Hydrophilic Monomers

Polysciences, Inc. Announces the Availability of a Series of Hydrophilic Monomers for Research Applications

Introduction of hydrophilic properties into polymers is required in applications where higher water and oxygen transmission rates are desirable without sacrificing basic mechanical or physical properties of the polymer backbone. This property balancing act is particularly critical in end uses such as optical lenses, membranes, biomedical devices (e.g. topical dermal patches), breathable coatings and other high value-added applications.

Hydroxyl Functional Monomers

(HEMA-10) Poly Ethoxy (10) ethyl methacrylate (CAS # 25736-86-1)

This homolog of HEMA bears 10 ethoxy units on the ester linkage. These water soluble pendant, non-ionic side chains not only increase water compatibility in the polymer but can enhance stabilization of latex systems alone or in combination with added non-ionic surfactants.

Hydroxypolyethoxy (10) Allyl Ether (CAS # 27274-31-3)

Where ester groups are undesirable due to hydrolytic conditions, allyl ethers may be useful in vinyl polymerizations through the allylic olefin to impart hydrophilic properties in aqueous solution or emulsion polymers.

These higher homologs are extensions of the Polysciences, Inc. hydroxyethyl methacrylate-HEMA (Cat. # 04675) currently available as a high purity optical monomer.

N, N-Dimethylacrylamide, 99.9% (CAS # 2680-03-7)

Amido functional monomers increase hydrophilic properties and copolymerize well into a range of acrylate and methacrylate systems. This exceptionally high purity monomer is ideal for research in optical lens applications.

Physical Property Profiles of Ethoxylated Monomers

<table>
<thead>
<tr>
<th></th>
<th>(HEMA 10) Poly Ethoxy (10) ethyl methacrylate</th>
<th>Hydroxypolyethoxy (10) Ally Ether</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Weight</td>
<td>526</td>
<td>498</td>
</tr>
<tr>
<td>Ethylene oxide, moles</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Active Content (%)</td>
<td>90</td>
<td>99</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Hydroxyl number (meq KOH/mg)</td>
<td>98</td>
<td>115</td>
</tr>
<tr>
<td>Inhibitor (p-benzophenone, ppm)</td>
<td>800</td>
<td>—</td>
</tr>
<tr>
<td>Appearance</td>
<td>Viscous Liquid</td>
<td>Low Viscosity Liquid</td>
</tr>
</tbody>
</table>

Physical Property Profile of N, N-Dimethylacrylamide

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Weight</td>
<td>99</td>
</tr>
<tr>
<td>Purity (%)</td>
<td>99.9</td>
</tr>
<tr>
<td>Water (%)</td>
<td>0.1</td>
</tr>
<tr>
<td>Inhibitor (MEHQ, ppm)</td>
<td>50</td>
</tr>
<tr>
<td>Appearance</td>
<td>Clear Liquid</td>
</tr>
</tbody>
</table>
Hydrophilic Monomers

Ethylene Glycol Dimethacrylate, 99.7% (CAS # 97-90-5)
Where crosslinking of acrylate or methacrylate polymers is required to achieve a porous network structure, ethylene glycol dimethacrylate may be used as a high purity crosslinker with bridging/spacing capability between polymer chains.

**Physical Property Profile of Ethylene Glycol Dimethacrylate**
- Molecular Weight: 198
- Purity (%): 99.7
- 2-hydroxyethylmethacrylate (%): 0.3
- Appearance: Clear Liquid

Acid Functional Monomers

**Methacrylic Acid, 99.9% (CAS # 79-41-4)**
High purity carboxylated monomers increase the hydrophilicity in polymers and provide crosslinking sites for divalent ions (e.g. Zn++.)

**Beta-Carboxyethyl Acrylate, 99% (CAS # 24615-84-7)**
Polysciences, Inc. offers both methacrylic acid in high purity (99.9%) and a longer chain analog, Beta-Carboxyethyl acrylate (99%).

**Physical Property Profiles of Acid Functional Monomers**

<table>
<thead>
<tr>
<th>CAS #</th>
<th>Methacrylic Acid</th>
<th>Beta-Carboxyethyl Acrylate</th>
</tr>
</thead>
<tbody>
<tr>
<td>79-41-4</td>
<td>86</td>
<td>144</td>
</tr>
<tr>
<td>Molecular Weight</td>
<td>198</td>
<td>24615-84-7</td>
</tr>
<tr>
<td>Purity (%)</td>
<td>99.9</td>
<td>99</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>0.05</td>
<td>0.70</td>
</tr>
<tr>
<td>Inhibitor (MEHQ, ppm)</td>
<td>200</td>
<td>1,000</td>
</tr>
<tr>
<td>Appearance</td>
<td>Clear Liquid</td>
<td>Slightly Viscous Liquid</td>
</tr>
</tbody>
</table>

Sulfonated Monomer

**Sodium 1-Allyloxy-2 hydroxypropyl Sulfonate (CAS # 52556-42-0)**
Sodium salt of the allyl ether sulfonate. It readily undergoes vinyl polymerization reactions in aqueous or emulsion systems and provides a bound source of anionically charged sulfonate groups in a polymer backbone. Anionic charge assists in latex particle stabilization in low surfactant systems but also aids in downstream formulation work to avoid the addition of high levels of excess surfactants for formulation stabilization. This improves water resistance in formulations and provides low foaming properties.

**Physical Property Profile of Sodium 1-Allyloxy-2-hydroxypropyl Sulfonate**
- Molecular Weight: 218
- Water (%): 60
- Active Polymer (% in aq. sol.): 40
- pH (10% in water): 7.5

Other Specialty Monomers

**Diallyl Maleate (CAS # 99-21-3)**
Diallyl ester of maleic acid. Once polymerized through the vinyl center adjacent to the ester groups, it provides multiple post-functionalization target sites at the pendant allylic centers. This makes it particularly useful both in acrylic chemistry but also in combination with alkyd and polyester resins. When employed at very low levels it is an effective site for branching generation in emulsion polymers.

**Physical Property Profile of Diallyl Maleate**
- Molecular Weight: 196
- Moisture (%): 0.05
- Active Monomer (%): 99
- Acidity Value (meq/gm): 0.1

**2-Cyanoethyl Acrylate (CAS # 106-71-8)**
Used in a wide range of applications including photocurable resists for liquid crystal devices, photocurable polymer insulators for multilayer circuitry, electroluminescent products, graft polymers for controlled diffusion, vulcanization of rubbers and as an adhesion promoter. It is not to be confused with the alpha-cyano ethyl acrylate which is used in some Super Glue® products.

**Physical Property Profile of 2-Cyanoethyl Acrylate**
- Molecular Weight: 125
- Moisture (%): 0.2
- Inhibitor (HQ, ppm): 700
- Acidity Value (meq/gm): 0.03
- Appearance: Light Yellow Liquid

**Allyl Phenyl Ether, 98% (CAS # 1746-13-0)**
High purity monomer which has a high refractive index allowing it to be used as a synthon in modifying polymer refractive index properties.

**Physical Property Profile of Allyl Phenyl Ether**
- Molecular Weight: 134
- Specific Gravity (20°C): 0.97
- Purity (%): 98
- Refractive Index (20°C): 1.52
- Boiling Point (C): 185
- Appearance: Amber Liquid

<table>
<thead>
<tr>
<th>Description</th>
<th>CAS #</th>
<th>Cat. #</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>(HEMA 10) Poly Ehtoxy (10) ethyl methacrylate</td>
<td>25736-86-1</td>
<td>24890</td>
<td>100g</td>
</tr>
<tr>
<td>Hydroxypolyether(10) Allyl Ether</td>
<td>2774-31-3</td>
<td>24899</td>
<td>100g</td>
</tr>
<tr>
<td>Ethylene Glycol Dimethacrylate, 99.7%</td>
<td>97-90-5</td>
<td>24896</td>
<td>250g</td>
</tr>
<tr>
<td>N, N-Dimethacrylamide</td>
<td>2680-03-7</td>
<td>24895</td>
<td>100g</td>
</tr>
<tr>
<td>Methacrylic Acid, 99.9%</td>
<td>79-41-4</td>
<td>24897</td>
<td>250g</td>
</tr>
<tr>
<td>Beta-Carboxyethyl Acrylate, 99%</td>
<td>24615-84-7</td>
<td>24891</td>
<td>100g</td>
</tr>
<tr>
<td>Sodium 1-Allyloxy-2 hydroxypropyl Sulfonate</td>
<td>52556-42-0</td>
<td>24898</td>
<td>100g</td>
</tr>
<tr>
<td>Diallyl Maleate</td>
<td>99-21-3</td>
<td>24892</td>
<td>100g</td>
</tr>
<tr>
<td>2-Cyanoethyl Acrylate</td>
<td>106-71-8</td>
<td>24893</td>
<td>100g</td>
</tr>
<tr>
<td>Allyl Phenyl Ether, 98%</td>
<td>1746-13-0</td>
<td>24894</td>
<td>100g</td>
</tr>
</tbody>
</table>
Labeling of Polymers “Looking for Trouble”

The title is not designed to highlight how you can get into trouble by labeling polymers (although some may disagree). Rather, this article is about how labeled polymers can serve as sentinels or beacons to determine when trouble is near. There are numerous technical references and articles where labeled, tagged or UV active polymers have been used to detect or otherwise signal the presence of alien compounds. There are also a variety of other types of light emitters such as Quantum Dots, Organic Light Emitting Diodes (OLEDs) and electroluminescent compounds but this brief overview focuses on some intentionally functionalized synthetic polymers that can act as signaling agents.

Fluorescence in Polymers

One of the recent collated references on fluorescent polymers is entitled “Fluorescence of Supermolecules, Polymers and Nanosystems.” (Springer Series on Fluorescence, Vol. 4, M.N. Berberan-Santos-editor, XVIII, 2008)

Synthetic acrylic polymers (e.g. polyacrylates and polymethacrylates) are uniquely versatile in their ability to accommodate the introduction of fluorescent acrylic monomer probes. The reactivity ratios of acrylate type fluorescent monomers means they incorporate well into acrylate or methacrylate polymers and can be tailored to have different excitation and emission maximum. These capabilities are useful in studying the mobility of polymers in matrices, chain to chain interactions between polymers and for monitoring the type of environment the fluorescent probe sees during solution experiments or when included in cellular structures.

Fluorescent Microgel Thermometers

Reports of the synthesis of poly(N-isopropylacrylamide) labeled with a polarity responsive fluorescent monomer (benzofurazan molecule DBD-AE) have been designed to create fluorescent molecular thermometers. Once the temperature threshold in a solution of the microgel particles is reached, the particles fluoresce strongly. (Iwai et. al, J. Mater. Chem., 15, 2796-2800, 2005)

Medical Imaging

The use of fluorescing polymers is increasing in importance for monitoring the drug release from implantable polymers in medical imaging. A series of biodegradable polymers including poly(ethylene glycol)-(L) lactic acid) and polycaprolactone-PEG blends were studied with inherently fluorescing anticancer drugs such as topotecan and camptothecin. Using Fluorescence Lifetime Imaging Microscopy (FLIM), the release of the cancer drugs from the polymer in phosphate buffered saline were examined. (Nowaczyk et. al. at www.aapsj.org/abstracts/AM_1999/2206.htm)

Weapons against Cancer

Researchers at the University of Michigan are taking a unique approach to treating cancer. Dendrimers (multi-pronged star shaped polymers) growing off the surface of gold nanoparticles (3 nm particles) may be functionalized with folic acid/fluorescent probes and anticancer drugs. Since cancer cells have many more folic acid receptors, they bind to the dendrimer folate sites engulfing the gold nanoparticles with the imaging probes and the cancer drug. The fluorescent dye permits microscopic visualization inside the cell. (Dr. James Baker et. al. ‘Small’, July 2007 edition)

Biodegradable poly(lactic/glycolic acids)

Amino fluorescein has been used to couple with acid groups of biodegradable polymers rendering them visible during the degradation process. Using 5-amino fluoresceinamine, a 50:50 poly(lactic acid-glycolic acid) copolymer with free carboxylic acid was tagged. Lyophilization of the resulting polymer provides a labeled polymer whose rate of degradation and size of hydrolysis fragments can be tracked. (Stracke et. al. Journal of Investigative Dermatology, 126, page 2224, 2006)

Detecting Chemical Agents

Georgia Institute of Technology researchers have focused on using modified PPEs (poly paraphenylene ethynylene) which have inherent fluorescence to detect the presence of chemical agents such as cholera and anthrax. Fluorescent polymers will also detect peroxides which are often used in explosive devices. (Sanchez and Trogler, J. Mater. Chem., 18, 5134, 2008)

**Labeling of Polymers “Looking for Trouble”**

Europe: +(49) 6221-765767  Fax: +(49) 6221-764620  email: info@polysciences.de  www.polysciences.com
Polysciences, Inc. now offers the latest in silica based “precious metal” recovery systems for heavy metal scavenging of heterogeneous or homogeneous catalysts.

Thiol-SAMMS® stands for “Self Assembled Monolayers on Mesoporous Support.” Molecularly engineered mesoporous functionalized silica has the unique ability to bind palladium and other precious metals. The high surface area and functional thiol binding sites give the Thiol-SAMMS® tremendous capacity and kinetics to absorb such metals very quickly in catalyzed reactions.

Advantages of Thiol-SAMMS® technology:

• Adsorption of 99% of targeted metals in minutes
• Capacity up to 60% of SAMMS® weight
• Operational over a wide pH range (pH 2-12)
• Meets the requirements of TCLP (EPA Toxicity Characteristic Leaching Procedure)
• Allows for the reclamation of metals and adsorbents

Polysciences, Inc. offers a test kit for quick sample evaluations that includes THMS-03 (100 grams) and THMS-M1 (100 grams) for testing of laboratory scale waste stream removal.

For convenience in laboratory scale testing, Polysciences, Inc. also offers a rare earth block magnet (Neodymium-Iron-Boron) or our BioMag® Multi-SEP Magnetic separator magnet that will accommodate test tubes for metal separation.

New High Potency Linear Polyethylenimine “Max”
New Molecular Weight 4,000*

(Equivalent to Mw ~2,500 in free base form)

Cationic polymers with free nitrogen groups are difficult to produce from cationic monomers with unprotected amine groups as the starting materials. Polysciences’ current range of linear polyethylenimines are offered in three molecular weights; 2,500, 25,000 and 250,000.

Polysciences, Inc. is pleased to announce the availability of a new molecular weight of a virtually fully hydrolyzed linear polyethylenimine with longer contiguous ethylenimine segments. Our material is supplied as a hydrochloride salt for ease of handling but may be converted into the free amine form by neutralization with base.

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**New**

**Thiol-SAMMS® Metal Scavenger Kit**

Our high potency Polyethylenimine “Max” is supplied as a hydrochloride salt for ease of handling.

**Labeling of Polymers**

Water Soluble Fluorescing Polymers

The incorporation of FITC (fluorescein isothiocyanate) with t-butyl acrylate monomer and an amino monomer, designated as M-2, creates a water soluble fluorescing polymer. The high luminescence of this polymer in water allows for detection when bioconjugated with target biomolecules and cells.


Fluorescent Polymeric Microparticles

Among the advantages of the polymeric microparticles is their ability to accommodate different wavelength emitters, producing many distinct channels for detection. Polysciences, Inc. offers a wide range of fluorescent microparticles useful for many applications.

• Diagnostic systems including lateral flow assay kits
• Cell tracing by conjugate labeling
• Fluorescent labels for conjugation with proteins
• Flow cytometry
• Tracing water flow
• Attachment to bioactive molecules and removal magnetically
• Inclusion in product to identify the point of manufacture

Polysciences, Inc. offers a wide range of standard products as well as custom synthesis of labeled polymers for specialized applications, please contact us or visit www.polysciences.com for more details.

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**Elemental Analysis of Polyethylenimine “Max” 4,000 Mw**

(Equivalent to Mw ~2,500 in free base form)

<table>
<thead>
<tr>
<th>Theoretical *</th>
<th>%C</th>
<th>%H</th>
<th>%N</th>
<th>%Cl</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Found</td>
<td>28.99</td>
<td>7.47</td>
<td>16.52</td>
<td>42.06</td>
<td>95.042</td>
</tr>
</tbody>
</table>

* based on 5.4% water content

**Description**

**Polyethylenimine, Linear**

- 2,500 24313 2g
- 25,000 23966 2g
- 250,000 24314 2g

**New Polyethylenimine “Max”**

- -2,500 (in free base form) 24885 2g
- **-25,000 (in free base form)** 24765 2g

* Nominally 4,000 Mw in hydrochloride salt form (calculated value).
** Nominally 40,000 Mw in hydrochloride salt form.