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Revolutionizing Paper Strength and Production Efficiency with PVAm Chemistry


Rajesh Chhabra*
Managing Director


Tajinder Bir Singh Chahal*
AGM Sales


Simon GAMBATTO**
Technical Sales and B.D. Manager


Keshav Joshi*
AGM Technical

** Axchem India   ** Axchem France*

Abstract:

The pulp and paper industry has seen substantial transformations in recent years, spurred by a growing demand for high-performance, cost-effective, and environmentally sustainable paper products. These changes have brought innovations in chemical applications that enhance paper strength and optimize production processes, with PVAm (Polyvinylamine) chemistry emerging as a breakthrough technology in this space. Particularly beneficial in Kraft paper and fluting media production, PVAm chemistry helps address challenges like strength enhancement, fiber bonding, and improved drainage—all while providing economic and environmental benefits. This article delves into PVAm chemistry's mechanics, its unique advantages, and its application specifically in Kraft paper and fluting media. Additionally, case studies illustrate the significant impact of PVAm on production quality, cost efficiency, and machine performance in real-world settings.

Keywords: *Wet-end process, Recycled fibers, Drainage and Retention, Ionic and covalent bonding, Energy savings, Basis weight reduction, Environmental sustainability, Burst, Low-BOD.*

Introduction to PVAm Chemistry

PVAm is part of a new generation of strength resins developed to address the increasingly complex needs of the paper industry. Designed specifically to simplify the wet-end process of paper manufacturing, it acts as a wet-strength and dry-strength agent, providing superior bonding between fibers and fines while improving drainage and retention in the system.

PVAm is a soluble polymer, available in liquid form, making it easily adaptable for integration into various production setups. Whether applied in thick stock or thin stock, this versatile chemical offers excellent results, especially in applications such as packaging, tissue, molded fibers, and paper grades with high ash content.

The chemistry of PVAm is built on proprietary NVF (N-vinyl formamide) technology. This technology has allowed Chemical Solution Supplier to design a polymer with high cationicity and carefully balanced molecular weight, giving it the ability to bond strongly with fines and fibers without causing excessive charge attraction in the system. The result is an advanced polymeric system that improves both strength and operational efficiency in the papermaking process.[1]

Strength Resins: Chemistries and their Function

Key Advantages and Applications of PVAm

The adoption of PVAm in the production of paper products offers a range of benefits, both in terms of product quality and process optimization. Some of the key advantages include:

1. Strength Enhancement

The primary role of PVAm is to improve the strength characteristics of paper. The polymer enhances both wet and dry strength by forming strong ionic and covalent bonds with fibers and fines. This bonding significantly boosts mechanical properties such as Burst, Concora Medium Test (CMT), and Ring Crush Test (RCT) [2]. These improvements are especially important in applications where recycled fibers, like OCC (Old Corrugated Containers) and MOW (Mixed Office Waste), are being used, as these materials typically have lower inherent strength.

2. Drainage and Retention Improvements

PVAm's ability to improve drainage and retention without causing significant charge attraction in the system is a major benefit for paper mills. Improved drainage reduces the need for additional dewatering equipment, speeding up the production process and reducing energy consumption. Enhanced retention allows mills to capture more fines and fibers within the sheet, leading to better sheet formation and reduced material losses. [4]

3. Operational Efficiency and Cost Reduction

PVAm contributes to operational efficiency in several ways. By enhancing drainage, it reduces energy consumption in the drying section, leading to significant cost savings. Additionally, its ability to improve retention reduces the need for additional fillers and other chemical additives, further lowering costs. The reduction in energy and chemical use directly impacts a mill's bottom line, making PVAm a cost-effective solution.

4. Environmental Sustainability

The focus on sustainability is a key driver in the paper industry, and PVAm supports this by enabling the use of more recycled fibers and reducing the need for natural resources. Its high efficacy in low-quality fiber systems allows mills to increase the use of recycled fibers without compromising on product strength or quality. Furthermore, the polymer's ability to improve drainage means less water is required in the production process, helping mills meet stricter environmental regulations regarding water usage and effluent discharge, particularly for BOD emissions.[5]

5. Customization for Specific Grades

One of the standout features of PVAm is its ability to be customized to meet the unique requirements of different paper grades. For applications that demand higher strength, basis weight reduction, or the use of low-quality fiber, PVAm can be paired with an anionic polymeric component that acts as a booster. This combination balances the wet-end charge, optimizing mechanical properties while minimizing operational costs.[2] This customization ensures that PVAm can be applied effectively across a wide range of paper and board grades, from lightweight tissue to heavier packaging materials.

PVAm Resins: Key Benefits

PVAm resins are more than just dry strength resins, they are at the center of a whole concept to improve the profitability of the papermaking system and the quality of the produced paper (Fig. 1).

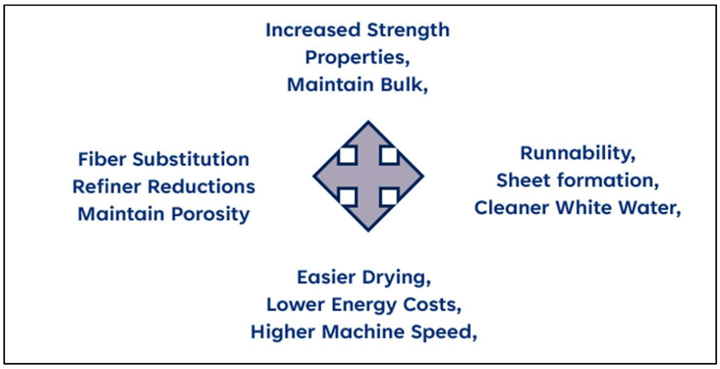

Fig. 1: Benefits of PVAm

Key Industry Drivers for Strength Resins

The need for innovative strength resins like PVAm is being driven by several industry trends and challenges:

• Increased use of recycled fibers

The increasing use of OCC and MOW in paper production has created a demand for strength resins that can compensate for the lower inherent strength of recycled fibers. PVAm helps manufacturers overcome this challenge by improving fiber bonding and enhancing the mechanical properties of recycled paper. [3]

• Reduction in basis weight

There is a growing trend towards reducing the basis weight of paper products, particularly in the board, tissue, and towel segments. Lighter-weight grades offer cost savings in terms of raw materials and transportation, but they also present challenges in maintaining product strength. PVAm's ability to provide synthetic strength helps mills meet these challenges without sacrificing product quality.[1]

• Higher drainage requirements

Modern paper machines are running at faster speeds, increasing the need for efficient drainage systems. PVAm enhances drainage without causing excessive flocculation or loss of fines, allowing mills to run machines more efficiently while maintaining product quality.[2,4]

• Environmental regulations

Stricter environmental regulations regarding BOD emissions and water usage are pushing mills to seek alternatives to traditional strength agents like starch. PVAm provides a low-BOD alternative that helps mills reduce their environmental footprint while maintaining or improving paper strength.[5]

Dry strength resins: benefits

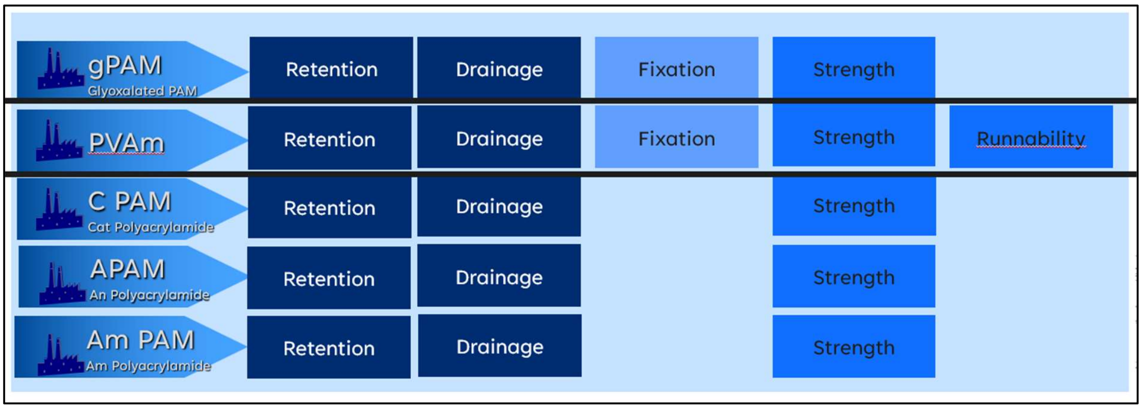

Fig 2: Benefits of Dry Strength Additives

Combined Technologies for Optimal Performance

For specific grades of paper that require even greater strength enhancement or basis weight reduction, PVAm can be combined with an anionic polymeric component. This combined technology optimizes the charge balance in the wet end, ensuring maximum retention and strength performance while minimizing operational costs.

When added in the thick stock, PVAm acts as a primer, adsorbing onto the fibers and cationizing them to promote the fixation of anionic components. This process improves fiber bonding and further enhances the mechanical properties of the final product. The anionic extender used in combination with PVAm is characterized by its molecular weight, charge, and form (liquid, powder, or dispersion), allowing mills to customize the chemistry to meet their specific production needs.

Global Acceptance and Applications

PVAm has been widely accepted by paper mills around the world for its proven ability to improve product quality and production efficiency. Its ease of application, combined with its versatility across a wide range of paper grades, makes it a valuable tool for manufacturers looking to enhance their operations.

The polymer is particularly effective in the packaging segment, where its ability to reduce starch usage and improve drainage and runnability has made it a popular choice for mills using recycled wastepaper. It is also highly effective in tissue and towel production, where the demand for lighter-weight grades requires advanced strength chemistry.[2]

CASE STUDIES

Case Study 1: Strength improvement

Overview

Grades : Coated Board
Furnish : 100% RCF
Ash : None
Filler : No fresh filler
pH : Neutral
Production : 40 T/h
Basis weight : 250 – 550 g/m²
PM : Fourdrinier, 4 plies
PM Speed : 200 - 500 m/min

Current Wet-End : Conductivity : 1400 µS/cm
Wet End chemicals :
PAC, CPAM, APAM
Dry Strength : Cationic starch, spray starch

Objectives Increase in the Scott bond
Reduce wet-end chemicals consumption

Approach Application of PVAm technology in the Under, Top and Center layer
Keep stable the Wet End conditions and optimize PAC and CPAM consumption according to cationic demand and retention levels

Results

- +30% of Scott bond
- PAC switched off
- Reduction of 50% on CPAM consumption

Case study 2: Strength improvement

Overview

Grades : Testliner
Furnish : RCF, 1.02 / 1.04
Ash : None
Filler : No fresh filler
pH : Neutral
Production : 18 T/h
Basis weight : 90 – 180 g/m²
PM : Fourdrinier, 2 plies and No Size Press
PM Speed : 700 - 1050 m/min

Current Wet-End Conductivity : 3000 µS/cm

Wet End chemicals TOP : PAC, Polyamine, CPAM, Bentonite
BOTTOM : PAC, Polyamine, CPAM
Sizing agent : ASA

Objectives

- To reach TL3 burst Index
- To optimize the Wet End chemistry

Approach : Application of PVAm and APAM

Results

- +40% of burst Index increase: TL3 level reached
- PAC switched off
- 25% reduction in ASA consumption

Case Study 3: Dewatering & Machine Speed

Overview

Grades : Core Base Paper
Furnish : RCF, 1.02 / 1.04
Filler : No fresh filler
pH : Alkaline
Production : 6 – 8 T/h
Basis weight : 400 – 500 g/m²
PM : Fourdrinier
PM Speed : 60 m/min

Current Wet-End: Dry strength: Cationic starch in Wet End, Native starch in size press

Objectives

- Increase productivity
- Reduction in wet-end and spray starch

CHEMICAL Approach

- Application of 20 kg/T of PVAm
- Elimination of wet-end starch
- Eliminate refining

Results

- Production increase by 8 %
- Better dewatering
- Wet-end starch on some grades eliminated, on other grades reduced by 40%
- Reduction in native starch (approx. 20%)
- Save refining energy

Conclusions:

PVAm is a revolutionary strength resin that addresses the key challenges facing today's pulp and paper industry. By improving fiber bonding, enhancing drainage, and optimizing operational efficiency, it offers a powerful solution for mills looking to improve product quality while reducing costs and environmental impact. Its versatility, sustainability, and ability to be customized for specific grades make it an essential tool in the ongoing evolution of paper manufacturing.

As the paper industry continues to embrace innovation, PVAm will remain at the forefront of chemical applications, driving improvements in both production efficiency and product performance. Through its advanced chemistry and proven results, PVAm is helping mills around the world meet the demands of a rapidly changing market while staying competitive and sustainable.

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