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

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

United Nations Industrial Development Organization

Distr.
LIMITED
ID/WG.226/7
23 April 1976
ENGLISH
ORIGINAL: ITALIAN *)

Technical Course on Criteria for the
Selection of Woodworking Machines
Milan, Italy, 17 - 26 May 1976

PAINTS FOR FURNISHINGS 1/

by

Giorgio Grecchi**

*) Translation from the Italian prepared by the organiser of the Course.

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.

** Director of ILVA Veneer Factory.

I think that it is particularly difficult to give a sufficiently precise general picture about the subjects concerning wood painting and paints for furniture in particular.

We can at first remark that few technological sectors have had, in the two last decades, such a marked technical growth and perfectioning as the one of paints for furniture. One should consider that no more than twenty years ago furniture painting was still bound to the use of paints based on alcoholic shellac solutions applied by hand with the French-polish system, in a succession of several operations, using each time the paint more and more diluted as the wood pore absorption became saturated. A good painting done in this way required really long manpower times even though the aesthetical result obtained was really great.

This starting point of furniture painting coincides, as a matter of fact, with the starting point of the modern furniture industry which, as you well know, originates from a typically handicraft activity or, from the historical point of view, from the shop of the master of arts. The boom of furniture industry, transformed into a mass production system, would have been impossible if the painting chemistry had not given a valid contribution to this growth by developing new synthetical films for new and faster painting systems.

After this premise, let us examine together which are, or should be, all the physical, mechanical and technological characteristics which we shall put as a target for painting furniture: in other words, which

./.

are the real specifications which the paint shall meet both during application and as a finished product.

As a matter of fact they are many, and some are very important. From the application point of view we can list:

1) maximum ease of application, possibly with automatic machines (for instance glazing machines or roller coating machines).

2) maximum drying speed.

3) perfect penetration into the wood pore (if it is a primer).

4) absence of flow faults and of any other defect.

5) pot-life as long as possible, if it is a catalyzed product.

6) easy cleaning of the machine at end of process.

7) ambient pollution as low as possible.

As to the characteristics of the dried paint-film, we can list the following:

1) perfect transparency in order to enhance the aesthetical characteristics of wood.

2) perfect adhesion both to the wood and among the different layers which make up the painting cycle.

3) optimum hardness, however combined with a sufficient elasticity.

4) optimum sanding capability if it is a primer.

5) high wear resistance if it is a finishing layer.

6) absolute resistance to moisture, domestic cleansing agents, food stains, liqueurs and therefore alcohol.

./.

7) optimum heat resistance, at least up to 100^C (we think of pots containing hot foods).

8) impermeableness to steam.

9) good impact strength.

10) minimum possible inflammability.

11) endurance in time of all the above mentioned characteristics.

It has to be added to this that the costs both of products and of the painting process must be restricted, obviously, within such amount as to avoid having a negative incidence just on the characteristics which we have listed up to now.

Here it is clear that not all requirements can be fully met and not all in the same amount.

We are confronted with a possible choice among different types of paints, each representing the best solution for certain characteristics and in connection with a certain applying technology.

The first furniture painting system, which started realizing a method with technical times proportioned to the requirements, employed nitrocellulose paints. Nitrocellulose paints, which by now have been used in the furniture sector for more than twenty years, are practically solving the requirements for painting cycles with spray or glazing machine application, which feature fast drying times, good aesthetical results, but have the negative aspects of all the paints which dry only by a physical process (solvent vaporization), which can be summarized as follows:

- low solid content (therefore poor filling capability),
- not so good hardness or resistance of the film,
- the film dissolves again after drying when a second coat of the same type of paint is applied,

./.

- poor resistance to solvents,
- high inflammability of nitrocellulose material.

On the contrary, the characteristics of easy application, fast drying and pot-life absence are positive, since these products do not harden by chemical reaction.

These characteristics, intrinsic of nitrocellulose paints, make them sufficiently appropriate for obtaining open or semi-open pore finishing, while their use is critical when a full pore painting is desired.
As a matter of fact, in this case the high number of layers which are required to reach the desired thickness, and the non-exceptional stability in the course of time of this thick film, discourage the use of such kind of paints.

The paints based on resins hardening by chemical processes (i.e. by tridimensional reticulation of the polymer) have solved this and other problems connected with wood painting.

Such resins are substantially the following:

- ureic or melaminic resins, hardening by acid catalysis,
- unsaturated polyester resins (styrene polyesters),
- polyurethans,
- epoxy resins (which practically have not yet been used at least as essential elements).

The first types, which are derived by a polycondensation process between urea (or melamine) and formaldehyde, are generally used with the addition of an alkyd, not siccative resin as a plasticizer,

./.

have rather fast hardening times either with air or heat, and are normally employed both with wood-block floor paints and with dull or semi-dull finishing paints for furniture. Their principal advantages are the excellent surface hardness, a good resistance to solvents and post-yellowing, the disadvantages can be summarized in a high filling power, possibility of changing colour due to the reaction of the acid with some types of wood, corrosion of the metals that are part of the furniture if the hydrocloric acid is used as a catalyst. Moreover, their resistance to brittle lacquer is not one of the best, if their formula is not based on a perfect compromise between hardness and flexibility.

The two types of synthetic polymers, which have practically solved all quality requirement problems connected with furniture painting, are, as a matter of fact, the unsaturated polyesters and the polyurethans. We must consider, on the basis of our production statistics, that the Italian furniture is presently treated, at least in the 90% of cases, with polyester or polyurethane resins.

The unsaturated polyesters gained market acceptance in the years 1958-1960 and the reasons of this success were:

- the cost of the product which has not been excessive since then,
- their unequalled filling power,
- fast drying,
- the possibility of getting a full-pore glossy finishing (obtained by mechanical polishing of the sanded film),
- an excellent stability of the polymerized film.

In view of these results, the user accepted also to be subjected to the restraints imposed by catalyzed products, with a pot-life in the

./.

range of 15 to 20 minutes, for the first products which were applied with the spray system.

However, if we consider that this problem has been since long brilliantly overcome by the use of the double-head glazing machine, where one head is forming a polyester film with catalyst addition, and the other is forming another film with accelerator addition (these films overlapped make it possible for the polymerization reaction chemistry to take place), the reasons appear clearly why the polyester paint is the most used product in furniture painting.

The polymerization times for unsaturated polyesters are between 3 to 5 hours at ambient temperature and between 12 to 15 minutes with hot air or infrared plants.

If we anyway add the fact that some specific types of these polyester paints, either applied with the roller coating or glazing machine, can be polymerized with new photopolymerization techniques, based on radiations in the ultraviolet band, in times ranging around tens of seconds and in some cases in few seconds (5 to 8 seconds), we shall undoubtedly be sure that this type of resins, or some similar type that can in any case be polymerized by using this energy, are and will undoubtedly be the modern paints of furniture industry.

Polyurethane based paints

1) The use of these particular polymers in wood paints has had a really remarkable growth in Italy chiefly in the last decade, i.e. since when the furniture sector, with its new technological and aesthetical requirements, has posed new problems to the painting experts, and in view of the fact that the solution to many of these problems was just found by using polyurethans.

./.

Not even in Germany, where the polyurethans were discovered, there has been, in the wood sector, such a large increase in the consumption of these paints: this can be explained both by the special finishing requirements of the "Italian furniture" and, allow me to say that, by the readiness with which the Italian painting industry has studied and solved the research and production problems connected with the polyurethane paints.
It is well know that the polyurethane paints for furniture can be basically subdivided into (two) groups:

Products based on two components

One component of these consists of a polymer having free oxidrils (usually it is a saturated polyester with tridimensional structure, either modified or not, with fat acids, however any of the polymers characterized by mobile H atoms shall not be excluded). The other component is formed by a polyisocyanate containing a certain number of - NCO reactive groups (these are either pre-polymers or polymers derived by the toluendiisocyanate). The chemical hardening of the paint film takes place because of the reaction of the isocyanate groups with the oxidrils thus forming some urethanic groups.

Products based on one component which harden in the atmospheric moisture.

These are formed by pre-polymers which have some isocyanic - NCO groups in their macromolecule. These groups are responsible for the hardening of the film caused by the reaction with the moisture present in the atmosphere and by the consequent reticulation of the polymer.

./.

As a matter of fact, the polyurethane paints used for furniture painting are based substantially on two-component products and, in a lower amount, on single-component products which harden with moisture. An approximate evaluation of the combination possibilities of the various types of polymers with free oxidrils, (poly-oils), (for instance saturated polyesters, alkyd resins, polyethers, epoxy resins, oxidriled acrylic resins, oxidriled vinyl resins) with the various types of polyisocyanates (linear pre-polymers, poly-functional pre-polymers, isocyanided polymers at various polymerization, and therefore functionality, stages), allows immediately to foresee the possibility of a range of two-component polyurethane paints which seems almost endless: each paint obtained will differ little or much from the others both from the strictly chemical and technological points of view. It is therefore evident that the definition "polyurethane two-component paint" is much more vague, from the structural point of view, than is, for instance, the definition "unsaturated polyester based paint".

It is just because of the large choice possibilities, which are offered to the polyurethane chemistry technician, that these paints are practically covering all the furniture painting requirements.

2) This mention to the technical aspects of the problem evidences the fact that there can be several types of polyurethane products eachone capable of meeting a particular requirement of the user. The formulations differ according to the type of application (spray, roller coating, with glazing machine, air-less and electrostatic), to the type support (solid-wood or veneering), to the type of finishing, type of sanding (mechanical or by hand), therefore it is not an exceptional fact that

./.

a factory specialized in paints for furniture is manufacturing some twenty types of polyurethane products. A good polyurethane product which can be applied by spraying or with the glazing machine is in any case characterized by a solid content in the range of 40 to 45% at the application time, by a 20 minutes dust dry, heardening in the range of some hours, and a pot-life of 4 to 6 hours. Obviously after 6 to 8 hours in the air the sanding capability must be perfect.
Other types (for instance the ones for chairs), even if provided with a slightly lower solid content feature much shorter hardening times, so that sanding can take place after two hours only.
The ideal forced drying equipment units for polyurethane primers are obviously the hot air ones (both of the carrousel mounting type or plane surfaces vertical development), which allow to reach times in the range of 40 minutes with max. temperature of 65 to 70°C.
In any case sanding is faster and less troublesome with these types than with paraffined polyesters, while the polymerized film assures the adhesion, transparency, flexibility and stability features which are the premises for a first class painting.

3) Finishing paints

The phisical and mechanical characteristics of the polyurethane film, which are:

- high surface hardness,
- high wear resistance
- high resistance to solvents and domestic cleansing agents, are obviously utilized in the best way as finishing paints, since in last years their trend has gone towards variable dull tones, going from the half-luster to the real dull.

./.

Recently new polyurethane finishing products (dull and pigmented) have been developed, suitable for drying in infrared ray tunnels (IRL both with radiant plate and lamps).

The high effectiveness of these plants, in addition to the use of polyurethans based on mixed alyphatic-aromatic polyisocyanydes or on polyisocyanides at internal plasticization, allows drying of dull polyurethane in short times (3 to 4 minutes of flash period at 30 to 60°C + 45 seconds of IRL + cooling) with glazing machine application on quantities ranging from 100 to 120 gr/sq.m.

The polyurethanes for finishings suitable for these plants are also extremely fast drying in the air at temperatures of 40 to 60°C, such as can be obtained in vertical development plants. With the latter units the staying time can be almost reduced to half (25 to 30 minutes) as compared to the one of classic polyurethanes. Another positive feature of these new polyurethane finishing types is that, notwithstanding their fast hardening characteristics, they show a very good pot-life, in the range of 8 to 12 hours.

Future Developments of Paints for Furniture

All efforts of the researchers of this branch are being concentrated on the solution of the only problem which has not, up to now, been suitably solved: the pollution problem both of the working site and of the surrounding area. As a matter of fact, it is evident that all paints about which we have up to now spoken are based on resins dissolved in solvents (in the specific case of unsaturated polyesters the solvent is styrene, which although involved in the polymerization

./.

process has, anyway, the possibility of evaporating during application).

As a matter of fact, when we speak of "solvents" we mean also "inflammability and air pollution".

The theoretical possibilities of solving this problem are, in my opinion, only two:

Paints soluble in water with subsequent thermal drying.

Paints free from solvents based on non-evaporating oligomers that can be polymerized both thermally and by photopolymerization with radiations in the ultraviolet band.

Personally, I must say that this second solution seems the most promising, since it allows reaching very short polymerization times, although it cannot be applied in all cases.

As a matter of fact, some polymers have already been obtained on an experimental basis that can be applied with roller, which feature a solid content of 100% and polymerize in times ranging between 4 to 8 seconds under radiation, by using high power lamps in the ultraviolet band (200 watt per inch).

In case of water-soluble paints the big problem consists in the difficulty of getting good polymerizations at the relatively low temperatures which can be employed in wood painting and which, obviously, can go to a maximum of 70 to 80°C, while a water-soluble paint, suitable for oven drying, that is already used for metals requires temperatures in the range of 120 to 140°C.

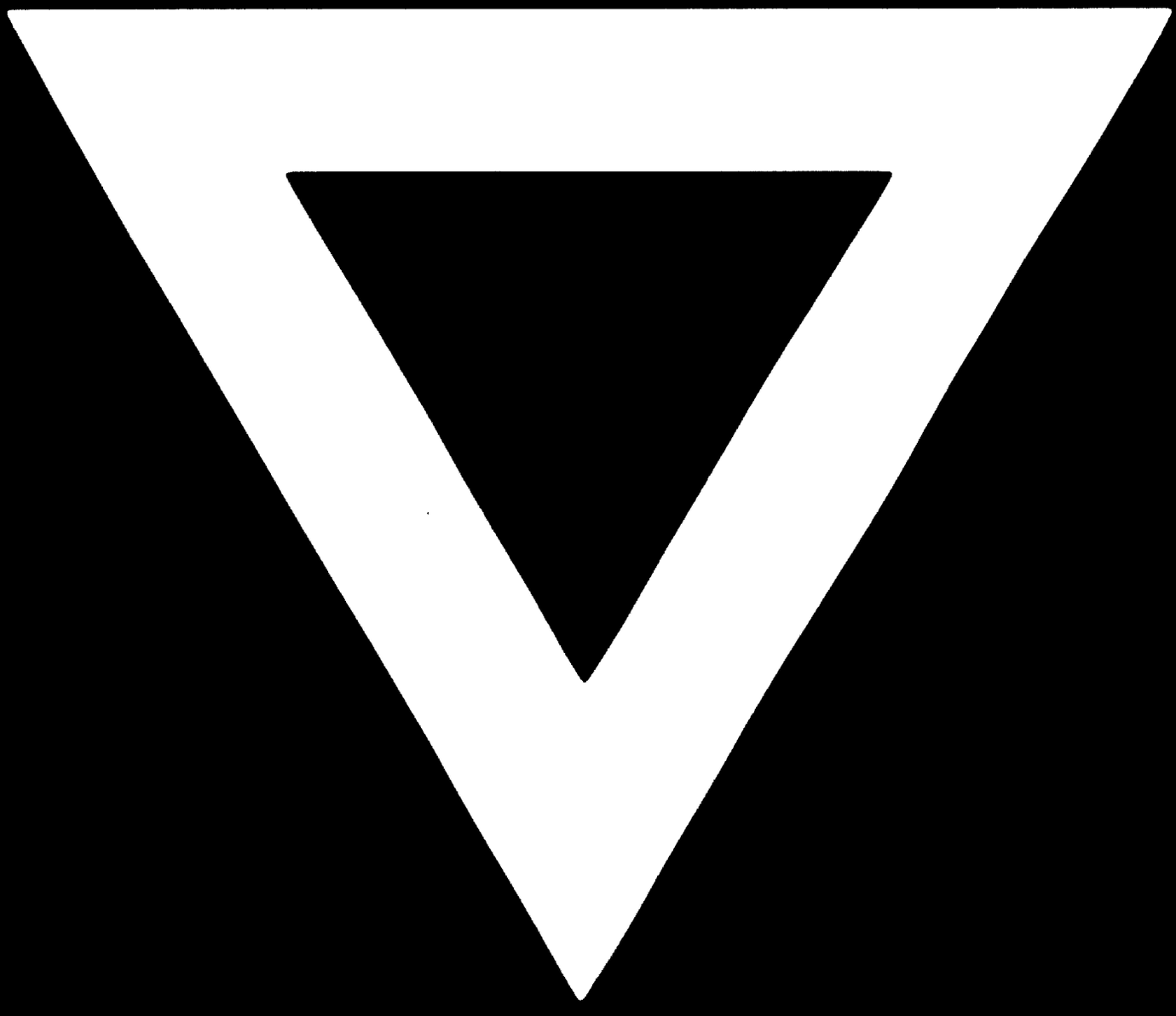
If any case, it is clear that the pollution problem in the painting stage is presently the one in which the industry of paints for furniture is basically engaged.

./.

I have not dwelled upon the specific aspects of furniture painting too much, also because they are such and so many that the time which is kindly destined to me in this occasion would not have given me this possibility. I thought it more logical to leave more time for a possible discussion with you on particular problems which might interest you, and which will obviously be dealt with more in detail in a conversation than in a generic talk.

I thank you for the attention you have paid to me and am waiting for your questions, which I hope to be able to answer.

B-268



77.06.28