Mixing technology
An introduction

Tetra Pak PROTECTS WHAT'S GOOD™

Table of contents

Introduction

Mixing – a key process with complex demands

Mixing is the process of dissolving, emulsifying or dispersing powder and liquid ingredients into a liquid medium. Mixing, a common operation in food processing, aims to efficiently achieve a smooth, homogenous product with consistent quality.

Food processors, and consumers, insist on a perfect product every time. To achieve this, food processors must stay in complete control of every aspect of their production from beginning to end. Mixing is a highly complex operation and often takes place early on in the process of food production. Thus, it is crucial for food processors to have the right mixing solution from the start and ensure complete control over the many factors that affect mixing efficiency and end-product quality.

This overview of mixing technology covers guidelines for producing various common consumer products and ingredients, important mixing parameters, formulations, and explains how to overcome the key challenges within mixing.

The right mixing solution maximizes product quality and operational efficiency

Powders

An overview of powder properties

The handling of ingredients in powder form has many advantages. Powder ingredients have longer shelf life and are smaller, lighter and more convenient to transport and store. This has lead to an increase in powder ingredient use.

A wide range of ingredients are available in powder form, including starches, fibres, vitamins, proteins, emulsifiers, stabilizers, spices, flavourings, probiotics, milk, and sugar. The various powder ingredients have very different characteristics, depending on what raw ingredients they are made from, and how they are modified to fit different processing needs and recipes. Some powders such as aspartame, powdered milk, and tea powders are prone to foaming and require special attention.

Understanding common stabilizers
Stabilizers are important functional ingredients in food production since product consistency often plays a decisive role in how consumers experience a product. But, they can be very difficult to incorporate into liquids without lumping occurring.

Stabilizers are based on either polysaccharides, such as potato, corn, and tapioca starches, or proteins such as casein and egg white. Other common polysaccharide stabilizers include pectin, guar gum, carboxylmethyl cellulose, and xanthan gum.

Certain powders, such as pectin, do not deliver their functional properties unless they have reached the correct temperature. Pectin, for example, needs to reach 80°C in order to be activated so that it protects the proteins in, for example, a milk-juice beverage.

Stabilizers are modified to meet specific processing needs. For example they must maintain the right functionality under end-product storage conditions and they may need to be able to be treated with high shear forces. This functionality may be the right mouthfeel, the right consistency for keeping particles in a solution, or that the product must be able to be frozen and thawed. Stabilizers, and other powders, may also be modified to make them easier to dissolve. These kinds of modified powders are called agglomerated powders.

Type of powder	High viscous	Foam	Lump	Dust	Low solubility	Cold swelling	Hot swelling
Aspartame		●			●		
Skim milk powder		●					
Maltodextrine			●				
Whey powder		●					
Tea powder		●		●			
CMC*	●					●	
Pectin	●		●				●
Cocoa powder			●		●		
Caseinat		●				●	
Starch	●					●	●
Gum agent	●		●			●	

* *Carboxy methyl cellulosa*

Solubility limits in powders

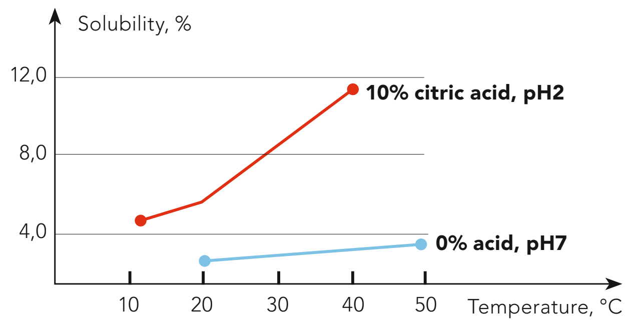
There are physical limitations on how much powder it is possible to dissolve into a liquid. Some common examples where the limits of solubility are important to consider are aspartame, lactose, and stabilizer ingredients.

In some powders, such as aspartame, pH affects solubility. For example, a citric acid solution of 10% and with a pH of 2 can accommodate a 5 to 8% solution of aspartame while a non-acidic solution can only accommodate a 1% solution of aspartame. Temperature also affects the solubility of aspartame. Higher temperatures allow more aspartame to be dissolved in a solution. The high temperature effect on aspartame solubility is even greater when combined with a low pH (see diagram at right). Aspartame is also more easily and quickly dissolved with the help of high shear forces.

Stabilizers and thickeners have a critical limit where viscosity increases so much that the liquid can no longer reach the inner particles in order to dissolve the powder. It is therefore crucial to know the final viscosity of an end product when working with stabilizers in powder form. It is also very important to understand how mixing technique must be adapted to ensure optimal mixing efficiency when working with stabilizer powders.

Ingredient suppliers modify stabilizers in various ways and use various raw materials to achieve various desired functionalities. This is why highly detailed information is required in order to make recommendations on what amounts are possible to dissolve in specific recipes. For example, when using pectin a 5% solution can vary in viscosity from 300cP to 3000cP.

The solution with lower pH enables a higher solubility of aspartame. The rate/amount of aspartame that is possible to dissolve in the solution increases more quickly when the low pH is combined with a higher temperature.



Mixtures
Two types of mixtures and their unique properties

Continuous phase	Dispersed phase: Solid	Dispersed phase: Liquid
Solid	Solid	Gel
Liquid	**Suspension**	**Emulsion**

Continuous phase **Dispersed phase**

This section describes two main types of mixtures handled in the mixing process. The first type of mixture is a suspension, defined as a mixture of solids and liquids. The second type of mixture combines liquids with other liquids to create an emulsion.

Classifications of mixtures

This document will focus on suspensions and emulsions, which are the mixtures most commonly used in the food industry.

Mixtures
Suspensions

Suspensions and their properties

A suspension is when denser particles are evenly dispersed in a less dense liquid. The goal in mixing suspensions is to achieve stability. This is achieved by counteracting their naturally unstable nature.

To achieve a stable suspension, it is important to understand the properties of a powder as well as what happens when powder and liquid meet. This understanding enables food processors to determine the most efficient way to introduce it into a liquid.

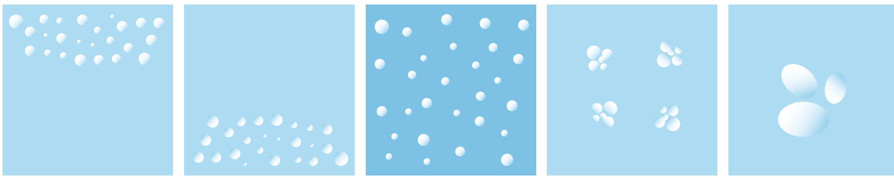
When powder is introduced to a liquid, the liquid penetrates through the pores of the powder with the help of capillary forces and increases the contact area between the powder and the liquid. Then, it is necessary to add energy in the form of heat and/or shear forces to wet and disperse the powder as quickly and efficiently as possible in the liquid.

Flocculation and sedimentation

Suspensions are unstable due to electrostatic forces between the ingredients and density differences in the dispersion. These can cause separation through flocculation, where particles clump within the product, or through sedimentation, where particles fall to the bottom of the liquid. Both flocculation and sedimentation may complicate further processing of the food product and potentially shorten the shelf life of a product.

Stability is achieved when particles remain equally dispersed in liquid without changing or separating over time. It is important to achieve stability to ensure the correct shelf life and end-product quality.

Creaming **Sedimentation** **Optimal** **Flocculation** **Coalescence**



Achieving efficient wetting and preventing fish eyes

Faster wetting prevents lumping and increases the overall efficiency of the mixing process. However, when a high-viscosity powder such as guar gum is added to a liquid too quickly and in too large amounts, the viscosity of that solution increases and the dissolution rate slows, hindering the thorough wetting of particles. The product then risks the formation of fish eyes, lumps of dry powder with an outer gelling layer.

How much shear force is required to prevent fish eyes and achieve a stable suspension depends on a number of factors including powder wettability and cohesivity.

When using certain powders, the viscosity of a solution can increase during dissolution. When the viscosity of a solution increases it may lead to decreased flow in the solution, which in turn leads to slower wetting and prolonged mixing time.

Wettability describes how much a solid is wetted by a liquid through the force of adhesion between the solid and the liquid phase. And cohesivity describes how tightly particles are attracted to each other.

Powders with high cohesivity, such as some food stabilizers, are more difficult to wet and benefit therefore from being pre-mixed with other more easily mixed ingredients such as sugar before being introduced to a liquid. This helps prevent issues such as fish eyes but also ensures that producers get the most possible function out of ingredients.

Mixing temperature is also important to consider in enabling a successful dissolution. At higher temperatures, more energy and faster molecular movement in the mix can increase the dissolution rate.

Mixtures
Suspensions

How to make a stable suspension
Stoke's law describes the separation behaviours of particles in suspensions.

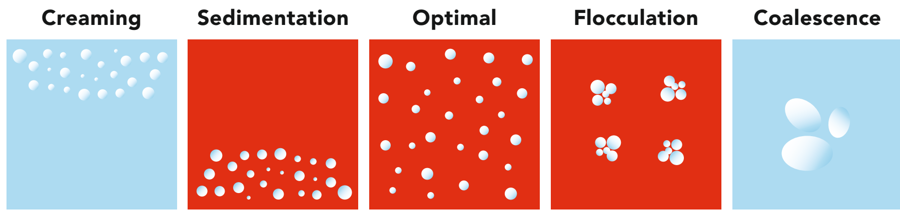
$$V = \frac{d^2\,(p_1 - p_{fl})}{18n}\,g$$

The settling velocity (V) is influenced by the particle diameter (d), the particle density (p_1), the density of the solution (p_{fl}) and the viscosity of the solutions (n); (g) describes the acceleration due to gravity.

According to Stoke's law, food processors may improve suspension stability by:

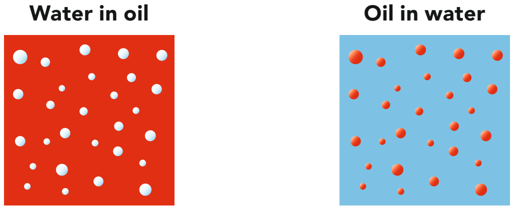
1. Decreasing the difference in density between the particles and the surrounding solution
2. Reducing particle size
3. Increasing the viscosity of the surrounding solution

The main types of separation in suspensions are flocculation and sedimentation



Mixtures
Emulsions

Emulsions and their properties
Emulsions are mixtures containing two liquid phases that do not naturally mix, one of which is dispersed in the other as droplets. There are two types of emulsions in the food industry – oil-in-water emulsions and water-in-oil emulsions. In oil-in-water emulsions, the oil phase is the dispersed phased and water phase is the continuous phase. This is the most common type of emulsion and examples include mayonnaises, dressings, soups, and sauces. In water-in-oil emulsions, which include margarines and spreads, water is the dispersed phase and oil/fat is the continuous phase.



For example margarine and spreads

For example mayonnaise, dressing, soups and sauces

Emulsions components

Oil phase
The oil phase (fats and oils), provide the main flavour of a product since fat carries a large amount aroma and flavour.

Water phase
The water phase includes water and water-soluble ingredients such as sugar, mustard seeds, proteins, vitamins, minerals, and some thickening agents.

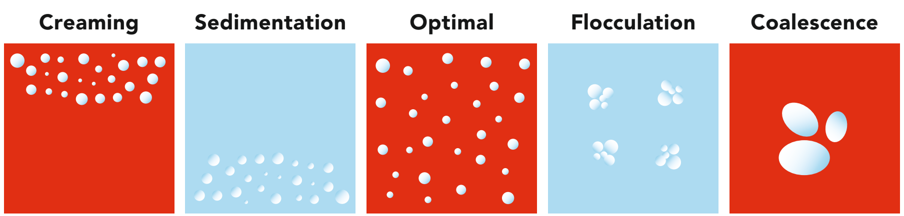
Emulsifier
Emulsifiers are the compounds that make emulsions possible by stabilizing the dispersed phase and the continuous phase. They reduce the interfacial tensions between the two phases. An emulsifier has one lipophilic tail, which loves the fat phase, and one hydrophilic head, which loves the water phase. This makes emulsions possible by connecting two phases that do not naturally mix.

Mixtures
Emulsions

Coalescence and creaming

The main types of separation in emulsions are creaming and coalescence, with fat separation as a result. Creaming occurs when the difference in density between the fat droplets and the surrounding liquid is too high, and makes the fat droplets rise to the surface. By reducing the droplet size, either through high shear mixing or homogenization, the speed at which the fat droplets rise to the top is slowed (see Stoke's law on page 10). Milk is one example of an emulsion where homogenization is necessary to reduce droplet size in order to prevent creaming, and increase stability.

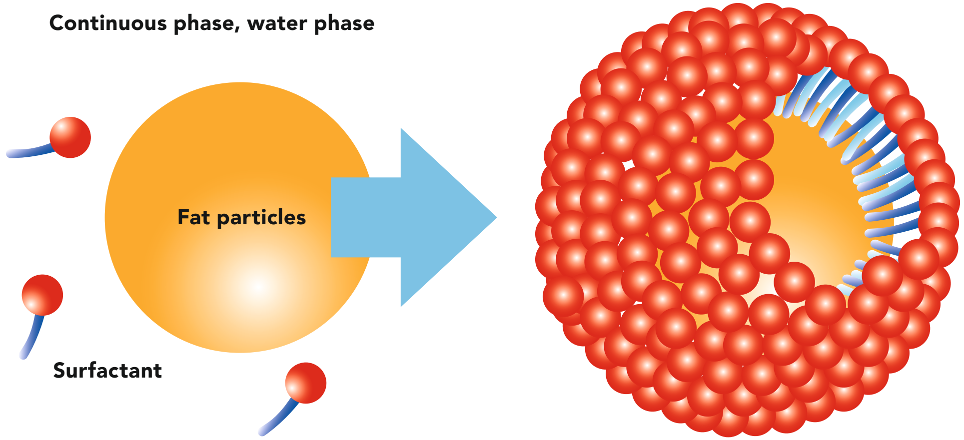
Coalescence occurs when small droplets form larger droplets in order to decrease the contact surface to the liquid. It is possible to prevent coalescence with the help of emulsifiers. Emulsifiers are surface-active compounds that adsorb at the interface of the two phases, lowering the interfacial tension that causes coalescence.



How to make a stable emulsion

Mixing fats and oils into water-based liquids is a major mixing challenge, since water and oil are insoluble in each other. Emulsification of fat into a water phase is, however, a fundamental step in the processing of many foods. The challenge lies in achieving a stable formulation where the oil phase is finely dispersed into the water phase, or less commonly, water is dispersed in oil.

Achieving a stable emulsion takes significant energy and requires the presence of emulsifiers such as proteins or specially designed emulsifying additives. The emulsifiers are surface-active molecules, meaning that one part of the molecule orients itself into the oil phase (the lipophilic tail) and the other part orients itself into the water phase (the hydrophilic head), thus forming a barrier that stabilizes fat globules. Without a stable emulsion, fat separates into an undesirable layer on top of the water phase. Droplet size is also important to the stability of an emulsion. The smaller the droplet size, the more stable an emulsion will be. The drop size of emulsions typically ranges from 1 to 10 µm.



Efficient mixing technology secures consistent quality and cost savings.

Mixtures

Understanding key mixing challenges

Air incorporation and foaming
One of the main challenges in mixing powders with liquids lies in preventing unwanted air and foaming. Air may be incorporated into a product by mixers with whipping action or when adding ingredients such as powder, which tends to trap air.

Air bubbles rise to the surface in a product. From there, they escape. However, if foam-stabilizing ingredients such as protein are present, they stabilize into foam at the product's surface instead. Air may dissolve into products and cause foaming later in the production process.

Air incorporation causes major problems in processing and end-product quality. Air in the product may cause increased fouling in heat exchangers, cavitation in homogenizers, and unwanted whey formation in fermented products. Fouling in heat exchangers leads to shorter running times and increased cleaning time. Cavitation in homogenizers leads to higher maintenance costs. In terms of product quality, air in the product can cause oxidation, both during processing and in the package on the way to consumers. Oxidation increases risk for off flavours, browning, and loss of sensitive nutrients such as vitamin C.

Air incorporation can also lead to significant product losses in production – if the air creates large volumes of unwanted foam in mixing tanks and other equipment, since foam is nearly impossible to remove.

Lumping

The formation of lumps when mixing powders with liquids also presents a challenge to food processors. Lumping is of particular concern when working with high viscous stabilizers and other powders, such as cocoa, that are difficult to wet. Lumps occur when a large amount of powder is added to the liquid phase all at once. When this happens, stabilizers can form a gelling surface around powder particles. The gelled surface prevents the liquid from fully wetting the powder and causes the powder to lump. The functionality of a stabilizer is not utilized efficiently when lumping occurs, meaning that more must be added to the recipe to achieve the same functional results.

Powder lumping reduces the stability of a product and may lead to sedimentation, which shortens shelf life. Lumps may also cause sterility problems in the product since the inner temperature of lumps may not meet the required temperature during heat treatment.

Clogging

The formation of particularly large lumps in a product is sometimes an issue if the cohesive powder ingredient has been exposed to moisture. These large lumps can cause clogging in equipment, reducing production capacity and operational efficiency.

The right solution conquers mixing challenges
Preventing air incorporation and foaming

The right solution overcomes the mixing challenges just described and ensures efficient operations with longer production hours, lower maintenance costs, and safe, high quality end products.

Choosing the right mixing equipment

It is important to look at the entire processing line and take all measures to minimize air and foam – especially when working with a product that is sensitive to air incorporation and foams easily. It is important to consider the type of mixing equipment, the design of surrounding equipment, how powder is added, and processing temperature. All these factors also depend on the specific ingredients and formulation of each unique specific product.

Advantages of vacuum mixing

Using a vacuum mixer is an effective way to minimize air incorporation and foaming in a product. In a vacuum mixer, the mixing tank is evacuated and vacuum is created inside. The liquid surface then borders vacuum instead of air. Thus, whipping action inside the mixing tank does not create air bubbles. In addition, ingredients are injected through powder inlets positioned on the mixing tank body well below the liquid surface. The valves regulating powder flow flip open and close intermittently in order to maintain vacuum inside the tank. Although vacuum mixing minimizes air in a product, all powders still trap some air in or between the powder particles, making it impossible to remove it all. In order to minimize air incorporation through powder addition, it is important to optimize the opening time of the valves.

Advantages of rotor and stator mixing

When not using a vacuum mixer, it is important to minimize mixing time and thus minimize time during which air could be incorporated into the product.

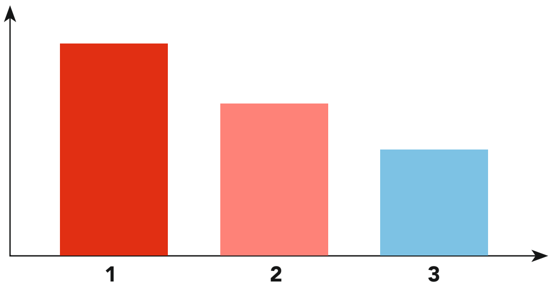
Minimizing mixing time requires an effective mixer. A robust solution for this is a mixer that utilizes a rotor and stator to produce the high shear forces required to efficiently dissolve, emulsify and disperse ingredients to achieve a smooth homogenous product and effective wetting of powder. In a mixing unit with a rotor and stator, liquid and powder is forced down to where the blades underneath the rotor push the mixture through the perforated stator. This motion creates the high shear forces required to ensure that both easily dissolved ingredients, such as skim milk powder, as well as typically difficult to dissolve ingredients, such as pectin and xanthan gum, dissolve efficiently and completely. The high shear forces are also strong enough to emulsify oils, providing that emulsifiers are present and that the oil phase is liquid.

It is also possible to use a rotor and stator mixing unit without vacuum, where powder is added on the liquid surface. However, it is then crucial to control the mixing vortex more carefully in order to prevent surface turbulence and to prevent the vortex from reaching down to the mixing head, both of which would incorporate air. It is also important that the mixer is placed deep under the liquid surface, ensuring calm rather than turbulent liquid surface and thereby avoiding air being whipped into the product.

Reduced air incorporation with vacuum mixers
This shows how air incorporation is minimized by using vacuum:

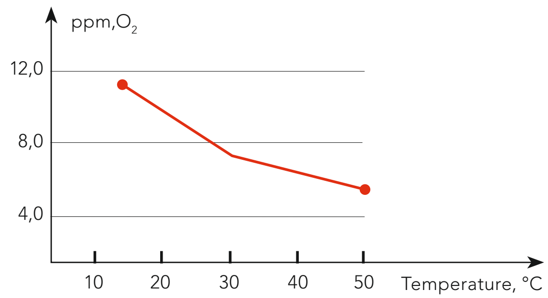
1. **High speed blender, like a pump and a powder hopper with venturi nozzle.**
2. **High shear mixer with a rotor and stator technique.**
3. **High shear mixer with a rotor and stator technique combined with a vacuum.**

Air in the product, volume index



The solubility of air in liquid at different temperatures
Since air incorporation affects the product so profoundly, measuring how much air is incorporated in a product and finding a solution to minimize it is important. Dissolved oxygen meters easily measure the dissolved air in ppm oxygen but "free air" or volume of bubbles is much more difficult to measure. With foam resting on top of the product, it is impossible to measure a homogenous product sample. However, it is possible to measure changes in total volume, since foaming increases volume, in order to determine how much air has been incorporated. This graph uses this measuring technique to show how air incorporation can be minimized by using a vacuum and rotor and stator mixing unit.

Choosing the right temperature
To further minimize air incorporation, it is also important to choose the right processing temperature for each product. For example, it is useful to perform the mixing process at a higher temperature since air is less soluble in a warm environment.



The right solution conquers mixing challenges
Preventing lumping and clogging

To prevent lumping and clogging, it is important to handle powder correctly, choose the right equipment with high shear forces, control how the powder is added to the mix and choose the right mixing temperature.

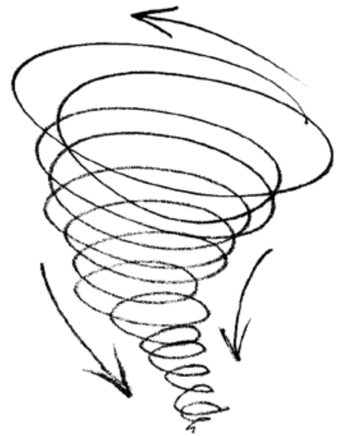
Some cohesive powders, such as stabilizers, tend to lump if not stored or handled properly. Powders stored in a humid environment, for example, absorb moisture and form lumps. Vacuum mixing makes it possible to store and dose the powder in a separate processing hall designed for storing and handling powders. This ensures that powders are not exposed to the humid environment of the mixing area and prevents related lumping and clogging issues.

Many powders that tend to lump, such as stabilizers, are also notoriously difficult to disperse. These difficult powders require high shear mixing to prevent lumping and clogging. The mixer may be mounted either below or inside the tank. To achieve the high shear forces required for full dispersion of difficult powder ingredients, it is important that the design of the tank and the rotor and stator are optimized.

Advantages of batch mixers
When dealing with difficult powders and highly viscous products, batch mixers, with the mixing unit inside the mixer tank, are the ideal solution. Dosing powder on the liquid surface and transporting it quickly down towards the mixing head in a controlled vortex, achieves optimal wetting of powder by ensuring maximum exposure to the liquid medium. Since there are no circulation loops around the mixer, the entire mixture in the vessel is forced through the mixing head more often than in conventional systems with circulation loops. This efficiently mixes powders with low wettability or solubility as well as products with very high viscosity.

Advantages of pre-mixing
These same difficult powders also benefit from being mixed with other powder ingredients, such as sugar, before being added to a liquid mix. This allows stabilizers, for example, which must otherwise only be introduced intermittently and in small amounts, to be added all at once in a steady stream and dispersed more quickly into the liquid.

Choosing the right temperature
To more easily dissolve high-viscosity powders in larger amounts, it is common to process at a higher temperature. Some powders with specific functional properties may also require processing at a higher temperature in order to activate these functional properties. This is the case with pectin, for example. In some formulations that contain fat, such as some flavoured milks, it can be helpful to perform the mixing process at a temperature above the fat's melting point. In other formulations, such as herb butters, it is necessary to perform the mixing process at a temperature below the fat's melting point.



Powerful controlled vortex ensures maximum exposure to liquid for optimal wetting of powder and minimal air incorporation.

Mixing guidelines

Below are mixing guidelines for some common products/ applications. These guidelines are general examples and the choice of ingredients and processing equipment must also be considered.

Pectin solutions

Pectin is a common ingredient used in products such as yoghurt, milk-juice beverages and jams. In formulating water-based products with pectin, a mixing vessel is filled with hot water at 70 to 80°C. Pectin is gradually added to reach the desired concentration, up to 10% at 80°C, and the pectin solution is added to the final product. Pectin may be added directly to a final product if the temperature, pH, or shear rates are sufficiently high to prevent immediate gelation and the final product reaches 70°C to 80°C enabling full pectin functionality. Once the pectin has been dissolved and reached functionality, it is important to not subject the product to high shear force, which may lead to an undesirable breakdown in product texture.

Long life yoghurt-based drinks

Pectin is often used as a stabiliser for long life yoghurt-based drinks. A pectin solution of 2 to 4% is added to the yoghurt base after fermentation. The optimal pH range for mixing is 3.8 to 4.2.

Pectin is hygroscopic and difficult to mix in water. However, using a highly efficient mixer with a rotor and stator technique enables pure pectin to be added to water. Dry-blending with sugar eases the mixing of pectin in water even further.

Once a pectin solution is prepared, it is heat treated to reach over 70°C in order to fully dissolve the pectin. A yoghurt base mixed with a pectin solution, is homogenised in the heating stage in order to achieve optimal stability in the final product. Pectin prevents the milk proteins from aggregating during this heat treatment.

High acid protein drinks

Milk-juice beverages, known as directly acidified milk drinks, are created by mixing juice and milk in varying concentrations. Juice lowers the pH level of the product and this requires the use of a stabilizer to protect the milk proteins from aggregating. Pectin is the stabilizer most often used in directly acidified milk drinks, as well as acidified soy milk and whey drinks.

The formulation of milk-juice beverages with fresh milk, begins with the creation of a 5% pectin solution by dissolving pectin into heated water, or a heated milk base at 70°C to 75°C. The solution must be heated to 70°C to fully dissolve the pectin. After this, more water, sugar, and milk ingredients are added at low temperatures. The mix is switched to an external circulation tank, and cooled to minimum 40°C. Then juice is mixed with the milk-base and pH is adjusted to circa 3.8 to 4.0. Next, high shear mixing helps pectin adsorb effectively to milk proteins and homogenization eliminates any large protein aggregates, ensuring full pectin adsorbtion to milk proteins. This prevents proteins from aggregating during final heat treatment and aseptic filling. Pectin is also suitable for acidified soy milk drinks and whey drinks.

To formulate milk-juice beverages, a circa 5% pectin solution is made by dissolving pectin into 70°C to 75°C heated water. Then water at 50°C is metered into the mixing system and milk powder, melted butter oil, and sugar are added. The rest of the mixing process follows the same procedure as for milk-juice beverages with fresh milk.

Recombined milk

To achieve the best mixing results in recombined and reconstituted milk, the optimal mixing temperature is 45°C to 50°C since the rate of dissolution of milk powder is much faster at higher temperatures. The greatest increases in dissolution rate are seen in the temperature intervals from 10°C to 30°C. Thereafter, from 30°C

up to 45°C, smaller increases are seen. And raising the temperature above 50°C has not been shown to achieve any more positive effect on the speed of powder dissolution. It is important to note here that when working with products with high dry matter content, the effect of temperature on powder dissolution rate is even stronger than when working with products with normal milk dry matter content.

The high temperature also enables the milk components to establish full dissolution on a molecular level more quickly since the molecules move faster, something that cannot be achieved with a mixing unit alone, no matter how efficient it is. However, it is very important to use an efficient mixer in combination with the right processing temperature, to minimize the time it takes to establish equilibrium. In an efficient mixer, the first phase of dissolution is achieved almost instantly when the product passes through it. Further, recombining and reconstituting at a higher temperature also ensures less air incorporation than if the mixing process is performed at a lower temperature.

When recombining and reconstituting milk at a higher temperature, it is crucial to be aware of the risk of microbiological growth in the product if it is held for too long at the higher temperature.

Mixing guidelines

Chocolate milk

Chocolate milk is produced by mixing either fresh pasteurised milk, or recombined pasteurised milk, with cocoa powder and sugar. And it is usually stabilized, with for example carrageenan, to prevent the sedimentation of cocoa particles during storage. The content of cocoa powder in chocolate milk is usually in the range of 1.5 to 2% and a dark, alkalized cocoa powder with a fat content of 22 to 24% is normally used for chocolate milk. The pH of the cocoa powder should be as close as possible to the pH of the milk.

The quality of the milk required for making chocolate milk is the same as for milk intended for pasteurisation or UHT sterilization without flavouring additives. The quality of cocoa powder can vary greatly but to minimize sedimentation and bacteriological problems, the powder must be finely ground and have a low content of shell particles.

A common challenge when working with cocoa powder is that it tends to float on the surface of the milk and is difficult to wet. An efficient mixer conquers this challenge since the mixing head forces all product in the mixing vessel down and through the mixing unit.

The right mixing temperature and mixing process is also important. It is most efficient to mix the cocoa, sugar and other additives such as stabilizers, at 55°C with one tenth of the total amount of milk in a recipe. This way, the cocoa undergoes a higher mixing intensity than if it is mixed with total amount milk right away. In addition, cocoa dissolves more fully and quickly in warm milk than in cold milk. After this pre-mixed slurry is complete, it is then cooled down and/or mixed with the remaining milk before further heat treatment and packaging. Traditional recommendations call for pre-pasteurisation of the cocoa slurry.

Mayonnaise

The amount of fat and vegetable oil used in a mayonnaise formulation depends on the fat content desired in the final product. For example, the production of mayonnaise with lower fat content requires more powder ingredients and emulsifiers to stabilize the emulsion and achieve desired properties.

In mayonnaise production, the water phase is stabilized to increase viscosity by dispersing powder ingredients, such as starch. The starch used to increase viscosity may be either cold swelling or hot swelling starch. If the starch is hot swelling, the water phase and starch must be heated to above the swelling point.

Then, an emulsifier, such as egg powder or starch must be added to the water phase. Finally, oil is slowly added to the mixture. In order to achieve a stable emulsion, it is important to minimize the oil droplet size. This is achieved with a high shear rotor and stator.

This mixing technology is valid for:

Hot-hot emulsification: The hot oil phase and the water phase are combined under vacuum at a high temperature (70°C to 85°C) and emulsified.

Hot-cold emulsification: The hot phase and the cold water phase are combined under vacuum and emulsified at the mixing temperature.

Cold-cold emulsification: The water phase and the oil phase are kept cold and are combined and emulsified under vacuum.

Tetra Pak