Efficient homogenization of tomato products

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Homogenization of tomato products is not rocket science, but there is still a lot to think about for those who want to achieve the best possible end product at the lowest possible cost, both for the product and the process. Among other things, it is important to find a point of optimal homogenization, that is, one providing the best product quality (viscosity, taste, mouthfeel, etc.) but at the same time minimizing the wear on the homogenizer. Here are some facts and tips.

An effective homogenization of tomato juice, ketchup, sauce and paste provides a wide range of positive effects that result in a better overall product quality. These include:

Less separation/watering off  
…since the homogenization binds the water in the product and makes it stable.

Higher viscosity  
…since homogenization effectively disrupts particles and uses the viscosity-enhancing properties of the tomato’s natural pectin.

Improved mouth feel  
…since the homogenization distributes the elements that provide taste and results in a smoother product.

Reduced need for raw material  
…since an efficient homogenization means that the same quality in the end product – viscosity, mouthfeel, taste – can be reached with a lower concentration of raw materials.

Reduced need for additives  
…since the preferred viscosity can be obtained without – or with a minimum of – stabilizers.

Improved colour  
…since the tomato’s natural colour agent (lycopene) is efficiently distributed in the product.

Improved bioavailability of lycopene  
…meaning that the health effects associated with lycopene can also be associated with your product.
Illustration: How watering off or syneresis is commonly measured. A known amount of tomato product is applied to a graded paper and left untouched for a set time. The spreading of water is measured in length/time unit.

**Homogenization – the basic principle**

The basic principle of homogenization is that the product runs through a small gap at a high velocity, thus creating a turbulent flow. An effective homogenization means that the turbulent forces break down the particles and fat globules in the product to the desired homogeneity and stability.

**What’s the optimum level of homogenization?**

In general, one can say that the higher the homogenization pressure, the more efficient the breakdown of particles, but when a certain pressure is reached there will be no significant additional decreases in particle size. Also, there is a peak level for viscosity, and increasing the homogenizing pressure above that level will decrease the viscosity. Furthermore, the higher the pressure, the higher the wear on the homogenizer and its parts. All these factors have to be taken into consideration when finding the optimal homogenization pressure for each product – particle size, desired viscosity and wear on the machine.
Graph: The influence of homogenizing pressure on particle size. The graph shows a very efficient reduction in particle size with pressures up to 700 bar, but there is no significant difference between 700 and 1300 bar.

Graph: The viscosity in a tomato product builds up as homogenizing pressure increases, but after a certain point viscosity starts dropping again.
Tomatoes – a highly abrasive raw material
The general build-up of the tomato structure and the fact that the fruit flesh will always contain small silica (sand) particles means that it is very abrasive to processing equipment, and especially to the homogenizer, as a result of the high pressure and turbulence. To withstand this, it is important to choose highly wear-resistant materials in the wear parts. The uptime and life cycle of the wear parts can also be substantially prolonged by using a second homogenizing step. Please see separate article to find out more about two-step homogenization.

The benefits of downstream homogenization
Regarding the processing setup, it is also important to know that tomato ketchup and ketchup-like products are sensitive to shear forces after homogenization. These forces, which might be caused by passing through a heat exchanger, a pump or tubes with sharp bends, will typically cause an undesired decrease in viscosity. To avoid that, and to minimize shear after homogenization, it is always a good idea to place the homogenizer downstream, as close to the filling line as possible and without any pumps or sharp bends.

Illustration: Downstream homogenization (Alternative I) versus upstream homogenization (Alternative II) of tomato ketchup. Placing the homogenizer downstream means less risk of reducing the viscosity achieved thus far in the process.