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PROPOSERS;

- LOSAN
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- ROLDECO
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REDUCTION OF ABRASIVENESS AND SPLINTERING IN THE MACHINING OF DECORATIVE PLASTIC SURFACES

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ABSTRACT

Melamined particleboard can generate economical losing when they are mechanized to manufacture furniture and other products. A project supported by the European Community has been developed to fix the causes that make the melamined particleboard abrasive and to obtain melamined particleboard with low abrasiveness and splintering by means of the formulation of the melamine resin and improvements on particleboard characteristics. For this purpose, it has been developed a "Short-therm" mechanizing test to evaluate these materials abrasiveness. As a consequence, many variables related to the melamine formulation and particleboard manufacturing processes have been studied at laboratory and industrial scale, determining which of these variables are the responsible of the aforementioned effects.

INTRODUCTION

Decorative plastic surfaces are widely used in building and furniture sectors on account of their excellent surface properties and their wide range of possibilities for use, as well as a great facility to reproduce several designs. Taking into account todays existing polymers with these kind of applications, melamine surfaces constitute a very important percentage of total surfaces used in those sectors. These polymers are pressed on particleboards and Medium Density Fiberboards in order to obtain melamined particleboard or melamined fiberboards.

Melamined particleboard are very abrasive materials which cause a lot of problems for companies devoted to the manufacture of furniture and other goods. Some of these problems, like the quick wearing of the mechanizing tools, cost of the cutting tools, additional time needed by the operator to change weared cutting tools, etc... are produced when melamined particleboard are mechanized by milling, sawing,.., that is, in industrial mechanizing and cutting processes used widely.

Taking into account all these real problems and the high cost they mean, the objective of this project is the obtaining of different benefits in three fields:

1.- Industrial field "

The problems studied in this research affect mainly to the small and medium enterprises, due to the fact that, currently, they do not have any R&D department able to solve these kind of problems. The possibility of taking part in this research project allows to achieve the knowledge needed to solve these two problems: abrasiveness and splintering.

This knowledge should enhance their own Know-How that is a strong tool to improve their competitiveness in todays market, monopolized by very large enterprises.

Finally, the knowledge gained during this project would be a very important means to improve several manufacturing processes, like melamine pressing conditions on the particleboard, and others.

2.- Economic field

This field is strongly closed to the last one, due to the fact that the economic benefits are a result of improvements on industrial processes. The optimized processes will reduce the costs in the following way:

decreasing the number of cutting tools needed for the same mechanizing length

decreasing the time the operator needs for changes in weared cutting tools

reducing the number of defective pieces in the manufactured product and therefore the number of refunds from clients because of the high abrasiveness or defective particleboard.

3.- Standardization field

This research is a very significative stage to define Standards which would be included in CEN/TC-249 SC3 WG4. The purposes of this matter are:

the definition of a testing method to evaluate the abrasiveness of such materials

to stabl ish a specification related to the maximum accepted value for the abrasiveness of melamined (or not) particleboard.

All these fields have been taken into account in order to develop a good quality project. This way, the main objectives fixed for the performance of the project are stated below:

the" obtaining of-an accelerated testing method which allows to evaluate, by a short-therm test, the abrasiveness of such products.

to make up a database about the characteristics of todays melamined particleboard.

to acquire the knowledge about the influence of the different constituents of a melamine formulation on the abrasive and splintering effects.

in the same way, to define which is the influence of the parameters taking part in the manufacture of a particleboard.

to fix the possible correlations between the splintering and the abrasiveness effects at laboratory scale (short-term machinability tests) and in the machining into industrial conditions.

TECHNICAL DESCRIPTION

To achieve all objectives stated in the last point, a lot of tests and studies shared among several tasks have been carried out.

First, it has been stablished an accelerated testing method which allows to evaluate quickly the abrasiveness degree of these materials. The type of mechanizing test developed for this purpose has been the vertical milling at Laboratory scale, and some mechanizing parameters, like type of cutting tool, feed rate, cutting depth, rotational speed, etc., have been defined.

After this method has been stablished, the abrasiveness of melamine boards being in the market, as well as their surface characteristics have been analyzed. This matter led to stablish a large database about the properties of todays melamined tableboards and compare them with such melamine surfaces that can be formulated and developed as a results of next steps. These formulations should be less abrasive guaranteeing the same surface properties:

.- abrasion resistance

.- resistance to acids

.- vickers microhardness

.- resistance to cigarette burning

.- reistance to cracking

.- resistance to stain .

In this way, the influence of the following parameters taking part in a melamine coating manufacture have been studied.

.- absorptioning base paper

* grammes/m^2 of used paper
* paper pH
* percentage of paper's ashes

.- impregnation and drying conditions of the melamined paper

* grammes/m^2 of resin application
* drying time
* drying temperature

.- finished product obtaining conditions

* working pressure
* pressing time
* pressing temperature

In addition to this matter, the influence of the formulation of the impregnation resin on the abrasiveness have been analyzed. The variables which have been studied are:

.- each formulation constituent, that is, water, plasticizer, melamine resin, humectant, etc...

.- influence of the nature and percentage of some additives, like plasticizers.

.- compatibility of the polymerized melamine resin in water

.- pressed melamine curing degree

After this, all the parameters taking part in a particleboard manufacture, as well as the characteristics of the particleboard obtained as a result of its manufacture have been anal yzed:

.- pressure, time and temperature

.- particle size or granulometry

.- chips quantity

.- glue percentage

.- density profile

.- kind of wood

.- ashes percentage

.- etc...

When all these variables have been analyzed, the influence of such variables proved as most influential, was studied in depth at industrial scale.

The conditions of current particleboard obtaining were changed, modifying the parameters which determine the abrasive effect. After this, and with the obtained particleboard, mechanizing tests at industrial and laboratory scale have been done to compare and analyze the abrasiveness and splintering results from the particleboard obtained at industrial scale.

Finally, they have been analyzed too, the correlations between the mechanizing into real cutting conditions (at industrial scale) and the developed short-term machinability tests.

RESULTS

The results obtained during the project performance have been really positive, and interesting conclusions at the end of the project were achieved.

With this purpose, a lot of processing variables (related to raw materials and the production procces) were studied, refered not only to melamine covering. On the other hand, several matters related to the support were studied in order to obtain an overview about the abrasiveness effect.

First of all, an accelerated testing method was developed allowing to evaluate quickly the abrasiveness of these materials; so, they have been specifically defined:

Kind of mechanizing

Cutting conditions

Abrasiveness and splintering evaluation systems

On the other hand, it has been made up a great database about todays melamined particleboard surface characteristics, as well as other properties like density profile or

abrasiveness. This database is a reference point for the improvement of these materials characteristics which should be developed in the future.

A lot of parameters taking part in the manufacture of melamined particleboard were thoroughly studied.

The base paper gramage limits the maximum quantity of resin which can accept a certain base paper; however, said papers can accept a great variability of resin quantity, so it is not a parameter which determines the abrasiveness of the covering by itself. So, this is a parameter of secondary importance, directly related to the amount of resin required for a given production.

During the impregnation process, the pH of the melamine resin has a value of 7, so depending on the base paper pH, the resin bath can be acidified or take pH higher than 7. In the first case, after the impregnated base paper is dried and when it is going to be pressed on the support, the curing process will be additionally catalyzed and in the second case would slow down. Anyway, it must be taken into account that:

An acid pH generates a precondensing effect which makes the adherence of the melamine to the support difficult, and surface characteristics are damaged. Moreover, during the mechanizing of the melamined tableboard, the covering suffers a shelling phenomenon. This effect is higher in a MDF support than in a particleboard support because the surface is much less rough and the adherence is lower in the case of MDF support.

A basic pH involves lower reaction speed which is not good from an industrial point of view. Base papers pH must be taken into account to fix pressing time and temperature, because all these variables determine the curing degree of the melamine resin, which is related to the abrasive effect.

The same happens with the melamine resin pH.

Percentage of paper ashes and inks content on the base paper do not affect to the abrasiveness effect.

The amount of applied melamine resin produces a proportional abrasiveness; however, its influence, within the usual gap of resin application values, can not be seen because the influence of the support overlaps this effect.

Drying conditions do not affect too much to the abrasiveness; this is a factor related to the productivity.

The final good obtaining conditions are directly related to the melamine resin curing rate, For that reason, they must be carefully controlled so that an overcuring effect on the resin is not produced, and increase as a consequence the surface hardness (it must be taken into account that it is a direct and proportional relation between the curing rate and the surface hardness).

The melamine resin does not accept any variability, because this raw material is supplied always in the same way and with the same characteristics. It is possible to vary only the condensation degree of the resin when it. is polymerized; moreover, it has been worked in all cases with the lowest condensation degree, that is, when the resin has the higher elasticity possible (with higher polymerization degree, the resin loses its elasticity). The catalyzer increases the reaction rate during the curing, but it does not give to the melamine resin any specific property. The water modifies the viscosity of the melamine formulation and would affect to the resin grammage and indirectly to the abrasiveness; anyway, its influence is not important.

The humectant and the mould release agent do not affect to the abrasiveness. The plasticizer affects proportionally to the melamine covering surface hardness and therefore, to its abrasiveness. The nature of the plasticizer may have some influence, but its precentage percentage is the factor determining the abrasive character.

In addition to all these variables, all the parameters involved in the manufacturing of the particleboard have been anal yzed. In this way, tests carried out with some samples seem to indicate that the softest woods would provide lower abrasiveness rates.

It has not been proved a direct relation between silex percentage and abrasiveness. On the other hand, within the narrow gap of studied values, it has not been detected any significant influence of the glue on abrasiveness.

Variations on particleboard overall density do not produce substantial increases on abrasiveness, because if tableboard overall density is increased, the density of the external layers do not increase in the same proportion; so, the abrasiveness of the external layers is approximately the same. To detect clearly this effect, tableboards overall density must be increased much more.

However, the density profile of the tableboard, in addition to the particle size of external layers, produces high differences on abrasiveness values.

CONCLUSIONS

The main general conclusions about the study carried out during the project can be summarized as follows:

First, it has been made up a extense database about the characteristics of current melamined particleboard which can be found in todays market.

It has been proved that the short-term machinability test is a good means to evaluate the abrasiveness of these materials; moreover, mechanizing tests done into real scale show good correlations with the short-term test.

The pressence of a hard melamine covering on the particleboard, generates a small wearing on the cutting tools used during the mechanizing. However, this matter does not determine the whole abrasive effect, due to the fact that it has been proved that the abrasiveness of the particleboard support is much more important than the melamine covering's.

Among all the variables related to the melamine covering, the most important variable which can change the abrasiveness of such surface is the plasticizer amount and nature (in addition to the melamine resin compatibility). Melamine formulations with high levels of plasticizer makes possible the obtaining of softer melamined surfaces, which obviously produces a lower abrasive effect on the cutting tools. In any case, the reduction of the abrasiveness by adding more plasticizer is not as high as expected because the support overlaps this improvement and generates high abrasive levels too.

On the other hand, other properties related to the melamine formulation do not affect significantly the abrasiveness of the cured melamine surface.

It has been proved that the main abrasive effect is caused by the quality and characteristics of the particleboard external layers.

Melamine pressing conditions, as well as particleboard manufacturing conditions, can influence a bit the abrasive effect.

The splintering is a direct consequence of the abrasive effect, instead of the fact that the cured melamine surface properties would have some influence.

Finally, it has not been proved that ashes percentage would determine the abrasive and splintering effects.

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EXPLOITATION AND MARKETING PLAN

It must be stated that additional activities are necessary to transfer the achieved results into the commercial production of delaminated particleboard. This is due to the fact that the obtained results and given recommendations to manufacture low abrasive delaminated particleboards are general suggestions. Obviously, each company must adapt these recommendations to the needs of its own manufacturing process. Because of these reasons, each company taking part in this research project, must carry out definitive studies if they want to exploit results and want to get economical benefits from the knowledge provided by this research project.

Results' exploitation plan will be carried out individually by each company belonging to the Consortium. Since it seems to exist competitiveness among them, they have decided to exploit the results each one by their own.

Morevoer, the enterprises which can exploit the results directly are:

- ISOROY
- EGGER-ROL
- LOSAN

Both ISOROY and EGGER-ROL decided to exploit the results by their own, because they have their own means to try to apply these results on their production processes.

However, LOSAN has not the means enough to apply these results by their own. For this reason, and as it was pointed in previous lines, they are considering the development of a new research project in cooperation with CIDEMCO, with the aim of finding ways to exploit ASPLAS'S results.

The other enterprises do not manufacture particleboard, but convert it mainly into furniture, so, they would not get benefit directly; they would take profit from the knowledge and the application of this knowledge by particleboard manufacturers.

Up to this moment, nothing has been published; however, the developed testing method has been explained in a biennial Congress held in Spain (Jornadas Técnicas de Maquinabilidad. Eibar (Spain), 1,994)

COMMUNICATION STRATEGY

By the moment, there is no intention to maintain any specific communication strategy. Contacts with other enterprises or new partners will be done after the results application by means of a new particular project between LOSAN and CIDEMCO, in LOSAN'S factories.