How to identify a potential application?

Introduction

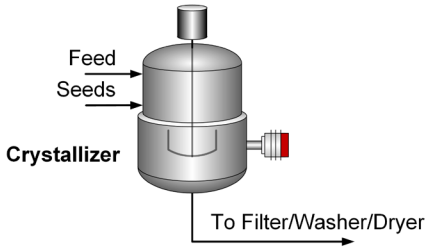
As a general rule, the K-Patents refractometer measures the concentration of any dissolved material in a liquid. A typical measured medium is a binary solution, but it can also be a mixture of more than two components. In multi-component solutions this is a checksum; if one of the components is wrong, the overall refractive index value changes.

The potential applications in different industries are countless. Although the manufacturing process, environment and processing medium vary from industry to industry, all basic unit operations and control strategies are roughly the same despite of the end product.

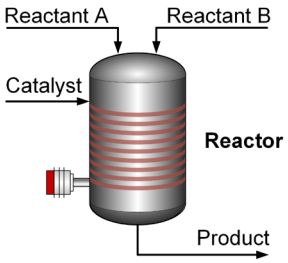
This guide is a summary to give you an idea how the K-Patents refractometer is used in different operations within a process manufacturing facility.

Basic guide to K-Patents applications

Crystallizer

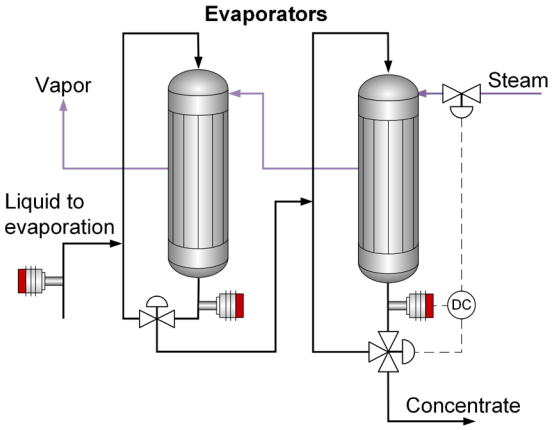


Supersaturation is the most important factor in a crystallization process as it influences crystal size and quality. Tight control of the process conditions, including mother liquor concentration and temperature results in high-yield and high-quality crystals. The K-Patents refractometer monitors the mother liquor concentration in order to determine the correct seeding point (evaporative crystallizer), or to detect when crystals begin to form (cooling crystallizer). The measurement by the refractometer is not influenced by the crystals formed and is selective to the liquid phase. This makes the K-Patents refractometer ideal to follow with high accuracy liquid-solid mass transfer operations. Therefore, the detection of the seeding point is accurate and repeatable. It is also possible to calculate the supersaturation based on the refractometer readings and other parameters of the liquid.



Reactor and reaction degree

In-line refractive index measurement makes it possible to follow in real-time the progress of a reaction. The refractometer monitors continuously the degree of the reaction and provides useful information to determine the exact end-point of the reaction. The reaction is completed when value levels out. Another common practice is to allow the reaction to proceed until a set refractive index value is reached. The refractometer's reading can also be used as an indication of the point at which other ingredients need to be added.

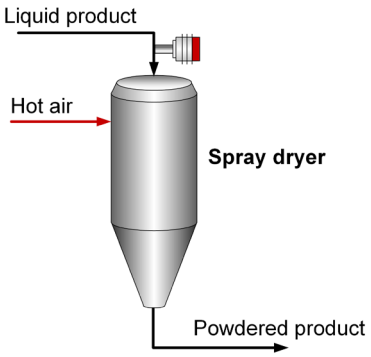


Evaporation, ultrafiltration, reverse osmosis

The main task for the K-Patents refractometer is to provide real-time information of concentration changes of a medium. The refractometer is ideal for operations where the liquid is being concentrated by means of, e.g. evaporation, ultrafiltration or reverse osmosis. The refractometer provides continuous information of the inlet, outlet and intermediate stages in the concentrator for process optimization. For instance, in an evaporator, the Ethernet or 4-20 mA output signals of the refractometer are used for controlling the heat source flow (steam) to make adjustments and achieve the target concentration. If the concentration of the product is under the specified value, the refractometer's signal controls the valves to either decrease the feed flow to the evaporators or to increase steam flow. With accurate in-line

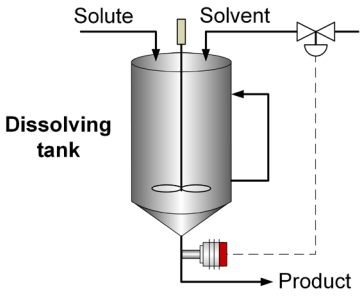
measurements the steam consumption is reduced, and the process optimized.

Spray-dryer



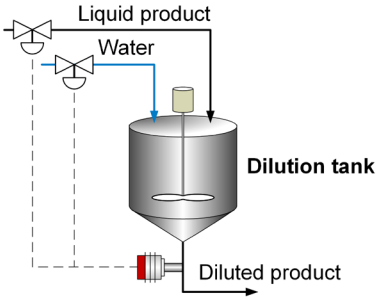
The K-Patents refractometer is used for monitoring the concentration of the feed line to the spray dryer. This measurement point is necessary to ensure the correct particle size after drying, and to increase the final product shelf life. An efficient drying operation also improves packaging by having the correct bag size and less weight due to the moisture.

Dissolving tank or vessel



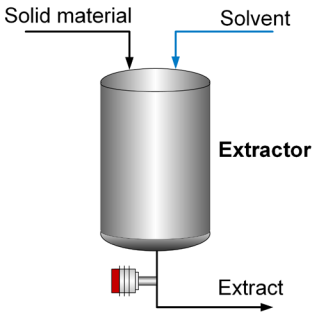
One of the most common applications for the K-Patents refractometer is dissolving. In this application, the refractometer measures continuously the concentration of the resulting solution as the solute dissolves into water or solvent. The refractometer provides instant information of the dissolving rate and dissolved solids amount. The refractometer's output signal can be used for automated control of the dissolving operation to always achieve the exact target concentration. This reduces man-labor and raw material usage, and it eliminates the need for sampling and off-line tests. Dissolving tanks with stirrers are common in this application. The stirrer can cause vibration or bubbles that are common source of error in other measurement devices. The K-Patents refractometer is not affected by undissolved matter, bubbles or vibration of the equipment.

Dilution, mixing or blending



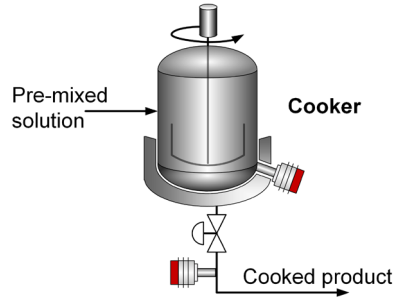
Dilution is a good application for the K-Patents refractometer. In the dilution process, a product is diluted with a solvent (most often water) to reduce its concentration value. The dilution can take place for example, in a tank or in a static mixer. The dilution process can be controlled by using the refractometer's output signals to control the feeding valves. The concentration signal is fed back to the controller to ensure stable and correct concentration out of the dilution or blending process. Similar to dissolving applications, the K-Patents refractometer is ideal for this operation as it is not influenced by bubbles that might be formed during the mixing.

Solid-liquid extraction



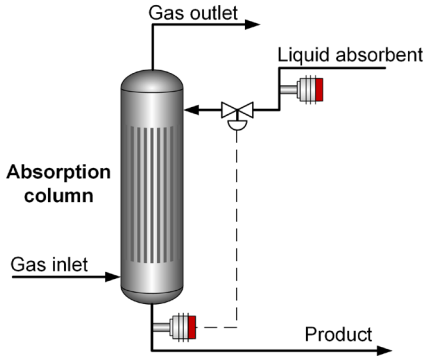
Solid-liquid extraction is a very common operation in the food, pharmaceutical and cosmetic industry to obtain ingredients from a natural raw material. The K-Patents refractometer is used to detect the amount of extracted substance (dissolved solids) in the liquid after the extraction process. The measurement by the refractometer is not affected by undissolved solids, only by the dissolved matter, making it ideal to follow extraction efficiency. The in-line measurement by the refractometer is valuable for making adjustments in real-time to increase the productivity and reduce costs.

Cooking process



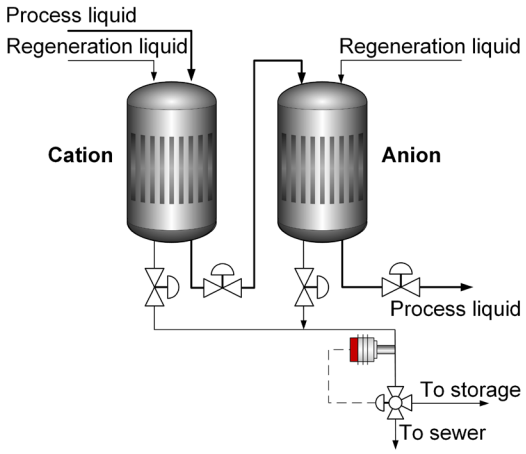
Cooking processes are common in the making of jam or sugar confections. In this process a mixture containing sugar is cooked until the right concentration is achieved. The refractometer is used to monitor in-line the refractive index as cooking takes place to determine the end-point, and to increase cooking yield and efficiency. The K-Patents refractometer can be installed directly in the cooker. This is particularly beneficial in cookers that work under vacuum, as there is no need to disrupt the process for sample taking.

Absorbers and wet scrubbers



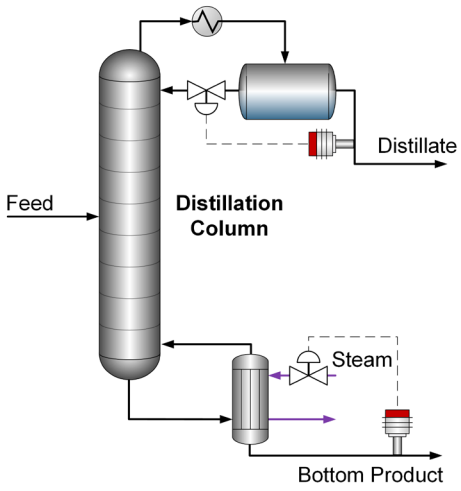
Absorption operations can be monitored and controlled with the K-Patents refractometer. In a liquid-gas contactor or wet scrubber, a gas is purified by absorbing a solute into a liquid stream. The absorption efficiency can be followed by a refractometer in the outlet stream from the column. In some liquid-gas operations, the mass transfer is maximized at a certain concentration of the absorbing liquid. The K-Patents refractometer is used also to monitor the concentration of the inlet liquid to ensure the operation is within the optimal conditions, and to maximize the separation.

Ion-exchangers



Ion-exchange resins are often used for purification of liquids. With time, the resins get saturated with the trapped ions and need to be regenerated to improve process efficiency. The refractometer monitors the interface between the product and the rinse water, or the liquid at the outlet line from the ion-exchange columns prior to the regeneration process. Typically, the sensor is installed in the waste line before the divert valve. The Ethernet and 4-20 mA output signals from the refractometer are used to open and close the valves and direct the flow to the process line or sewer.

Distillation



Distillation is one of the most common and important unit operations. In distillation, a mixture of chemicals is separated into its pure components based on their unique boiling points. Control of distillation is essential to meet product specifications, reduce investment and energy costs and limit environmental impact. These goals can be achieved by maintaining the purity of the column's top and bottom products within

the given specifications. The K-Patents refractometer monitors in real-time the concentration of the distillation products. The refractometer is installed directly in the line after the column (bottom) or after the condenser (distillate). The Ethernet or 4-20 mA output signals of the refractometer can be used to adjust automatically the columns reflux or boil-up to meet product specifications. In binary systems, the refractometer provides accurate information of the product concentrations. In multi-components system, control can be based on a property which is a function of the composition.

Interface detection and product identification

Refractive index (RI) is an intrinsic property of the liquids and is a useful method for their identification. The high reliability and fast response time of the K-Patents refractometer provides an ideal optical detection method that can be used as a *fingerprint* for chemical identification and interface detection. The RI signal is used, for example, for detecting product-to-water, product-to-CIP liquid and product-to-product interfaces. This information is necessary for complete automation of CIP, filling line processes and chemical loading and unloading operations.

Quality control

The final product quality can be monitored with refractive index. As all liquids have a unique refractive index value, the K-Patents refractometer can determine the final quality of the liquid and ensure that the product is within the specifications. Real-time detection provides fast information of process disturbances and potential quality variations.