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PHILIPPINES

Technical report: Advisory Service in Furniture Finishing to the Wood Processing Industry of the Philippines*

Prepared for the Government of the Philippines
by the United Nations Industrial Development Organization

Based on the work of Gabriele Varenna,
Consultant in surface finishing
of furniture

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Industrial Management and Rehabilitation Branch

* This document has not been edited.

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I. Introduction

The Government of the Philippines has requested the United Nations Development Programme (UNDP) to provide financial and technical assistance in the Export Development field. A project was agreed upon and implemented. This was followed up by a second phase (project No. PHI/87/007), which is a Government executed project, the executing agency being the Bureau of Export Trade Promotion (BEPT).

A portion of the project's activities have been subcontracted by BEPT to the International Trade Centre (ITC) and UNIDO through a standard Inter-agency Letter of Agreement.

As part of the services subcontracted to UNIDO, it has provided the services of a consultant in surface finishing of furniture, Gabriele Varenna, for a total of 2.5 months, in two missions. His duties are given in Annex I.

The first part of his mission was from 9 December 1990 to 3 February 1991. This report covers the activities carried out in this period.

II. General Considerations on the Situation of Furniture Finishes in the Assisted Companies.

The kind of finishes normally used for the furniture conforms with the American market's requirement. In a lot of cases, the finishing products utilized are imported from the USA. One of the major problems of local suppliers is that the companies producing paints are not specialized and they produce a wide range of products for painting products ranging from masonry to automotive and marine. Normally, technical specifications of products are not provided, and the main concern of the paint suppliers is to meet the only customer requirements: "the cheaper the better". Under these conditions, the efforts of the paint producer to penetrate the market through technical assistance and training of customers too poor and only sporadic. Almost no effort is devoted to research and development of new products. These are the consultant's impressions. However, he was not able to contact all the major paint suppliers. This opinion on the other hand, is shared by the biggest company assisted: they are lamenting on the lack of quality control in the production of paint. Thus, one of the most important element for successful finishing is missing: the technical support from the paint supplier. Only one of the paint suppliers contacted is moving in the right direction, i.e. providing technical assistance to the furniture industry. The other problem, mentioned by the paint producer, is that imported paints are cheaper than those produced locally. This is due to the taxation on raw materials necessary for paint production, resulting in local paints costing 15 percent more than imported paints. This taxation policy is hampering the development and success of the local paint industry. The finishes in the companies visited are sufficiently good. The workers know when the quality is acceptable. When not, a lot of rework and touch-up is done in order to reach the desired level of quality. The workers know how to do their work, but they do not really understand its technicalities. Words like nitrocellulose, polyurethane, acid-curing, viscosity, etc. are partially, if not totally unknown to them. However, if the companies intend to venture into the European market, and a number of them are actually already selling to Europe, it would be good for them to learn about the European finishing products and methods. Certainly, the worst aspect in the companies visited is the poor

conditions of their finishing shops. Only one factory is doing its finishing activities in an enclosed environment, separate from the production cases. The finishing shops are usually open, dusty and not properly set-up. The lack of organized layout, racks, trolleys to move work pieces are other common undesirable aspects of most companies visited. In a number of cases, air compressors are too small, no compressed air network and air service units exist, there are dirty long rubber hoses and no water/oil drainage, and the maintenance of the above equipment is poor. All these aspects are contributing in slowing down production and reducing quality. In the majority of cases, the equipment being utilized for spraying is the conventional air gun. In a number of cases, the gun is not of an industrial type and does not correspond to the production requirements. Only a couple of airless units have been noticed by the consultant. This again is not contributing to productivity, quality and economy in paint consumption. This is mainly due to the lack of knowledge and the belief that the cheaper the equipment the better the profit and that money should not be wasted in buying modern and too expensive spraying equipment. This is also a consequence of the fact that equipment suppliers began introducing new equipment to the furniture industry just recently.

Needless to say that consideration to safety and fire prevention is normally not among the concerns of the companies.

One of the positive aspects is the quality and type of sanding paper used, but the machines, or even power tools, are only seldom utilized and, for this reason, sometimes big flat surfaces are markedly uneven.

III. Suggested Programme for the Second Part of the Mission

The second part of the mission will last for one month and should start late in April or early in May. During this phase, the consultant will do the following:

1. Visit the factories that received assistance during the first phase in order to:

   - assess if any improvements have been made and to what degree the consultant's advice was actually applied.

   - discuss and find solutions for all sorts of problems arising from new finishing equipment, methods or products.

2. Give the factories all the necessary advice based on the current situation.

3. Prepare written notes and technical specifications to implement and upgrade the notes already given to the industries to solve more specific problems based on the finishing activities of the companies assisted.

4. Continue the analysis of the situation of paint suppliers to get a better picture of the situation in the country to be able to make recommendations to paint suppliers and furniture industry.

5. Suggest reliable products and suppliers to the industry in order to extend the range of methods to also include European finishing methods (at present American finishing methods are usually applied).

6. Give a seminar in Manila to provide assistance to other companies who are not participating in the project. (This is to further disseminate new technologies to the industry.)

7. Provide advice to the Philippine Trade Training Centre in order to expand the range of finish-testing equipment adding few simple finish-testing methods.

8. Prepare a report on the job done and technical advice given to companies analyzing the level of response from the factories and giving recommendations towards developing and improving further their productivity and the quality and marketability of the local products.

IV. Report on the factory visits, consultancy given and recommendations made:

(a) AKKA WOOD Inc.
San Joaquin Street, San Angelo Subd.
Angeles City, Pampanga

Profile of the Company

This factory is producing small cabinets for the export market (USA). Its manager however intends to develop more products. The factory is employing at the moment 30 workers and is also relying on other factories doing subcontract work. The factory is equipped with small fundamental woodworking machines. At present they have no finishing shop, but are subcontracting the finishing. The cabinets are all made of lauan timber (SHOREA SPP.). Their design and quality levels are acceptable. The cabinets are decorated with carvings and pierced ornamental patterns, and their capacity is limited to about 150 items per month, i.e. 7-8 pieces per day. Routers are widely used to reduce the use of hand carvers to a minimum. The owner of the factory is following an old family business in furniture production, interrupted when the father died, and only started again recently. The present location of the factory is not in the area of the old family factory, the sheds being utilized by another company. He is planning to move as soon as possible (maybe within the early months of the year) to the old factory that consists of two sheds with a covered surface of 1600 m^2; the total area of the site is 26,000 m^2. A big kiln dryer is all that was left from the previous activity. It is the intention of the owner to activate the kiln dryer and increase production by adding new models to the present line of products. At the moment, finishes are not directly handled by the company but by the firm "Made Philippines". Finishes are done with stains and nitro-cellulose products following the American finishing methods. The quality level of finishes is acceptable and normally there are no complaints from customers. The company plans to venture into finishes in the near future.

Consultancy Service provided to the Factory

Since the company is not doing any finishing at the moment, and due to the limited time available, the consultant spent half a day with the owner of the factory.

The owner has been briefed about the most relevant aspects in setting-up a finishing shop, and in selecting equipment and products. A separate technical report has been given to the owner as reference material so that the right information may be easily accessible to him at any time. During the second part of the mission, the consultant will be available again to the AKKA WOOD Factory to provide further clarifications.

(b) FURNITUREVILLE
109 San Juan Bautista, Betis
Guagua, Pampanga 2003

Profile of the Company

The factory is located in a U-shaped shed with an enclosing concrete wall and concrete floor. A small showroom and offices are located near the main entrance. The factory is currently under reorganization and parts of the shed are not utilized for the moment. A proper finishing shop will be created soon. Basic, mainly second-hand, woodworking machines from different origins are available. The factory has some 100 workers. Carving and sanding accounts for 60 percent of all the work. 13 workers are operating the machines, 15 are carpenters, and only 3 are dealing with finishes. The items produced range from chairs, tables, mirror frames, to cabinets. All products are abundantly decorated with a big variety of carved ornamental patterns. The monthly production normally consists of 250-300 chairs, 50 tables, 50 mirror frames and a few cabinets for the local market. The bulk of production is exported mainly to the United States. At present a lot of finishing jobs are subcontracted to "Made Philippines", and only a small portion is done by Furnitureville itself.

Findings

The finishes are intended for the American market and consequently, the products and application techniques are also according to the American requirements. Some 80 chairs per month are made in Chippendale style and finishing is done with stains and clear lacquer by "Made Philippines". The quality of finishing is acceptable, normally there are no complaints from customers. The main problem however is related to the fact that the back of the chair, being decorated with delicately pierced carved patterns, is the most likely to break. The species of wood used (LAUAN) is certainly aggravating the problem. At present, in order to overcome this drawback, they produce the components using a two-layer laminated lauan board, the consultant suggested either to change species or, better still to use the multi-layered lamination techniques with proper, thermosetting glues, from a properly equipped subcontractor.

At present, the finishing at Furnitureville is done in a poorly kept environment located in a corner of the shed between the sanding and carving areas. No barriers exist to separate the sections and the area is very dirty. The two compressors now in use in the production area have a very limited capacity: the bigger one is currently supplying compressed air to two

different brand-new machines provided with pneumatic devices, the smaller (only a fraction of a H.P.) is utilized for the needs of the spray guns. There is no compressed air network and there are no filters. A very long multi-purpose hose dragged across the concrete floor is the only way to transfer air from the compressors to the various work stations.

Another finishing area is located upstairs near the offices. All the shop's floor, ceiling, walls and all premises are made of wood, and this also does not contribute to the safety of the building and nor of the operators. The know-how in handling paints is coming straight from paint suppliers and the terminologies normally used to call the different fini hing products are: wash-coat, sanding sealer, glaze, wiping stains, top-coat, etc. Nobody knows the exact composition of the paints because nobody seems familiar with terms like nitrocellulose, PU, AC etc. Furthermore, the two air guns now in use are of poor quality.

Consultancy Service provided to the Factory

One whole day was spent by the consultant on the factory floor to train the personnel and to give advice to the owner about improvements and investments required to upgrade the present situation and to set up a new finishing area. Advice was also given to improve sanding. Electric powered tools exist in the factory but are not utilized. The three workers in charge of finishing were briefed about the correct set-up, regulation and utilization of air-guns and the cleaning and maintenance of compressors and air guns. The most relevant aspects relating to setting-up a better finishing area, proper selection of equipment and paints, costs and other matters related to finishes were discussed with the owner. A separate technical report was given to provide the factory with a permanent consulting tool. The possibility of setting up a finishing shop in an area separated from production (preferably in a different building) was also considered.

Recommendations

- The fact that finishing is currently done by a specialized factory is to be considered an advantage.

- Finishing operations in the wooden shop should be discontinued. A new finishing area should be set up according to safety requirements and all other suggestions contained in the separate technical report.

- A new compressor, of at least 10 HP should be installed.

- A compressed air network should be installed according to the suggestions contained in the technical report.

- Better quality spray guns should be purchased and the possibility of using air mix should be considered.

- Whenever possible, existing power tools should be used for better sanding.

- The possibility of acquiring a narrow-belt sanding machine for sanding table tops, components of drawers, and all other flat surfaces should be considered.

- In cooperation with paint suppliers, other wood finishing products with higher solid content and wearability like AC (acid curing) or PU (polyurethane) should be tried. These types will save time, manpower, equipment maintenance, improve production quality and profits.

- In order to obtain the best results in finishes, it is of utmost importance to develop solid cooperation between the factory involved in application, the paint suppliers and the equipment suppliers.

(c) CRUZ WOODEN INDUSTRIES
Platte Street, Riverside Subdivision
Angeles City, Pampanga

Profile of the Company

The factory is located near the Clark Air Base, a United States military installation. Widespan sheds with sufficiently clean concrete floors accommodate lumber, machines and workers. The owner has recently acquired a number of second-hand machines which are to be installed in the factory to increase production capacity and enable the company to develop more product lines. An appealing showroom, located near the factory, gives a good picture of the items produced. Furniture and a good variety of architectural decorations such as fireplace mantels, ceiling decorations, wooden pillars etc. are exhibited for the benefit of wood carving amateurs. The bulk of the range are carved items. Copying machines are sometimes used to speed-up the production process. Carvings are properly done and the designs are good, mostly due to the long family experience in this field (45 years). The owner's father started the business. Carving has been improved through the years, and still efforts for improvements continue. The owner himself works on the factory floor, explaining designs to carvers, correcting work not properly executed, and training carvers. Creation of new samples and ornamental patterns as well as participating in furniture exhibitions are among the concerns of the owner.

The factory employs directly 300 workers plus 180 subcontractors. Finishing is carried out in a separate factory mainly by subcontractors under continuous supervision of Cruzwood. Equipment and finishing materials are provided by Cruzwood. All items are intended for the USA market and only the items rejected are sold on the local market. Finishing products and techniques are as per American requirements. Finishing products come directly from an American firm (Guardsman) through their representative who is based in Manila.

It is the intention of the owner to group, under one roof, all the activities of the company (finishing jobs are now done outside); for this reason the factory will be shifted to another area and new sheds will be built. The factory is employing at the moment 300 workers considering also the subcontractors, 23 of whom are doing the finishing.

Findings

At present, finishing is mainly carried out by a subcontractor located far from the production area. Cruzwood is providing both paints and equipment to the subcontractor. The shed where the finishes are carried out is

sufficiently big, the floor is made of concrete and the area is enclosed by a concrete wall, only one side is fully open and another one has two big openings to allow circulation of air and dust. The finishing operations are carried out without any rational layout. Two too small compressors, no air compressed network, no service units, no fire prevention measures are other negative aspects of this factory. For spraying, only a conventional air gun was utilized although two airless units from Germany have been there for more than one year, representing an inoperative cost; this is because the instructions for operating the two units were in German. Curing, sanding, spraying are not carried out in separate spaces but normally the workers follow the casual disposition of items trying to move them as little as possible and movement of products is done exclusively by hand. Storage of products (big 50 gallons drums) is done in a corner of the shed and all around there is a metal net fence topped with barbed wire. Nobody knows the exact content of the barrels and cans and they are approaching finishes with names like sanding sealer, top coat, clear sheen, stain, etc. They know how to use the products because the supplier is sending personnel to the factory for training but unfortunately nobody knows what kind of products they are using and consequently it will be impossible for them to move into better finishing systems. Summing up, they know how to do the work, but not what they are doing. The products utilized are coming directly from the American paint manufacturer Guardsman and they are as follows: Dye stain (colours black, dark yellow, dark orange, red), Van Dyke Glaze - 1 gallon per day, wood tone filler - 1 litre per day, lacquer sealer - 2 gallons per day, of 35 percent gloss lacquer - 3/4 gallons per day, flat 10 sheen - 1 gallon per day, basic white glace, red oxide, black clear tone, white clear tone, yellow oxide clear tone and thinner is utilized, 4 gallons of chrome daily. All these products are intended for American style finishes and this is good since the production is destined to America. Gilding is also practised with the decalcomania system (golden leaves are from Italy).

Consultancy Service provided to the Factory

The consultant spent three days with the factory's workers and managers involved with finishes. The intervention has been carried out in the form of a seminar/workshop since the number of people involved was quite high (more than ten). During the first day lectures were given relating to the set-up of the finishing shop, compressors and compressed air treatment, conventional air guns with practical demonstrations in the afternoon. During the second day, the consultant covered the topics related to the equipment for spraying such as airless, air assisted and air mix guns and paints such as N.C., P. U., A.C., polyester in order to broaden the knowledge of the participants. In the afternoon, the concept and importance of viscosity has been illustrated in a practical way with a viscosimeter, provided by a participant. The airless unit has also been started and all the necessary recommendations relating to safety, correct use, trouble-shooting were thoroughly explained to the participants, after which a practical session with workers directly involved in airless gun handling and spraying closed the day. The third day was dedicated to sanding problems, abrasives, standards and quality control in finishes, trouble shooting in finishes (reason for the defects and remedy), topics related to gold leaves and gold dust gilding and burnishing of gilded items has also been covered. During the three days the consultant answered the questions the participants had. Specific rules for safety in handling airless guns were written and given to the workers, more written material will follow. A copy of a separate technical report and other reference materials provided by the consultant have been distributed. The evenings were spent by

the consultant as a guest of the owner and a lot of ideas and topics related to finishes and factory improvement have been discussed.

Recommendations

- The finishing area should be laid out as illustrated in the following figure. Spraying booths with water curtains should be used and air compensation for the exhausts through inlet fans should be ensured (positive pressure in the finishing area is advisable). By this means a lot of touch-up and reprocess and rework now necessary will be avoided.

- The compressor and the compressed air network must conform to the guidelines given in the separate technical report.

- The possibility of electrostatic spraying and its advantages should be considered.

- The opportunity to try new finishes in strict cooperation with a reliable paint supplier should be considered.

- As a first step service units for the compressed air should be introduced in the finishing shop, namely: an air pressure gauge, a pressure regulator and an air filter.

- All finishing products should be stored in a separate building.

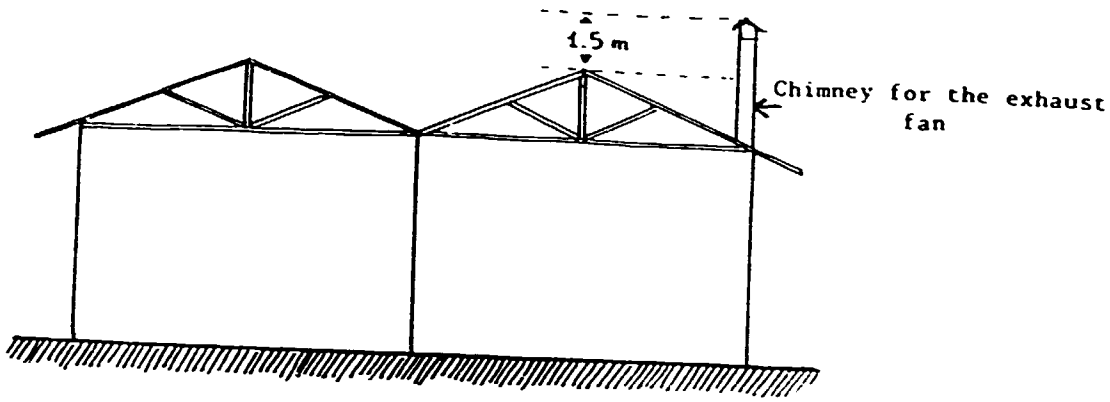
- Metal trolleys and tables with wheels and castors to move items from the spraying area to the curing and sanding areas should be made.

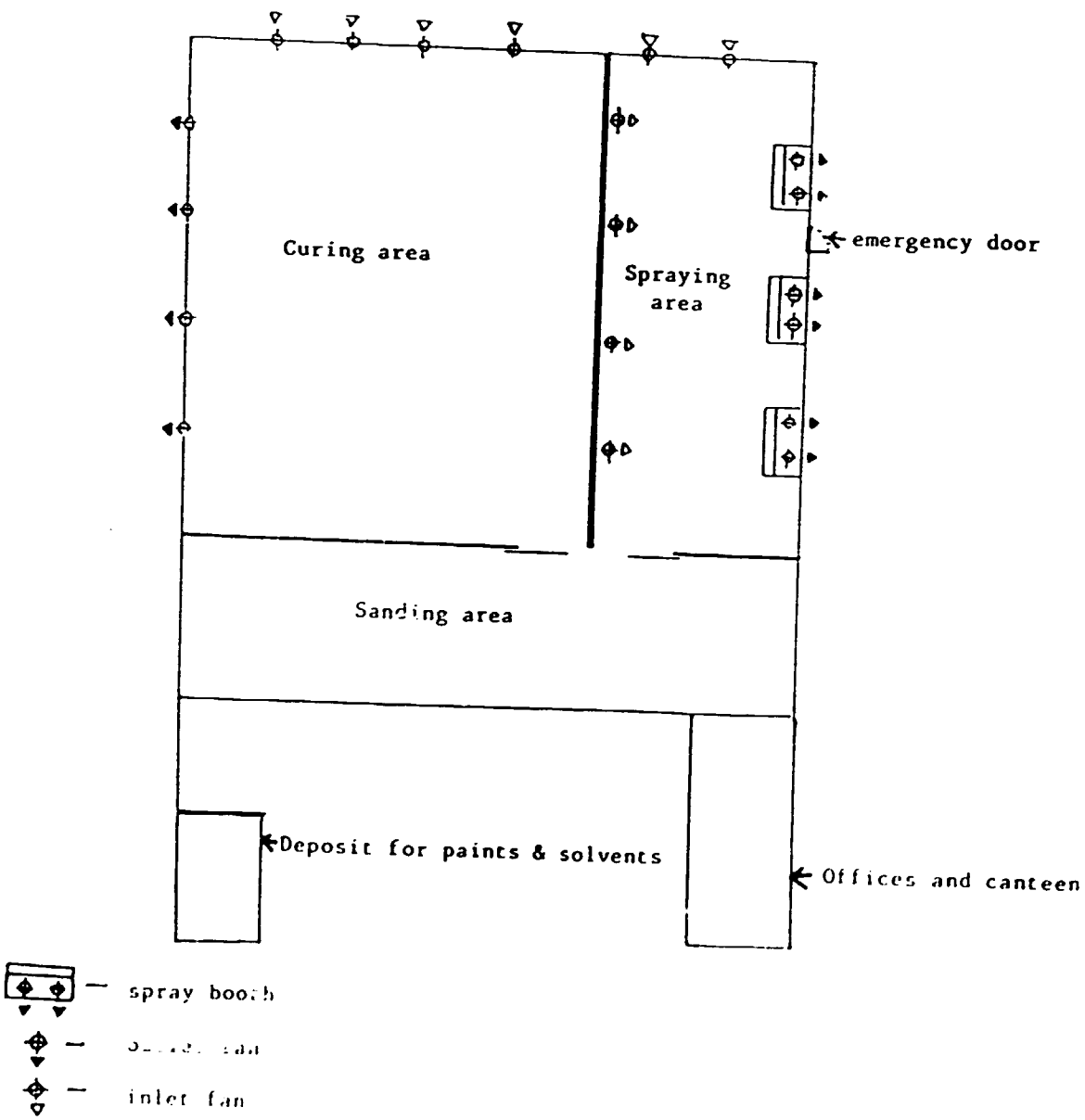
(d) SIMBULAN INDUSTRIES
Quirino Avenue, Baliwag, Bulacan

Profile of the Company

The factory is located at present in sheds with roofing supported by wooden beams. The sheds have been expanded from time to time in order to cope with the expansion of the business. Very limited walls, a concrete floor, a dirty environment, an absence of organized layout and subdivision of the available space are other characteristics of the factory. The owner is planning to build a proper factory complying with all the necessary requirements in the near future. 9000 m^2 of land have already been purchased and work on the site has already started.

The factory is employing at the moment 64 workers: 18 carpenters, 5 upholsterers, 5 carvers, 6 are in charge of office and delivery and 30 workers do the finishing. The workers in the finishing department are divided in six groups of five each, and every group has a worker skilled in handling spray guns. The company is relying also on a few subcontracting factories employing six workers each plus another with 18 workers for panel production. The services of more subcontractors can also be used on a temporary basis to cope with high volume orders.


1.5 m
Chimney for the exhaust fan


Curing area
Spraying area
emergency door
Sanding area
Deposit for paints & solvents
Offices and canteen
spray booth
inlet fan

The product range covers all the furniture items and the market is mainly local (about 90 percent). The furniture is delivered to showrooms in Manila or directly to customers through orders from interior designers. So far, only loudspeaker boxes and incineration urns are produced for export. The factory tried to venture into the American and Australian markets with chairs, but no follow-up ensured. This was due to problems arising from the company in charge of marketing. The intention of the owner is to increase the volume of export to 50 percent of his overall production.

Findings

Finishing is now carried out in a separate shed, but no walls separate it from the yard and production areas, consequently the environment is very dusty. In order to overcome problems related to dust, top-coating is normally done in the evening, 15 minutes before work stops. No fire prevention gear has been noticed by the consultant and the paints are stored in a wooden room, located right in the middle of the factory. The compressor is of sufficient dimension for two guns. The compressed air network is not properly installed. The air service units currently used in the finishing area are good for power tools and for pneumatic pistons fitted to machines. On the other hand, the service units in the production area are exactly the correct units for spraying, in so far that they also have an oiler.

Two different kinds of finishes are mainly being carried-out in the factory:

(a) Clear lacquering - (1) first sanding (50-180); (2) sanding sealer; (3) sanding (180-220); (4) stain application; (5) sanding sealer; (6) sanding (220-400); (7) toning; (8) sanding sealer; (9) fine sanding; (10) top coating, normally two coats without intermediate sanding.

(b) Closed-grain Pigmented Finish - (1) wood sanding (50-180); (2) sanding sealer; (3) sanding (180-220); (4) primer (epoxy primer for automotive when high-gloss finishes are required); (5) sanding (220); (6) gloss-coating, 1-2 coats of sheen clear (sometimes acid curing Dutch Boy brand).

Open-coat silicon carbide sanding paper is not utilized. The quality of finishes is quite good despite the poor environmental conditions in the finishing shop. Only one of the factory's air guns is of good quality.

Consultancy Service provided to the Factory

The consultant spent three days in this factory. During the first day, his consultancy focused on problems relating to finishes. All the aspects relating to the proper set-up of a finishing shop, compressor selection, maintenance, compressed air network and service units were discussed with the owner.

On the second day, aspects relating to the spraying equipment (proper use and maintenance), technical aspects, advantages and disadvantages of new kinds of finishing equipment like airless, airmix and electrostatic guns, were discussed with the owner and the finishing supervisors. The afternoon was

spent discussing problems with the workers and training them on fundamental finishing operations and maintenance of equipment.

The third day was dedicated to briefing the factory owner on the different types of products used for finishing and the relative criteria for their correct selection. Sanding paper and sanding have also been thoroughly covered during the discussion. A visit was paid to the future site of the factory in order to identify the best location for the finishing shop. All the aspects and requirements of the future finishing area were thoroughly discussed and sketches drawn in order to illustrate the positioning of the different working areas (spraying, curing, sanding), and the localization of the spray booths. More advice was given, upon the request of the factory owner, about standards in finishes, quality control, modern drying methods and finishing lines.

A copy of the separate technical report was given to the factory owner and a number of other photocopies from the consultant's reference materials were also supplied together with sketches.

Recommendations

- The air service units from the finishing shop should be exchanged with those in the production area.

- Open-coat silicon carbide sanding paper should be used for sanding between coats and aluminum oxide abrasives for wood sanding.

- New finishing materials and cycles should be tried as per to the European finishing criteria.

- The new finishing shop should be set according to the criteria stated in the reference material provided by the consultant.

- Air-assisted spray units should be introduced to save spraying materials and improve quality and productivity.

- In the future, an attempt should be made to select a well-defined line of products for the export market. Incineration urns seem to be a good business. Chair production can be another business where the factory has sufficient know-how to venture into the external markets. The main problem in this case is to identify the right models and to reduce the range produced to no more than two or three models to increase productivity. The finishing equipment must be selected according to the range of items produced, for chairs, the faster and most profitable finishing system is electrostatic spraying, provided that the productivity is high enough to guarantee a return on the invested capital within a reasonable period of time.

(e) POLYMART INC.
#37 Wawa Street, Alabang
Muntinlupa, Metro Manila

Profile of the Company

This 25 year old factory is producing bamboo, rattan and iron frame furniture. They export 90 percent of their production (60 percent to Europe, 30 percent to the USA, Japan, Mexico, South Africa and 10 percent are sold on the local market). The furniture produced ranges from baskets, complete sets for dining and living rooms, wall units to bedrooms. The volume of production is estimated at 4 to 5 containers per month. The factory is employing five permanent workers at managerial and supervisory level and the overall number of workers ranges from 50 to 100 depending on production requirements and delivery schedules. Eight subcontractors normally work for Polymart. The production is carried out in spacious sheds with concrete flooring. A good range of machines is available in the factory and there is also a separate finishing shop, a metal working shop and a maintenance shop.

Findings

The finishing shop is enclosed and separated from the production and warehouse by a self-closing plastic curtain. The shop, except for the wooden ceiling, has concrete walls and is equipped with a locally made water-curtain spray booth, that is normally working, though suffering from limitations: its width, length and height is sufficient, but the curtain of water is limited to the upper part of the booth, leaving more than 50 cm of wall at the bottom where the oversprayed materials are settling without being trapped by water. Water is circulated by an electrical pump of 0.5 HP and, at the top, there is a sufficiently big exhaust fan. The air compressor is sufficiently big, the main compressed air network is even over-dimensioned, but it would be better to use a bigger compressor in the future. However, improvement may still be done on this network. The location of the compressor outside the factory in a clean environment can also be considered good. A number of air-service units are also available. The only problem is that they are located far (except for one) from the point of utilization (spray guns) and they are in very bad condition, though apparently, serviced (drainage of water). The compensation of the air exhausted through the spray booth is coming through windows in the opposite wall and the outside environment (neighbouring garden) is sufficiently clean. Curing and spraying areas are big enough, but not separated. 30 workers are dealing with finishing: four for spraying and 26 for staining, surface preparation and sanding. As far as fire prevention is concerned, there are boards indicating "no smoking areas", an extinguisher is also available, but it is insufficient (too small). Finishes are normally agreed on with customers through samples and pictures and apparently, there are no customer complaints in this respect.

The knowledge of the personnel in charge of finishing on the products used is insufficient. When questioned by the consultant, they were not able to give adequate and sufficient answers about the cycles and the products they were using.

The two types of finishing methods currently in practice are:

(a) (1) Blow-torching; (2) sanding (240); (3) colour (Sinclair); (4) gloss (Guardsman), (5) white enamel for

automotive (for white was finishing - Globesco); (6) rubbing; (7) top coating (gloss or semi-gloss - Guardsman).

(b) (1) Blow-torching; (2) sanding (240); (3) staining (solvent-based); (4) sanding sealer; (5) toning; (6) top coat (normally glossy).

At the time of the visit, finishes were not a bottle-neck for the company. The sanding paper utilized between coatings is of a good quality: silicon carbide, open-coat lubricated electrostatic coated and with the correct grade of grit. According to the finishing area supervisor, the water of the spray booth is changed weekly and all the components are cleaned.

Consultancy Service provided to the Factory

The consultant spent one day in the factory. During the morning all finishing aspects and problems were discussed with the factory's general manager. The manager has been briefed on improvements that may be introduced and on the proper layout and maintenance of the finishing shop. The afternoon was partially spent with the finishing supervisor trying to identify and solve problems. The consultancy had however to be interrupted due to the absence of the factory's owner. The personnel were busy attending to overseas customers and preparing prototypes for a furniture fair. A copy of the technical manual was handed over to the general manager to serve as reference material. More time will be allocated during the second part of the mission in order to give Polymart a better consultancy service.

Recommendations

- The spray booth should be improved by extending the water curtain to the floor, and by extending also the water tank into the floor for a better trapping of oversprays.

- The service units which are old, damaged and spoiled should be chanted.

- The technical report should be studied and the necessary action taken in order to improve quality and productivity.

- New finishing products based on European finishing systems (acid curing and polyurethane) should be experimented on.

(f) GRASSROOTS
Telabastagan, San Fernando
Pampanga

Profile of the Company

The factory is producing wooden toys and models of planes made of wood and polyurethane. The bulk of production is entrusted to about 50 subcontractors employing 6-10 workers each. The factory is located in two separate areas: in one location toys are produced and in the other the plane models. The factory producing toys is located in a shed with three enclosing concrete walls and wooden beams to support the roof. One of the worse aspects of the production area is the lack of a dust extraction system, the machines

and technologies used in production are poor (a number are locally made equipment). The finishing, packaging, and quality control sections are located near the production area and are on two floors. The other factory is bigger and the construction is more recent and has better characteristics, if compared with the first one. This building is not fully utilized at present and it is mainly used for finishing, as a warehouse, for quality control operations and some minor jobs, like application of small parts to the model planes. The production is almost totally exported to the United States, Europe, Japan etc.; only a small portion is destined to the local market. The factory's owner is mainly involved in the marketing of the products through an office in Manila. A general manager is in charge of the coordination and control of the production aspects. All the subcontractors are under the supervision of the company's permanent staff in charge of quality control.

Findings

The finishing shop is currently located on the second floor of the same building that accommodates the quality control, the warehouse and the packaging departments. The spraying area is separated from the curing area but the main problem is that the whole building (except one wall) is wooden and this certainly does not comply with safety requirements. A small exhaust system (through fans) is available. However, it is inadequate and not in the proper location. The air gun is of good quality but the compressor is too small and the compressed air hose is exceptionally long. A service unit plus filter is also available but not serviced. A brand new 10 HP air compressor will be ready for service soon.

The environment is sufficiently clean (as it has to be in order to avoid defects in the finishes and customers complaints). No fire prevention systems have been noticed by the consultant and the electricity network does also not meet the safety requirements. It seems however that the owner is willing to shift the offices to the building where the finishing department is located now and this will be definitely be better so that safety requirements are met. One of the problems of finishing relates to a small toy train painted with non-toxic pigmented lacquer, this toy did not so far encounter the expected success because of its high cost. Thirty percent of the cost of this toy is represented by the finishing itself. Five years ago, the factory bought 60 gallons of non-toxic paint that have not been used because the colours were not as bright as those of the traditional paints. The suggestion by customers was to buy in Hongkong a better non-toxic paint. The management worries because this will add an additional cost to the production of an item that did not yet succeed on the market. This toy is finished by dipping in sanding sealer, then sanding with silicon carbide abrasive 240 and a final topcoat of non-toxic pigmented lacquer using a spray gun. Another common finishing procedure is as follows:

1. Stain the components in a water based stain.
2. Dip into sanding sealer.
3. Sand with 240 Silicon carbide sanding paper.
4. Dip in mineral oil.
5. After a few hours wipe off the excess oil and after 24 hours of drying wrap in paper to absorb the residual oil.

A third finishing process is as follows:

1. Stain the components in water based stain.
2. Dip in sanding sealer.
3. 240 Silicon carbide sanding.
4. Top coat with ECG lacquer (ECG is an acronym for economic clear lacquer prepared from a resin extracted from a local tree called Almaciga (AGATHIS ALBA) most probably this resin is colophon). This top coating is done with a brush or with an air gun (but the air gun is only used when it is necessary to speed up production). The items that do not have the required gloss or presenting finishing defects are sprayed a second time.

All processes, except for the air gun spraying, are subcontracted.

As far as the plane models are concerned, the situation is different: the in-house finishing is carried out in a better shed, located far from the toy production. A big 10 HP compressor is installed next to the finishing shop. The major problem of the compressed air is due to the fact that the main compressed air network is made of a pipe with too small a diameter. A few other things should be changed in order to get better performances. Dry, wooden spray booths are also utilized for spraying but the fans are too small and the compensation air is coming from the dirty internal environment. Some subcontractors also have small compressors (too small and also locally made) and air guns.

The maintenance of the equipment is very poor (drainage of water is not considered). In some of the subcontractors' houses finishing is not separated from the kitchen and living room and young children are playing among solvent vapours and overspray; this is certainly not contributing to the health and safety requirements related to finishing operations. The majority of model planes are made of wood and only a few of polyurethane injected into moulcs. In order to cover all the marks from carving, moulding and assembling, the models are at first covered with several coats of putty and an automotive type primer; intermediate sanding is also carried out and only when the surface is sufficiently smooth are two to five top coats of pigmented lacquer sprayed. After this, the models are ready to receive hand decorations and decalcomanias. Air brushing camouflages and top coating with clear lacquer to protect decorations are carried out in the main factory. Acrylic products are used on polyurethane planes and plastic models imported from Hongkong in order to obtain the proper gripping of the paint.

Consultancy Service provided to the Factory

Two days were spent in the Grassroots factory. On the first day, the general manager accompanied the consultant through the production and finishing areas in order to identify problems and to consider different aspects related to the finishing operations of the products. After this, the general manager was briefed on improvements and the correct layout of the finishing shop. All the aspects related to equipment and maintenance have also been discussed. The second day was spent training the workers on the use and maintenance of the equipment. Several subcontractors have also been visited in order to identify and try to solve problems. A separate meeting was also arranged by PRODEX with the owner of the factory (not available during the visit to the factory). The consultant tried to explain to him that the statement "*best profit equals cheapest workmanship plus cheapest equipment*

and finishing products" sometimes does not apply. The owner of the factory was briefed on safety requirements and on the advantages of introducing new techniques like air assisted or electrostatic spraying. A copy of the technical report was given to the general manager.

Recommendations

- As soon as possible, the finishing area should be shifted to the area where the offices are located now.

- A compressed air network as outlined in the technical report should be set up in order to use the new compressor as soon as possible.

- Setting-up a spray booth or at least a good exhaust system as per the suggestion of the consultant should be considered.

- The subcontractors should be provided with good and efficient equipment. If the subcontractors cannot afford this equipment, the factory should provide it and deduct the expenses from payments on a monthly basis. If the subcontractors are the owners of the equipment they will better care for it.

- The introduction of more efficient spraying techniques like the air-assisted system should be considered. Shifting to electrostatic spraying should also be considered for the future.

- In order to combine orders, a consortium with other factories should be created to combine orders of non-toxic paints, thus obtaining better consideration and better conditions from the paint suppliers.

(g) CARLOS ANTONIO DISENOS, INC.
Hernan Cortes Street, Bgy. Banilad
Mandaue City, Cebu

Profile of the Company

This factory is producing furniture made from rattan and a combination of solid wood and rattan. The production is exported mainly to the United States, France, Australia and occasionally to the United Kingdom. The production destined to France is not finished. Finishing is done in France. The factory is located in a wide concrete and metal structural framed shed with a good concrete floor sufficiently clean and smooth. Parts of the sheds have been badly damaged but are recovering fast. Before the typhoon the area covered by sheds was 5000 m^2 and what is left is big enough even for further expansions. Wooden frames and components are machined in a separated shed equipped with a good variety of woodworking machines. The rest of the factory is for the more space-consuming rattan operations. The factory is employing 135 workers: 20 for wood machining, 100 for rattan furniture production and 15 in charge of office and inspection (quality control). The factory is also relying on two small cottage industries as subcontractors.

Findings

Since the typhoon, finishing has no longer been done in the factory so that the items are either delivered unfinished or are sent to Manila for finishing before shipment. The finishing now done in France will be carried out soon at the factory. A worker has been sent to France to receive proper training and the factory owner is planning to build a separate shed with a surface of 600 m^2 for finishing. Three dry spraying booths having sufficient dimensions are now available in the factory but they are not utilized. The sequence of the finishing operations is as follows:

1. Sanding with grades of grit 80, 150, 240.
2. Wash coat.
3. Staining.
4. Coat of sanding sealer.
5. Sanding with an abrasive having a grit of 240.
6. Toning (in order to adjust and match colours).
7. Another coat of sanding sealer.
8. Sanding with 240.
9. Top coating, normally two coats with an intermediate 240 (or sometime 320) sanding.

This finishing is close grain, stained clear, sometimes glossy according to the customer's specifications, but mainly matte or semi-glossy.

For one customer items are sanded and coated by brush or rubbed with sanding sealer. Sometimes, white-wash finishing is also done according to the following procedure:

1. Bleaching.
2. Wash coating.
3. Base staining.
4. Sanding sealer.
5. While enamel (automotive type).
6. Rubbing.
7. Clear lacquer, 2 coats.

Consultancy Service provided to the Factory

Considering the limited time available and since the two companies being assisted in Cebu have similar finishing problems, the advisory service was carried out at the same time for both factories (Carlos Antonio Disenos, Inc. and Berben Wood Industries Inc.) enabling a better and deeper transfer of know-how.

Three days were spent by the consultant giving advice to the two factories. The first day was spent visiting the factories and identifying problems and aspects related to finishes. The rest of the day was spent with the owner of one factory and the general manager of the other discussing the general aspects of the existing finishing shops. Particular advice has been given for the new finishing shop that the two factories are going to build soon. During the second day, technical aspects, advantages, disadvantages, maintenance and cost considerations related to the spraying equipment (air gun, airless and air assisted electrostatic) have been illustrated. In the afternoon, the consultant moved to the factory of the Berben group, which is

equipped with a good quality locally made water curtain spray booth, to train workers in spraying different items, in the handling and correct use of spray guns, maintenance and servicing of the equipment involved in finishing (spray booths, guns, air compressors, compressed air network and air service units). The utilization of a Ford cup viscosimeter has also been demonstrated during this practical session. Problems arising from spraying different species of wood and different items have also been discussed and solutions have been proposed by the consultant. The third day was fully spent discussing with the owners and managers of both factories finishing products, finishing cycles normally used in Italy utilizing polyurethane products, sanding, sanding machines, quality control, testing, curing, trouble shooting in finishing were also among the topics covered during this day. A copy of the technical manual and photocopies of almost all the consultant's reference material have been given to the two factories.

Recommendations (for both factories)

- First of all a good fully enclosed finishing shop possibly typhoon proof with cement block walls should be set-up.

- The shop should be equipped with two or more locally made spray booths with water curtains.

- Spraying, curing and sanding between coats should be separated; the three environments are not compatible.

- The finishing shop should be provided with proper transport means like trolleys or metal racks on wheels in order to move the work pieces from spraying to curing and to sanding areas without damaging them.

- At a later stage (not as first priority) the introduction of a mechanized overhead conveyor line should be considered.

- The introduction of forced drying through a tunnel oven can be considered as a second step to improve and speed up finishing, thus avoiding possible future expensive expansions of the curing area.

- Already now consideration should be given to introducing air assisted spraying units and, in the near future, the introduction of electrostatic spraying systems to save finishing products, increase quality, productivity and profits should be also considered.

- A reliable paint supplier should be selected and experiments on new types of finishes according to the European criteria utilizing polyurethane or acid curing products should be attempted.

(h) BERBEN WOOD INDUSTRIES, INC.
103-107 Plaridel Street
Cebu City, 6000

Profile of the Company

The factory is located mainly in two large wooden structured sheds with a proper and sufficiently clean concrete floor. Other sheds of the same type are available, part of the sheds have been badly damaged or totally levelled by the recent typhoon. Despite heavy damages, the factory recovered soon and a lot of repairs have already been done. The two biggest sheds accommodate a good variety of woodworking machines some of which are brand new or recently purchased. The factory produces furniture components, chairs and tables for outdoor use. All items are for the export market: 85 percent for the United States, 5 percent for Australia, and 10 percent for Europe. The wood utilized is from non commercial species like "Toog" and "Bihuang". The factory is employing 78 workers and does not rely on subcontractors.

Findings

After the damages resulting from the typhoon, the finishing carried out in the main factory is only limited to spraying some components and dipping. A new finishing shop will be available soon. At the moment, finishing is done in an open area with sufficiently good air guns, adequate compressors, extra long rubber hoses, no compressed air network, and service units borrowed from a machine equipped with pneumatic fittings. The rest of the finishing is done in a factory of the Berben group which normally deals with wrought iron and relative finishes or they are subcontracted to another factory having good finishing facilities. 14 workers, involved in finishing, are divided equally for spraying and sanding. The finishing operations now carried out are as follows:

1. Filler
2. Sanding with 180 open coat sanding paper
3. Sanding sealer
4. Sanding again with 180 abrasive (this kind of abrasive is preferred because one of the characteristics of the wood utilized is the particular swelling of the grains after each coat).
5. Primer
6. Sanding 180
7. Final top coat (normally with pigmented lacquer).

Consultancy Service provided to the Factory

See (g) "Carlos Antonio Disenos, Inc." above.

Recommendations

See (g) "Carlos Antonio Disenos, Inc." above.

(i) MADE PHILIPPINES
Friendship Hwy, Riverside Subd.
Angeles City

Findings

The main activity of this firm is to finish, on a subcontracting basis, furniture items produced by a group of associated companies (among whom figure AKKA Wood and Furnitureville). The factory is located near the United States Air Force's Clark Field Base. The production facility comprising the sanding, staining, spraying, packaging and warehousing operations is located on the ground floor. The owner and his family live on the floor above the factory. From an environmental and health point of view this is unacceptable. The owner is aware of this fact. In the opinion of the consultant the area which is now used for finishing is only good for packaging and delivery. The main concern of the owner is to build a suitable factory with a surface of at least 1000 m^2 but the more serious problem is related to the financial aspects of this operation. The environment in the areas now allocated to curing, sanding, rubbing and staining is sufficiently clean. This cannot be said for the spraying, since this operation is normally carried out in the middle of a dusty road at the back of the shop. A spray booth is being constructed. It needs only few modifications to improve its efficiency but its construction is already advanced and the booth can be operative in a short time. The factory owner was also constructing a curing room but stopped at the recommendation of a UNIDO consultant. All the frames of the heating units are wooden and the heating system and the electricity network are not safe. Bearing in mind that upstairs, over the wooden ceiling, there is an apartment, the interruption of the construction can be considered more than wise. Two compressors - which are too small - are feeding two small and inadequate guns through very long rubber hoses. No consideration is given to pressure regulation and proper treatment of compressed air. Despite this, there is nothing to complain about in the quality of finishes, but certainly quite a number of problems like touching-up, repairing and reworking can be avoided if the fundamental rules relating to the spraying equipment are followed closely. The factory is employing 26 workers: 5 for spraying, 5 for sanding, 2 for hand-filling with spatula and brush, 4 for glazing by rubbing and brushing, 4 for packaging, 4 helpers for sanding, etc. one manager and one secretary. There is no data available on the factory's monthly output. It depends a lot on the fluctuating situation of the orders. Finishing is done using American paints from Guardsman. The finishing is performed mainly as follows:

1. Sanding 220 - 240 (for correcting the sanding already done by the producing factory),
2. Substain (spraying) for matching different colours.
3. Base stain.
4. Sanding sealer
5. Sanding 360
6. Filler
7. Sanding sealer (sanding 360 or more)
8. Glaze
9. Sanding sealer.
10. Sanding 360 or more
11. Glaze
12. Sanding Sealer
13. Sanding 360

14. Top coating with up to three coats with intermediate sanding.

Consultancy provided to the Factory

The consultant spent two days with this company. The first day was spent briefing the owner on setting up a finishing shop, problems related to compressed air, its servicing and maintenance. A lot of other different aspects related to finishes and problems which the factory faced were thoroughly discussed.

The second day was spent partly with the finishing manager and the workers involved in spraying in order to explain proper spraying techniques, guns, compressors and maintenance of premises. The rest of the day was spent with the factory owner covering all the relevant aspects relating to finishing equipment (airless, airmix, electrostatic) use of abrasives in finishing, new finishing products (like P.U., A.C.) and their related advantages and disadvantages. A copy of the technical report was given to the factory owner as permanent reference material.

Recommendations

- A finishing shop in a different more appropriate area should be set up.

- The instructions in the technical report should all be followed in order to buy an adequate air compressor and in order to set up a proper compressed air line with all the required accessories.

- Better guns should be bought and serious consideration given to the introduction of air assisted spraying techniques.

- All the equipment can be purchased and utilized immediately. It can later be transferred to the new plant.

- New products according to the European finishing criteria should be introduced. This operation must be carried out with a reliable and cooperative paint supplier.

(j) VERAWOOD Industries
Ramar Village, San Agustin
San Fernando, Pampanga

Profile of the Company

The factory is producing basketry made of rattan, bamboo or other natural fibres, cabinets and chairs. 70 percent of its production is exported to countries in Europe and 30 percent is exported to other countries. The factory is employing 140 workers plus another 300 subcontractors. The fixed workers are working on a contract basis. The factory is located in different sheds and few fundamental machines are utilized. The owner developed some of the machines plus looms for webbing of bamboo strips and other natural fibres. Sometimes epoxy resin decorations are added to the baskets. The bulk of production is done in the same style: thin strips of bamboo poles hand webbed

are covering plywood and wooden frames of chests and storage units. The factory is expanding and more sheds have been added recently.

Findings

Finishing is now carried out mainly in a shed separated from production but totally opened (without enclosing walls) and sometimes spraying is done in the dusty yard. Other finishing operations are done in one of the new sheds with concrete hollow block walls. No fire prevention systems have been noticed by the consultant. The compressor is sufficiently big and the compressed air network needs only a few improvements. The air service unit is located too far from the guns. The guns are of the cheapest type and of poor quality, they lack regulators and air leaking from rubber hoses and connections prevents an effective set-up. At present 60 workers are dealing with finishing which is the bottleneck of the factory. Four of the 60 workers are handling spray guns, more than 30 are involved in sanding and the rest are cleaning, blow-torching, staining and rubbing. The finishing processes for baskets are as follows:

1. Blow torch in order to burn small emerging fibres.
2. Sanding.
3. Blow torch again.
4. Staining (when required) followed by drying for one to three hours.
5. Blow torch again.
6. Varnishing with E.C.G. (economic clear lacquer-most probably colophon) normally 2 coats. Sometimes high gloss clear lacquer (probably nitro-cellulose) is utilized for the last coat of varnish.

The following finishing procedures are used for furniture made of bamboo or rattan (sometimes also for components of lauan wood):

1. Blow torch.
2. Sanding.
3. Blow torch.
4. Coat of sanding sealer.
5. Sanding.
6. If surfaces are smooth enough staining (if required).
7. Application of stain by brush and rubbing with foam pad (the stains normally used in this step are: brown, light brown, grey, black, green).
8. If required, sometimes white and green lacquer is sprayed and then rubbed with foam pads.
9. Finally, two to three coats of top-coating clear lacquer.

Consultancy Service provided to the Factory

Two days were spent by the consultant to give advice to the factory. During the first day problems and aspects relating to finishing were discussed, he also visited and analyzed the production and finishing areas. All aspects relating to the layout and equipment for a new finishing shop were discussed together with the circuit of a compressed air network, the importance of service units and maintenance of the different equipment. Setting up a spray booth with a water curtain and technical aspects related

to spray booth construction were other aspects thoroughly discussed. The morning of the second day was spent briefing the factory owner on spraying equipment, like airless, air assisted or electrostatic guns. Advantages and disadvantages together with technical characteristics of each have been explained. European finishing methods have also been illustrated. On request of the factory owner the technical aspects of a tunnel oven were discussed. Ideas and simple solutions for air heating and a transport system through the oven were also suggested and sketches made.

The afternoon was spent with the workers involved in finishing explaining the fundamental aspects relating to the proper use and maintenance of air guns and equipment, including practical demonstrations. A copy of the technical report was given to the factory owner.

Recommendations

- The finishing shop should be set-up as per the requirements of the technical report.

- Locally produced spray booths should be adapted with a water curtain. All the indications needed to make this equipment were given.

- The possibility of setting up a curing tunnel with a proper transport system to move the workpieces through the oven should be studied since currently curing is using up a lot of space.

- The compressed network should be improved and more air service units (one for each spray gun) added.

- Buy new spray guns with more regulating possibilities than those now utilized.

- The opportunity of introducing the air assisted spraying system, and even electrostatic spraying at a later stage should also be considered.

- With the cooperation of a reliable paint supplier, experiments on new finishes like acid curing and polyurethane in order to save materials, speed up production and add more value to the products should be carried out. In Europe A.C. and P. U. are normally utilized for the kind of items produced by the Vera factory.

(k) GROVIL Woodcraft Philippines Inc.
Sta. Cruz
Laguna 4009

Profile of the company

The factory is mainly located in two different areas: an original shed of about 1400 m^2 where kiln drying, wood machining operations and metal works are carried out and another with an area of 8000 m^2 (about 4000 m^2 of which is covered) where sawmilling, kiln drying, machining, finishing, packaging and delivery are carried out. There are 100 permanent workers employed as follows: wood milling 30, finishing 20, packaging 30, office 20. The factory

is mainly relying on 20 subcontracting factories with varying potential (from 10 to 50 workers). The total number of workers involved with production at Grovil is about 1000. Most of the subcontractors are dealing with finishing The products are: Christmas decorations 20 percent, napkin rings 50 percent, assorted decorations 30 percent. As far as marketing is concerned, 50 percent of the products are exported to the United States, 40 percent to Europe and 10 percent to Asia/Japan. The factory also produces and sells small wood components for jewellery and other uses on the local market.

Findings

The bulk of the jobs related to finishing is carried out by the subcontractors and is giving work to more than half the 1000 people working for Grovil. Some of the subcontractors have spray guns or "airbrush" but the majority is working with brushes. The items are finished in different ways, with all sorts of paints, lacquers or varnish ranging from masonry to automotive, N. C., P. U., acrylic, wax, etc. After the application of masonry paint, used to seal and fill the grains, the items normally undergo a series of brush decorations: sometimes decorations are carried out with an airbrush, silk screening or the application of decalcomanias. Paints are normally purchased on the basis of the cost per litre and normally cheap products are used following the rule that the cheaper the product the higher will be the profit. A finishing area is also located inside the main Grovil factory area. This area has a concrete floor covered by a wooden structure shed separated from the warehouse and packaging area by a plywood wall, the other three enclosing sides are fully open. The items to be finished are accommodated on metal net trays standing on low fixed tables. The spraying operations are carried out by itinerant workers who drag an exceptionally long compressed air rubber hose along the concrete floor to feed the air gun. The compressor is located in a dirty area and is abundantly covered with multi-colour oversprayed lacquers. It is impossible to read the pressure on the air pressure gauge since it is coated with pigmented lacquer. There are no service units (gauge, pressure regulator filter) nor any metal piping for the compressed air distribution network.

Of all the guns available in the factory only one is of good quality, even though it is very dirty and badly maintained. No fire prevention systems have been noticed by the consultant and finishing products are located in many different places (there is no storing area). If this is the situation in the factory, the situation in the finishing shops, subcontractors utilizing spray guns is certainly not better. One of the items Grovil produces is a high gloss black lacquered tray for the Japanese market. This is certainly the most difficult finish carried out by a Grovil subcontractor. The subcontractor has a partially closed finishing shop with a small and inadequate dust extraction system; the compressor is too small, dirty and without maintenance. In this case, the lacquer is supplied by the Japanese customer. The finishing shops of other subcontractors utilizing air guns are in even worse conditions. Finishing does not represent a bottleneck for the company, since there is no limit to the number of subcontractors it can use.

Consultancy Service provided to the Factory

The first day was spent with the owner of the factory and with the managerial staff trying to identify the factory's problems relating to finishing. A number of subcontractors were also visited and finishing problems were discussed with them.

The second day was spent giving a short course to subcontractors and factory workers involved in finishing. The expert demonstrated the correct use and maintenance of the guns and equipment. A new type of finishing utilizing coconut fibre masking was also tested. The third day was spent with the factory owner discussing and illustrating modifications, improvements and innovations in equipment and in the finishing shop's layout. Since the firm is also involved in metal work, sketches of mechanical constructions were given to the owner illustrating possible equipment for dipping, curing, trolleys, fans, spray booths, etc. A copy of the technical report was given to the factory's owner as well as many photocopies of other reference material.

Recommendations

- A finishing shop with the following characteristics should be set up:
  - Closed in order to keep it dust-free (enclosing walls of concrete hollow blocks).
  - Exhaust of overspray through a water curtain spray booth or at least through an exhaust fan.
  - Spraying and curing sections should be separate.
- The fans and all the necessary equipment should be produced in the well equipped metal shop.
- Well designed metal trolleys to move the work pieces from the spraying to the curing and sanding areas should be produced.
- A curing area with good ventilation and an inlet of air through filters should be set-up.
- All aspects relating to fire prevention should be considered (big fire extinguishers, emergency door, explosion proof electric network with proper enclosures for electric motors, lamps, switches).
- Outside the factory, a proper storage building for finishing products should be set-up (sufficient openings in the enclosed walls, floor absorbing or dissipating flammable materials from spillage).
- The compressor should be located outside the finishing area.
- A compressed air network should be set-up.
- A compressed air service unit (pressure gauge, pressure regulator and air filter) should be installed near the gun.
- The length of the air hose should be kept as short as possible.
- Consideration should be given to the introduction of an air assisted spraying unit for the near future and the eventual

introduction of an electrostatic spraying unit as a further improvement in quality, productivity and profit.

- Silicon carbide open coat sanding paper should be used between coats: it will last longer than the common sanding paper now used.

- The finishing products should be properly evaluated and an attempt should be made to find a reliable and cooperative supplier in order to provide the factory with lacquers having constant colours and characteristics.

- An attempt should be made at installing all the operations related to priming coats and uniform colour coats under one roof. These operations should be done with proper finishing equipment (spray guns in order to save time and improve quality).

- Subcontractors should only be relied on for hand-made decorations.

- As far as the subcontractors are concerned:

  - All the necessary equipment for setting up a finishing shop: exhaust fan, revolving table, good compressor, service units, good gun should be provided to them.

  - A certain amount of money should be deducted each month from the subcontractors' entitlements for work done in order to cover the cost of the equipment provided. The subcontractors will take better care of the equipment if it is their own.

- Consideration should be given to the construction of a dipping machine for small items according to the consultant's suggestions.

- Consideration should also be given to the utilization of tumbling for finishing of small components (30 mm maximum dimension and without sharp corners). The tumbling device can be made according to the data and equipment already in the possession of the factory's owner.

- Consideration should be given to training of personnel for hand decorations also through know-how acquired abroad where this type of decoration has reached a high level of skill in execution (eg. in Northern Thailand).