POLYMER SLURRY

Typical end products
Polymers and copolymers such as nitrile butadiene rubber (NTB), polyvinyl alcohol and polyacrylates.

Chemical curve: R.I. at Ref. Temp. of 20˚C

Application
Polymerization is commonly done as a solution in stirred reactors. A charge normally consists of monomer, initiator, and a liquid reaction medium (e.g. a solvent or water). Different monomers can be combined to improve the final properties and produce advanced technical polymers.

The reaction starts once the initiator is added. During polymerization, the initially non-viscous liquid monomer is converted into a polymer solution with increasing solution viscosity. As the reaction proceeds, the amount of monomer decreases, and the polymer concentration increases, changing the refractive index value of the polymer slurry.

The reaction continues until the target conversion or polymerization degree is reached. At that point, other ingredients are added, or the polymerization is simply stopped. After polymerization, the polymer slurry is removed from the vessel and is pumped to further treatment and purification, for example, through distillation, condensation, filtration or monomer recovery.

The polymerization reaction can be carried out at low or elevated temperatures and it can take several hours. The amount of reactants and reaction end-point typically depends on the polymer specific recipe. Manufacturers that produce more than one polymer or copolymer, usually have different recipes for each product based on the polymer’s refractive index or viscosity value.

Instrumentation and installation
The K-Patents Process Refractometer PR-43-GP provides accurate and reliable refractive index measurement of the polymer slurry. The

Introduction
Polymers are macromolecules built up by a large number of small molecules called monomers. Polymers are found everywhere in our everyday life and are used for many purposes, for example, for packaging, paints, fabrics, rubber, plastic bags, electric components and medical supplies.

Polymers are produced through chemical reactions that combine monomers into large polymer molecules. This process is known as polymerization. If the resulting polymer involves two or more types of monomers, the process is known as copolymerization.

Polymerization on an industrial scale is conducted using five basic methods: bulk, solution, suspension, emulsion, and gas-phase. In all polymerization processes, the reaction should be closely controlled as the polymer properties are very sensitive to the operational conditions. Control of the polymerization results in high quality specialty polymers that meet specific applications and market requirements.
refractometer is installed in-line in the bypass line of the reactor or directly at the bottom of the vessel, through the steam jacket. The continuous measurement of the refractometer reduces the need for sampling and laboratory analyses, promoting safe processing, and increased productivity.

Changes in the refractive index can be monitored in real-time to follow closely the polymerization reaction and the degree of polymerization. The K-Patents PR-43-GP indicates when the target conversion and reaction end-point are achieved. This increases monomer conversion and polymer productivity.

The measurement by the refractometer also provides valuable information for better understanding of the reaction. For example, the residence times can be optimized, and the concentration of residual monomer and side-products can be minimized. The presence of excessive monomer or other components in the polymer slurry might have a negative effect in post-polymerization treatments and require more costly operations.

Conventional methods to monitor polymerization, such as Gas Chromatography (GC) or laboratory tests, require time-consuming sampling and analyses. In addition, solvent evaporation, variations in the sampling line versus the reactor, and the operator’s own assessment are sources of error.

In-line viscosity is also widely used for monitoring polymerization. However, some polymerization reactions are very sensitive to the amount or concentration of charged initiator. For instance, an excess of initiator will result in a solution that appears to not polymerize (polymer chains stay so short that gelation does not take place and the polymer stays in the solution). The K-Patents PR-43-GP provides a reliable measurement of all the dissolved material in the polymer slurry in order to identify problems and take corrective actions. The refractometer’s output signal can also be used for automatic dilution of the polymer product with water, when necessary.

The K-Patent refractometer is factory calibrated for the full refractive index and temperature range. The refractometer converts the measured refractive index and temperature values directly to concentration units for the given process medium. The conversion of the refractometer matches exactly the standard chemical curves. Alternatively, a refractive index based curve can be used for a refractive index set-point. Temperature changes are automatically compensated in the readings. Because of its unique 3-layer calibration method, the refractometer offers free interchangeability between applications or recipes without any mechanical adjustment. The refractometer is maintenance-free and does not require recalibration.

The precise, in-line measurement of refractive index by the K-Patents refractometer provides an important tool for controlling product quality, and optimizing the process.

Automatic prism wash may be required in this application. Hazardous and intrinsic safety approvals are available when required.

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<th>Instrumentation</th>
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<td>K-Patents Process Refractometer PR-43-GP</td>
<td>is a general industrial refractometer for pipes and vessel installations. The PR-43-GP can be installed with 2, 3 and 4 inch flange and 3 inch Sandvik L coupling process connections and a variety of flow cells for pipe sizes of 1 inch and larger.</td>
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| User Interface | Selectable multichannel MI, compact CI or a web-based WI user interface options allow the user to select the most preferred way to access and use the refractometer measurement and diagnostics data. |

| Measurement range | Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight. |