POLY CROSS®

Cross-linkers

- Blocked Isocyanates
- Polyfunctionals cross-linkers
- Melamine resins

imagine!
MECHANISMS THAT IMPART DURABILITY
Example of application in fluorocarbon resin finishing

Application of POLYFLUOR BS (fluorocarbon resin) on two different fabrics and two different cross-linkers agents

**POLYFLECT® FC**  
(Blocking Isocyanate)

**POLYFLECT® MLF**  
(Melamine resin)

**Fabric: Cotton 100%**

Formulation used:
- DYEWET FC 1 gr/L
- POLYFLUOR BS 40 gr/L
- POLYFLECT FC 10 gr/L

Pick-up: 85%
Temperature: 140º C

**Fabric: Polyester 100%**

Formulation used:
- DYEWET FC 1 gr/L
- POLYFLUOR BS 25 gr/L
- POLYFLECT MLF 5 gr/L

Pick-up: 72%
Temperature: 160º C
### BLOCKED ISOCYANATES (BI)

<table>
<thead>
<tr>
<th>GRADE</th>
<th>TBI</th>
<th>TP</th>
<th>TBI 50</th>
<th>FC</th>
<th>FX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Composition</strong></td>
<td>HMDI</td>
<td>HMDI</td>
<td>HMDI</td>
<td>MDI</td>
<td>TDI</td>
</tr>
<tr>
<td><strong>Unblocked temperature</strong></td>
<td>110ºC</td>
<td>110ºC</td>
<td>110ºC</td>
<td>140ºC</td>
<td>140ºC</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Adhesives &amp; finishing</td>
<td>Coating &amp; finishing</td>
<td>Adhesives &amp; Coating</td>
<td>FC bath’s 10 HL/DC</td>
<td>FC bath’s 50 HL/DC</td>
</tr>
</tbody>
</table>

### POLYFUNCTIONAL REACTANTS (RT)

<table>
<thead>
<tr>
<th>GRADE</th>
<th>RT</th>
<th>HPL</th>
<th>6822</th>
<th>6849</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Composition</strong></td>
<td>TDI - ethyleneimine compound</td>
<td>Aliphatic poliisocianate</td>
<td>Aliphatic poliisocyanate</td>
<td>Polyaziridine</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Printing</td>
<td>LAD properties on FC application</td>
<td>Printing, adhesives &amp; coating</td>
<td>Printing &amp; adhesives</td>
</tr>
</tbody>
</table>

### GLYOXALS & MELAMINS (ML)

<table>
<thead>
<tr>
<th>GRADE</th>
<th>FF</th>
<th>GLX</th>
<th>LF</th>
<th>MLF</th>
<th>MLC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Properties</strong></td>
<td>Free formaldehyde</td>
<td>Less formaldehyde content</td>
<td>Less formaldehyde content</td>
<td>Less formaldehyde content</td>
<td>Less formaldehyde content</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>DMDEU</td>
<td>MDEU</td>
<td>MDEU</td>
<td>Methyl melamine</td>
<td>Methyl melamine</td>
</tr>
<tr>
<td><strong>Reaction</strong></td>
<td>Catalyst</td>
<td>Self-crosslikable</td>
<td>Catalyst</td>
<td>Catalyst recommended</td>
<td>Catalyst recommended</td>
</tr>
</tbody>
</table>
**Blocked isocyanates in aqueous environment**

POLYCROSS® BI blocked isocyanates are the result of synthesising the reaction between an isocyanate and a protection element (commonly called blocking agent) to produce an isocyanate adduct with no free NCO groups, which is stable in resin preparations with temperatures up to almost 60°C.

POLYCROSS® BI cross-linking agents, among others, are used in coating, printing, adhesive, water-repellent formulations, etc., which are applied to various textile substrates with resins that have a polymeric structure capable of organising itself according to temperature; allowing the functional groups of the isocyanate to react with the reactive groups of the polymer and of the fabric, resulting in compounds with high molecular weight.

The thermal dissociation of these blocked isocyanates produces a variety of link mechanisms according to the composition of the actual polymer to be cross-linked. Normally, the groups of the isocyanates react with the aromatic nuclei between 80 and 100°C and with the aliphatic groups between 120 and 150°C.

The process of dissociation by temperature of this type of cross-linking agents is merely the opposite of the reaction between the isocyanates and the blocking agent. In the specific case of the POLYCROSS® BI series, the blocking agents remain stable until 80°C and begin to dissociate with energy after 110°C due to a complex proton exchange system.

In the dissociation process, the proton joined to the nitrogen atom in the urea allows the transfer of the adjacent proton corresponding to the nitrogen atom of the blocking system, causing the subsequent reorganisation of the ring when the temperature rises above 100°C. The transfer of the protons at temperatures below that mentioned above is cancelled out by the presence of hydrogen atoms belonging to the polymer or polymers to be cross-linked.

It is important to stress that the final properties of a finish with resins can rarely be attributed to a single component of the formulation, but the use of an isocyanate makes it possible to obtain measurable values, such as resistance to abrasion, to hydrolysis, adhesion, solidity to washing and light, etc., unlike formulations that do not contain isocyanate.

**Properties**

The functionality and structure of the POLYCROSS® BI cross-linking agents have an important effect on the chemical resistance of the finish. For example, polyester-based polyurethanes are sensitive to hydrolysis in acid, basic and even, in certain cases, neutral conditions and are unsuitable for applications that entail extended exposure to high temperatures. Polyurethanes derived from polypropylene oxide have no hydrolysis problems but, when exposed to temperatures of 30°C or less, their physical-chemical properties are substantially altered and they lose their flexibility. The use of our blocked isocyanates solves the problems of both these cases, since exceptional chemical resistance to a broad range of temperatures and pH levels is achieved.

The flexibility of a finish with resin cross-linked using a blocked isocyanate is less affected than might have been initially expected. This property is determined by the mobility of the structure immediately after the group cross-linked by the isocyanate, unlike the cross-linking systems based on aziridines or polysiocyanates (POLYCROSS® RT) or melamine resins (POLYCROSS® ML), which produce much more rigid structures.

A considerable advantage of using POLYCROSS® BI cross-linking agents is that they grant excellent adhesion to a broad range of substrates. The choice of the blocked isocyanate to be used plays an essential role in determining the force of the link joining the isocyanate and its support. Adhesion is a complex process that includes dynamic interactions at molecular level between the surface of the substrate and the layer in contact with the latter, which involves factors such as the viscosity of the compound, its extensibility, the polarity of the various compounds of the formulation, the grammage of the deposit, etc.

The design of a formulation that can fulfil all the properties, considering the variety of substrates, application systems and types of resins commonly used, requires a composition and stability which, in many cases, are beyond the reach of the formulator; however, a compromise can be obtained when the maximum number of parameters are taken into account in the design of these preparations.

It is important to remember that there are two main factors that lead to satisfactory adhesion of the resins on the substrates when the blocked isocyanates are used.

First of all, the cross-linking agent must be perfectly dispersed within the formulation and, secondly, the resin must be deposited on the substrate as evenly as possible to facilitate the subsequent chemical reactions, since the isocyanate in its dissociation phase, which started with drying, must react with the radicals of the polymer and the substrate at the same time. Therefore, meticulous control of the kinetic reaction, extensibility and interactivity between the various components of the formulation is required.

The blocking agents used by the POLYCROSS® BI play an essential role in the process of forming the structure of the finish, since the residual element of the dissociation breaks down immediately without reacting with any other component that the formula may contain, such as pigments, silicones, thickening agents, etc., without therefore altering its capacities such as feel, colour, etc.