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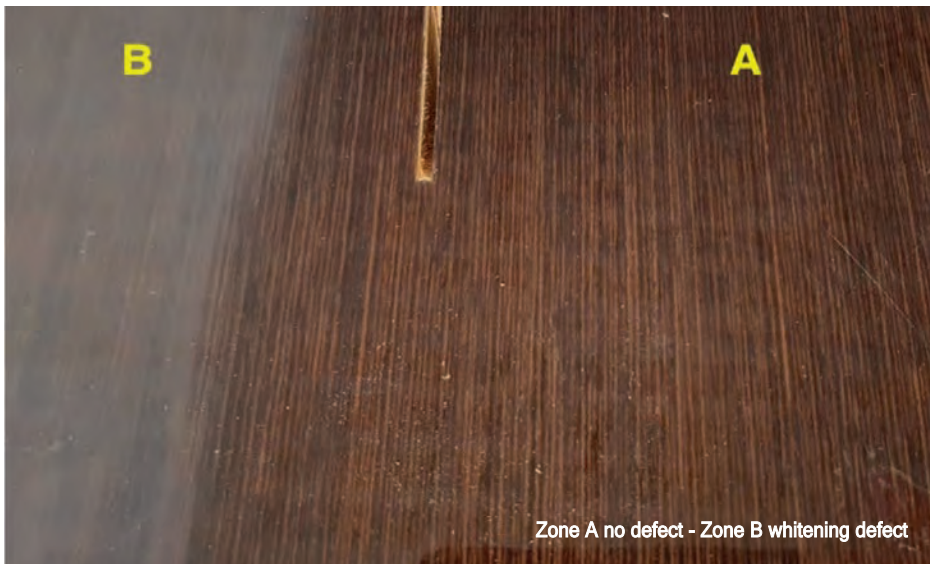
THE 'WHITENING' OF CLEAR COATINGS

High quality furniture surfaces are usually obtained using coating systems consisting of multiple layers alternating with sanding operations. The coatings used in most of these applications are those that guarantee a high cross-linking of the resins to finally get to a hard and compact film. These procedures are particularly suitable for high glossy surfaces to avoid or to limit the so called 'sinking effect'- the loss of specularity - caused by the relaxation during time of the coating film which is typical of products based on thermoplastic resins.

Among the most widely used coating systems, those based on polyester coatings are prominent. They generally consist of one or more base coats layers followed by the application of a polyurethane-based top coat, when the final polishing of the polyester is not performed.

This article deals with the problem of 'whitening' of clear coating films, a defect more frequent in the case of coating systems involving the use of polyester-based coatings.

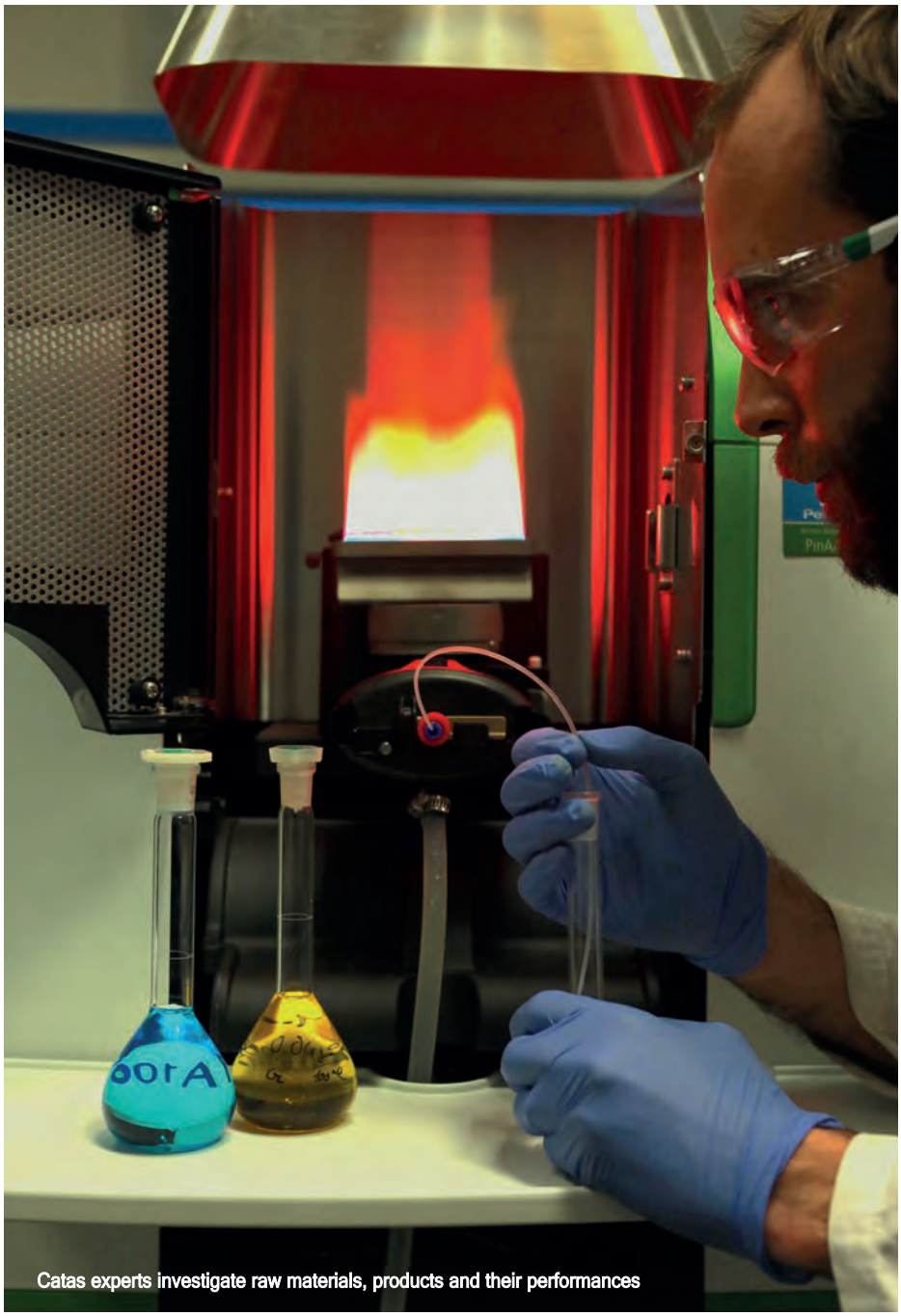
This phenomenon can be regarded as one of the defects that occur quite often especially on high glossy clear surfaces being not yet known in detail. The whitening of the film usually develops over time with an intensity that tends to progressively grow. This dynamic leads to two kinds of problems for coating producers and their users. The first is that the defect is not predictable by an initial visual inspection of the finished surface. Secondly, if the defect occurs in use, the problem is represented by the uncertainty about the real causes and about the possibility to avoid it for future productions.



Zone A no defect - Zone B whitening defect

Since both naval and home furnishings made with coatings of this type are generally very expensive, the problem starts as a mere technical issue but frequently, finally becomes a legal case.

The whitening phenomena of the coating films have been the object of a specific research carried out by Catas some years ago whose procedures and results have also become a practical investigative tool for the cases that still are presented to our laboratory. Inside the Catas laboratories there is, in fact, a specific section dedicated to the analysis of defects whose task is to help companies to understand the causes of technical problems that may arise during the production or when the product is in its final use. Above all, the final goal of the Defects section of Catas is to


Catas experts investigate raw materials, products and their performances

try to find the elements that allow the companies to avoid or in any case to reduce the incidence of defects for the future productions.The last defect of this type that we analyzed at Catas was affecting a piece of furniture installed in a penthouse, worth about 10 million dollars, in New York.

THE MOST INVOLVED FOUR PARAMETERS

The studies carried out, according to the internal procedures mentioned above, allow us to state with sufficient confidence that the four parameters most involved in the development of this defect are:

1. The application of high coating thicknesses in a single coat

By applying high thicknesses of coatings in a single coat, the solvent that remains trapped inside the dry film can create "escape routes" over time. Then, when the incident light encounters these voids it is subject to refraction and reflection phenomena which finally lead to the loss of transparency of the coating film.

2. The presence of moisture during the coating phases

The presence of moisture trapped inside the dry coating film can lead to undesirable optical phenomena like those already presented in point 1 considering that this substance is not miscible with the resin of which the coating is made.
In addition to this, it is also possible to produce real chemical interactions (hydrolysis phenomena) which can lead to alterations of the entire system with consequent opacification of the film.
One of the possible sources of moisture is acetone (a hygroscopic substance) very often used for the dilution of polyester coatings during application.

3. Effect of the thinner added for the coating application

Depending on the quantity and type of thinner added, various phenomena may occur, the results of which are precisely the unwanted whitening of the coating film.
The first effect can be traced back to a fast evaporation of the thinner with immediate drying of the outer layer of the coating film. The rest of the thinner molecules trapped inside the film can consequently generate the problems already presented in point 1.
The other effect, always linked to the rapid evaporation of the thinners, is a sensitive cooling of the coating during drying (the evaporation of the thinners subtract heat from the film). If the drying environment is particularly humid, a partial condensation phenomenon can consequently occur which bring the problem back to what has already been dealt with in point 2. Moreover, if the composition of the substances constituting the thinner is not balanced in relation to the nature of the resin, precipitations or separations of the components of the liquid coating may occur after application, with consequent formation of unwanted optical phenomena.

4. The dilution of the coating with an excess of styrene

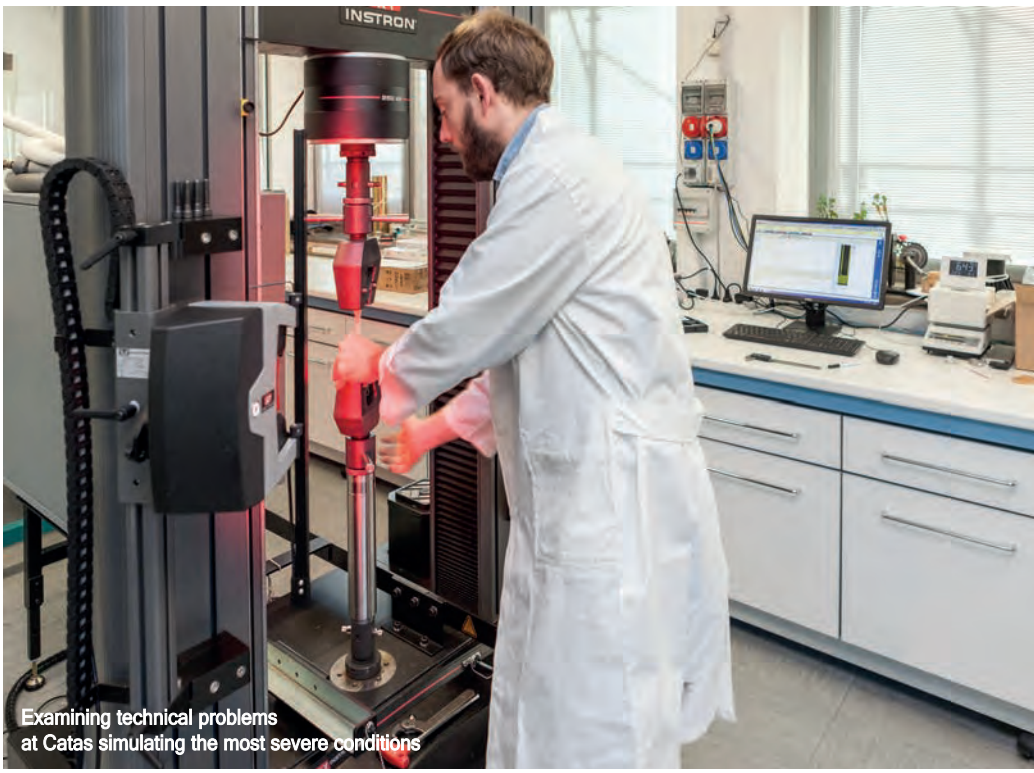
The styrene molecule is chemically very reactive and in the event of an excessive presence in the liquid coating, this substance can react with itself creating small polystyrene polymer chains capable of refracting light causing, finally, the optical effect of whitening.

SOME PRACTICAL ADVICE

Acting on these parameters, Catas was able to reproduce the defect in the specific case analyzed, which, as often happens, was linked to the presumable application of high thicknesses in a single coat. This conclusion was particularly evident after the observation of different sections of the sample with an optical microscope. The intensity of the whitening effect was, in fact, directly proportional to the thicknesses of the polyester layer in the different parts of the sample.

In relation to the evidence that emerged, both in the study carried out and in the numerous cases of this type examined in the Catas Defects Section, we can conclude this article by providing some practical advice in order to avoid or, in any case, to limit the onset of possible whitening defects on clear coating films:

1. use dry (reduced moisture content) and non-aged (no development of polystyrene) styrene;
2. adequately dose the dilution, necessary for the application, to avoid the solvent trapping into the single coats;
3. favor the application of several thin coats rather than a single coat with high thicknesses;
4. do not apply coatings at temperatures that are too low and/or with relative humidity of the air that is too high;
5. respect the drying times between one coat and the next to allow for the correct elimination of the solvents (check the drying conditions).



Examining technical problems at Catas simulating the most severe conditions

The CATAS Defects Section

It is a multidisciplinary working group: our experts coming from the Chemical, Surface and Mechanical Departments get together to jointly study the technical problem deriving from the market. Competence, experience and scientific equipment represent the "toolbox" of this section.

Competence: experts in chemistry who investigate the content and composition of raw materials, components and products, together with the colleagues who are able to study their behavior and their physical-mechanical characteristics. All of them are highly specialized in the wood and furniture sector.

Experience: our experts observe and test in the lab hundreds of samples every year.

If the defect is an ordinary one, the solution is already available: we can suggest the appropriate testing program to apply and how to interpret the results.

If the defect is new, we gear up to study it at the best: we observe it from different points of view, set up pilot test sessions, draw on our rich historical catalog of defects / solutions, that is a relevant component of our technical background built in over 50 years of activity in the wood and furniture sector.

Scientific equipment: the best technologies and equipment, which allow us to investigate the problem from the most different prospective. Cutting-edge analytical techniques in the field of spectroscopy, elemental analysis, chromatography, thermal analysis and equipment that allow us to reproduce defects or simulate the most severe conditions of use and stress in terms of temperature, humidity, solar radiation and other kinds of physical-mechanical stresses (abrasions, heat, impact, chemical aggressions,...).

Our work at Catas Defects Section becomes information and knowledge available to the growth and development of the wood and furniture sector.

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It's a matter of quality