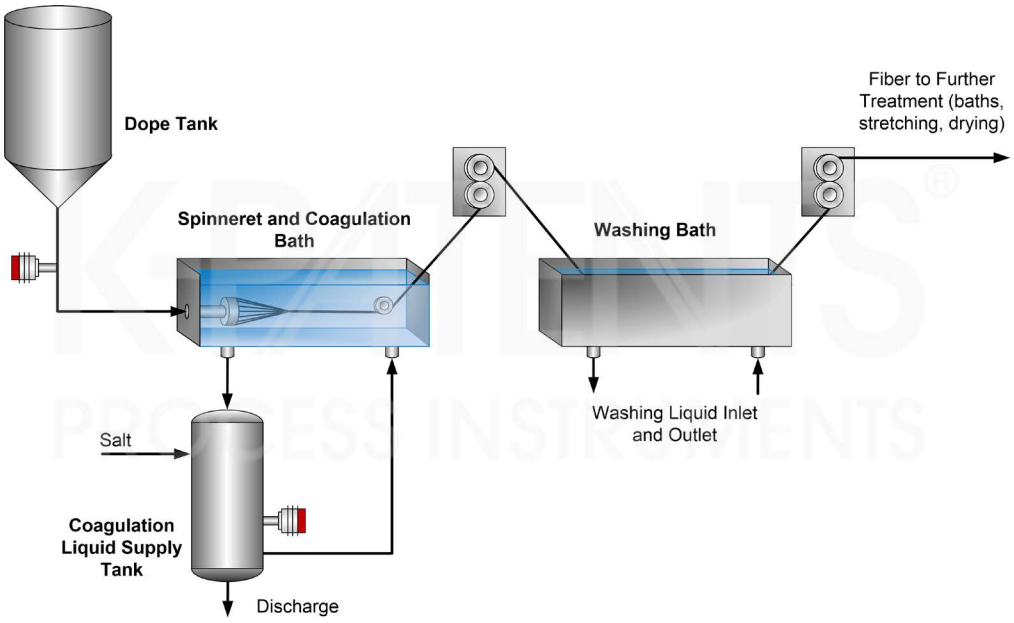
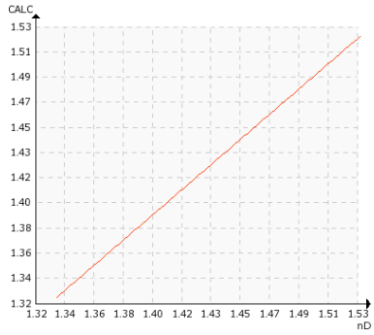


SODIUM ALGINATE, $NaC_6H_7O_6$, CALCIUM CHLORIDE, $CaCl_2$

Typical end products

Alginate fibers, such as sodium alginate, calcium alginate or hybrids for the production of wound dressings and medical fabrics.

Chemical curve: R.I. at Ref. Temp. of 25˚C



Introduction

Alginates are biopolymers extracted from brown algae species such as seaweed. They have a variety of uses in different industries because of their unique properties. These materials have been extensively used in pharmaceutical applications as they are gel forming, non-toxic and highly absorbent.

Fibers made of alginate have become very popular for the production of wound dressings. These fibers are biocompatible, have hemostatic properties and accelerate the healing process by creating a gel that keeps a moist interface on the surface of the wound. The composition of the fibers can be modified by a controlled process to enhance their hemostatic properties and obtain fibers with additional healing effects.

Application

Alginate fibers are produced by a *wet-spinning process*. It is called wet-spinning because the fibers are extruded directly into a solution or bath. The bath is usually a salt solution or a mixture of salts, containing metal ions, but it can also be an inorganic acid solution or an organic solvent depending on the desired final product. The most common salt is calcium chloride, but salts containing zinc, silver, and other bioactive additives, beneficial for wound healing, are also used.

For the production of the fibers, a *spinning dope* or *spinning solution* is prepared by mixing sodium alginate with water, to form a homogenous solution. The concentration ranges between 5 and 10 %. This solution is then spun directly in the coagulation bath through a spinneret or a nozzle, to convert the solution into fibers. As the sodium alginate contacts the salt bath, water is removed from the formed fiber leaving behind only the biopolymer (alginate).

Coagulation happens when the sodium ions come into contact with the polyvalent ions of the bath (e.g. Ca^{2+}). The sodium ions exchange places with the calcium ions to form calcium alginate, which is not soluble in water. The resulting fiber is washed, stretched and dried to obtain the final product. Additional baths can be used to alter the composition of the fiber and obtain additional wound healing properties.

The concentration of both, the solution dope and the coagulation bath, play an important role in the final product quality. If the concentration of sodium alginate in the solution dope falls too low neither coagulation nor formation of the alginate filament will take place. In addition, the hemostatic property depends on the concentration of the alginate.

As sodium alginate is extruded, the coagulation bath inevitably gets diluted. The concentration of the bath should also be monitored as the morphological structure of the fibers is affected by the composition of the salt.

Instrumentation and installation

The K-Patents Sanitary Refractometer PR-43-A provides real-time, accurate and reliable concentration measurement for ensuring the highest quality, purity and consistency in pharmaceutical applications.

A refractometer is installed directly on the filling line to measure continuously and precisely the concentration of sodium alginate solution pumped into the bath. The concentration of the dope solution ranges between 5 and 10 %, at a temperature of 35-50 ºC (95-122 °F). A second refractometer monitors the concentration of the coagulation liquid as water content builds up. To ensure a high product quality, the water content should be kept under 20 %.

The K-Patents refractometer provides Ethernet or 4-20 mA output signals for real-time process control. The concentration of the bath can be controlled and kept at its ideal value by a circulation system where more coagulation agent is added to restore the concentration.

The K-Patents PR-43-A refractometer is designed to meet all the pharmaceutical industry standards and regulations, and it is the ideal in-line process instrument for the Process Analytical technology (PAT) framework.

Instrumentation	Description
	K-Patents Pharma refractometer PR-43-PC for hygienic installations. The PR-43-PC is installed in the main processing line or vessel and no by-pass arrangements are required. Optional laboratory test cuvette (LTC) for off-line laboratory testing and validation.
	K-Patents Sanitary Compact Refractometer PR-43-AC for hygienic installations in small pipe line sizes of 2.5 inch and smaller. The PR-43-AC refractometer is installed in the pipe bend. It is angle mounted on the outer corner of the pipe bend directly, or by a flow cell using a 3A Sanitary clamp, I-clamp or Varinline® connection.
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.