

Mixing Technology is Decisive for Product Quality

Selection of the right mixer for the food technology

by Hans-Jürgen Sussann (Dipl.-Ing)

Various mixing requirements have to be fulfilled for the food production industry. Therefore, mixers of different designs are available. The following overview of the operating methods and application fields of the most commonly applied mixers should aid in the selection of a suitable mixer for the respective mixing process.

Mixing is the most important process for handling of raw materials in the food industry, and furthermore, it is decisive for the quality of the final product. Our company has gathered a comprehensive knowledge-base with respect to mixing technology during their many years of development and construction of complete handling systems. With the integration of Reimelt Henschel MischSysteme GmbH, Kassel, into the group, this knowledge base has been expanded. This article will provide an overview of the design, function and the most important fields of application of the various mixer types available in our systems.

Pneumatic mixers - quick and gentle

Air supported discharge systems, also called fluidizing beds, have proven their reliable operation in silos and hoppers for many applications. One of the effects of these systems is a homogenizing of the bulk materials. Based on the knowledge gathered from application of these fluidizing systems, we have developed these pneumatic mixers (figure 1). They consist of a vertical mixing hopper that is equipped with a fluidizing bed. Pressurized gas - mostly air - flows through the bed and the dry, granular bulk material is thereby fluidized. The gas is injected in cyclical intervals and thus generates an upward flowing, fluidized bulk material/gas mixture. In the non-aerated zones, the product flows downwards. This continuous, three-dimensional circulation results in an intensive and gentle mixing of the bulk material. Special mixing tools are



Figure 1: Pneumatic mixer for dry bulk material of similar grain size and shape, designed as a pressure vessel for the pneumatic conveying of the mixture

not required in the hopper. Therefore, these mixers can be easily cleaned. Further process steps, such as heating and cooling, can be easily integrated.

Pneumatic mixers can very quickly and above all gently mix bulk materials with a similar grain size, shape and bulk density. For example, they are excellently suited for mixing flour and baking ingredients. Furthermore, even sensitive products such as cappuccino mixes can be produced successfully in the pneumatic mixer without destruction of the agglomerates. Typical models have a maximum volume of 2 m³.

To summarize: the advantages of pneumatic mixers include a short mixing time - characteristically between 1 and 2 minutes per cubic meter of product to be mixed, they do not contain any moveable parts inside the hopper and have smooth inner surfaces. Therefore, they can be easily cleaned and discharged without de-mixing of the product. The incorporation of a max 10 % of shortening and other liquid ingredients is possible with the addition of one or several dual-fluid nozzles in the pneumatic mixer.

Mechanical mixers

In contrast to pneumatic mixers, mechanically operating mixers are generally equipped with mixing tools. Mostly, mechanical mixers are multi-purpose machines that cover a wide field of applications and are used in various branches of the industry. Thus, they are of a robust, very complex design. This is the reason why our company decided to develop and produce a mechanical mixer for the food production and handling industry. This is designed specifically for a variety of special process requirements and specific applications.

Homogenizing with screw mixers

The screw mixer consists of a vertical cylindrical mixing hopper with a conical outlet, in the center of which, is installed a tapered screw expanding to the top. The rotating screw conveys the various inner bulk materials upwards; at the hopper wall they flow downwards so that a mechanically forced mixture is generated. The rotation speed is determined by the specific mixing process and the products to be mixed. Due to their simple design, screw mixers are inexpensive, can be completely discharged and are easy to clean.

The screw mixer's main field of application is the homogenization of whole meal flour and special baking mixes. Their easy design allows the addition of sensitive ingredients such as chocolate chips without any product degradation and homogeneously into finished mixes for cakes. Furthermore, they are used as receiving hoppers with an integrated final mixer with the purpose of reversing segregation which may occur in the conveying and storage systems. Currently, screw mixers with a max capacity of up to 5 m³ have been built.

Premix production with the vertical ribbon blender

We have developed the vertical ribbon blender especially to produce the dry pre-mixes of flour and baking

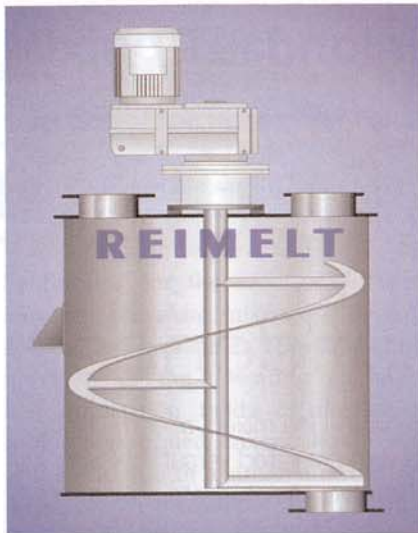


Figure 2: Vertical ribbon blender for the production of dry pre-mixes consisting of flour and baking ingredients.

ingredients for the continuously operating dough mixing and kneading system Codos®. The mixer consists of an upright cylindrical mixing hopper in which a screw-like mixing tool rotates with a constant or a variable speed (figure 2). This mixing tool conveys the product near the hopper wall upwards and thus in the center of the hopper a downwards-flowing stream is generated. The product to be mixed is circulated three-dimensionally so that a very homogenous mixture is produced. The standard design is available in two sizes with a nominal volume of 500 l or 1,200 l.

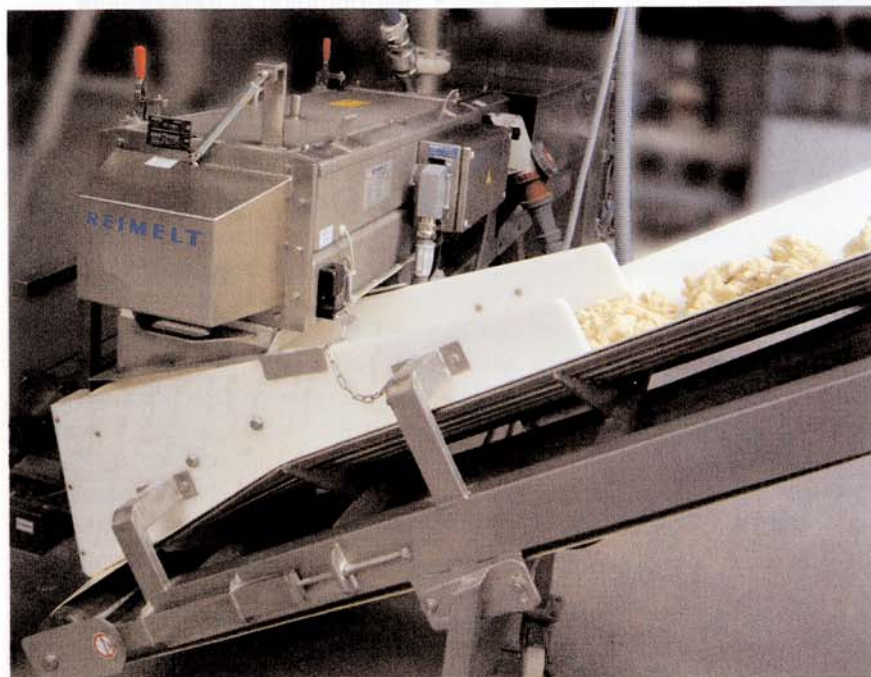


Figure 3: Horizontal double-shaft mixer for the Codos® dough mixing and kneading system, with discharge of the mixture to the transport belt leading to the kneader. Photos: Reimelt

Horizontal double-shaft mixer for continuous mixing

The horizontal double-shaft mixer (figure 3) is equipped with a trough-shaped mixing hopper that is open on the top. Inside the hopper rotate two interlocking, helical, horizontal mixing tools. They are driven by a geared motor and distribution gear. These special mixing tools cause an effective mixing of powders and liquids with a low energy input. Thus, they avoid unnecessary heating build-up in the mixed product.

This mixer was developed to continuously produce dough mixes. An important factor for this is the conveying effect of the mixing tools that continuously transport the product through the mixing hopper. At the beginning of the mixing zone the bulk material, e.g. flour and sugar, or a corresponding bulk material mix is fed by differential metering scales. Immediately afterwards, the liquids required for the recipe (yeast/milk mix, temperature-controlled water, shortening, fat, etc.) are continuously metered volumetrically or gravimetrically. This mixing process ensures an optimum moistening for the production of dough with an increased absorption of water. At the end of the mixing zone decorating products such as chocolate chips, raisins, etc. can be

gently mixed in, i.e. nearly degradation-free.

The double-shaft mixer can mix bulk materials quickly and easily with liquids so that a great number of mixes can be continuously produced. For example, a well-know producer of biscuits utilizes this mixer to produce the glazing mass for their biscuits based on a mixture of powdered sugar, water and liquid food colorings. A sugar producer uses this machine to color granulated sugar with a mix of glucose and molasses. At present these mixers are available with capacities of 1 to 6 t/h and they are completely composed of stainless steel.

Mixes with a large percentage of liquids: The vertical shear stream mixer

In systems for the continuous production of liquid dough, sponge or sour dough, it is necessary to mix wheat flour continuously and quickly with water and yeast solution. To execute this process, we developed the patented shear stream mixer. It consists of an upright cylindrical mixing hopper, in which shearing bars are mounted, and a rotating shaft that is also equipped with shearing bars (figure 4). This vertical mixer is fed continuously with flour by a differential metering scale. Water and yeast solution are metered in at the same time. The mixing tools function according to the rotor-stator principle, ensure intensive contact between the flour and the liquid. The shearing energy required for the mixing process is provided by an electrical geared motor. A pump installed downstream conveys the liquid mass into the fermentation system.

Vertical shear stream mixers are – in addition to these applications – suitable for all industrial processes that require a quick and intensive mixing of dry raw materials with liquids. With the application of shearing energy, various liquids or pasty masses are able to be intensively mixed.

Container mixer eliminates cross-contamination

Today, modern mixing factories in the food industry must guarantee production with a very high level of quality

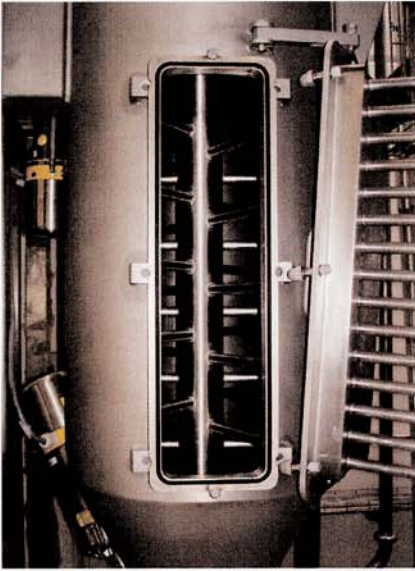


Figure 4: Vertical shear stream mixer that operates according to the rotor-stator principle with the shearing bars mounted in the hopper and to the shaft

and safety. Due to the multitude of various raw materials and ever-changing recipes, the requirements inherent to products free from cross-contamination are very high - especially with respect to production free from allergens and the production of kosher goods. To provide solutions for these requirements, we have developed the ReciPure® concept. Characteristic for this type of system is the storage, discharge and metering of the raw materials singly in hoppers and containers and the scaling of the various raw materials in containers according to the recipe. When the recipe is ready in the container, a mixing process usually follows.



Figure 5: Container Mixer CM 300; the mixing hopper and lid with mixing tool within a solid frame in resting position

Commonly available or customized containers serve directly as the mixing chamber for this type of mixer. For this purpose, the company uses a fixed frame equipped with a swiveled cross piece with a lid to receive the container (figure 5). In addition, the mixing tool is integrated in this lid. For the mixing process, the container is docked and pivoted into the mixing position (figure 6). Then the mixing tool starts; in addition, the container moves relative to the mixing tools. By this operation, a homogenous mix is gently created. After the mixing process, the container returns to its initial position and is ready to provide the finished mix to the downstream process.



Figure 6: Container Mixer CM 300 in mixing position

The mixer – an integral part of system solutions

Our company develops and executes system solutions by utilizing our experience and the wide range of mixer solutions available. We identify the right solution for the required mixing process by selecting the most suitable mixer for the application. In addition to the mixing process, these projects comprise all of the other process requirements; from tempering and drying, humidifying, homogenizing, sifting, mixing and kneading to recrystallization systems for bulk material such as powdered sugar and cocoa powder. The systems are equipped with bespoke automation technology, made exactly to the customers' requirements.

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