OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

05308

Distr.
LIMITED

ID/WG.151/27
[illegible] October 1973

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Technical Meeting on the Selection
of Woodworking Machinery

Vienna, 19-23 November 1973

SELECTION OF SPREADING AND COATING MACHINES FOR THE WOODWORKING INDUSTRIES[1]

by

Robert L. Koch II, President, Ashdee Division,
George Koch Sons Inc., Evansville, Indiana,
U.S.A.

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.73-7185

ID

[illegible] Add.1

[illegible]: ENGLISH

United Nations Industrial Development Organization

Technical Meeting on the Se[illegible] of
Woodworking Machinery

Vienna, 19-23 November 19[illegible]

SELECTION OF SPREADING AND COATING MACHINES FOR THE WOODWORKING INDUSTRIES[1]

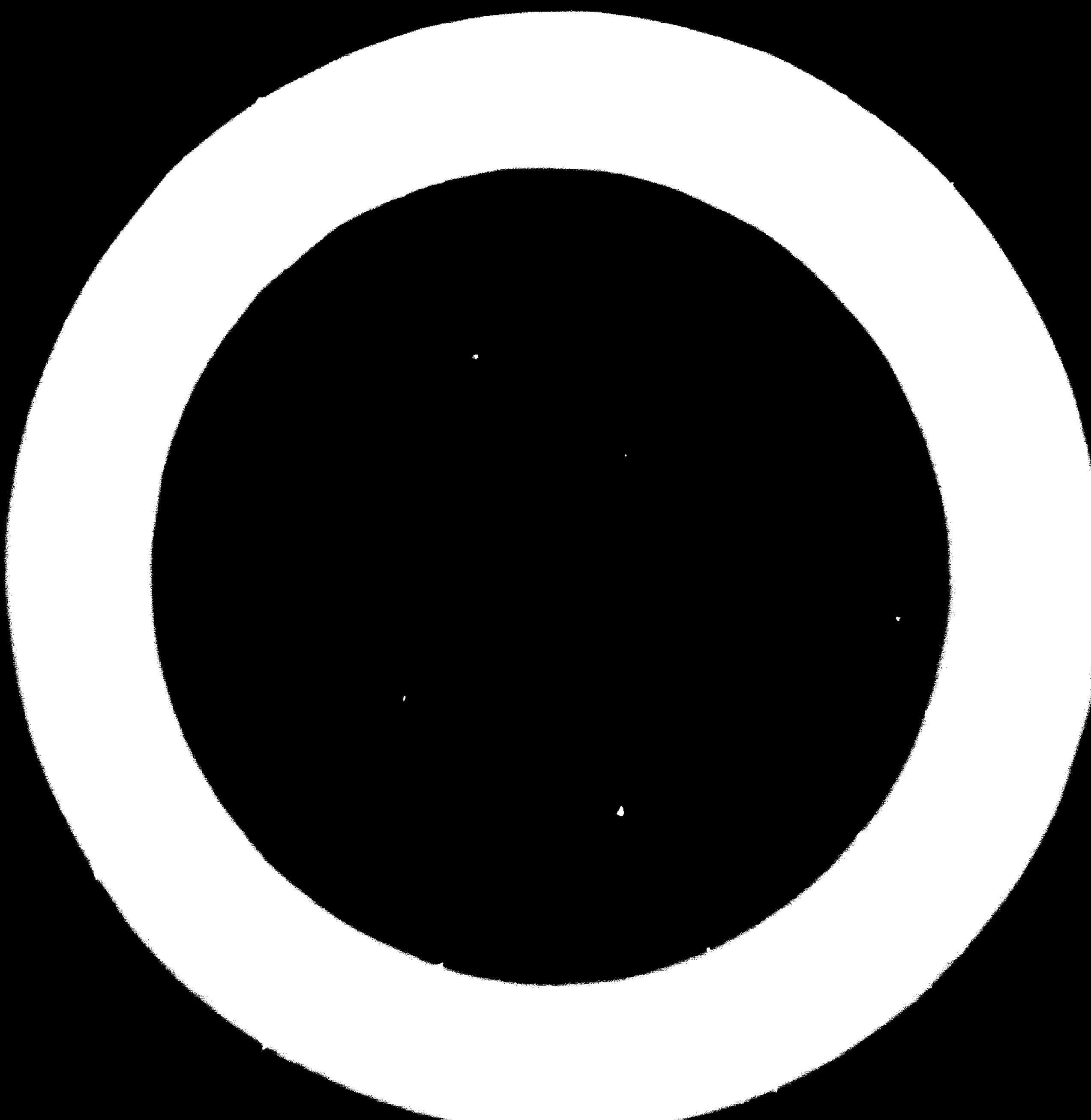
by

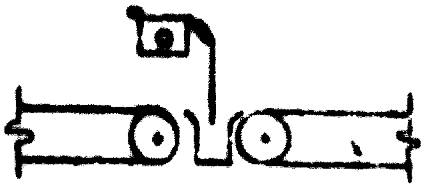
Robert L. Koch II, President, Asndee Division,
George Koch Sons Inc., Evansville, Indiana,
U.S.A.

Addendum

The figures overleaf illustrate the various types of coaters referred to in the study.

id.73-7418



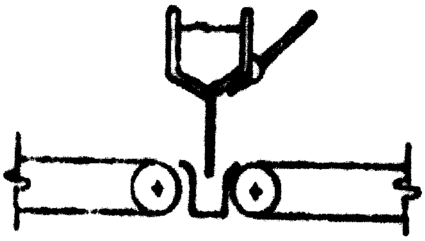


GRAVITY OVERFLOW CURTAIN COATER

Coating thickness control
1. **Pump Speed**
2. **Conveyor Speed**

Downward Curtain Velocity
1. **Head Height**

See 2.1.

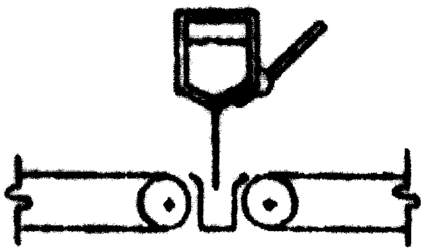


GRAVITY ORFICE CURTAIN COATER

Coating thickness control
1. **Conveyor Speed**
2. **Orfice Opening**

Downward Curtain Velocity
1. **Head Height**

See 2.2.

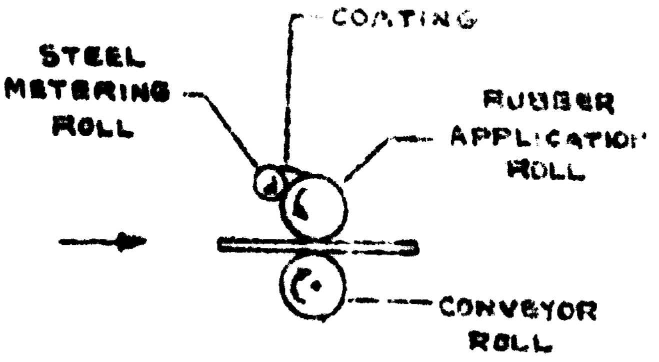


PRESSURE CURTAIN COATER

Coating thickness control
1. Pump Speed
2. Conveyor Speed

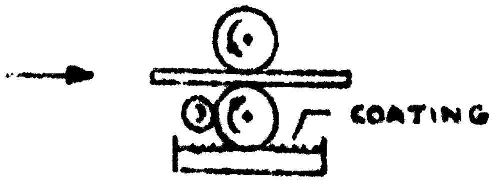
Downward Curtain Velocity
1. Head Height
2. Orfice Opening

See 2.3.



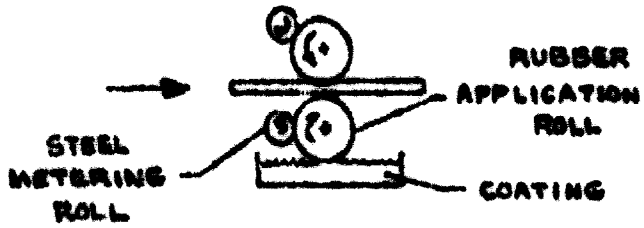
TOP DIRECT
ROLL COATER

See 3.1.



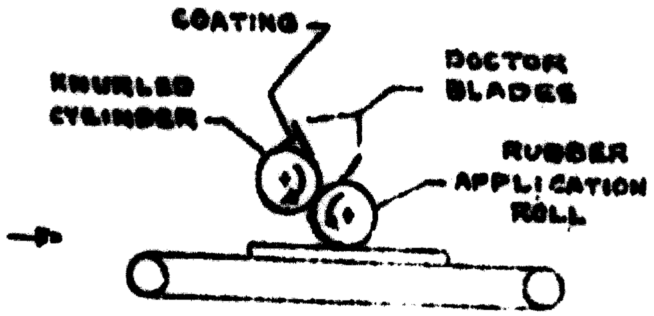
BOTTOM DIRECT
ROLL COATER

See 3.2.



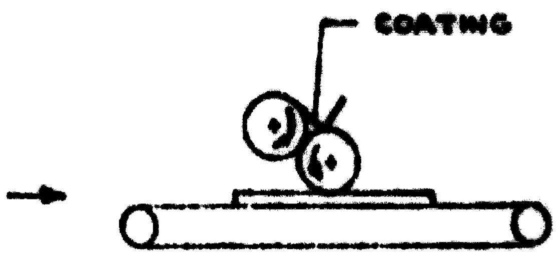
TOP & BOTTOM
DIRECT ROLL COATER

See 3.3.



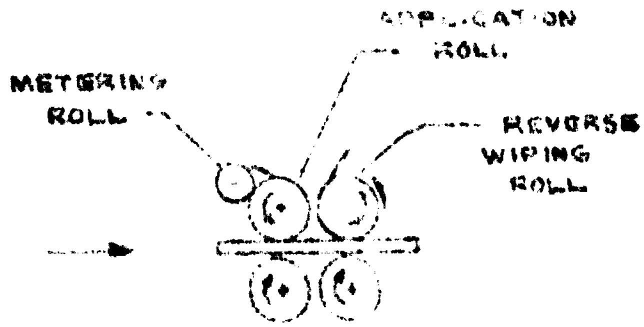
TWO BLADE
PRECISION
ROLL COATER

See 4.1.



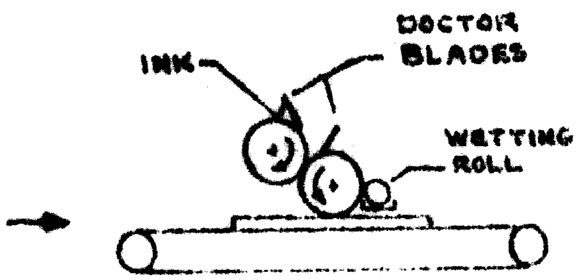
SINGLE BLADE
PRECISION
ROLL COATER

See 4.2.



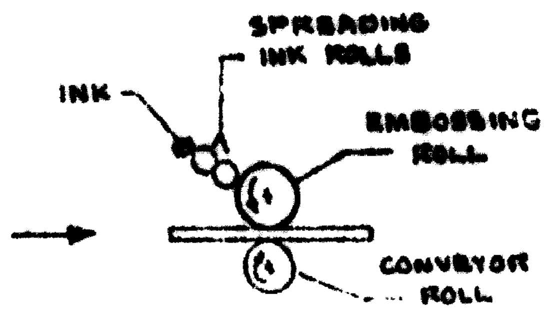
REVERSE ROLL FILLING MACHINE

See [illegible]



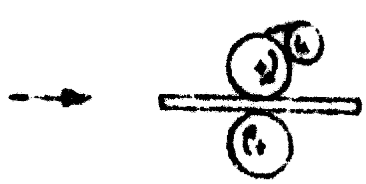
TOP PRINTER

See 6.1.



EMBOSSER & VALLEY PRINTER

See 6.2.



REVERSE ROLL COATER

See 7.1.

mb

Distr.
LIMITED

ID/WG.151/27 SUMMARY
29 October 1973

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Technical Meeting on the Selection of Woodworking Machinery

Vienna, 19-23 November 1973

SELECTION OF SPREADING AND COATING MACHINES FOR THE WOODWORKING INDUSTRIES[1]

by

Robert L. Koch II, President, Ashdee Division,
George Koch Sons Inc., Evansville, Indiana,
U.S.A.

SUMMARY

There have been through the years many developments in coating machinery for use in the woodworking industries. These coating machines vary considerably in their efficiencies, operating characteristics, control parameters, applied coating thicknesses and other results. Some of these machines make contact on the surface to be coated during coating while other machines do not.

It is the purpose of this paper to give the reader a familiarisation with the various types of machinery available.

Coating machinery is separated by categories according to their designs. The particular capabilities of each machine in each category are then discussed. Emphasis is placed on glue spreading as well as coating application in the machine description.

Production rates are pointed out for the various machines along with initial investment, maintenance and manual support required for production. At the end of the paper, typical layouts are given for production, including coating systems for preparing and coating particleboard using an ultraviolet cured filter through a print and cured topcoat.

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.73-7186

Distr. LIMITEE

ID/WG.151/27 RESUME
29 octobre 1973

FRANCAIS
Original : ANGLAIS

Organisation des Nations Unies pour le développement industriel

Réunion technique sur le choix des machines
dans l'industrie du bois

Vienne, 19-23 novembre 1973

RESUME

CHOIX DE MACHINES POUR L'APPLICATION DE REVETEMENTS UTILISEES DANS L'INDUSTRIE DU BOIS[1/]

par
Robert L. Koch II,
Président, Ashdee Division,
George Koch Sons Inc., Evansville, Indiana
(Etats-Unis d'Amérique)

Au cours des années, de nombreux perfectionnements ont été apportés aux machines pour l'application de revêtements utilisées dans l'industrie du bois. Ces machines varient considérablement pour ce qui est de l'efficacité, des caractéristiques de fonctionnement, des paramètres de contrôle, de l'épaisseur du revêtement appliqué, etc. Certaines entrent en contact avec la surface à revêtir, d'autres non.

L'étude a pour objet de familiariser le lecteur avec les différents types de machines offertes sur le marché.

1/ Les opinions exprimées dans le présent document sont celles de l'auteur et ne reflètent pas nécessairement les vues du Secrétariat de l'ONUDI.

id.73-7187

Distr. LIMITADA
ID/WG.1[illegible]/[illegible] SUMMARY
29 octubre 1973

ESPAÑOL
Original: INGLES

Organización de las Naciones Unidas para el Desarrollo Industrial

Reunión técnica sobre selección de maquinaria
para trabajar la madera

Viena, 19 - 23 noviembre 1973

SELECCION DE MAQUINAS DE ENCOLAR Y DE REVESTIR SUPERFICIES PARA LAS INDUSTRIAS DE TRANSFORMACION DE LA MADERA 1/

por

Robert L. Koch II, Presidente de la Ashdee Division,
de la George Koch Sons Inc., de Evansville
(Indiana, Estados Unidos)

RESUMEN

A lo largo de los años, se han producido muchas novedades en lo que respecta a la maquinaria para revestir superficies utilizada en las industrias de transformación de la madera. Estas máquinas revestidoras varían considerablemente en cuanto a eficacia, características de funcionamiento, parámetros de control, grosor de las capas de revestimiento aplicadas, y otros resultados. Algunas de estas máquinas entran en contacto durante el proceso de revestimiento con la superficie que ha de revestirse; y otras no.

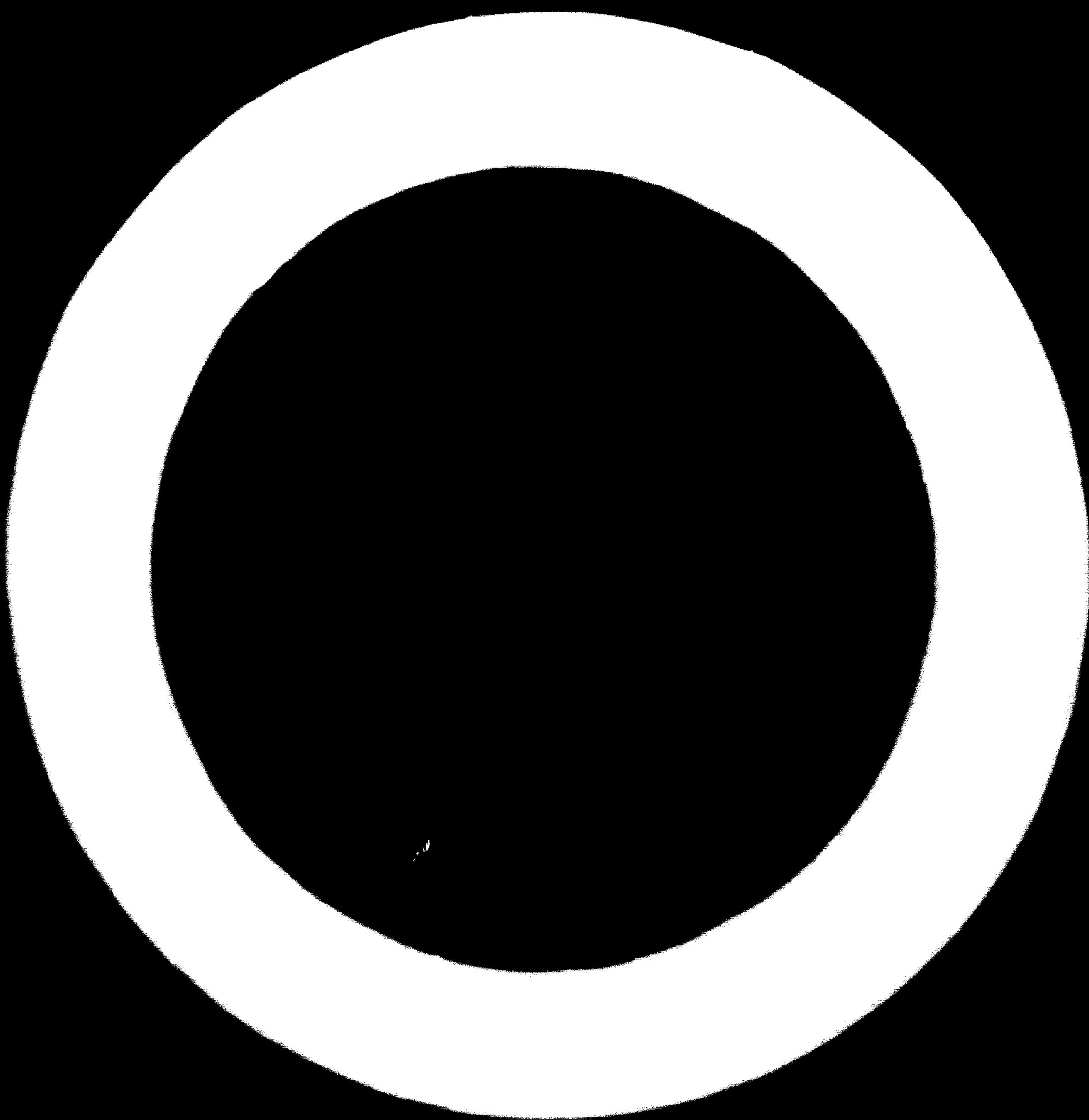
La finalidad de la monografía que aquí se resume es familiarizar al lector con los diversos tipos de maquinaria disponibles.

Después de clasificar, conforme a su diseño, las distintas máquinas de revestimiento de superficies, en la monografía se discuten las posibilidades de cada máquina. Al describir las máquinas, se presta atención preferente al extendido de la cola así como a la aplicación de la capa de revestimiento.

Se dan los índices de producción correspondientes a las diversas máquinas, junto con datos sobre inversión inicial, mantenimiento, y apoyo manual que la producción requiere. Al final de la monografía se facilitan planos típicos de distribución en planta de las instalaciones, incluidas las correspondientes a sistemas especiales de revestimiento utilizables para preparar y revestir tableros de partículas utilizando un substrato secado con rayos ultravioleta que atraviesan una capa superior ya curada y estampada.

1/ Las opiniones que el autor expresa en este documento no reflejan necesariamente las de la Secretaría de la ONUDI. La presente versión española es traducción de un texto no revisado.

id.73-7188



Après avoir classé en catégories les différents modèles de machines pour l'application de revêtements, l'auteur examine les caractéristiques spécifiques de chaque machine en accordant une attention particulière à l'encollage et à l'application de l'enduit.

Il indique les capacités de production de différentes machines et fournit des données sur les frais de premier établissement, l'entretien et la main-d'oeuvre nécessaire pour assurer la production. En terminant, l'auteur décrit quelques plans d'implantation type des installations, notamment les dispositifs pour l'application de revêtements utilisés pour préparer les panneaux de particules et les imprégner d'une couche primaire séchée aux rayons ultraviolets et d'une couche finale imprimée et polymérisée.

- - - - -

CONTENTS

INTRODUCTION

1. If one wanted to trace the history of coating applications to wood, you could go back to the time when coatings were applied by brushes and hand-operated rollers. For the purposes of this talk, we will start with those production-used coating systems that still remain in current use today. During the last ten (10) years, there have been relatively few, if any, radically new developments in coating application machinery for woodworking. If any, there have been more refinements of existing or previously-developed machinery so that they meet specific purposes. It is the purpose of this paper to acquaint the student of coating machinery for flat panels about the capabilities of different types of machinery, their operating characteristics, coating thickness application rates, production rates, deficiencies and, particularly, their advantages and superior characteristics.

2. In recent years, the developing countries have been engaged more in plywood production. In this paper, we will deal with the different ways to apply glue in the manufacture of plywood from the earliest schemes, which are now over 50 years old, to the current and newest schemes. Further, we will deal with finishing techniques for this plywood, including the application of coatings to stained as well as painted-out type plywood paneling. We will also deal with

the newest UV-type curing systems whereby particleboard can be used for the manufacture of quality furniture when the coatings are applied and cured properly.

3. To expand the usage or market demand, first of all wood products must have a certain quality level. Obviously, the higher the quality level, the wider the scope of their usage. Another way of expanding the usage or potential volume of wood products is by prefinishing the boards so that they can be easily used for more applications. In other words, prefinished paneling has more value than the unfinished paneling. Similarly, boards that are prefinished for kitchen cabinets, furniture and other types of panel requirements will be more readily used than if the board is supplied without finishes.

4. In this paper, we will, therefore, talk about the various types of coating application equipment that are available to the manufacturer for application of various types of coating materials. It is important, however, before deciding on the coating machinery, to determine the final results that are to be achieved in the production plant, i.e. it is important to know what types and what quality of coatings you desire to apply to the product and, particulary, what markets you wish to penetrate as different markets do demand different qualities of wood products and finishes.

5. We can say that wood wall paneling, for example, must have an attractive appearance; however, the performance demands

of coatings on wood paneling are not very stringent. However, furniture generally requires a smoother, even more pleasing appearance than wall paneling, again, with not too stringent physical performance characteristics but, obviously, better performance than on wall paneling. Perhaps the most severe performance requirements are those of kitchen cabinets where foods and food stains can be irregularly subjected to the finishes. However, from an appearance standpoint, perhaps the finishes on wood kitchen cabinets are not as demanding as on wood furniture. Finally, in reviewing plywood, obviously, exterior-grade plywood must have better spread rates and more uniform glue application than interior-grade plywood.

6. Therefore, even after a thorough understanding of the capabilities of the coating machines as presented in this paper, it is indeed important to understand the final market which is intended to be served by the product produced; and further consultation with both a coating or glue supplier in conjunction with a machinery builder is the ideal situation for an efficient, optimum processing plant.

7. As a necessary prelude to this type of meeting, one must obviously assess the raw materials available and the amounts of money available for investment in plant and equipment as well as the market potentials which can be served best by the raw materials and monies available.

I. SPRAY APPLICATION OF COATINGS

Spray equipment is a type of equipment which belongs to the category of being able to coat irregular-shaped objects on a flat belt conveyor. In other words, while much of the panel coating equipment relies on the panels being absolutely flat on the surface, some classes of coatings then can be used with variations in the surface that are not very severe while equipment, such as the spray coating equipment, can be used with quite irregular shapes on the face of the panels being coated. An example of this would be for applying coatings to door fronts that have been decorated with plastic mouldings, such as is the scheme currently used in the USA. Spray coating systems generally then tend to be less efficient than other types of coating systems, such as roll coaters and curtain coaters. The reasons being that the atomised particles do not all deposit on the surface to be coated and some bounce away resulting in deposition efficiencies frequently less than 50 percent.

1.1 TYPES OF ATOMIZATION

There are basically three (3) types of spray systems: The air-atomizing system, which is frequently used for coatings that are more difficult to atomize; for finer finishes, the internal mix air-atomizing nozzle, which is not so commonly used as before, and high-pressure airless atomizing. The internal mix nozzle relies on a quite low-viscosity coating for proper atomization and a fine finish. Perhaps the newest development in spray finishing has been the high-pressure atomization system, frequently referred to as the hydraulic atomizing system or airless atomizing system. In this system, paint under high pressures up to 5,000 lbs. per sq. inch is forced through a tiny orifice as small as .0001" in diameter, which then serves to atomize the paint into tiny droplets. This type of atomizing system has become more common in the furniture industries in the USA, particulary for spraying lacquer-type coatings, because it tends to be able to apply coatings at a faster rate than by the air-atomizing techniques.

A further development that has been added to spray systems has been that of preheating the coating in the lines as it travels to the spray atomizing head, thus lowering the viscosity of the coatings and reducing the energies required for atomization of the coating. By reducing the atomization energies then, the application efficiency is improved. Where high volumes of coatings that lend themselves to preheating are used frequently, this type of system is incorporated into the coating equipment.

1.2 BY TYPE OF GUN MOUNTING

The gun system then, whether it be internal mix air-atomizing, external mix air-atomizing or hydraulic and whether it be heated or unheated, requires that the guns be mounted in a fixed position above the conveyor on a reciprocating gun stand or on a rotating gun stand. Each of the three above-described schemes for mounting guns are presently used for production systems around the world.

1.2.1 FIXED GUN MOUNTING

Where speed of the line is quite high or where you only want to strip or antique in the direction of travel, fixed guns are frequently used. These guns are mounted over the conveyor and positioned so that the spray pattern covers the area intended during production.

1.2.2 RECIPROCATING

As the panel speed would decrease down the line, one may elect reciprocating spray guns because, generally speaking, the output volume of a spray gun is higher than the volume requirements of coating on the operating production panel finishing line. Therefore, one or two guns on a reciprocator can cover an area four feet wide operating up to several hundred feet per minute. Further, by using a reciprocator-type mounting arrangement for the guns, you are assured of more uniformity across the width of the panel, which may otherwise be difficult to maintain constantly in production with several guns faced across the top of the panel.

1.2.3 ROTATING

As the shapes of the top surface of the panel become more pronounced and more severe, it is necessary that the guns rotate around on a rotary wheel while spraying the panel to insure coverage of all sides and surfaces of the raised features of the panel being processed and coated. Such systems are much less efficient than those previously mentioned but do enable automatic coating of decorative panels on high-speed lines that otherwise would have to be done manually with hand spray systems or slower, less efficient lines.

1.3 CONVEYOR FOR FLAT PANEL SPRAY FINISHING

In all of the above causes, it is common to transfer the panel through a spray area by wires or special holders so that a minimum amount of paint or coating is sprayed onto the conveyor system. It may be necessary then to regularly clean the wires each time around so that coatings are not offset or printed on the back surface of the panel.

1.4 SPRAY BOOTHS FOR FLAT PANEL SPRAY FINISHING

All of the above spraying is normally done in a spray booth, which is an enclosure around the spraying that is designed to remove the overspray from the area rapidly and effectively. It is further the purpose of the spray booth to separate the overspray paint from the air stream by means of filters, water or other type of separating technique so that air that is free of paint particles is exhausted outside the building to the atmosphere.

II. CURTAIN COATERS

Curtain coaters are one of the later developments for flat line finishing. In fact, while spray coating was first developed, curtain coating was the last major process to be developed. Like spray, however, for curtain coating applications, the curtain coater head does not come in contact with the part. Unlike spray, though, effective curtain coating depends on a relatively flat surface. The surface does not have to be completely flat as in the case of roll coating, but only gradual undulations are successfully coated by the curtain coater. The pressure curtain coater is effective at coating surfaces with more severe undulations than the gravity-type curtain coater heads. Different from the spray, the curtain coater scheme of coating application is much more effective in that virtually 100 percent of the coating does go onto the product ultimately. During the coating process, coating that does not go onto the product is captured in a trough and drained to a main reservoir tank where it is recirculated back to the application or pouring head. There are basically three (3) types of curtain coaters: The gravity overflow, the gravity with orifice control and the pressure with orifice control.

2.1 GRAVITY OVERFLOW CURTAIN COATER

This curtain coater is characterized by a trough or gutter-type pouring head. Usually, the top of the head is opened to the atmosphere and the coating enters in the lower extremities of this gutter-type head. The coating then cascades or flows over a weir or dam-type arrangement. The overflowed coating is then deposited on the top surface of the product moving under this waterfall. In the conveyor transport, immediately below the water flow is another gutter recessed in the conveyor bed to collect coating that does not deposit on the product and return it to the main reservoir tank. Usually, this coater has a positive displacement pump with a variable speed motor for controlling the flow rate of coating over the waterfall. Another control for the thickness of the deposited film is the conveyor belt speed. The conveyor belt speed is a control used for film thickness variation in all of the above-mentioned curtain coaters. For the coating to be the same from side to side, it is necessary that the ov rflow weir be precisely level so that the same amount of coating is flowing over the weir across the entire length of the weir. The downward speed of the curtain is limited to the viscosity of the coating and the height of the fall. As the head is raised higher above the product, the terminal velocity as the coating reaches the part is determined by the forces of gravity and the viscosity. The initial velocity of the coating as it leaves the head is, of course, determined by the viscosity of the coating. The gravity overflow-type coater is limited to relatively low-viscosity coatings up to about 500 cps.

2.2 GRAVITY ORIFICE-TYPE CURTAIN COATER

The gravity orifice-type curtain coater is characterized by a special head that is a reservoir for coating with a slot extending the entire length of the head at the lowest portion of the head. Usually, an overflow drain located near the top of the head prevents the head from overflowing onto the conveyor belt. Sufficient coating is pumped to the head so that some coating is continuously overflowing through the overflow drain and returning to the reservoir tank. Therefore, a fixed static head puts a little downward pressure on the coating so that this type of head can be used with slightly higher viscosity coatings than the gravity overflow-type head. Since more than enough coating is always being pumped to the head, usually a centrifugal or less-sophisticated pump is used for delivering the coating to the head. Controlled coating thickness on the gravity orifice-type coater is obtained by the conveyor belt speed and by adjusting the orifice opening at the bottom of the head through which the coating material falls. The exit velocity of the coating through the orifice is determined by the fixed static head of coating in the curtain coater head. The terminal velocity where the coating reaches the product is determined by the static head, the viscosity of the coating and the height of the head above the product.

Film thickness repeatability and control is somewhat complex with this unit since a very small movement in the orifice opening significantly affects the amount of deposited film so that it is difficult to maintain and control the deposited film thickness with a high degree of precision with this type of coater.

2.3 PRESSURE ORIFICE-TYPE CURTAIN COATER 1/

By far, the most sophisticated and more versatile type of curtain coater is the pressure orifice-type coater. This coater is characterized by a sealer reservoir-type head with the adjustable orifice slot extending the length of the head as its lowest point. The pressure curtain coater system has by far the largest range of operating viscosities since at a low viscosity, the coating head operates in a vacuum and as the viscosities increase, the coating head acts under pressure. Coatings as high as 80,000 cps. have been successfully used in production operations using the pressure or orifice-type head. On the other hand, coatings as low as water viscosity have also been poured successfully at relatively low conveyor speeds compared to the other two (2) coater schemes. To operate this coater, you first close the orifice knives and open an air bleed valve in the head. You then start the positive displacement pump operating and

1/ A detailed description of such a coater is given in the document entitled "Ashdee Glue Pressure Curtain Coater and Layup Lines for Plywood Production" (ID/WG.151/CR?) by the same author and is available at the meeting.

pump coating material into the head about three-fourth's the way up into the head. At this point, you then close the air bleed valve and open the orifice handle. From this point on, the coating system operates as a sealed system independent of the atmospheric pressure. The two (2) controls that govern the amount of coating deposited are the conveyor belt speed and the speed of the positive displacement pump. As you would slow the positive displacement pump to one-half the speed, the coating thickness would be decreased to one-half the thickness. As you would increase the conveyor speed to twice the speed, the coating thickness would be decreased by half. This unit is extremely reliable for repeatable precision results. While this type of coating is generally the most expensive, it serves to be the most economical where high volumes of coatings are used. So precise is the application thickness that a coat weight computer has been developed that senses the rate of the positive displacement pump and the speed of the transport belt and gives a reading with a digital meter in the coating thickness being applied to the product as it passes through this curtain coater.

Curtain coaters are usually used for putting on somewhat thicker coatings than precision roll coaters or direct roll coaters. Curtain coaters do put on a very smooth surface because of the fact that the applicator head does not touch the surface. About the minimum film thickness that can be deposited with the curtain coater is approximately 1 to 1.5 mils wet film thickness. You can go up to as high as 10 or 12 mils with proper formulation, though. For this reason, the curtain coater is generally used for topcoat applications where you desire to smooth durable coating as a final finish. Frequently, the curtain coater is used for painting wood paneling white or painting bathroom and kitchen cabinets as may be required.

A new use for the pressure orifice curtain coater is the new plywood layup line. For additional information on this, turn to Section #8, which gives a detailed description of the glue pressure curtain coater layup line. About the minimum speed that you can operate a curtain coater is 200 to 250 FPM with a maximum speed being as high as 1,000 FPM. As a result, you may need a small section of conveyor before and after the curtain coater to provide a speed-up and slow-down area. Typical production speeds are around 300 to 400 FPM.

III. DIRECT ROLL COATERS

The first developments for a more efficient type of coating application were done in the 1930's for the application of glue materials to thin veneers for the manufacture of plywood.

3.1 TOP SIDE DIRECT ROLL COATER

In a direct roll coater machine, there must be a transport system, which commonly is a rubber-covered conveyor roll, although it may be a steel conveyor roll or even a metering roll. Of both rolls that rotate during operation of the equipment, the applicator roll is normally larger in diameter than the metering roll and operates with the same surface speed of the board that is traveling through the machine to be coated. The metering roll, on the other hand, is smaller in diameter and is normally a steel smooth surface roll and rotates in a direction opposite that of the applicator roll so as to provide a small opening between the metering roll and the applicator roll allowing a certain amount of coating to stay on the applicator roll, which is then transferred to the surface of the board as the board passes under the applicator roll on the conveying mechanism. You can, therefore, see that the surface of the roll and the surface of the board must match up quite accurately together for complete and uniform transfer of the coating from the machine to the surface of the board. On the other hand, such a coating scheme is extremely efficient and results in only the clean-up losses for the coating material. Further, systems of this type do not require spray booths or separation of coating materials from the air; and, generally, no additional exhaust equipment is required. However, if the coating materials applied tend to have a highly volatile solid as a part of them, it may be necessary to install an exhaust hood over this coating machine to remove the volatile solvents that have evaporated into the air from the room.

Direct roll coaters are still used today in some cases for applying glue to veneers, although now the new curtain coater glue application technique is establishing in-roads because of the efficiencies that it brings with it. Direct roll coaters are also used for applying basecoats and sometimes clear topcoats to open-drained wall paneling. If you use this type of coater on a smooth solid surface, there tends to be a roping pattern that develops as the coating is applied so that it is not desirable to use this for applying coating materials to surfaces of those boards that are finally used for fine furniture.

3.2 BOTTOM SIDE DIRECT ROLL COATER

Basically, the bottom side direct roll coater operates similar to the top side coater just previously described. Perhaps the main difference is, as in the title, the bottom side of the board is coated rather than the top. This is sometimes used as a primer coating scheme for particleboard or other internal surfaces of furniture where high quality is not required. For a bottom side direct roll coater, of course, you must have a conveying means of delivering the board to and from the coater. Usually, a metering roll that is steel rotates in a pan of the coating material. The metering nip is set between the metering roll and the applicator roll such that a specific amount of coating is then transferred onto the applicator roll, which then, of course, is transferred to the bottom side of the panel as the panel passes over the top of the applicator roll. Frequently, the applicator roll is of a soft rubber material as is the case with the top side direct roll coater. The outfeed conveying mechanism usually consists of some sort of belt with raised cleats on it or a chain conveyor outfeed to minimize the marking of the coating deposited on the underside of the panel.

3.3 TOP AND BOTTOM DIRECT ROLL COATER

This is more commonly referred to as the glue spreader and is the old way for applying glue to veneer for use in the plywood layup and manufacturing. Using such a coater, an individual feeds strips of veneer into the top and bottom roll coater and glue is applied to both the top and underside surfaces simultaneously; and then the coated strip of veneer is caught by a veneer layup man, who then places this coated strip of veneer on a back until coated strips of veneer cover the entire back. Then, a face is laid on the top of this assembly, thus, producing a three-ply plywood panel.

IV. PRECISION ROLL COATERS

Actually, the precision roll coater is a modification of the off-set Gravure printer where the engraved print cylinder is replaced with a machined, patterned-type coating cylinder. The first models of precision roll coaters were, in fact, direct duplicates of printing equipment with the exception that the rolls or steel cylinders had been changed as described. Recently, an evolution in the design of the precision roll coater has been taken place as it has been found that the same results can be obtained with less rolls on the equipment and, even now, doctor knives than used with the older printers. The results of the new improvements are simpler machines that are easier to adjust, maintain, operate and clean up. Precision roll coaters are used where a thin, smooth côat of paint is required. Such a place would be as a background, ground color or basecoat over the surface of a smooth board prior to grain printing. In this case, it is desirable to have as smooth a surface as possible to obtain the high amount of detail of an intricate grain pattern. Another use for precision roll coaters recently has been the application of a sealer coat on a printed surface or the application of a high-solids UV curable topcoat providing a very durable surface over a printed board. The common patterns that are used in the machined, engraved cylinders include the trihelical pattern, the quad pattern and the pyramidal pattern. The patterns are further described as to the number of lines per inch; and it is common in the precision roll coaters to use one or more of the above cylinders with patterns varying from approximately 40 lines per inch to 110 lines per inch, depending upon the thickness of coating desired for depositing.

In fact, you must select a specific pattern to obtain a certain film thickness of deposition. Any change in film thickness then usually requires a different type of pattern.

As with the direct roll coater, the precision roll coater requires at least some method for transporting the panels under the coater head. In the smaller, cut-to-size panels, a belt conveyor is almost always used. Sometimes where larger wall panels or full-size sheets are coated, the conveying mechanism may be powered rolls that move the board through the coater.

4.1 PRECISION ROLL COATER WITH TWO (2) BLADES

A two-blade precision roll coater has at least two (2) rolls, and there are some models with a third roll. The first roll would be the rubber applicator roll, which takes the metered or printed coating and deposits it on the surface of the panel. This is usually a rubber-covered roll either 6" or 9" in diameter and is covered with a rubber, solvent-resistant coating with a durometer from 35 to 55. The second roll, which all precision roll coaters have, is the engraved or knurled cylinder with a series of cavities precisely machined in the surface of the roll that deposit a specific amount of coating on the applicator roll. Coating is transferred to the rubber-covered roll through the nip in the amount of the pattern that is engraved in the steel cylinder. On each revolution, then, the rubber roll is cleaned by the doctor knives so that it can receive a fresh application of coating through the nip. The rolls turn on a 1:1 basis. Arranging and designing a drive mechanism to drive the rubber-covered roll and a steel cylinder so that they drive on a 1:1 basis is a bit complex, in that you must provide for some swelling of the rubber roll, which will occur throughout an extended production run. Solvents in the coatings applied by the precision roll coater tend to swell most all types of rubbers, enlargening the outside circumference and changing the surface speed. Therefore, a drive arrangement usually consists of a positively powered engraved cylinder with the rubber-covered roll being powered by a slip clutch arrangement so that if the size of the roll is expanded, positive traction between surfaces will drive the rubber roll rather than the chain and sprocket arrangement.

4.2 PRECISION ROLL COATER WITH ONE (1) BLADE

It was later found then, particularly in a case where relatively low-viscosity coatings were used and a coarse pattern, for example 45 quad meaning 45 patterns per lineal inch, that even after the doctor blade scraped the excess coating from the surface of the knurled cylinder, that if the pressure between the rubber-covered roll and the engraved cylinder was high enough, a head or roll of coating material would form at the nip between the engraved cylinder and the rubber applicator roll. By experimenting then with removing the doctor blade on the knurled cylinder and maintaining the main reservoir of coating material in this nip between the knurled cylinder and the rubber-covered roll, it was found that there was practically no difference in the quality that was obtained, thus, the beginning of the single-blade precision roll coater. So, it was found that the action of the steel doctor blade on the chrome-plated knurled cylinder did cause wearing on the knurled cylinder; and by removing this doctor blade, of course, the wear of the cylinder was certainly minimized increasing the life of the knurled cylinder.

4.3 TANDEM PRECISION ROLL COATER

Sometimes, a single precision roll coater is used by itself; but this is for applying a very thin coating, for example just a sealer coat of a dry film thickness in the range of .2 to .4 mils. Most commonly, precision roll coaters are used in pairs; and this is frequently referred to as a tandem precision roll coater. Generally, in a tandem precision roll coater arrangement, the first knurled cylinder is a more coarse cylinder to put most of the coating on the board; and the second cylinder tends to be engraved with a finer pattern so as to smooth out the application so that the dried coating will also be very smooth and receptive to a high degree of fidelity in the transfer of the grain pattern.

V. REVERSE ROLL FILLING MACHINES

5.1 REVERSE ROLL FILLING MACHINES FOR CONVENTIONAL MATERIALS

Normally, a reverse roll filling machine for conventional material means a filling machine for alkyds, epoxies, lacquers and other normal air-drying or hot air-drying coatings. These filling machines are usually two-stage machines, the first stage consisting of a direct roll coater application and the second stage, a reverse wiping roll to smooth out the finish. The applicator roll is normally a rubber-covered steel roll so that the rubber covering will conform to the surface of the board. This roll is backed up by a steel conveyor roll. Coating is applied on the surface of the board being filled by the direct roll coater action. Immediately after application of the coating, a reverse, chromed smoothing roll operates over the surface to smooth out the surface and to remove excess coating. Coating thickness is controlled by the nip opening at the direct roll coater application section and by the speed of the reverse wiping roll and the pressure exerted by the reverse wiping roll.

5.2 REVERSE ROLL FILLING MACHINES FOR UV CURABLE COATINGS

Reverse roll filling machines for UV curable coatings are very similar, with the exception that the applicator roll is normally a steel roll. This is because the monomers used in UV curable polyester coatings are very hard on rubber compounds causing them to swell and making it very difficult to clean the rubber applicator rolls. Therefore, a steel metering roll and steel applicator roll are normally used for the application of UV curable filler materials. The conveyor roll backing up the applicator roll is normally rubber covered. In the second stage, the reverse smoothing roll operates very slowly so that it does not remove too much of the coating. The reverse smoothing roll is kept clean by a doctor blade, first of all; and usually second, a wiping pad that insures the reverse roll is very clean when it again makes contact with the surface on the next revolution. Frequently, reverse roll filling machines are equipped with material pumps that simply pump filler from a large drum to the nip opening between the metering roll and the applicator roll. Within the filler machine, itself, a transfer of coating or pumping action does take place, in that excess coating removed from the surface is removed on the reverse wiping roll. The reverse wiping roll is cleaned primarily by a doctor blade, which gathers this material; and as a large amount of material accumulates at the doctor blade, it breaks loose and falls onto the applicator roll and again returns to the material reservoir in the nip between the metering roll and the applicator roll. With most all coating materials, it is necessary to rotate the metering roll slowly or to reciprocate in the reservoir to insure that the coating material stays uniform in consistency.

VI. PRINTERS

6.1 WOOD GRAIN TOP PRINTER

A top printer is by far the most common in use today in the USA, and perhaps throughout the world. The top printer prints the top surfaces of board as it passes on a conveyor belt through the printer. The configuration of rolls in a printer is very similar to the configuration of rolls in a precision roll coater, two-blade type. There is, of course, a rubber-covered blanket roll, which conveys the pattern to the surface of the board. The pattern is transferred to the rubber-covered roll by an engraved cylinder that has engraved into it the pattern to be transferred. Ink is placed into these engravings, either by the use of a fountain roll and doctor blade or by the use of a [illegible] rotated between the doctor blade and the engraved cylinder. A doctor knife on the rubber-covered roll cleans off the print pattern that is not transferred onto the board so that a fresh print pattern is placed on the rubber-covered roll on each revolution. Although a single grain pattern is the most common, frequently, printers are made in two (2) or three (3) color stations, with some printers being made up to four (4) and five (5) color print stations. As a general rule, when multiple stations are used, the least critical effect is placed on the board first. For example, with a distress pattern, which is common in the USA, the distress marks are placed on the board with the first print pattern, then an overall shading and, lastly, the detailed fine grain pattern.

Although grain printing makes up only a very small percentage of final costs, the quality of the finish is a major factor in influencing the buyer of your product, whether it be paneling, furniture or even kitchen cabinets. Therefore, preparation of the cylinders and design of the graining system are extremely important. The selection of the veneer flitch to make an engraved cylinder is probably the most important step in your finishing operation. The final appearance of the product you sell depends directly on the selection of the veneer. When designing your cylinders, be sure the equipment manufacturer, coatings supplier and your own men work closely together to insure that you get the finish you want. Your finisher should have a good knowledge of wood as well as coatings to insure the success of capturing the beauty of real wood.

The veneer, together with the number of cylinders and selection of printing inks, can duplicate any type of wood as well as any desired cut (quartered, rotary, flat-sliced) and layup (slipmatched, bookmatched or mismatched). The veneer selected also depends on the size of board to be printed. A furniture manufacturer, for example, would normally require a 6" or 9" diameter cylinder for a nonrepeated design about 18" or 28" wide. Wallboard manufacturers use larger sizes, such as 15" or 20" cylinders. The cylinders are adjusted to print in register or at random for the desired effect.

Each color requires a separate cylinder, except for the background color, which is the color of the groundcoat. In grain printing, the color of the groundcoat is chosen to match the flake color of the grain to be reproduced (pale yellow for oak, dark brown for walnut, rust for mahogany). Groundcoats mask the appearance of the filled, sanded substrate.

The substrate may be embossed for adding grained texture to the finished surface. Printing machines have been

- -

developed to run with as many as seven or eight cylinders. The printed finish may include distressing or highlighting and padding.

6.2 EMBOSSER

In addition to printing to give a realistic grain pattern to filled wood, embossers have been employed. An embosser actually indents the wood with a grain pattern indentation effect. The least expensive and simplest embossers simply emboss with a tick pattern that does not follow the grain configuration. More elaborate and more realistic embossing conforms to the grain pattern. The most realistic type of embossing includes valley printing, i.e. when the embosser roll makes contact with an inking roll so that the raised embossings on the embosser roll have ink on them when they make contact with the board. As the embossing is made, ink is deposited in the recesses of the embossing in the board, giving it a very realistic wood grain pattern effect.

VII. OTHER SPECIAL COATERS

There are various other types of special coaters for flat surfaces, edges, mouldings and other wood products.

7.1 REVERSE ROLL COATER

A reverse roll coater is sometimes used when a very heavy coating application is desired. In a reverse roll coater, the applicator roll operates in the reverse direction to the flow of the product through the machine. Thereby, coating is literally peeled off the applicator roll onto the surface and piled up on the surface. Frequently, certain types of adhesives and other types of very thick coatings are applied in this manner.

7.2 FLOOD COATER

Flood coaters are used for wall paneling primarily. A flood coater is sometimes used after a piece of wall paneling has been embossed and the long grooves are cut in the wall paneling. Then, a dark coating is flooded over the entire surface and the excess wiped away to give the dark effect in the grooves and embossings. Such a coater puts on a high amount of coating and requires a considerable length of oven to follow it. Coating is applied in a flood coater by a variety of techniques, by roll or by spray; but the important part is that more than enough coating is applied to the surface and immediately behind, squeegie rolls or a padding arrangement is employed to remove the excess coating so that only the coating remains in the recesses giving a pleasing toning effect.

A stainer machine operates very similarly, in that it floods on an excessive amount. Then, by pads, the excess is removed, leaving only the amount required to leave the pleasing stain effect.

7.3 EXTRUDER

Extruders are used for edge filling of particleboard. A small extruder can be used to extrude a highly viscous coating to the edge of particleboard to completely seal the edge and provide a solid color on the edge of particleboard.

XIII UV CURE FINISHING LINES FOR PARTICLEBOARD

Up to now, we have been talking about the coating application equipment and its variables, its descriptions and its characteristics. To understand completely how this equipment fits into a total operating line, it is necessary to spend just a minute understanding the drying techniques that are used and the coatings that can be applied with these machines. There are basically three (3) types of drying principles. These are as follows:

1. Hot air, either by high velocity or low velocity
2. Infrared, either by electric or gas
3. UV energy

In the newest and latest production panel coating systems, UV plays an important part, at least, for the filler coat and, frequently, for the topcoat. In UV curing, the process involves the use of ultraviolet light such as found in ordinary sunlight. Prior to exposure to the UV rays, the finish, normally a polyester, is in a liquid state. When the liquid finish is exposed to the UV light, a chemical reaction occurs, which bonds the molecules into an extremely hard, solid surface. Test results show that there are eight (8) advantages of the UV filler. The filler is the first coat applied to the substrate and is used to fill any flaws or holes to give an even substrate tone for the subsequent groundcoat, ink pattern and topcoat. The advantages of UV filler are that it requires one-pass fill, gives fast cure, requires less sanding, has a vapor barrier, gives improved adhesion, is for a fast in-line system and reduces the amount of groundcoat and the cost.

High-velocity warm air then is used for drying the groundcoats in the minimum amount of space and time. The ASHDEE UV System meets all of the USA National Kitchen Cabinet Association's physical tests. These are tests for shrinkage and heat resistance, hot/cold check resistance and chemical resistance to vinegar, lemon, orange, grape juice, catsup, coffee, olive oil, detergents and water.

In addition to chemical-resistance tests, the UV cure system undergone the same tests with the following liquid: Five percent Tide solution, beet juice, nail polish, concentrated soap, tea, coffee and water. The UV system has also been tested for resistance to abrasion, scrape abrasion, impact, washability and fire.

The abrasion tests were conducted by horizontally placing a revolving abrasive disc against the coated finishes. Weights measured in milligrams were placed upon the revolving discs. The abrasive resistance was calculated from the loss of surface finish due to the discs. A high-pressure laminate system has slightly more abrasive resistance than UV topcoats, but lacquer and varnish surfaces were by far inferior to both. The impact tests were made by dropping a one-lb. subnose steel weight onto the face of the panel. The weight was dropped from heights of 30", 36", 40" and 42". The UV system passed all four (4) impact tests, while lacquer and varnish failed at 36", 40" and 42" drops.

The following is a description of the operation of an ASHDEE Automated UV Cure Finishing System.

1. A 50 ft. bundle of 1/2" thick particleboard measuring 48" x 109" is loaded onto an automatic continuous panel feeder. This feeder is capable of moving the sheets through the line at the rate of 100 FPM. The sheets move through the steel applicator roll, which applies a UV-sensitive polyester filler to the surface. The reverse roll filler applies the filler at a thickness of approximately 10 mils. Access filler is removed with a reverse wiping roll. Significantly, the thickness of the filler remains constant before and after curing. This is called 100 percent solid material.

2. With the access filler removed, the board then moves by a flat bed conveyor to the ASHDEE UV Curing Oven. It enters a 55" long curing section. This consists of the ASHDEE Curing Unit containing six (6) high-pressure mercury vapor arc lamps. The lamps are rated at 200 watts per lineal inch. A 48" bulb then has an output capacity of 9,600 watts. Of the total power input, approximately 80 percent of the power is dissipated in the form of heat and visible light. The remaining 20 percent is in the

form of ultraviolet radiation. Sensitizers in the coating chemically formulated with the filler react when exposed to the high-intensity ultraviolet rays to form free radicals. These crosslink the polymerized polyester filler in this stage.

3. As the panel leaves the UV curing section, the coating is completely hardened. It next enters a speed buffer, which consists of a Scotch-Brite flat brush, which removes surface imperfections and deformities. The surface is now completely smooth and ready for subsequent finishing operations.

4. A basecoat is applied with a tandem precision roll coater. This basecoat is a catalized vinyl lacquer to give proper adhesion to the UV cured polyester filler. After application of the basecoat, it is rapidly dried in a high-velocity gas-heated oven. Next, it enters a cross-section transfer. The cross-section transfer and interim cross-transfer sections place the panel on a parallel line with the original line for continuous processing.

5. The next step is in the wood grain printer. In this particular line, a two-color or two-station grain printer applies a registered grain to the panel. Inks are solvent base and are dried rapidly by an infrared oven.

6. Next, a tandem or double precision roll coater applies a wet-on-wet UV curable polyester, super-hard topcoat.

This material is cured in the second ASHDEE Six-Lamp UV Oven. Normally, the finishes are cured with an exposure range of six to nine seconds. The panels emerge from the ASHDEE UV Oven and enter a short cooling section before they enter the panel turner. The panels are then automatically turned and stacked by an automatic stacker. The original stack of fifty (50) panel sheets is loaded again on a fork lift with the first side of the panels completely finished, and the entire process is repeated on the reverse side.

[redacted]

74. 09. 13