

GILUTON®

Wet strength agents in a wide choice for your special demands



Giluton

1500

1800

2100

Giluton

2400

2700

Giluton

3000

[m]

wet tensile strength

wet tensile strength



Riding a true wave of success with
GILUTON® – innovative wet strength technology
for the most varied customer requirements

High delivery reliability

One of the largest production locations for wet strength agents

Process reliability for more economy

Your Success is our Goal

Technology leadership

Continuous product development

Lifecycle management with a lot of service

Support of our partners

Wet strength agents of the GILUTON® range

Innovative wet strength technology for your paper production



With our competence, we assist our customers in the world of paper-making.

Wet strength agents of the Giluton® range belong to our core business with chemical additives for the paper industry. All products of this brand are – from the chemical point of view – polyamidoamine-epichlorohydrine (PAAE) resins. With this **wet strength agent portfolio**, BK Giulini established a leading position in the European market environment. The products were and are permanently improved by continuous **research and development activities** and thus meet all the requirements from various **fields of application in paper production** and the pertinent regulatory requirements. The selection of the appropriate best-suited product and the adjustment of the **optimal parameters for use** are supported by technically experienced field service staff. A well-equipped application technology department serves as **service partner**. BK Giulini, of course, holds regular **technology meetings** with its customers.

Trade name	Area of application	Organic chlorine content	Dry content [%]	Approvals
GILUTON® HPS	Hygienic and specialty paper	very low	approx. 12.5	FDA, BfR § XXXVI RAL
GILUTON® 1100/28 N	Hygienic and specialty paper	very low	approx. 14.0	FDA, BfR § XXXVI RAL
GILUTON® 14 XP	High performance product Hygienic and specialty paper	low	approx. 15.0	BfR § XXXVI RAL
GILUTON® LOX 15	Hygienic and specialty paper Food packaging paper	very low	approx. 15.0	FDA, BfR § XXXVI RAL, Nordic Swan
GILUTON® 20 XP	Hygienic and specialty paper	low	approx. 20.0	FDA, BfR § XXXVI RAL, Nordic Swan
GILUTON® 14 NW	Hygienic and specialty paper	low	approx. 14.5	FDA, BfR § XXXVI RAL, Nordic Swan
GILUTON® 1100/37 N	Wet strength agent of the 3 rd generation Hot-filter and hygienic paper	very low ultra low DCP & MCPD	approx. 15.5	FDA, BfR § XXXVI RAL, Nordic Swan
GILUTON® SLW 2	Wet strength agent of the 3 rd generation Hot-filter and hygienic paper	ultra low ultra low DCP & MCPD	approx. 14.5	FDA, BfR § XXXVI RAL, Nordic Swan

Dosage [% commercial product]	Application field
< 1	retention anionic trash control creeping agent
1 - 2	printing runnability and pick resistance (newsprint, carton and corrugating)
2 - 8	normal wet strength (tissue and towel, liquid packaging board, food packaging, carton and corrugating)
> 8	high wet strength (laminates, security paper, label paper)

If a wet strength agent is needed, then use **GILUTON®** BK Giulini Know-how transfer for your paper production

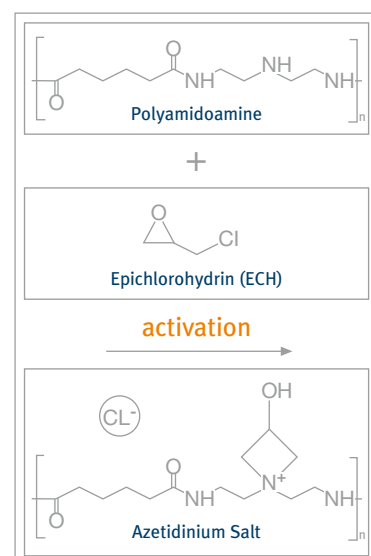
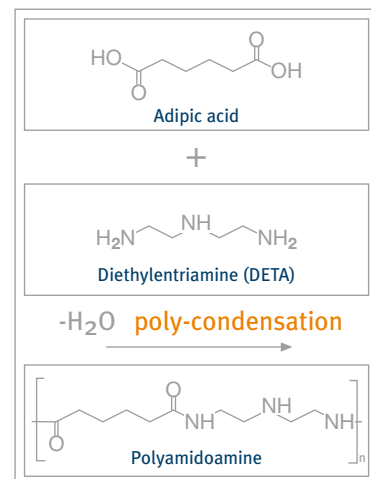
Wet strength resins change an important property of paper. The paper's strength properties are mainly determined by the formation of hydrogen bonds which are created at the contact points of the fibre surfaces when water is removed, e.g. during paper drying. An interference with or weakening of the hydrogen bonds can, e.g., be effected by applying hydrophobic spacers on the fibre surface. It is above all tissue softeners which take advantage of this effect. All hydrogen bonds can be immediately dissolved by complete wetting of the paper, inverting the paper-making process. When wet, all strength properties are completely lost. Wet strength resins added to the paper pulp are cationic and thus quickly absorbed on the fibres. During paper drying, these products react chemically with themselves caused by temperature increase and concentration and also with the hydroxyl and carboxyl groups on the fibre surface. The bonds thus introduced are not separated by water such that wet strength-finished paper still shows part of the strength properties of the dry condition when wet. For the use in paper pulp, 3 main product groups are available in cationic form:

■ Melamine-formaldehyde condensates react to form highly alkali-resistant crosslinks when subjected to acid catalysts. The effect decreases very much in the neutral pH range. Even when hardened, the products release low amounts of formaldehyde.

■ Polyamidoamine-epichlorohydrine resins crosslink by reaction of epoxide and/or azetidinium groups. The best effect is achieved in the neutral pH range. Because only a few specialty papers are still produced in the acid pH range, these resins are excellently suited for almost all papers to be wet strength-finished.

■ Polyacrylamide-DADMAC-glyoxal resins. Papers thus finished show a temporary wet strength which decreases with increasing wetting duration. These products are only slightly cationic and were not successful in highly closed water loops.

■ In addition, urea formaldehyde resins and glyoxal resins with nonionic or anionic charge characteristics are available. However, these products may only be used in size press formulations or coating colours. For insolubilisation of coating colours, metal salts, such as ammonium zirconium, are to be mentioned for sake of completeness.





Broad basis, best solutions More service and customer focus through technical support and innovation



A strong research & development as basis for our success. A new wet strength agent is "cooked" here.

All produced batches are sampled and checked by our quality assurance before leaving our factory.



Wet-strength papers

A simple classification of the wet-strength papers can be made by differentiating between low, medium and high wet strength:

- Low wet strength: base papers, tissues
 - Medium wet strength: towel crêpe, food packaging papers, coffee filters, liquid packaging board, cold store carton, wallpapers
 - High wet strength: decorative paper, bank note paper, label papers, security papers
- The wet strength, as result of a tensile test, is given either as absolute value in Newton or as ratio to the dry strength of the same paper in percent. Today, the major part of the wet-strength papers is produced with the help of polyamidoamine-epichlorohydrine resins. Melamine resins are still used in production using acid pH and/or which make highest demands on the alkali resistance of the papers (e.g. care label papers).

Polyamidoamine-epichlorohydrine resins

Wet strength agents from the class of the PAAE resins are produced in synthesis steps. In a poly-condensation, first the parent structure is synthesised from dicarboxylic acids (mainly adipic acid) and primary as well as secondary amines, ethylenediamine and diethylenetriamine being of major importance in this respect. In a next step, the poly-condensate is transformed in aqueous solution with epichlorohydrine which results in the formation of reactive groups (epoxide and azetidinium groups) at the parent structure. By adjusting to a weak acid pH value, the resin solutions such produced are prevented from self-cross-linking and are stabilised. Commercially available products contain between 12.5 and 25 % of active ingredient; above this percentage, no highly effective and at the same time storage-stable products are available. By varying:

- the ratio of amine to dicarboxylic acid
- primary amine to secondary amine
- epichlorohydrine quantity used and the ratio to the amines
- temperature range of the reactions, to name but a few synthesis parameters, the final product can be influenced in many ways and many options are given for a continuous further development of the PAAE resins.

Broad basis
Best solutions

Individual
agreement

Process acceleration
for more economy

Brand quality with
certifications

Application-
technical
service

Process consulting
for more safety

Quality management
Customer care
Technical field service

Storage service for
just-in-time delivery

Competence in wet strength agents BK Giulini Know-how transfer for your paper production

Technical sale & application consulting for best solutions

Often, only the active ingredient content is used when comparing PAAE resins. In practice, however, often extremely different effects of various products in a given stock system occur even if the active ingredient contents are identical. A PAAE resin influences:

- wet strength
- retention
- trash fixation (anionic)
- performance of other additives, e.g. alkylated ketene dimer sizing
- adhesion at the Yankee cylinder (tissue)
- dry strength
- charge balance

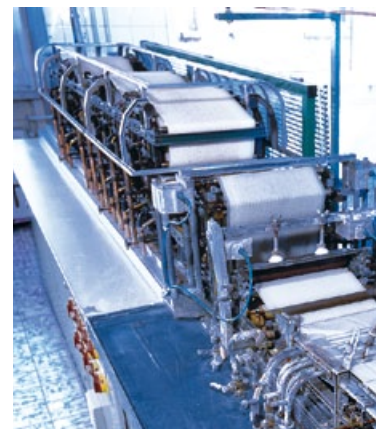
and all paper properties which can be deduced from this, e.g. printing runnability. Thus careful preparatory work is not only required when selecting the best-suitable product. Expert knowledge is also required when determining the dosage point, the type of dosage (Where? Which dilution? Distributed to 2 dosing points?), the dosage quantity and the dosage sequence (with the other additives) to prevent mistakes, exclude interferences and to achieve the application objective with the best price/performance ratio. BK Giulini employs excellently trained field service engineers which exclusively manage the customers in the paper industry. The tasks of our employees also include passing on wishes

and problems of our customers to our research team to be able to do practice-orientated and timely development work. Our consulting activities also include the selection and provision of suitable storage, dilution, dosage and measuring/control technology.

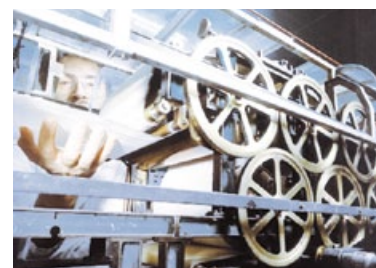
Application technology

Unfortunately, the precise preparation of a concrete application recommendation may normally not only be made based on the long-term experience of our employees. The general conditions of a real-world case are often included in the pre-analyses of our application-technical department. These analyses may cover short manual trials up to comprehensive analysis series on our pilot paper machine. On this machine, the compatibility of different additives and the achievable effect of a wet strength agent can be best determined under cycle conditions and realistic densities. Under standard climate, all common paper analysis can be carried out or e.g. the maturity progress of a wet strength agent under different storage conditions can be analysed on the customer-specific stock system.

New products from chemical research are analysed for their effectiveness by the application-technical department before any decisions on steps for marketing are made.



High product reliability by simulating your production conditions on our trial paper machine.





Giluton

wet tensile strength

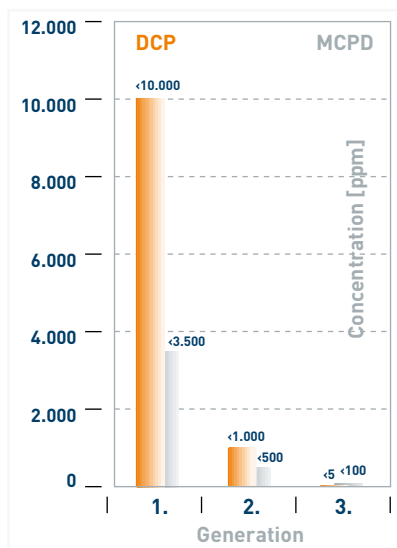
Giluton

wet tensile strength

Giluton

Definitively the best solution for your products

Definitively the best consulting, management, and support



Reduction of chloro-organic by-products



Notes on environmental impacts

Polyamidoamine-epichlorohydrine resins are activated with epichlorohydrine, a component which contains organically combined chlorine. In the chemical reaction, azetidinium groups are introduced at the polyamidoamine and inorganic chlorine is generated. Unfortunately, by-products and reconstitution of chloro-organic monomers occur even given ideal control of reaction because of the reaction with chloride. In this respect, the two most important substances are dichloropropanol (DCP) and monochloropropanediol (MCPD). In the past 20 years of the development of PAAE resins, the contents of chloroorganic compounds (OX) have been ever-decreasing without having to suffer significant performance losses. The first endeavours to minimise the OX content resulted in products of the 2nd generation. Further significant improvements in chemical synthesis again led to significantly reduced OX contents. Corresponding wet strength agents are counted among the 2.5th generation. With their OX content, these products are not far from products subsequently purified by ion exchangers, ultra-

filtration and biotechnological methods. These products are designated as 3rd generation products. In the year 2009, the European Union published limit values for the sum of chloro-organic monomers which must be contained in wet strength agents if the corresponding tissue papers were to be marketed with the ecolabel. Modern wet strength agents of BK Giulini meet these requirements. Most of our wet strength agents also meet the requirements of the recommendation XXXVI of BfR, the RAL ecolabel for paper, the Nordic Swan Label as well as the FDA rules 21 CFR §§ 176.170 and 176.180 (for packaging papers for dry or aqueous and fatty food).

Observance of the statutory limit values

Important aspects are also the AOX in waste water of the paper production or also the OX content of the paper product. We advise and support our customers with regard to both parameters with suitable measures and products to observe the statutory limit values.

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