese MDF machinery companies only produce single and multiple opening presses at present, leaving foreign machinery manufacturers to supply continuous presses to the growing number of MDF factories deciding to produce thin, higher priced MDF panels.

China's MDF factories are estimated to have the total capacity to manufacture about 18.4 million cu m of MDF a year. Imported continuous press lines total around 4 million cu m installed capacity and account for about 22% of the industry's total capacity. Chinese MDF machinery makers consequently have supplied machinery capable of producing about 14.4 million cu m of MDF annually to local customers, with a small number also having exported MDF lines to customers in various Asian countries.

Dieffenbacher is the largest overseas supplier of continuous presses to China, having signed contracts to supply 13 MDF lines and one particleboard line to mainland customers since 2000. Eight companies that have bought continuous MDF presses from Dieffenbacher are using them to make thin board less than 4mm thick. Dieffenbacher signed its most recent order in October 2005 for a 150,000 cu m/yr MDF line with Shengda of Chengdu that will be used to manufacture MDF mainly to produce floor boards.

Siempelkamp is estimated to have supplied five MDF lines and one particleboard line to China since 2000. The company's largest customer is Shanghai Dare International Import & Export Co Ltd of Shanghai which has installed three machines believed to have the combined capacity to produce 600,000 cu m/yr. Siempelkamp recently has supplied one MDF line to Fanglin Wood Board Co of Guangxi Province in southwest China that is due for commissioning in 2006.

Another company to have supplied a continuous press to China is Metso, which since 2000 has supplied one MDF line to Robin MDF Co and one particleboard line to Fuzhou Particleboard Co of Fujian Province.

Older imported MDF lines also are in operation in China. Plantation Timber Products, now owned by Carter Holt Harvey owns two Dieffenbacher lines along with one Mende line.

Kronospan is another company to have supplied MDF lines to China in the 1990s. In August 2004 the Austrian firm reached an agreement to purchase a 70% stake in Shanghai Wood-Based Panel Machinery Co Ltd (SWBPM), China's largest manufacturer of MDF presses. Kronospan purchased its stake from the Shanghai Electric Group, leaving the group with a 30% shareholding as part of Shanghai Electric's plans to focus on its core power plant and turbine generator machinery business.

Kronospan's interest in taking over SWBPM is understood to be to expand the company's machinery building business activities and expand the group's wooden panel activities in Asia, particularly the fast growing Chinese market. Kronospan's machinery construction business previously was the responsibility of Kronomech spol. of Jihlava in the Czech Republic and Polytrans sro of Presov in Slovakia.

SWBPM produces a range of machinery including MDF, particleboard and laminating machinery, rubber moulding machines and plastic moulding machines. For the wooden panel industry SWBPM focuses on single and multi level presses. Equipment supplied includes dryers, coating and laminate presses, sanding machines and handling units. The company produces multi open face MDF machinery capable of producing up to 80,000 cu m of MDF annually. Until 2001 most open faced MDF lines that the company supplied averaged about 30,000 cu m/yr in designed capacity. Since then most MDF lines supplied have been either 50,000 cu m or 80,000 cu m/yr machines.

SWBPM has supplied about 90% of all large Chinese-made MDF lines installed in China. At the end of 2005, it had supplied or received orders for a total of 192 MDF lines from Chinese customers capable of producing 8.9 million cu m of MDF annually. The list includes orders for 10 MDF machines that were ordered in 2005. In addition SWBPM has received orders from overseas clients for about six MDF machines.

Originally SWBPM expected the Kronospan Group's

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The internationally operating sia Group, which is present on the world market with 16 group companies and representations in over 80 countries, has been concentrating on its core competence – surface process – for more than 130 years. Carefully selected first-class raw materials, ultra-modern production plant and highly advanced production technologies are the factors that guarantee products of the highest level with consistent quality.

sia Abrasives offers a product range for sanding composite panels such as particleboard, MDF and OSB. siapan sanding belts are also used for the plywood, HDF, cement fibre board, gypsum and mineral fibre board industries and are used in the production of solid edge-glue wood panels and agricultural boards made from bagasse, wheat and rice straw.

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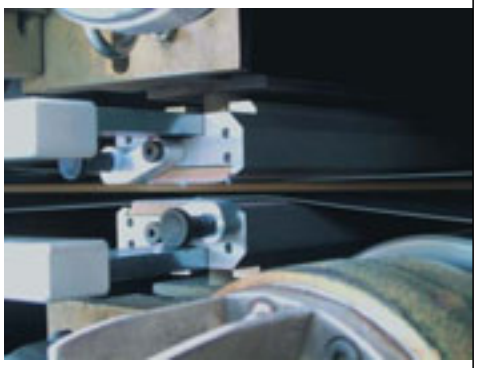
"Ready-to-use" pads ensure constant sanding precision

Yet again, sia Abrasives is enhancing the range available on the abrasives market with a powerful innovation, the sia-slide-system. Consisting of the sanding platen and the sia-slide-pad, this novel product makes work far easier for its users in many ways. From now on, the time-consuming preparation of the sanding platen is no longer needed because the sanding platen (aluminium beam) is permanently installed and it stays in the machine even when the sia-slide-pads are changed. The ready-to-use pad comprising an MDF slide and graphite-faced support material (felt or foam) can simply be slided-in and out, as the name says.

What improvements do the new sia-slide-pads offer? Simple handling speeds up the working process because platen conversion is not necessary anymore and changing time of the slide is reduced to an absolute minimum (slide-in-slide-out). The high costs of maintenance and spare parts are also eliminated – and users are rewarded by constant precision in the sanding process and perfect results on the workpiece. And finally, there's a positive side-effect – the sia-slide-pad can be disposed of or recycled on the spot.

The new sia-slide-system is the ideal complement for the high-quality sanding belts in the siapan series. sia-slide-pads are available in units of 10 and lengths from 1400 to 3300 mm. For a width of 80 mm, the area in contact with the workpiece is 40 or 55 mm, and for a width of 115 mm the figure is 90 mm. This sophisticated system has been tested through to the pre-market launch stage in cooperation with Kronospan of Menznau in Switzerland. The sanding platens can be purchased individually to match all the sanding machines available on the market. This Swiss quality product has already generated great interest among the large numbers of specialists attending the 2005 LIGNA+ fair in Hanover and in the course of 2005.
sia-slide-pad – another highly promising innovation from sia Abrasives.



The new sia-slide-system

"Your Key to a Perfect Surface" –
Made in Switzerland by sia Abrasives!

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involvement to assist in plans to develop the first Chinese-made continuous press and had hoped to convert its existing customers' open presses to become continuous presses. It now appears the development of a continuous press will take five years or more due to a number of technical reasons. None of the necessary parts are made in China as yet and would need to be imported at considerable cost.

Current plans call for SWBPM to continue supplying its multi open face MDF machines to the local market and to various companies in the Kronospan Group. SWBPM is also looking to develop export sales to India and nearby countries where demand is expected to grow for moderately priced wood panel machinery.

Apart from SWBPM, another 10 or more Chinese companies also produce MDF machinery for local sale and export, often as part of a wider range of wood panel and related machinery. Included in the list of MDF machinery producers is Sufoma Co Ltd of Suzhou in Jiangsu Province, a listed company run by the Ministry of Forestry.

Sufoma specialises in the production of plywood machinery, but also produces MDF, particleboard and veneer machines and dryers. The company also produces short cycle open press single opening and multi opening machines. Sufoma is thought to have sold about 10 machines in 2005. The firm recently has introduced a six foot wide MDF machine after previously making four foot width machines capable of producing from 30,000 to 100,000 cu m of MDF a year. Suzhou Forestry Machinery Factory Co Ltd, a subsidiary of Sufoma, makes raw board handlers in cooperation with Dieffenbacher and Siemplekamp.

Shanghai Jiecheng Manufacturer Co of Shanghai, is a private company that makes multi opening MDF machines capable of producing from 50,000 to 80,000 cu m/yr. The company is believed to have received orders for two MDF machines in 2005 and previously has exported two 50,000 cu m MDF machines to Iran.

Chengdu Donghua Co of Chengdu, capital of Sichuan Province, is another private company that makes multi opening MDF machines. The company produces MDF machines ranging from 15,000 to 60,000 cu m/yr in capacity. Other products include particleboard machines. Orders from Chinese customers are thought to have totalled one or two machines in 2005. Chengdu Donghua previously is believed to have supplied several 15,000 to 30,000 cu m/yr MDF machines to Vietnam.

State-owned Kunming Forestry Machinery Corporation of Yunnan Province is believed to have supplied two local customers with two single opening MDF lines to produce thin 3mm board in 2005. The company is capable of building machines up to 50,000 cu m/yr in capacity. In addition to local sales, Kunming Forestry Machinery is rumoured to have supplied 15,000 and 30,000 cu m MDF lines to Vietnam.

State-owned Shenyang Heavy Machinery of Liaoning is understood to have exported two multi opening MDF lines to Russia in 2005. The company previously made single opening machines in cooperation with Dieffenbacher under an agreement that expired in 1990. The company produces 4 by 16 ft multi opening presses and single opening 8 ft presses capable of producing up to 50,000 cu m/yr.

Other Chinese companies that can produce MDF machines include Xinyang Machinery Co of Henan Province, Changshu Forestry Mechanical Machinery of Jiangsu Province, and Changshu Fly Machinery Corporation of Jiangsu, and Quilin Co of Shanghai.

Meanwhile, a shortage of raw material supplies following the rapid growth of the nation's MDF production capacity is one of the major issues facing China's MDF industry. A number of MDF lines in Shandong and Hebei provinces are rumoured to have closed in 2005 due to local materials shortages.

"Most MDF companies of all sizes have plantations, otherwise they close," commented one MDF machinery salesman, "Big companies can buy their timber and pay more than small companies that cannot increase their production quality or charge a higher price for their MDF which means they cannot pay more for their timber supplies. Raw materials will affect the MDF industry. The only way is to own a timber plantation. There is not much chance to use new raw materials apart from timber just yet. That will take time."

In Shandong Province some of a group of about 15 small MDF plants installed with locally-made MDF lines has had to close due to timber shortages after being built next to a large aluminium smelter that encouraged small and medium enterprises to locate nearby to consume surplus electricity supplies. Shandong provincial government also encouraged pulp and paper factories to set up nearby offering free electricity, steam and providing factory land at no cost.

Problems have arisen, however, as the MDF factories do not own sufficient timber resources to meet their needs. "Each factory puts a sign with a purchase price for logs at its factory gate each day and local farmers bring their logs by horse and cart and check all the prices before deciding where to sell their logs. Most of the MDF is low quality and used for furniture," the machinery salesman said, noting that Shandong provincial government is offering inducements to other factories set up nearby to replace the closed MDF plants.

Other problems have arisen for small MDF plants elsewhere following the government's decision to ban high formaldehyde MDF with a content exceeding 20mg per 100 grams. "Small factories all have problems with this and some are forbidden to sell their board," the salesman said.

Chimar Hellas State-of-the-Art MDF Technology

"According to the EPF annual report (2004-2005), MDF production in Europe over the past decade has been rising determinedly along the lines of an average annual growth rate of 13%. During the same period, the MDF consumption has also been expanding at an average annual growth rate of 13%, perfectly corresponding to production growth."

This is a very promising industry situation for those involved in the sector knowing very well that MDF applications will further future demand growth mainly due to the so-called "laminate flooring effect". Remaining loyal to this tendency Chimar Hellas S.A., a global technology provider for the resin and wood-based panels industry, has further expanded and refined its MDF technology. The business strategy of Chimar Hellas aims to improve product performance through:

- a significant reduction of formaldehyde emissions without decreasing the properties of the end product;
- enhanced moisture resistance MDF panels;
- adhesive systems production using high-added value products;
- increased reactivity and subsequently increased line speed;
- and finally, achievement of cost-effective systems.

Such an aim bears in mind that MDF encompasses a wide variety of applications such as furniture for both the office and home, fitments, shelves and storage units, table bases and tops, children's toys and games, chairs, frames, benches, wall panelling, flooring, doors and many other interior and exterior applications. Accordingly, as far as the thin (<3,2 mm) board is concerned the company currently offers:

- *Super E0 – standard grade* with emission < 0,3mg/L JIS A 1460 F**** class
- *Moisture resistant E0 board* – emission <0,5mg/L JIS A 1460 F*** class

Latest development relates to the exterior grade E1 board category in 6-8mm and special requirements concerning the V100 and wet MOR tests. In addition, for customers who work with dry resination systems, a specially developed adhesive system offering the mechanical and physical properties needed for the effective use of the subject resination systems, is also available.

Traditionally, the waste MDF panels resulting from the production and end-users' applications were sent to landfill sites. This is now considered an unacceptable solution due to the high organic load included. Chimar Hellas has thus developed an innovative recycling technology (WO 01/39946), which enables the reuse of a large percentage of wood panels at the end of their service life, into new marketable fibreboards with minor capital investment in machinery.

Using specific chemicals at certain stages of the dry MDF process, it is possible to produce boards from fibres originating from a mixture of fresh wood and various types of waste panels. Use of adhesives and additives enables the production of new high-quality fibreboards according to the EN standards.

The main advantages claimed by this technology are a significant contribution to the reduction in the amount of "waste" wood panels that need to be deposited in landfill sites, providing at the same time, substantial savings in the demand for fresh wood, plus savings in investment and production costs.

Chimar Hellas has now been involved for 28 years in the development of state-of-the-art technology and will continue to create added-value, cost-effective products required by the needs of the MDF panel sector and the principles of eco-efficiency.

GLOBAL MDF MARKET DYNAMICS FORCE REAPRAISALS

BY PRODUCERS TO SECURE FUTURE STABILITY

MDF YEARBOOK again publishes its annual analysis of the challenges and opportunities that face producers of MDF as the industry continues to add fresh manufacturing capacity on a global scale. Our editors have met with and have spoken and communicated with a number of leading producers and machinery suppliers in a number of countries. Resulting from these exchanges of opinion, the Yearbook and PMP*digest* has prepared this exclusive review. In particular, the data presented in chart form, represents the latest available input from many sources. Some earlier data has been revised and updated based on more recent and reliable local information.

Changes in the Global Market

Producers in mature markets are being forced to move away from a reliance on the production economies-of-scale, in order to guarantee their survival in tomorrow's market place. Mergers and acquisitions have continued during 2005, with one of the biggest global company leaders deciding to exit the panel industry. Increasing competition and overcapacity arising from non-traditional sources is finally starting to emphasis the need for a shift in emphasis away from a constant drive to increase the production throughput of machinery towards improved quality, consistency and added-value.

The MDF industry's spectacular growth curve of recent years has begun to slow down. Only a handful of new plants were built during 2005, although a number of existing plants expanded by adding new machinery. This on-going market development process is in response to market demand that is focused on lower price materials as a result of supply and capacity imbalances. Such imbalance is no longer regionally contained as in the earlier years and is the result of new large capacity having been installed in developing economies whose trade has been strongly reliant on exports.

Production will favour integrated, low-cost producers who can continuously sustain maximum output of consistently high quality material; and get this to the market place quickly.

The present stage of maturity in the MDF sector has reached a point where it now is likely that a spate of mergers and acquisitions will occur. These are seen as necessary in order to resolve the problems identified and to enable corporate companies to share the costs of further investment. Such investments are also allied to a need for some producers to secure captive raw materials supplies in order to ensure higher value-added materials. Integrated producers with well-based regional production and sales coverage are growing in strength but a lot of capacity has been added to the global MDF sector in the past three years which yet has to find regular, consistent and profitable market outlets. There has been a groundswell in production of 'thick' MDF and a noticeable change during 2005 has been the preference for machinery to make and process thin, and sometimes, very thin MDF. But this also demands greater consistency of fibrous raw materials and allied manufacturing skills.

Laminate flooring has recently become the leading end-user market for MDF. With the rapid expansion of the laminate flooring markets, it has in now the largest consumer of MDF with an approx. share of 45%. The furniture industry has now fallen to second place with a market share of about 19%, followed by the building industry at 16%.

Global Industry Growth

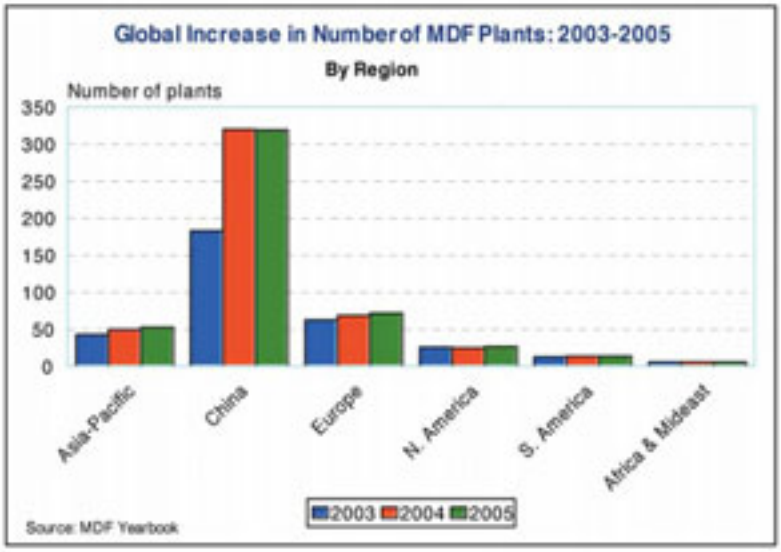
The following table shows a general breakdown of the global number of MDF plants by main regions for each of the past three years and the change in engineered capacity corresponding with those plants. The increase in global engineered capacity over the past two years equals a compound annual growth rate of 13.64% and the increase in the global number of installed plants equals a compound growth rate of 21.25%

MDF PLANTS AND CAPACITY 2003 - 2005

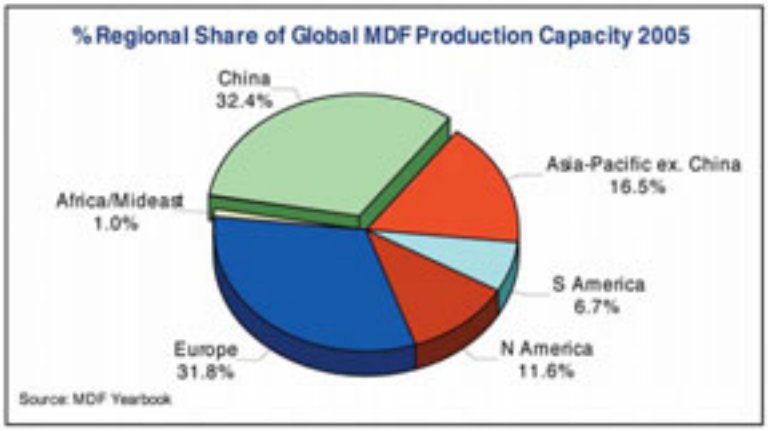
Region	Number of Plants			MDF Capacity cu m/yr (,000)		
	2003	2004	2005	2003	2004	2005
Africa	4	4	4	245	245	245
Asia-Pacific	43	50	53	7,083	7,591	7,973
China	183	320	319	9,184	16,219	15,690
Europe	63	69	72	12,802	14,239	15,416
Mideast	2	2	2	180	180	190
North America	26	25	27	5,248	5,041	5,634
South America	13	14	14	2,770	3,262	3,292
Total	**334**	**484**	**491**	**37,512**	**46,777**	**48,440**

For the second consecutive year China has the worlds, largest production capacity, followed closely by Europe.

The figure below shows the whereabouts of global MDF capacity by total number of plants. It shows that the China was lead installation region between 2003 and 2005. Thus the region has added some 183 plants in the past two years, accounting for an additional 6,506,000 cu m, being the equivalent of a 30.71% compound gain.

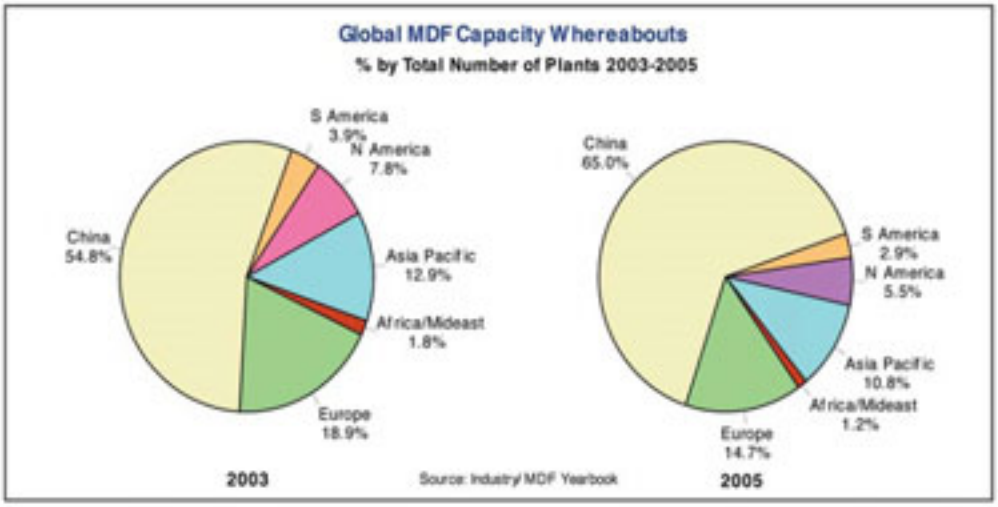


Along with the wide variation in regional share distribution of MDF plants, so also does the average capacity of each mill vary by region. Plants in Europe, North and South America tend to be of similar average size, of around 200,000 cu m production capacity per year. Mills in Africa, Mideast and China tend to have a much smaller average capacity.

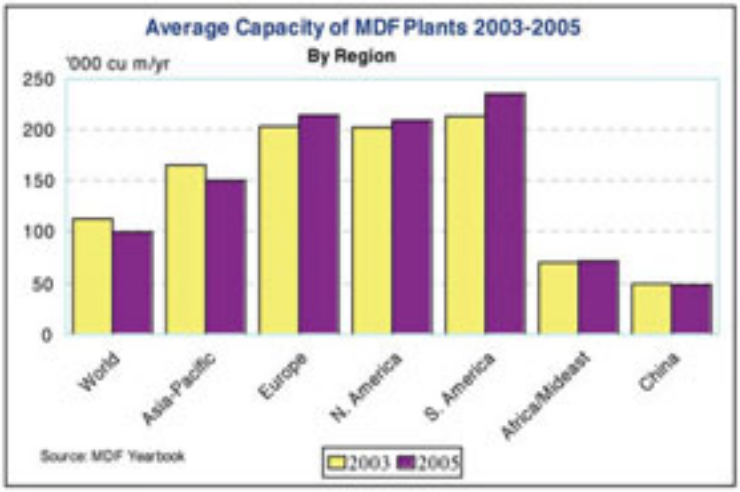


World MDF capacity

World MDF capacity has continued to grow in 2005, albeit it a bit more slowly than in previous years. The increase of almost 1.4 million cu m, is nearly 3% more than in 2004.



The European MDF industry reached a new high with 15,416,000 cu m production capacity for 2005. Most of the new growth was in eastern Europe, Russia and Turkey. Also the former Pindos plant in Greece was put back into operation with an estimated production capacity of 100,000 cu m/yr. Germany remained the major producer of MDF in Europe with about 22.5% of production capacity.



Canadian MDF production capacity remained stable. However, there were several ownership changes. ATC Panels (Aconcagua Timber) took over the Temple-Inland mill at Pembroke, Pfleiderer acquired the Uniboard mills and Georgia-Pacific sold its share of the Sault Sainte Marie plant to Flakeboard. In

the USA production capacity expanded slightly with ATC Panels now operating the Shippenville, Pennsylvania mill previously owned by Temple. Also the addition of CMI, in Pennsylvania, which was reported to be a Masonite site acquired by the company.

South America and Africa have seen virtually no change. The Asia-Pacific region, excluding China, was seen some minor capacity modifications, specifically in Korea, Malaysia, Thailand and Sri Lanka, and a new line started up in Vietnam.

China MDF Capacity Growth Slows

Some large machines have been added in the past 15 months but the big growth in installed capacity in mainland China has begun to slow, following the period during which the state contributed funding to individual companies. The emergence of several powerful groups, two of which now rank among the world's top 10 players, has begun to influence changes in quality. Such groups will be well positioned to increase exports of panels and semi-finished products to near and far markets.

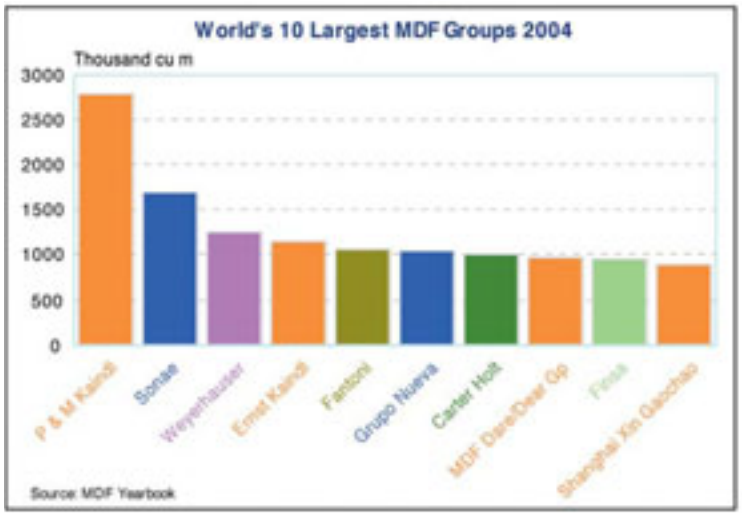
Understandably, producers are looking for business growth but the next couple of years may prove to be less lucrative than has been the case during the past six years. A combination MDF production overcapacity of around 10%, plus a shortage of fibre raw materials probably means that some of China's smaller producers with less efficient machinery will close. Any further growth in China's MDF capacity will increase existing competition for already scarce timber resources, while at the same time, MDF prices are poised to fall during 2006-2007 as MDF producers seek to sell higher volumes to sustain equal revenue flows.

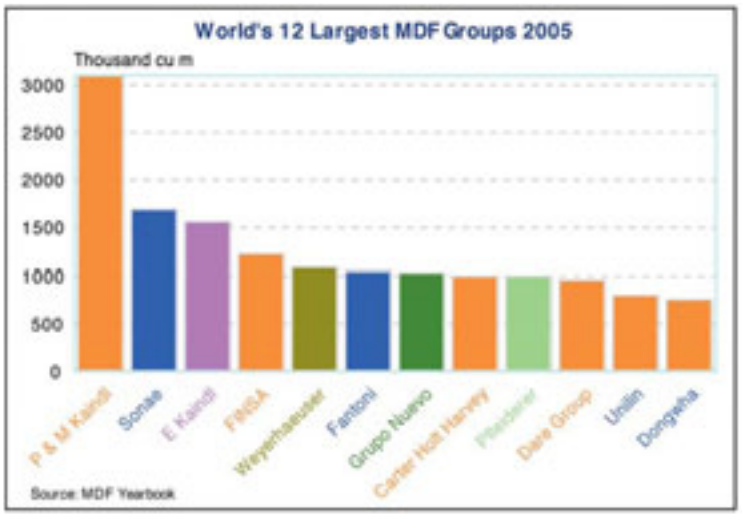
Nevertheless, China is expected to maintain its driving force in the production of MDF and already some of its producers are showing signs of adding value to the basic materials. As it is, China has seen a huge growth in the production of MDF during the past four years, rising from a 4.9% share of the global market to hold a 32.4% of the global total. At the same time, China's share of global demand moved from 24.3% in 2001 to 33.8% in 2005.

China has moved up the world economic rankings after reporting that its gross domestic product (GDP) is much larger than had earlier been thought. According to a recent state report, China's economy was 16.8% larger in 2004 than initially calculated. The new research raised the estimate of China's economic output in 2004 to nearly 16 trillion yuan. The Organisation for Economic Co-operation and Development (OECD) said that domestic demand would improve between 2006 and 2007, and that China would increase its share of global trade. The OECD expects the Chinese economy to grow by 9.3% in 2005, rising to 9.4% next year and 9.5% in 2007.

Leading Global MDF Producers

In a matter of just on two years the established leading global MDF producer companies have witnessed a big change in their respective rankings. China in 2004 entered the rank of top 10 Global scale producers, by including two world-scale companies. The following charts show world's largest MDF groups based on production capacity in 2004 and 2005.





P&M Kaindl and Sonae remain in the top positions, with E Kaindl coming in third. Weyerhauser dropped down from third to fifth place with the sale of it Morcenx mill in France, pushing FINSA, who acquired the mill up to 4th position. Weyerhaeuser has announced that it is seeking to sell its other composite panels business in North America and Ireland.

Fantoni and Grupo Nueva are in 6th and 7th position respectively. Carter Holt Harvey had been in 7th position earlier in 2005, until FINSA's recent acquisition which moved CHH down to no. 8. Pfleiderer's acquisition of Hornitix Nidda, and the Kunz group, which includes the Uniboard mills in Canada has placed it in the top group at no. 9, followed by the Chinese Dare Group and Belgian company, Unilin. Dongwha's purchase of the Rayonier mill in New Zealand has placed it in 10th position, until the above-mentioned acquisitions at the end of 2005, pushed in down to no. 12.

WORLD CAPACITY DATA 2005

MDF: North America

Country	Company/Group	Location	Cu m/yr			
			2004		2005	
Canada	Aconcagua Holdings (previously Temple-Inland)	Pembroke, Ontario	239,000		239,000	
	Flakeboard	St. Stephen, New Brunswick	202,000		202,000	
	Flakeboard (was GP-Flakeboard jv)	Sault Sainte Marie, Ontario	283,000		292,000	
	Pfleiderer (was Uniboard Canada-Kunz, Germany)	La Baie, Quebec	260,000		280,000	
	Pfleiderer (was Uniboard Canada-Kunz, Germany)	Mont Laurier, Quebec	140,000		140,000	
	Ranger Board (West Fraser)	Whitecourt, Alberta	265,000		265,000	
	WestPine MDF (West Fraser)	Quesnel, British Columbia	209,000		209,000	
		Total Canada		[illegible]		[illegible]
Mexico	[illegible]	[illegible]	[illegible]		[illegible]	
		Total Mexico		**60,000**		**60,000**
USA	ATC Panels-Aconcagua (SierraPine closed Nov 2004)	Moncure, [illegible]	[illegible]		[illegible]	
	Aconcagua Timber Corp (just starting up)	Shippenville,Pennsylvania	----		239,000	
	Bassett Furniture Industries	Bassett, Virginia	37,000		37,000	
	CMI/Craftmaster Manufacturing	Towanda, Pennsylvannia			177,000	
	Del-Tin Fiber (JV) – Temple	El Dorado, Arkansas	265,000		265,000	
	Georgia-Pacific (Koch Industries)	Holly Hill, South Carolina	177,000		177,000	
	Georgia-Pacific (Koch Industries)	Monticello, Georgia	64,000		64,000	
	Great Lakes MDF	Lackawanna, New York	212,000		212,000	
	Langboard	Willacoochee, Georgia	239,000		239,000	
	Norbord	Deposit, New York	147,000		159,000	
	Paragon Panels to start oct 2005	Clayton, Alabama				
	Pan Pacific Products	Broken Bow, Oklahoma	110,000		110,000	
	Plum Creek Timber	Columbia Falls, Montana	423,000		559,000	
	SierraPine	Rocklin, California	244,000		244,000	
	SierraPine (Medite Division)	Medford, Oregon	212,000		212,000	
	Temple-Inland	Mt. Jewett, Pennsylvnia	177,000		177,000	
	Unilin (prev Homanit)	Mt. Gilead, North Carolina	250,000		250,000	
	Weyerhaeuser (ex-Willamette)	Malvern, Arkansas	283,000		283,000	
	Weyerhaeuser (ex-Willamette)	Eugene, Oregon	150,000		150,000	
	Weyerhaeuser (ex-Willamette)	Bennettsville, Sth Carolina	260,000		260,000	
		Total USA		**3,383,000**		**3,947,000**
TOTAL NORTH AMERICA				**5,041,000**		**5,634,000**

INFORMATION ONLY

Total of 14 pages of world mill capacity data

Country	Company/Group	Location	Cu m/yr			
			2004		2005	
New Zealand	Carter Holt Harvey	Rangiora, South Island	210,000		210,000	
	Fletcher Wood Panels	Taupo, North Island	145,000		160,000	
	Nelson Pine Industries	Nelson, Richmond, S.I.	380,000		380,000	
	Dongwha Patinna (Was Rayonier)	Gore, South Island	170,000		170,000	
		Total New Zealand		**905,000**		**920,000**
Pakistan	Al-Noor MDF Board Industries	Moro, Nawabshah	28,000		28,000	
		Total Pakistan		**28,000**		**28,000**
Sri Lanka	Merbok MDF Lanka (Pvt) Ltd	Horana	100,000		180,000	
		Total Sri Lanka		**100,000**		**180,000**
Thailand	Agro Mats	Chachoung-sao	90,000		90,000	
	Bang Say	Bangkok (vicinity)	90,000		90,000	
	Khon Kaen Sugar (doorskin mill)	Khon Kaen	25,000		25,000	
	MDF Planner (Vanachai) Lines I & II	Bangkapong	270,000		270,000	
	Metro MDF Lines I & II	Kanchanburi	240,000		240,000	
	Siam Fibreboard (Evergreen)	Hat Yai	200,000		200,000	
	Thai Plywood Co	Kaeng Khoi, Suraburi	78,000		84,000	
		Total Thailand		**993,000**		**999,000**
Vi[illegible]	Cose[illegible] MDF (Mi[illegible]and [illegible]tion)	D[illegible] Ha, Q[illegible] Tri			[illegible]	
	Vina[illegible]	G[illegible]ai Hoa [illegible]	[illegible],000		[illegible]	
		Total Vietnam		**60,000**		**120,000**
TOTAL ASIA-PACIFIC excluding China				**7,591,000**		**7,973,000**

Shanghai Wood-Based Panel Machinery Looks to Overseas Customers as MDF Line Sales Slow Down

"In future MDF material supplies in China will be a big problem. The longer term tendency for the MDF business is a downturn."

The growth of China's MDF industry has slowed significantly during the past 18 months as timber supply shortages have begun to halt investors' plans to install new MDF lines. With the government now requiring MDF manufacturers to arrange timber supplies before receiving permission to install a new line, the MDF industry is unlikely to see substantial further growth until many more MDF producers establish commercial timber plantations to assure sufficient future raw material supplies. Materials shortages have affected the level of MDF production equipment orders for many of China's MDF machinery suppliers over the past year. MDF machinery orders have been hit most in areas where timber resources are in short supply.

"We have supplied two MDF lines to Shanghai companies in 2005 but because of material supply problems investors had to cancel plans for another eight MDF lines in Shanghai," commented Zhang Guoxian, vice-managing director and senior engineer of Shanghai Wood-Based Panel Machinery Co Ltd (SWBPM), China's leading panel board machinery manufacturer and one of the world's largest multi open face MDF machinery producers. MDF plants need a lot of materials, but not high quality materials. Timber imports are too expensive to make MDF although African timber is imported to make veneer. China still needs good quality MDF supplies all over the country. The MDF machinery market in 2006 is very difficult to forecast but the tendency is towards a downturn due to materials supply problems."

SWBPM received orders for 11 MDF lines from customers across China in 2005. The orders were for

machines ranging from 40,000 to 80,000 cu m/yr capacity. Of the 11 MDF lines ordered, six are for existing customers while the five other MDF lines will be delivered to new clients. "MDF is a new industry for them as they are not wood-based companies," Zhang said, referring to the new customers, "They plan to supply MDF for furniture production for the domestic market."

Orders from domestic clients in 2005 were down by about one third compared with the previous year when SWBPM is believed to have sold between 15 to 20 multi open face MDF lines. The number of contracts signed with Chinese customers in 2005 was just one quarter the number of domestic sales contracts signed in 2003 when SWPBM supplied 42 MDF lines to clients across China.

SWBPM's local competitors also have noticed a drop in orders for popular size multi open-face MDF machines capable of producing 40,000 to 80,000 cu m/yr. "There are other companies in China making MDF lines but they have had a tough year," Zhang said, "There is price competition. We are a little higher because of our market share. Customers cannot take a risk just for small savings."

The materials supply situation facing China's MDF industry differs in various parts of the country. While the southwest and western regions have sufficient commercial timber resources, the situation along the developed east coast region where Shanghai and other major cities are located is different as there is less forest land. Timber materials are scarcer as generally they are used in inland areas. "The west and southwest regions have timber supplies but they must send timber to east coast MDF factories. There are highways but in the past suppliers have had to overload their trucks to send timber at an economical price," Zhang noted, "Now the highway police are checking trucks as overloaded vehicles are damaging our roads, which has increased road taxes for all vehicles. Timber trucks cannot overload and so the timber transport cost has increased."

Zhang Guoxian, VP director & senior engineer, SWBPM

"The distance from western China to the east coast is about 2,000km. When timber trucks were 100% overloaded there was no problem but this destroyed the roads. "Up to 500km is an economical transport distance by road in China, but not more." Aware of the timber materials shortage, the government has introduced regulations restricting construction of new MDF plants to those that already have secured their material sources prior to opening. "MDF plants in eastern China must have their own timber plantation to install an MDF line," Zhang explained, "More companies are doing this now. Eucalyptus is planted in the south and poplar trees in the north. Poplar and eucalyptus are cut down after about five years growth."

Most MDF producers are attracted to the industry by the prospect of earning quick profits

"The government also pays attention to industrial environmental pollution. Investors need permission to set up an MDF plant and then the local environmental bureau must check the plant after it is running. If there is dust emission the plant will not get an operating license, so the investment cost is higher than before."

Although various raw materials can be used to make MDF, few, if any, Chinese MDF manufacturers appear interested in researching the use of alternative materials to timber. Most MDF producers are attracted to the industry by the prospect of earning quick profits from China's large demand for furniture and kitchen cabinets, and want to copy the business model of other established MDF producers. "Most of our customers are private companies. They do not want to test new materials. They just want to buy MDF machines and make money," Zhang commented, "Their short term outlook is a new attitude. In future MDF material supplies will be a big problem. The longer term tendency for the MDF business is a downturn."

"Two years ago the housing market heated up and many furniture and cabinets were needed. Now the market is not so hot. Glue, formaldehyde, timber and electricity prices have all increased a little, so our customers cannot make a lot of money. The real estate market is not so good now. If the real estate market were hot then MDF use would increase. The selling price of MDF has increased, but not the same as costs – that is the problem."

SWBPM also is unwilling to research the use of new materials for MDF production due to the risks and R&D costs involved. The company's view is that research is the task of specialized institute's rather than the business sector. "We do not want to test new materials as we are a commercial enterprise and not a research institute that does it for customers," Zhang said, "The customer will think it is easy to use the new material in a laboratory situation, but in a real factory there could be problems with the material supply and other problems. "It's different when you use a new material as you need a continuous supply. "There can be transport problems for materials or storage problems."

Supply problems and production quality issues have probably already caused closure of some plants

In fact, material supply problems and production quality issues are believed to have caused a number of MDF producers to close during the past 12 months. The

problems appear to have affected small MDF producers rather than medium and large enterprises. Those MDF companies affected are unlikely to be taken over by other companies looking to increase market share due to the absence of a corporate merger and acquisition tradition in China. "Most problems are in Shandong Province where several plants have closed. They cannot sell their factories as other companies will not accept their machinery," Zhang said, "No one will buy small MDF companies. They will just become bankrupt. It is difficult to take over a small company with a financial problem."

Shanghai Wood-Based Panel Machinery Co Ltd was established in the mid-1960s as a member of the state-run Shanghai Electrical Group in Shanghai's Anting industrial district. The company produces a range of machinery including MDF, particleboard and laminating machinery, rubber moulding machines and plastic moulding machines. SWBPM produces single and multi level presses for the wooden panel industry. Equipment supplied includes dryers, coating and laminate presses, sanding machines and handling units. The company produces multi open face MDF machinery capable of producing up to 80,000 cu m of MDF annually.

Until 2001 most open face MDF lines that the company supplied averaged about 30,000 cu m/yr in capacity. Since then most MDF lines supplied have been either 50,000 cu m or 80,000 cu m/yr machines. Until now SWBPM has supplied about 90% of all large Chinese-made MDF lines installed in China. At the end of 2005, SWBPM's sales reference list showed the company had supplied or received orders for a total of 192 MDF lines from Chinese customers capable of producing 8.9 million cu m of MDF annually. The list includes orders for 10 MDF machines that were ordered in 2005. In addition since 1997 SWBPM has received orders from overseas clients for five MDF machines.

SWBPM's plans to become a global wood panel machinery supplier appeared to take an important step forward in August 2004 when Kronospan of Austria agreed to purchase a 70% stake in the company from the Shanghai Electric Group, leaving the group with a 30% shareholding. Shanghai Electric is thought to have accepted a reduction in its stake holding to that of a minority interest as part of the group's plans to focus on its core power plant and turbine generator machinery business. Shanghai Electric also has retained total ownership of the group's six MDF plants that are equipped with seven MDF lines supplied by SWBPM.

Kronospan's interest in taking over SWBPM is to expand the company's machinery building business activities and expand the group's wooden panel activities in Asia, particularly the fast growing Chinese market. Until the takeover Kronospan's machinery construction business had been the responsibility of Kronomech spol. of Jihlava in the Czech Republic and Polytrans sro of Presov in Slovakia.

Growing western investment in China's manufacturing sector has begun to influence local attitudes to client relations and production control. For most former state-run Chinese enterprises, the western emphasis on quality is a new development and poses challenges for many local companies in the ongoing transition from a government-controlled economy to open competition. Since taking over SWBPM, Kronospan has introduced a new commercial philosophy to the company's senior management and all staff. "Quality is a big issue," Zhang commented, "We must work hard and change peoples' attitudes to think about quality, as our salaries come from the customer. If we supply low quality then we lose future opportunities. All our after sales service is provided from Shanghai. Most of our customers are old customers."

Until recently almost unknown outside China due to the company supplying most of its MDF machinery to the domestic market, SWBPM has been working on developing a continuous MDF press for the past four years as part of efforts to develop local and export sales opportunities. SWBPM originally expected the Kronospan Group's involvement to assist in plans to quickly develop the first Chinese-made continuous press and had hoped to convert its existing customers' open presses to become continuous presses. It now appears SWBPM's ambitions to develop a continuous press will take longer to achieve than previously expected. "Completion of our continuous press is still far away. It's not so easy. We want to have this machinery but the technology and machine parts are not so easy," Zhang said, "It's not possible to get parts for a continuous press in China yet. Most parts are not available here, so we think the completion of this project is still far away – maybe five years."

"Now we can make multi open presses up to 80,000 cu m/yr in capacity. That's enough for us. We are concentrating on the Chinese and Asian market for multi open presses. If we make an expensive machine there is no chance for us to sell it as the customer will go to a European supplier, not us. "Our current lower price is very important due to customers' payment capability. The continuous line is a different market. Some of our customers have our multi open press and a continuous press, but their continuous press is to produce thin board, which is for a different market. Our machines make board a minimum thickness of 9mm, while a 15mm MDF board thickness is the average for our machines."

Meanwhile, SWBPM and other Chinese MDF machinery manufacturers are looking to develop the export potential of their machines now that the domestic market seems poised to experience a downturn. Developing countries in Southeast Asia and the Indian Subcontinent are the main export target where small, price conscious wood-based companies are looking to upgrade and expand their panel board production.

In Pakistan SWBPM is installing a 40,000 cu m/yr MDF line for Crystal MDF Ltd which has a plant near Rawalpindi that already produces particleboard. The MDF line will be used to make 4 by 8ft board using local timber supplies. The Pakistan line follows the earlier installation of a 30,000 cu m/yr line with an Andritz 36/38-1CP refiner for Iran's state-run Sanaye Choobe Khazar Co. The MDF was installed in the company's Babolsar plant and is believed to have started up in early 2004.

SWBPM exported its first MDF line to India in 2005 where installation of a 40,000 cu m/yr capacity line is underway at an unnamed Mumbai-based client's plant near Delhi. More orders are pending once clients receive official approval. "Our Indian client has a particleboard plant already and will produce MDF as India's panel board market is growing. This is our first order from India," Zhang said, "India has no continuous presses installed yet. They are all open face. We are discussing many projects but customers must get an import license and need approval. We have many inquiries from India. It is a big potential market. They will use Indian wood as raw material."

"We have signed three contracts and now we are waiting for down payments. These contracts are for lines to make 4 by 8ft size boards with 15 to 16 openings capable of producing 150 cu m per day. All of them are 40,000 cu m/yr lines. Materials are the main requirement for MDF lines. All the customers are located near Delhi as northern India has many forests. They are private companies with second hand European particleboard machines. All the MDF would be produced for the Indian market."

SWBPM also has supplied short cycle lamination machines to India and Pakistan that produce paper and melamine lamination materials for the furniture industry to finish particleboard. Six lines have been supplied in total – five to Pakistan for factories in Karachi, Lahore and Peshawar, and one to India in Mumbai. All six lines are each designed to produce 1.2 million square metres of surface finishing a year. "We have started our overseas export business using direct sales. Customers do not like to buy through an agent as this is a low priced market," Zhang said, "We participated in the Milan Xylexpo and Hannover Lignaplus machinery fairs so customers can get to know our company."

China's furniture industry, is the major user of MDF

Meanwhile, China's furniture industry, including furniture exports, remains the major consumer of MDF board, using an estimated 50% of all locally produced MDF. Flooring is the second largest consumer of MDF with an estimated 30% of MDF used for flooring. Of the total 50% furniture share, MDF used to make kitchen cabinets and other fitted household cabinet items accounts for about 20% of overall MDF output. Freestanding furniture items represent another 20% while the remaining 10% is used for door panels, window and door frames, and wall skirting boards.

China's huge housing construction programme and the poor reputation of particleboard are two major factors that have helped boost demand for MDF. New apartments are sold bare of any fittings leaving the new owners to install all the necessary cabinets and fittings themselves. SWBPM has calculated that an average 100 square metre new apartment requires about one cubic metre of MDF for cabinets and other fittings, not including any freestanding furniture. MDF flooring is made from 8mm thick MDF panels while door frames and interior wall skirting boards are made with either 12mm, 15mm or 18mm thick MDF panels.

MDF is popular in most areas of China except for the north and northeast where there are very few MDF plants as poplar and eucalyptus trees do not grow quickly in the cold northerly climate, where particleboard preferred. Purchases of particleboard continuous presses are growing in the north, in fact where particleboard is used mostly to make free standing furniture and kitchen cabinets. Also, 25mm and 28mm thick particleboard covered with waterproof and fireproof high pressure melamine lamination is widely used for countertops. Elsewhere, Zhang noted that a number of provinces have developed large MDF industries, some mainly geared to exports while others supply both local and overseas markets. Most MDF panels for export are further processed into knock down furniture or interior construction fittings before shipment.

Guangdong and Shandong provinces are China's largest MDF production centres, each with about 2 million cu m of annual MDF production capacity. Guangxi Province is close behind followed by Jiangxi, Jiangsu, Hebei, Zhejiang and Fujian provinces, each with approaching 1 million cu m MDF production capacity. "Guangdong's furniture industry is very strong, but there is an export dumping problem with the United States," Zhang noted, "The construction industry is strong so the local Guangdong MDF market is equally strong. "The Chengdu construction market in southwest China also is likewise, due to private investment by local people. In northern China there is some market demand near Beijing."

Larger producers with several MDF lines are beginning to dominate the MDF industry as smaller producers feel growing pressure from competition. Some larger producers have expanded outside their home province. For instance, several companies from Zhejiang Province have set up MDF plants further south in Fujian Province.

China MDF Production Capacity 2005

Item	Company/Group	Province	Location	Capacity m3/y		Put into Production
1	Anhui Hualin Wood based Panel Co., Line 1	Anhui	Anqing	50,000		1995
	Anhui Hualin Wood-based Panel Co., Ltd. - A Member of Malaysia Samling Group, Line 2	Anhui	Anqing	80,000	130,000	2002
2	Chuzhou Huaneng Artificial Board Co., Ltd., Line 1	Anhui	Chuzhou	50,000		2000
	Anhui Asia Europe Wood Industrial Co., Ltd., Line 2	Anhui	Chuzhou	100,000	150,000	2005
3	Anhui Jinchan Wood Based Panel Co., Ltd. / Huaibei Coal Mine Bureau Line 1	Anhui	Huaibei	15,000		1996
	Anhui Jinchan Wood Based Panel Co., Ltd. / Huaibei Coal Mine Bureau Line 2	Anhui	Liuan	80,000		2003
	Anhui Taihu Board Industry Limited Liability Co. / Huaibei Coal Mine Bureau Line 3	Anhui	Taihu	80,000	175,000	2004
	Huangshan Green Continent Wood Based Panel Co., Ltd., Line 1	Anhui	Qimen	10,000		1997
	Huangshan Green Continent Wood Based Panel Co., Ltd., Line 2	Anhui	Qimen	40,000		
	Huangshan Green Continent Wood Based Panel Co., Ltd., Line 3	Anhui	Qimen	30,000		2000
	Anhui Green Continent Wood Based Panel Co., Ltd.	Anhui	Suzhou	80,000		2004
	Jiangxi Green Continent Wood Based Panel Co., Ltd.1	Jiangxi	Jian	80,000		2003
	Jiangxi Green Continent Wood Based Panel Co., Ltd.2	Jiangxi	Jian	80,000		2004
	Hubei Green Continent Wood Based Panel Co., Ltd., Line (1)	Hubei	Xianning	30,000		1995
	Hubei Green Continent Wood Based Panel Co., Ltd., Line (2)	Hubei	Xianning	30,000		2000
	Xijiang Green Continent Wood Based Panel Co., Ltd.	Xinjiang	Changji	40,000	420,000	2005
5	Shenhua Wood Based Panel Plant, Line 1	Beijiang	Beijing	15,000		1990
	Shenhua Wood Based Panel Plant, Line 2	Beijiang	Beijing	100,000	115,000	1999
6	Sichuan Guodong Construction Co., Ltd., Line 1	Chongqing	Chongqing	30,000		2002
	Sichuan Guodong Construction Co., Ltd., Line 2 Bamboo material	Chongqing	Chongqing	50,000	80,000	2002
7	Fuzhou Wood Based Panel Plant, Line 1	Fujian	Fuzhou	53,000		1982
	Fuzhou Wood Based Panel Plant, Line 2	Fujian	Fuzhou	56,000	109,000	1996
8	Fujian Yongan Forestry (Group) Joint-Stock Co., Ltd., Line 1	Fujian	Yongan	30,000		1996
	Fujian Yongan Forestry (Group) Joint-Stock Co., Ltd., Line 2	Fujian	Yongan	80,000	110,000	2003
9	Guangdong Deqing Kanglan MDF Group Co., Line 1	Guangdong	Deqing	30,000		1992
	Guangdong Deqing Kanglan MDF Group Co., Line 2	Guangdong	Deqing	30,000	60,000	1996
10	Asia Dekor (Heyuan) Wood Ltd.	Guangdong	Heyuan	200,000	200,000	2004
11	Weihua MDF Manufacturing Co., Ltd., Line 1	Guangdong	Meizhou	30,000		1997
	Weihua MDF Manufacturing Co., Ltd. Zengcheng Branch, Line 2	Guangdong	Zengcheng	50,000		2001
	Guangdong Weihua Corporation Ltd., Line 3	Guangdong	Qingyuan	200,000		2004
	Guangdong Yangchun Weilibang Wood Industry Co., Ltd.	GuangdongYangchun		120,000	400,000	2006
12	Huaguang Decorative Board Factory, Nanhai, Guangdong, Line 1	Guangdong	Nanhai	30,000		2001
	Huaguang Decorative Board Factory, Nanhai, Guangdong, Line 2	Guangdong	Nanhai	30,000		2001
	Huaguang Decorative Board Factory, Nanhai, Guangdong, Line 3	Guangdong	Nanhai	35,000		2002

152	Shenyang Lantian Wood Products Co., Ltd.	Liaoning	Shenyang	30,000	30,000	1998
153	Shenyang Jinlong MDF Plant	Liaoning	Shenyang	15,000	15,000	1997
154	Shenyang Fuyang MDF Plant	Liaoning	Shenyang	30,000	30,000	1996
155	Liaoning Huairen MDF Plant	Liaoning	Huairen	30,000	30,000	1995
156	Shaanxi Tongchuan Wood Based Plant	Shaanxi	Tongchuan	10,000	10,000	1997
157	Shaanxi Wugong Wood Based Plant	Shaanxi	Wugong	10,000	10,000	1998
158	Shangdun Group, Heze, Shandong	Shandong	Heze	15,000	15,000	1996
159	Shouguang Cotton & Yarn Group	Shandong	Shouguang	30,000	30,000	1997
160	Shandong Wenshang MDF Factory	Shandong	Wenshang	30,000	30,000	2001
161	Shandong Chengwu Exported Tung Tree Products Factory	Shandong	Chengwu	15,000	15,000	1995
162	Shandong Houzhen Plywood Plant	Shandong	Houzhen	15,000	15,000	1995
163	Shandong Wenshang Wood Based Plant	Shandong	Wenshang	10,000	10,000	1996
164	Shandong Penglan Huanqiu Wood Industries Co.	Shandong	Penglan	30,000	30,000	2001
165	Huaxing Co., Ltd., Oil Field, Boxing County, Shandong Province	Shandong	Boxing	30,000	30,000	2002
166	Shandong Chiping Nengtong MDF Liability Co., Ltd.	Shandong	Chiping	40,000	40,000	2003
167	Shandong SenTai MDF Co., Ltd.	Shandong	Ningjin	40,000	40,000	2004
168	Shandong Linyi Hongbang Wood Industry Co., Ltd.	Shandong	Linyi	30,000	30,000	2004
169	Shanghai Wood Based Panel Plant	Shanghai	Shanghai	37,000	37,000	1987
170	Wood Based Panel Factory / Xishan Coal Mine Bureau	Shanxi	Taiyuan	15,000	15,000	1997
171	Sichuan Dajiang Decorative material Co.	Sichuan	Chongqi	15,000	15,000	1993
172	Sichuan Miyi Sugar Mill	Sichuan	Miyi	15,000	15,000	1994
173	Sichuan Dongliya Wood Industries Co.	Sichuan	Hongya	30,000	30,000	1996
174	Sichuan Green Continent Jusen Wood Based Panel Co.	Sichuan	Naxi	30,000	30,000	1998
175	Sichuan Dongfeng Timber Works	Sichuan	E bian	10,000	10,000	1997
176	Sichuan Shunda Forest Plantation Products Co., Ltd.	Sichuan	Ziyang	30,000	30,000	2004
177	Tianjin Fujin Wood Based Panel Co.	Tianjin	Tianjin	15,000	15,000	1983
178	Xinjiang Bo Lake Wood Based Panel Plant	Xinjiang	Bohu	15,000	15,000	1996
179	Xinjiang Aletai Mountain Bureau Wood Based Panel Plant	Xinjiang	Aletai	20,000	20,000	1998
180	Xinjiang Miquan City Yongnan Compress Boards Plant	Xinjiang	Miquan	40,000	40,000	2004
181	Ruijiang Fiberboard Co., Ltd.	Yunnan	Yuxi	30,000	30,000	1996
182	Mile Sugar Works	Yunnan	Mile	15,000	15,000	1996
183	Mouding Fiberboard Co., Ltd.	Yunnan	Mouding	15,000	15,000	1996
184	Puer Wood Based Panel Factory / Weigou Forestry Bureau	Yunnan	Puer	15,000	15,000	1997
185	Honghezhou MDF Factory / Honghezhou Forestry Bureau	Yunnan	Jianshui	30,000	30,000	1999
186	Shuangbai MDF Factory / Shuangbai Forestory Bureau	Yunnan	Shuangbai	30,000	30,000	1997
187	Yunan Chuxiong Wood Based Panel Plant	Yunnan	Chuxiong	30,000	30,000	1997
188	Zhejiang Quzhou Timber Industry Corporation	Zhejiang	Quzhou	15,000	15,000	1995
	Total Capacity			**15,690,000**	**15,690,000**	

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