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Understanding wet strength: what are MRA, WRA, and WPA?

Scope

To determine the “wet strength” needs of a corrugated box plant, one must first define the level of “wet strength” needed. Generally, the industry has accepted three levels of “wet strength” adhesive.

1. Moisture Resistant (MRA) – used for the lightest possible applications.
2. Water Resistant (WRA) – medium level of performance.
3. Waterproof (WPA) – highest level of performance.

This Technical Information Paper will identify the key characteristics of each type of “wet strength” adhesive and when it would be used. Proper test methods to determine the level of water resistance of a particular box will be discussed.

Safety precautions

There are no safety precautions.

Identification of test methods

Moisture resistant adhesive (MRA) most closely resembles domestic adhesive in formulation and application. A typical “MRA” starch will contain approximately 0.5% to 1% liquid resin relative to the liquid volume of the batch.

This level of resin would typically be used in a lightweight board combination where minimal exposure to increased humidity may occur.

No TAPPI test method is recognized to evaluate this level of “wet strength.” Generally, a one-hour soak test using a similar procedure to TAPPI method T 812 will be sufficient. If the board does not float apart, the box meets the minimum level of moisture resistance.

Water Resistant Adhesive (WRA) probably has the widest range of applications due to the fact that most corrugated box plants only have the ability to make one type of “wet strength”: adhesive. Water Resistant Adhesive will have between 1% and 1 ½% resin relative to the liquid volume of the batch. This adhesive formula can be used on lightweight boxes using normal or domestic starch settings. When running heavyweight boards, 250 pound test and above with greater end use demand, it is necessary to open the glue gap settings, at least an additional 0.004 in., especially at the singlefacer. Also, a minimum stack cure time of four hours is recommended for optimum results. Check with your supplier for stack cure requirements.

The typical test method for “WRA” starch is TAPPI T 812 “Ply Separation of Solid and Corrugated Fiberboard (Wet),” commonly called the 24-hour soak test.

An additional test, which is suitable for heavier test board (over 250 pound C flute), is the wet pin adhesion test. Prepare the samples as described in TAPPI T 821 "Pin Adhesion of Corrugated Board by Selective Separation" dry pin adhesion test and then soak the samples for 1 hour $\pm$ 5 minutes in ambient (70-74°F) water as stated in section 5.2 of T 821. At the end of the time period, gently shake off the loose water and test according to T 821. A generally accepted minimum is that the wet pin adhesion value should be at least four (4) pounds per two (2) lineal feet of glue line.

Waterproof Adhesive (WPA) is the highest level of "wet strength." This is itself a misnomer in that all starch is water soluble. This type of adhesive would typically be used in the most demanding applications. In addition to using 1.5% to 2% "wet strength" resin in relation to the liquid volume of the batch, it is essential that additional starch be applied to the board. Use of a modified carrier or a liquid performance polymer is also desirable. Allow the board to cure in its original stack for a minimum of four (4) hours before converting. If your operations won't allow this much time, leave it in its original stack as long as possible.

The TAPPI test method is the same as moisture resistant starch. Typically, the wet pin adhesive values will be a minimum of eight (8) pounds per two (2) lineal feet.

Guidelines for running and measuring performance results

Here are some general guidelines for running and measuring performance results:

1. Use fresh starch.
2. Use freshly resinated adhesive, not more than six (6) hours old. Unused resinated adhesive should be consumed on non-wet strength board.
3. Apply the normal amount of adhesive for light applications and approximately 50% more adhesive for 250 pound test and above
4. Allow the board to cure in its original stack for a minimum of four (4) hours. Twenty-four (24) hours cure time is recommended for wax impregnated board.

Sample starch adhesive formulas for MRA, WRA, and WPA adhesive

The following information is provided as a guideline. Actual formula adjustments should be made with your starch technician.

In a typical 650 gallon to 700 gallon batch:

MRA = 4 to 5 gallons of resin.

Application rate is the same as domestic.

In a typical 650 gallon to 700 gallon batch:

WRA = 8 to 10 gallons of resin.

Application is the same as domestic.

In a typical 650 gallon to 700 gallon batch:

WPA = 10 to 12 gallons of resin. Use a modified carrier or a liquid performance polymer for best results.

Application is 50% more than domestic.

Loads are stack-cured for a minimum of four (4) hours

*In a typical 300 gallon batch, these quantities are halved.

References

TAPPI Test Methods:

TAPPI T 812 "Ply Separation of Solid and Corrugated Fiberboard (Wet)"

TAPPI T 821 "Pin Adhesion of Corrugated Board by Selective Separation"