

Tomato Products

APV homogenizers have been used extensively in the processing of tomato products. Specific product types include tomato sauces, ketchup and juices. The benefits to be gained using APV equipment in the processing of these products include increased viscosity, reduced separation, improved texture, more uniform color and increased yield. All or some of the above improvements can be realized by the correct choice of equipment and processing conditions.

Before discussing the specific conditions required for the optimum improvement in a particular product, it is important to understand the mechanisms involved in general terms. These mechanisms relate to the changes in the structure of an aqueous tomato dispersion caused by the application of mechanical energy. The tomato pulp contributes many relatively spherical particles, which are insoluble in water and which must be reduced in size and uniformly dispersed throughout the product. If this is not done, a product with an excessively rough texture will result. Furthermore, since the carotene pigment is contained in these particles of pulp and fiber, failure to properly disperse them will result in a product with poor uniformity and depth of color. The APV homogenizer has proven to be well suited to meeting these requirements.

In addition to the above particles, a tomato dispersion contains a very large number of fibrous strands. Through proper processing techniques, these fibers form a structure that is responsible for the viscosity of the product and for its ability to retain free water. A large reduction in the length of these fibers, caused by some mechanical processing equipment, will destroy the fiber structure and result in reduced product viscosity and increased serum weeping. However, homogenization causes fibrillation of the fiber ends without a significant reduction in fiber length. This results in fibers

having ends similar in appearance to the ends of a frayed rope. The fibrillated fiber will absorb and retain water in the manner of a wick. The obvious result is increased product viscosity and reduced separation. Unfortunately, the process does have limitations. If too high a homogenizing pressure is used, then the fiber network will be broken down. Although the greater number of individual fibers will absorb more water and cause a greater viscosity increase, any remaining free water will quickly separate because the structure which bound this water will have been destroyed. In short, the price for greater viscosity increases is an increase in serum separation. In practice, processing conditions are chosen on the basis of a compromise between these two opposing effects.

A component that plays an important role in the preparation of tomato dispersions is pectin. This naturally occurring polysaccharide dissolves in water to form a jelly-like material. Obviously, such a material will increase product viscosity and reduce separation by tying up any remaining free water.

Homogenization increases both of these effects by aiding in the complete and uniform solubilization of the pectin. This is a very important point to consider, as it relates to the choice of a hot-break or a cold-break paste for use in tomato products. A cold-break paste contains an enzyme which inactivates the pectin and, thus, negates its positive influence on viscosity and, especially, separation. Homogenized tomato products made from cold-break pastes will separate severely. Thus, the use of a hot-break paste, in which the pectin-destroying enzyme has been inactivated, is recommended for any tomato product which will be subjected to homogenization.

Obviously, the preparation of tomato products is very much subject to variations in the structure and chemistry of the tomatoes used. This, in turn, is dependent upon such growing factors as: geographical location, climate conditions, weather variations, soil conditions, growing season and variety of tomato. There is no way to eliminate the influence of such factors. However, adjustments in homogenizing pressure can be used to compensate for unwanted characteristics in the final product resulting from these factors. This type of precise control over the physical characteristics of the finished product is very important in maintaining a degree of consistency from batch to batch.

Before proceeding to specific products, two more additional comments must be made. The term "viscosity" has been used freely without mentioning any means of measuring it. The standard device used in the industry for sauces and ketchup is the Bostwick Consistometer (available from CSC Scientific, www.cscscientific.com). Basically, this measures the distance in centimeters that the product will spread over in a time of 30 seconds. Thus, a lower Bostwick reading means a higher viscosity. For lower viscosity products such as juices, viscosity can be measured with a Brookfield Viscometer or similar device. The second comment relates to the effect of the handling of tomato products after homogenization. It has been found that the application of even moderate shear to the finished product can partially reduce the viscosity increase produced by the homogenizer. Thus, it is recommended that the amount of handling of the finished product be kept to a minimum. Since most of the viscosity increase is retained in a properly designed system, this effect has not been a major problem.

Having discussed tomato products in general, some comments on the specifics of processing the various classes of tomato products can now be made.

Tomato Ketchup

All grades of ketchup can benefit from homogenization and, depending upon the percentage of tomato solids in the formulation, an increase of 10-14% in the yield of the solids (insoluble and soluble) can be achieved. That is, ketchup homogenized at a pressure of 2500-3000 psi will have a Bostwick equal to that of unhomogenized ketchup containing 1.10 to 1.14 times as much tomato solids. Soluble solids are determined by analyzing the product with a refractometer and are reported as °Brix (same as percent sucrose). The term "total solids" for ketchup is "the refractometric sucrose value of the International Scale of Refractive

Indices of Sucrose Solutions to which is added 1 percent." (USDA Grading Manual for Tomato Catsup) Furthermore, the amount of separation will be minimal, the texture will be smooth and the color will be good. An alternate approach would be to retain the current level of tomato solids and produce a final product with a substantially higher viscosity. Of course, any compromise between the extremes of minimum solids and maximum viscosity can be reached to suit individual needs. One should be reminded that homogenization at pressures above 3000 psi will produce a greater viscosity increase, but for typical formulations, the separation will be severe and the color will be poor. In addition, the ketchup may develop a "slippery" mouth feel. Figure 1 shows how Bostwick changes with homogenizing pressure for ketchup processed on a laboratory homogenizer. In production, these Bostwick values may be slightly higher.

Tomato Sauce

These products vary greatly in total solids, but most will show a significant increase in viscosity as the homogenizing pressure is increased to about 2500 psi. Beyond this pressure, additional viscosity gains will be slight and the color will become very orange. Again, there will be a choice of retaining the viscosity gained or lowering the tomato solids level, until the viscosity is again at the level it was before homogenization. In general, the same types of improvements seen in homogenized ketchup will be seen in homogenized tomato sauces.

Homogenization is not recommended for sauces containing less than eight to nine percent soluble solids, because there are not enough tomato fibers in such a product to lead to a significant viscosity increase. Also, many of these low solids sauces use a starch for thickening, and homogenization will actually reduce the viscosity of a starch dispersion. Finally, the low level of pigment in these sauces will lead to a finished product with very poor color, if homogenization is used. Sauces containing a high level of tomato seeds, such as some pizza sauces, can also be adversely affected by homogenization. The crushing of these seeds during homogenization can release an oil which will impart a bitter taste to the sauce.

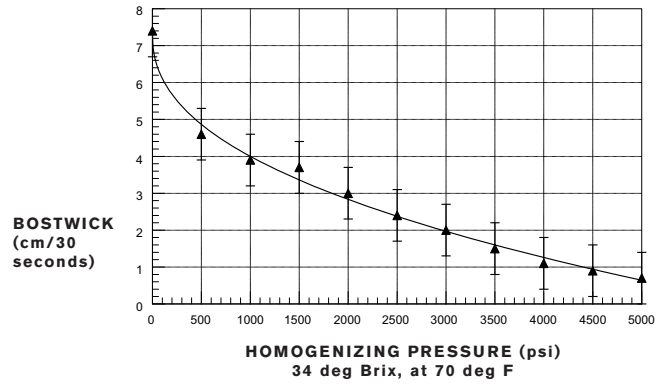
Tomato Juice

Homogenization of tomato juices or tomato/vegetable juice blends at pressures in excess of 1000 psi will result in an excessively slippery mouth feel and a loss of color due to the low level of tomato solids. However, homogenization at 500-700 psi is widely used

as a means of achieving a moderate viscosity increase, as well as improved texture and stability. This is especially important for tomato juice made from paste, because homogenization enhances hydration of the paste and ensures a smoother, better tasting product. However, if the same equipment will be used for sauces or ketchup, a homogenizer with a higher pressure rating would be required.

In addition to the above specific recommendations, two general statements should be made regarding the homogenization of tomato products. First, we have found no benefit in the use of a two-stage homogenizing valve assembly. A single-stage, wear-resistant homogenizing valve is recommended. Furthermore, 316 s. or equivalent material for cylinder construction is recommended for improved corrosion resistance. Second, the processing temperature has been shown to have little effect on the amount of viscosity increase attainable. Thus, the best location in the process line for the homogenizer can be made without regard to the temperature of the product at the inlet of the homogenizer. However, homogenization does add heat to the product so if the temperature exceeds the boiling point of water, then adequate backpressure should be used in the discharge line to avoid flashing. Elevated temperatures are neither beneficial nor detrimental to the process. However, the homogenizer should be positioned in the process at a point where there is a minimum of air in the product. Entrained air will adversely affect the finished product if this air is homogenized into the product.

BOSTWICK VS HOMOGENIZING PRESSURE AVERAGED DATA FROM LABORATORY TESTS



611 Sugar Creek Road, Delavan, WI 53115

P: (262) 728-1900 or (800) 252-5200, F: (262) 728-4904 or (800) 252-5012, E: wcb@spx.com

SPX reserves the right to incorporate our latest design and material changes without notice or obligation. Design features, materials of construction and dimensional data, as described in this bulletin, are provided for your information only and should not be relied upon unless confirmed in writing. Please contact your local sales representative for product availability in your region. For more information visit www.spx.com. The green ">" is a trademark of SPX Corporation, Inc.

ISSUED: 02/2009 3064-01-07-2008-US COPYRIGHT © 2008, 2012 SPX Corporation