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ENERGY AND WATER CONSERVATION AND FILLER SUBSTITUTES WITH PRE-TREATED FILLER TO IMPROVE COMPETITIVE EDGE AND ENVIRONMENTAL SUSTAINABILITY VIA 3D TRASAR™, FILLERTEK™ AND METRIX DRAGON™ TECHNOLOGIES

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ABSTRACT

In order to remain competitive, manufacturers need to increase quality and cost performance. Energy conservation and high-cost fiber replacement with lower cost filler are viable ways to sustain profitability. Nalco has several innovative new technologies, which are aligned with customer key sustainability drivers to improve overall performance of their processes and system.

Nalco's patented 3D TRASAR automation technology monitors water systems in real time 24/7 and feeds chemicals based on requirement with traced and tagged chemistry instead of a fixed schedule. 3D TRASAR innovation helps in identifying various stresses in cooling water treatment areas such as high heat load, variation in water parameters, turbidity, biological demand etc., and reacting to it instantaneously. This approach helps to save water and energy, and minimizes the environmental damages by reducing residual chemical in discharged water from the cooling tower.

Nalco's patented FillerTEK technology combines several aspects of chemical and mechanical filler modifications to pre-flocculate filler to well-defined particle size and distribution, minimizing the interference with the fiber-to-fiber network. The technology enables paper makers to increase filler loading in paper and paper boards and to reduce drying energy with no negative impact on strength, optical properties and printing or conversion.

Nalco's METRIX Dragon technology helps customers maintain strength properties at a lower refining level in paper and paper boards. Refining the pulp after a certain level will not help improve strength properties in paper and paper boards. The market requires an innovative solution to overcome these issues. Nalco METRIX Dragon technology also helps customers maintain more stable wet end chemistry by reducing other wet end additives like starch, coagulant and flocculant.

KEYWORDS

Nalco, 3D TRASAR Technology, METRIX Dragon, FillerTEK, Refining, Tracer, Filler.

INTRODUCTION

Paper industries continue to focus more on improving water and energy savings to reduce the overall cost of the product and to address the increasing environmental challenges across the globe. This has led Nalco to build road maps to sustainable development that conserve the earth's non-renewable resources, some of the most precious being water, energy (steam and power) and natural resources (wood). Critical aspects of any sustainability strategy, such as resource management, asset protection, safety and environmental compliance are all improved by innovative Nalco technology.

3D TRASAR automation technology helps industries reduce wastewater creation through increased water reuse. It enables to use grey water (wastewater) as the water source for the cooling operation at their plants without any performance deterioration, thereby reducing freshwater consumption. 3D TRASAR technology monitors the condition of the cooling tower continuously and adds appropriate chemicals only when needed, rather than on a fixed schedule. This technique saves water and energy, minimizes the use of water treatment chemicals and decreases environmental damage from discharged water. In 2015 3D TRASAR technology has saved 428 million cubic meter of water across the world.

Nalco FillerTEK technology saves fiber by replacing it with less expensive filler. Increasing the filler content in paper and paper boards is one of the options to reduce dryer section energy requirements and to reduce overall production costs by replacing more expensive fiber with low cost filler. Key challenges to filler loading are maintaining strength properties, retaining additional fine particle filler, and potential dusting issues at the converter at higher ash loading levels. Filler pre-flocculation by using Nalco FillerTEK technology is helping to address all of these challenges. This new technology is a fit for dispersed and undispersed fillers that are chalk, ground or precipitated calcium carbonate or a blend of these filler types. The filler treatment is carried out on site with the mill's existing filler slurry.

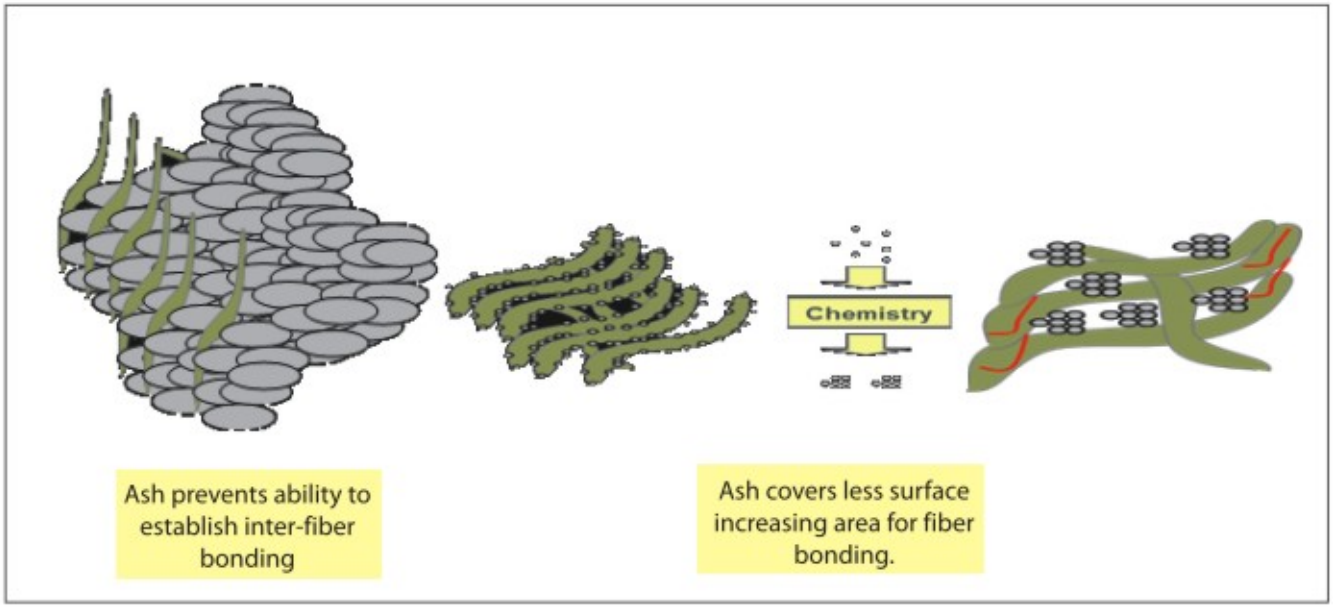
Nalco METRIX Dragon is a synergistic multi-component program developed to enhance productivity, strength development, and new product development at a lower refining level. Paper strength properties are one of the critical challenges faced by paper makers when developing new product, fiber substitution, energy savings, and increased machine speed and productivity gains. Paper strength properties depend on fiber source, refining, basis weight, press loading, formation and the use of chemical additives in order to meet the required specification at the lower cost. However there is a limitation on raw material availability. Improving inter fiber bonds, consisting primarily of hydrogen bonds between fibers; will help in improving strength properties in paper and paper boards. Refining furnish will help to improve inter fiber bonding, but after a certain level of refining there will be no impact on strength properties. METRIX Dragon helps to overcome this challenge

Working Mechanism

3D TRASAR technology integrates technologies that are necessary to anticipate system variability and automatically respond through advanced traced & tagged chemistry, providing two-way communications. When upsets are detected or control actions taken, the 3D TRASAR controller informs operators, allowing them to take further corrective action. Alerts are sent via text message or through an email. Nalco enVision, a system management web platform, allows the user to

make adjustment to the 3D TRASAR controllers remotely, to see at a glance the inter-relationships between all system parameters, to provide information quickly when trouble shooting a problem, and to show "cause and effect" when control action is taken. The multiple 3D TRASAR installation allows review of all systems from one location.

The FillerTEK approach utilizes chemistry and mechanical action to pre-flocculate the filler into flocs of a particular size range and distribution that are highly shear stable. The FillerTEK treated filler applied to a furnish stream will occupy less fiber space allowing for increased bonding sites and additional filler loading potential as follows,



The modified filler helps to retain the filler with the paper reducing the dusting issues in the final product and at the converter.

Paper in its most basic form is a 3-D matrix of cellulose fiber. Fibers are bound together by hydrogen bonding. Typically hydrogen bondings are polar attractions of oxygen (electrons) from one molecule to hydrogen (Protons) from another via water intermediate or directly between adjacent hydroxyl groups. Basically it is a weak bond, but collectively give paper its basic strength. METRIX Dragon will help to increase the number and strength of the fiber-fiber bonds and protect the hydrogen bonds from hydration. It will help to improve wire table drainage and thereby increase wet web strength.

Commercial application of 3D TRASAR technology

A paper mill in southern India uses 3D TRASAR technology for their Captive Power Plant of 21 MW capacity with a recirculation rate of 3600 m3/hr. Online 3D TRASAR monitoring could help to reuse paper machine secondary clarifier-treated water passed through filters and softener as makeup for this cooling tower. Performance is effectively managed through 3D TRASAR technology and continuously monitored remotely through the Nalco System Assurance Center. The Nalco program recovered and reused 800 – 850 m3/day or 80% of total makeup (1100 – 1200 m3/day) through ETP recycled water. As a result, the fresh water consumption is reduced to approx. 250 m3/day, which was originally 1200 m3/day.

By recycling this water back into a critical CPP application, the biological control is well managed through online ORP, which controls the chlorine dosing and stabilized bromine dosing. The surface condenser & cooling towers were inspected and found very satisfactory.

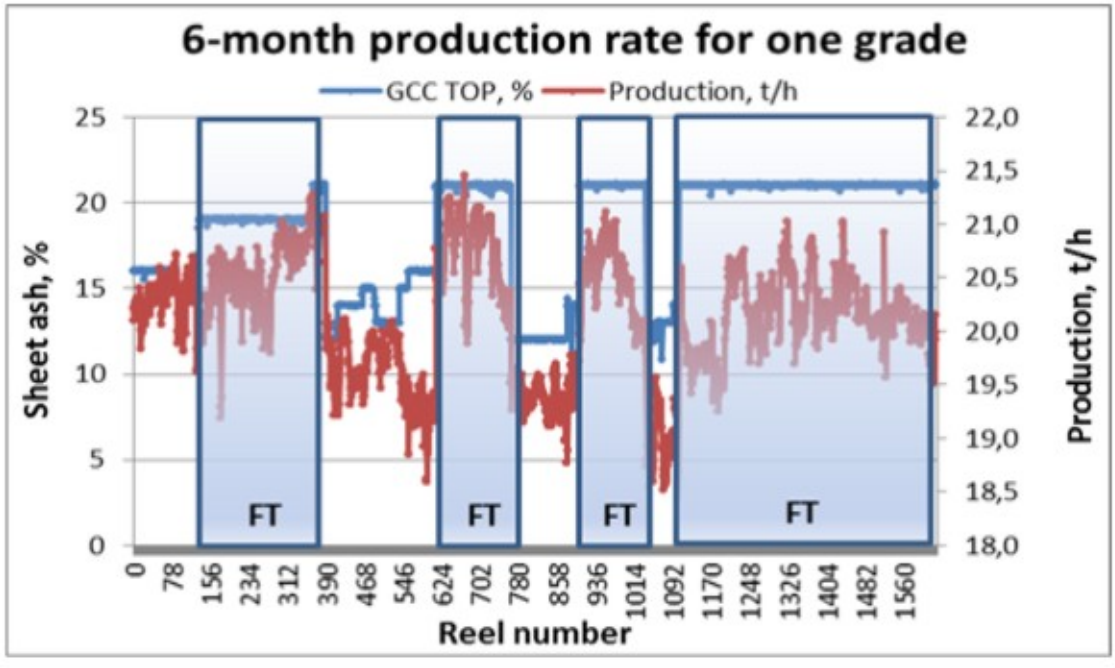
Occasional turbidity caused by fiber slippage in ETP treated water is being well handled through the tag polymer demand in the 3D TRASAR system.

Commercial application of FillerTEK-I (Board and Packaging grade)

The board machine produces 3-ply coated carton board, in which top and back plies contain 100% virgin Kraft fiber with some amount of GCC filler. The middle ply, which controls the board target grammage and stiffness, is made mainly of mechanical pulp with no fresh GCC filler. Based on a detailed machine audit and lab study, Nalco proposed the FillerTEK technology package, which included the FillerTEK DEV210 chemistry for online GCC filler treatment together with the treatment equipment. The preliminary target was to increase ash from the baseline 13% up to 18% while maintaining board strength properties and machine runnability. Based on positive results, the project was extended to the back-ply. The starting ash content in the top-ply was between 12-15% and 6% in the back-ply. Soon after the start-up the goals of the project were met. On average, the GCC filler was increased in the top-ply sheet between 5-7% points and in the back ply by 5% points. To maintain the final carton board grammage, the Kraft pulp amount was reduced accordingly in both outer plies.

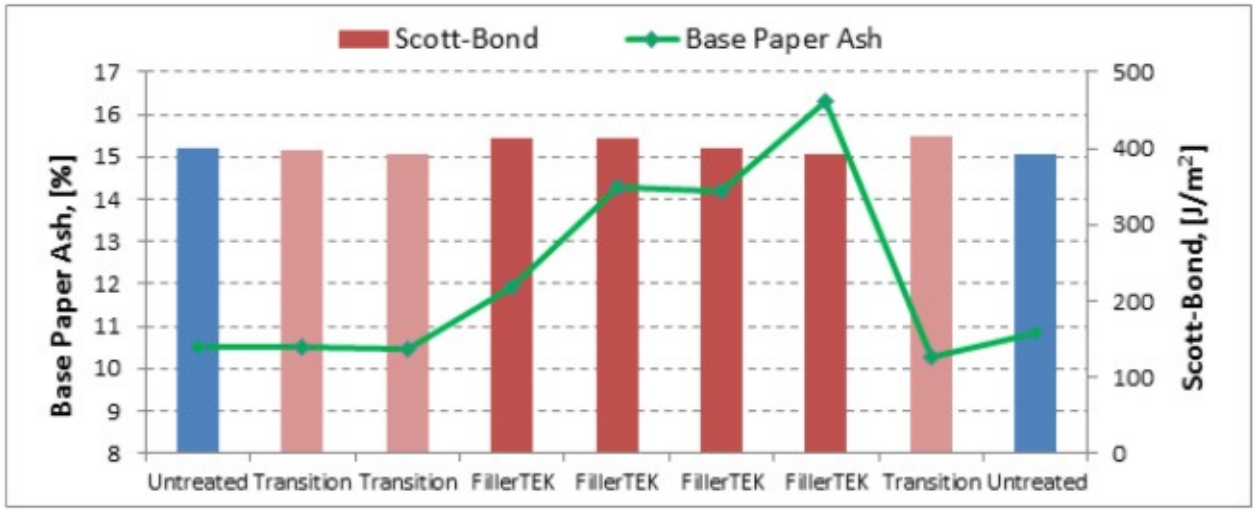
As a result of fiber replacement with filler, the energy for carton board drying was reduced, which is another positive benefit in terms of steam consumption and carbon footprint. Based on six months of continuous running, the FillerTEK program implementation has resulted in the following benefits:

- Virgin market Kraft pulp reduction by 2200 tons per year and consequently the GCC filler increase by the same amount.
- Carton board production increase by approximately 3% due to improved drying of the sheet.



Commercial application of FillerTEK-I (Graphics grade)

FillerTEK pre-flocculation technology was applied to a coated paper producer to maintain sheet internal strength and print quality at increased ash levels. The program for this trial included three tailored polymer chemistries to pre-flocculate filler with specially designed equipment. This technology demonstrated during production of 60g/m2 coated grades that the base paper ash could be increased over 5% (Base sheet ash level 10-11%) without sacrificing internal bond. In addition, slight improvements in coat weight uniformity, brightness, and gloss of the final coated paper were observed. Opacity and bulk were also maintained. In addition to maintaining sheet performance at increased ash, the steam energy for web drying was substantially reduced leading to additional savings from the fiber replacement.

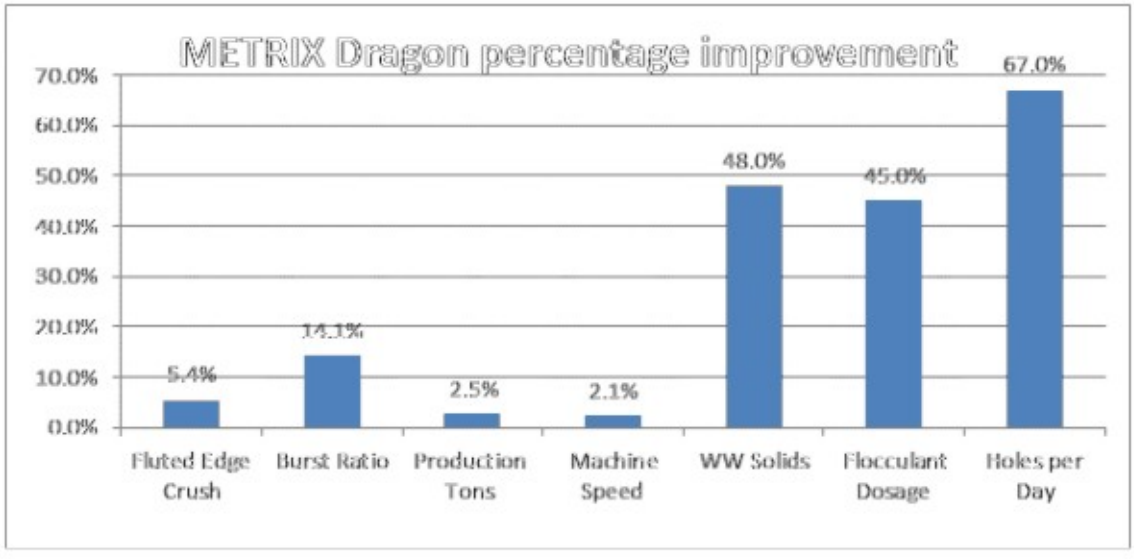


Internal bond strength (bars) and base paper ash (line) of 60 g/m2 coated & calendared paper from reels produced with and without FillerTEK Technology treatment.

Commercial application of METRIX Dragon-I

The mill with two ply fourdriniers machine produces recycled corrugated medium grade with the capacity of 900 TPD was looking for the solutions to improve edge crush test properties with target production level. METRIX Dragon dosage @ 2.5kgs./ton helped to achieve the following benefits,

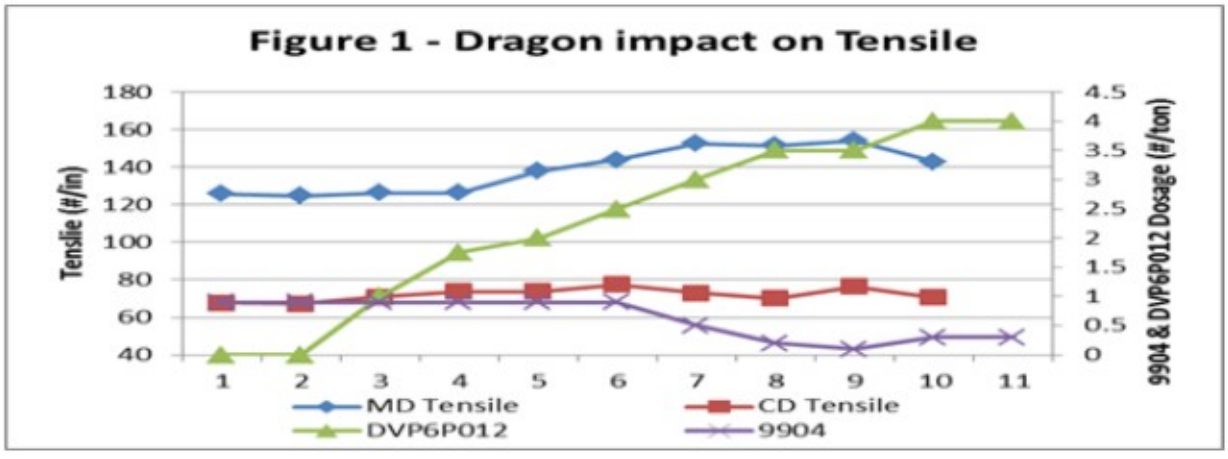
- Reduction in refining loading around 10%
- Increased 5 % in fluted edge crush and 14% in burst
- Increased production 2.5% from improved runnabilty
- Reduction of flocculant by 45% due to positive impact on WW solids.

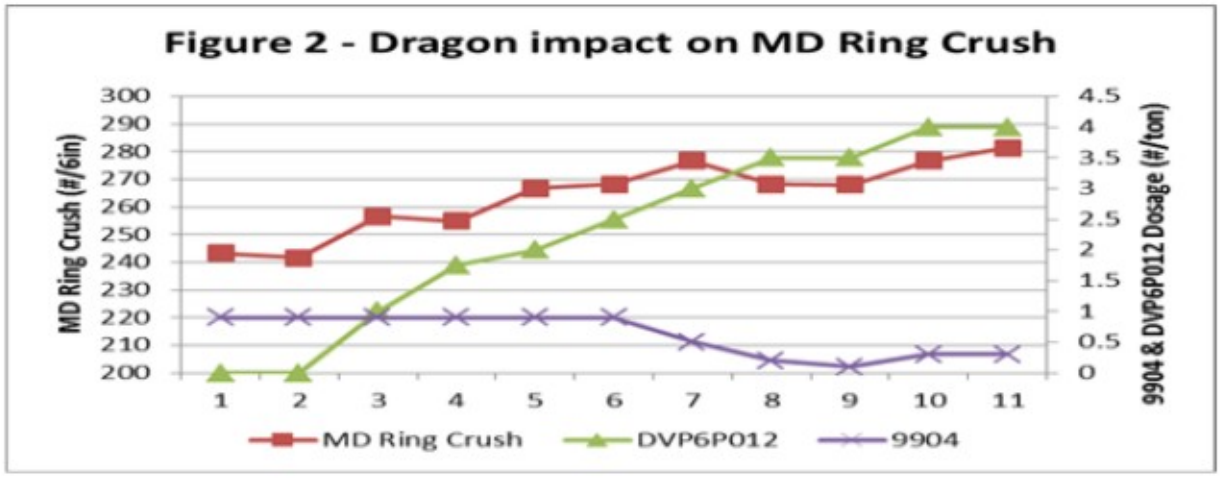


Commercial application of METRIX Dragon-I

The mill with single ply Fourdrinier with Top former produces Sack Kraft grade paper and looking for a solution to replace wet end cationic starch and to improve 30% tensile further from base line. METRIX Dragon @ 2.2 kgs. /ton helped to replace wet end cationic starch completely with the following benefits,

- 22% MD Tensile increase
- 8.7% CD Tensile increase
- 16.8% increase in MD ring crush
- 31.2 increase in Mullen
- 64% reduction in ASA dosage
- 67% reduction in cationic flocculant dosage with no change in tray solids





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METRIX Dragon application best practices guidelines book