

Innovative solution to address cracking problem in Kraft Paper

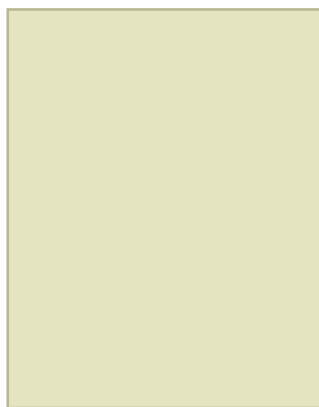
Abstract: *During the past one decade, the whole concern of Paper industry is to use limited chemicals and drastic cut down of costs, cost saving measures and dry run the Paper making system with just sizing chemicals and alum.*

Paper industry is off balance now with environment regulations, stringent measures to make industry zero discharge. Lack of prediction and cost cutting measures putting packaging paper industry in severe problem and their cost cutting measures of one or two chemicals usage made problems to mount all of a sudden. One of the major problems faced by packaging paper industry is "Cracking" due to usage of deteriorated recycled fibers and increased usage of starch to compensate for the strength.

Cracking problem in packaging paper is a serious concern for liner kraft and board manufacturers because of their usage in packaging boxes. These boxes are expected to maintain their shapes under the packaged conditions but due to cracking issues, they can't hold onto their shapes and open up on edges deshaping the boxes.

In this Paper, we have tried to explain the causes for cracking issues and our chemical solutions to address this problem.

Key Words: *Cracking, Flute Direction, Grain Direction, IPST Crack Angle test, AF&PA Test.*



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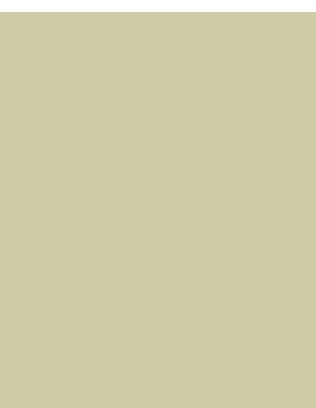
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Introduction

Paper industry, particularly packaging paper industry is having market, but with lower profit margins and in view of financial limitations, most of the kraft paper mills want mixed waste furnish, low quality fiber and cost effective sizing chemical with very less inputs.

Invariably they have to use starch in size press to obtain desired strength properties hence use oxidized starch from minimum 40 kg/t to maximum around 80 kg/t depending on BF/RCT/CMT/SCT requirements by their customers with limited ingredients.

Mostly mill people feel that starch is ultimate for everything and dump it in size press with or without much need. Acidity/pH of paper, starch content, short fiber in furnish all contributing factors for loss of folding endurance, cracking problems and off machine conversion problems. Some aspects and measures for cracking issue are discussed in this paper .



Problems and Reasons

Cracking problems in kraft paper is not just alone because of mill furnish and starch, but it can be also due to process conditions such as fiber length, moisture levels, corrugation gum composition etc. Cracking can happen in between flute and opposite to grain. During conversion of corrugation board to box, cracking problems appear. In case of multiply boards and higher gram weight boards, cracking can happen in printing process and folding of brochures etc.

Cracking problems of packaging paper are serious concern for liner

kraft and board manufacturers. Kraft paper manufacturers are literally on hot plate, till their papers are converted into boxes without any cracking issues.

Various reasons are being attributed for cracking problems in kraft paper.

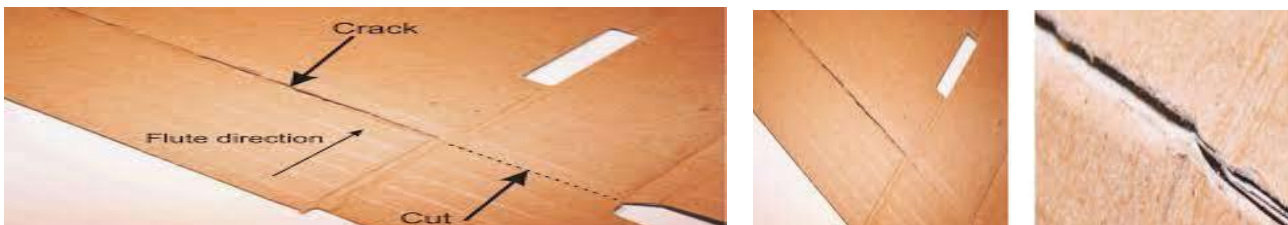
1. Weak fiber to fiber bonding
2. Over drying or uneven moisture
3. Flexibility and elastomeric properties of fibers which are needed for box making.
4. Brittleness can be reason to over usage of starch in size press

5. Starch recipe size chemical and strong acidic conditions can make paper brittle.

Mostly people believe that inherent process conditions of liner kraft pulp result in cracking problems. Simply to overcome this and to find an immediate solution, they generally incorporate long fiber and imported NDLC furnish which may result in higher costs of producing kraft paper which is not an ideal solution.

Some images of cracking problems as give as under:

FLUTE DIRECTION/GRAIN DIRECTION PLAYS A ROLE ON CRACKING.



Prediction of Cracking Propensity through Physical Testing

Cracking at folds causes pages to fall out of magazines or corners of boxes to split. The occurrence of fold cracking becomes more prevalent at low humidity and becomes worse when the ductility of surface fibers becomes diminished as may occur through application of starch coating or in the case of low freeness pulp being used in the top ply of multi-ply sheets. Increased use of recycled fibers also exacerbates the potential for cracking of sheets. An understanding of cracking mechanisms their measurement and control is desired for optimized production quality.

It is highly desirable from economic considerations to know the likelihood of a product to crack before it is shipped to a customer for converting. Below are some of the tests which are used to determine cracking problems:

- IPST CRACK ANGLE TEST
- FOLDED TENSILE STRETCH TO BREAK MEASUREMENT
- AF&PA CRACK TESTERS ARE.

Some manufacturing defects conversion like, corrugators defects, corrugators roll defects, pasting operation defects, creasing cutting and slotting defects also contribute cracking even without paper defects. But strictly speaking, problem can be at other end also that is consumer end, which is never discussed. It is true that dextrin and glues added for corrugation is also culprit for edge cracking and during crease in box folding process. So this problem requires a holistic solution at paper maker's end to ensure that cracking issue doesn't originate at their end.

Innovative Solution to Address Cracking Problem

We offer a two pronged approach to address this cracking issue in kraft paper:

1. Improve Starch Performance/Reduce Starch
2. Impart elasticity to Fiber at Size Press

1. Optimize Starch Usage:

Our first focus should be to look for optimizing starch usage while not compromising strength properties to address the cracking issues. One of the options is to use of Starch grafted DSR in minimizing the starch usage while maintaining strength properties.

A. Starch Grafted DSR:

Many do question, how we replace size press starch as we need strength to paper in addition to surface sizing. It is traditionally used size press chemical for various benefits. But definitely part of starch can be replaced by 'Starch Grafted DSR', which gives equal strength properties with less carbohydrate addition to paper. Buildup of carbohydrates is the sole reason for losing cationic starch business in wet end. Gelatinized starch is cross linked with cationic polyacrylamide to produce Starch grafted DSR, Which can impart equal strength and properties with less starch input into paper making system as a whole.

Graft polymerization of starch and cationic or anionic monomers of acryl amide bases yield a graft polymer

of combined/hybrid properties resulting in lesser requirement of starch for size press or wet end. More over these products in effluent stream are easily bio-degradable unlike acryl amides alone or very less COD & BOD results unlike starch alone which is another advantage of using starch grafted DSR replacing starch.

B. Starch Cooking Additive:

Besides Starch Grafted DSR to reduce or replace starch, we have a special additive "Starch Cooking Aid" to be added at a starch cooking stage which helps in cooking all the uncooked starch granules resulting in a better yield. This makes complete gelatinization and maximum utilization of starch leading to lower usage of starch while maintaining the same strength properties. This will eventually help to overcome the brittleness or cracking which is generally developed by high starch usage.

2. Enhance Fiber Elasticity:

We have a proprietary product called "Anti-Cracking Aid" which can be added to size press tank which when comes in contact with fiber increases its elasticity and also helps in maintaining the moisture levels by making a protective layer on the paper surface. The more elastic fiber and stable moisture will help in preventing the cracking.

Case Studies

CASE STUDY 1:

A kraft mill was having a serious cracking issues in the boxes made with their high BF paper. This mill was using 100% local OCC and was using 75 kg/T of oxidized starch with 100 GPL concentration in size press. Most of their box converters were complaining the cracking issues in their folding boxes after using paper supplied by this mill.

Solution:

Maxim team first analyzed the boxes with cracking issues to identify the main source of the problem and identified that problem was at paper mill's end only. So the solution offered by Maxim was to use a Starch cooking Additive, in Starch cooker at 150g/T to reduce starch consumption and Anticracking Aid at 1 Kg/T in Size Press to increase fiber elasticity. A program comprising of these two products helped mill to address cracking issue successfully.

CASE STUDY 2:

A 300 ton kraft paper mill was experiencing cracking problem complaints regularly from their market in their 20-24 BF Liner kraft. The mill was forced to increase paper moisture from 6.0 to 7.0% to address this issue but such

high moisture was not accepted by their customers. Then mill people asked Maxim for a chemical solution to address this cracking issue in high BF grades.

Solution:

Upon detailed analysis, it was found that usage of High Starch usage in high BF grades was the main reason for their cracking problem.

We attended this issue in two steps. First we added Max Aid BF to gain BF by 2-3 points in wet end itself to reduce their starch consumption by 20% in Size Press. Then we added 500 gram per ton of our Anti CrackingAid to improve pliability/softness of paper fiber. End result is extremely satisfactory with no market complaints of cracking problems. The reduction in starch also helped in reduced COD values in circulating or effluent waters in re-pulping.

Conclusion

The cracking issue, one of the ongoing serious issues faced by packaging industry, can be attributed to usage of high levels of starch , deteriorated recycled

furnish and other process related conditions. This problem can be mostly addressed by optimizing starch usage levels and increasing fiber elasticity besides maintaining

an optimum moisture levels. A preview of product quality both at supplier's end and consumer's end give confidence in both sides.

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