How to Quantify and Suppress Pre-curing in Wood Panel Manufacturing

Editorial by Chimar Hellas S.A.

The Issue and the Remedy

Adequate catalysis of the adhesive is a fundamental element of wood-based panels production and enables significant reduction of the production cycle and ergo, increasing productivity.

Nevertheless, as traditionally catalysts are either pre-mixed with the adhesive or added closely to it, often a considerable amount of the adhesive is cured before the mat enters the press, the adhesive is therefore often partly decimated, a condition known as pre-curing. Typical indications of the existence of pre-curing in a composite panel production line are:

- High resin factors
- Seasonal loss of board mechanical properties
- Extra press-time has no positive effect on board properties
- Board properties deteriorate in the warehouse

The only reasonable, yet rising financial burdens, answer to this issue seems to be the increase of resin consumption.

In this editorial, a methodology to estimate the magnitude of pre-curing and to remedy it is presented and results from MDF lines are discussed.

The discussed methodology evolves around the decrease of the reactivity of the adhesive, as to suppress pre-curing, and applying increased pressing cycles as to reach a fully cured state albeit the low reactivity of the adhesive. In lines that do not suffer from extensive pre-curing, the results did not indicate a possible resin loading reduction by applying this technique. But in cases where pre-curing was present, mechanical properties of the boards (e.g. internal bond values) were greatly improved and thus the resin loading could be reduced extensively. Needless to say, this is not an applicable remedy against pre-curing as it creates a bigger issue, the one of lost productivity.

Since though it was verified that, in certain cases, up to 20% of the adhesive can be lost because of pre-curing, a method of adding a catalyst just prior to the hot press was developed and patented. The advantage is twofold: a) the catalyst is not added with the adhesive so it's curing is not triggered until it is in the press and b) adhesives of low reactivity can be used that will sustain the acidity of wood and any possible exposure to mild thermal stress since there will be enough catalyst once in the press to cure them on time. In the case that aminoplastic resins are the adhesive of choice, the catalysts discussed comprise of blocked acidifying agents, that are typically sprayed on the mat just before the mat enters the press. Once in contact with the hot surface of the press platen, these substances decompose to produce among others, volatile acidic components. These released volatile acidifying agents flow towards the core of panel, following the course of the steam that heats the core and accelerate the curing of the adhesive just at the right time. Combining these catalysts with resins of reduced reactivity, that endure pre-curing, can result in significant reduction of the adhesive loading in combination with shorter production cycles.

Examples from applications of this concept in lab Particleboard are discussed and details and results regarding industrial implementation in an MDF line are presented.

Pilot Scale particleboard test based on the new methodology and innovative hardener

A series of standard 18mm 3-layer particle boards were produced in pilot facilities of target density 650kg/m3. The core to face ratio was 65/35 and the resin loadings were 8% resin solids per core dry wood and 10% 8% resin solids per face dry wood. The resin used was a plain Urea – Formaldehyde, capable of producing E1 boards while 0.5% paraffin was used in the form of an emulsion. As the catalysis effect was primer factor that was to be indicated in this experiment, the conventional hardener level (ammonium sulfate) of the core was kept low at 1% while none was dosed with the face glue mix.

As externally applied catalyst, SACOL ™ LH 1620 was used, a "Vapor Catalyst" specifically developed to accelerate the curing, activating the core of the mat, even when applied superficially e.g. by surface sprayers. Yet, additionally one more application method was tried, as part of the face glue mix. The boards were tested in two press factors of 8 and 10s/mm and the hot press temperature used for their production was 210oC. The results from the analysis of the boards are presented in the following Table 1.

Industrial MDF test based on the new methodology and innovative hardener

A bonding system containing a melamine reinforced urea-formaldehyde (UMF) resin in combination with SACOL™LH-1620 was used for the production of MDF panels at industrial scale. SACOL™LH-1620 belongs to the "Vapor Catalysts" family of products of Chimar being a hardener solution ready for use with polyamidic resins such as UMF and is specifically designed to accelerate the curing, activating primarily the core of the mat, even when applied superficially e.g. by surface sprayers. Reference boards were produced in parallel to the ones comprised from the above bonding systems, using a glue mix prepared from the same UMF resin. As a pre-curing suppressing agent, 0.3% solids per solids Hexamethylenetetramine (Hexamine) was mixed as a buffer with the resin. The hardener was sprayed on both the top and bottom surfaces of the mat.

For the production of the boards a 42m modern continuous press was used with temperatures 2400C, 2300C, 2100C, 1900C per zone. The board target thickness was 16mm, the target board density was 750 kg/m3 and the press factor was 6.5s/mm. The mechanical properties of the boards obtained were determined according to the European Standards EN 310 and EN 319 and the results are presented in Table 2:

Table 1

BOARD No.	Description	Press Factor	Thickness	IB	MOR	Swelling		Water Absorption	
		(s/mm)	(mm)	(MPa)	(MPa)	2h (%)	24h (%)	2h (%)	24h (%)
1a	REFERENCE	8	18.2	0.18	12.6	21.4	55.5	43.3	107
1b		10	17.9	0.25	12.6	17.5	50.6	41.7	105
2a	1% LH in Face Mix	8	18.4	0.25	12.2	21.3	52.3	45.1	103
2b		10	18.4	0.33	11.7	18.6	49.7	43.8	92
3a	1% LH in Face Spray	8	17.9	0.35	13.1	21.2	50.9	49.7	93
3b		10	17.7	0.43	12.9	19.0	47.6	45.0	91
4a	2% LH in Face Mix	8	18.0	0.42	13.4	20.5	47.2	53.0	96
4b		10	17.7	0.48	14.4	18.9	45.6	52.5	96
5a	2% LH in Face Spray	8	18.0	0.44	12.9	19.7	44.8	49.0	94
5b		10	17.8	0.43	12.4	24.1	46.1	51.7	94

The catalysis effectiveness of SACOL™LH1620 is clearly reflected on the results demonstrated above, even when the application was just spraying it on the face of the mat.

Table 2

No.	Resin Factor (% s/BDW)	LH-1620 % s/s	IB MPa	Density (kg/m3)	Line Moisture	Remarks
0	9.2%	0.0%	0.74	748.4	9.4%	Control Start
1	9.2%	0.0%	0.73	743.3	9.7%	Introduction of 0.2% s/s Hexamine
2	9.2%	0.0%	0.85	762.5	9.6%	10%-line speed Decrease (17% Increase on IB's)
3	9.2%	0.9%	0.88	748.1	9.2%	SACOL™LH-1620 Application Start (surface sprayers)
4	8.3%	0.9%	0.79	751.3	9.4%	10% less resin
5	7.9%	0.9%	0.71	761.2	9.1%	14% less resin
6	9.20%	0.0%	0.70	746.5	9.7%	Control End

Although the industrial experiment was executed at time of little precuring, significant resin reduction was possible by the introduced modifications on the resin and the applied catalyst SACOL™LH-1620. The adaptation of these modifications as modus operandi is expected to exceed 20% resin savings, year-round, a clear victory against pre-curing of resin.

In the following few lines, you may find some more information on the specific Vapor Catalyst used for the above experiments and about CHIMAR HELLAS S.A.

SACOLTM LH-1620

The above hardener belongs to the "Vapor Catalysts" family of CHIMAR's portfolio. It is a hardener solution ready for use with polyamidic resins at wood-based composite panels production where ammonium-based hardeners create pre-curing or are not effective. It is specifically designed to accelerate the curing of UF, MUF and MF resins, activating primarily the core of the mat, even when applied superficially e.g. by surface sprayers. Depending on the resin and application line characteristics, 1-5% wt of SACOLTM LH-1620 per wt of resin solids is sufficient to achieve the production acceleration required while preventing surface over- and/or pre-curing.

appearance	Transparent clear pale yellow liquid
active content*	38– 41%
pH (25°C)	6.9 – 7.3
specific gravity (20°C)	1.07 – 1.11
storage	Keep container in a cool well ventilated area. Keep container tightly closed and sealed until ready for use.
availability	1200 kg IBC's

* Up to 90% active content is available on demand

CHIMAR HELLAS S.A. provides a complete range of binder technologies and services for the resin and wood panel industries for over 40 years. CHIMAR also offers procurement and engineering services for turnkey resin-, resin additive plants and relative equipment.

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