



Ing. A. Rossi THOR Hybrid Flow MVR Evaporation System for Tomato

Introduction:

Evaporation is one of the fundamental processing steps undertaken by all California Tomato Processors. In its simplest terms, evaporation involves boiling off large quantities of water, and is inherently an energy intensive process.

Starting with raw tomato juice, typically in the 5 Brix range, the processor utilizes Evaporators to produce a wide variety of products. Examples are slightly concentrated topping juice for canned product, higher concentration for various sauce products, and finally tomato paste typically in the range of 30 Brix. For the readers reference, concentrating 100 gallons of raw tomato juice to 30 Brix paste requires over 83 gallons of water to be evaporated. That is a lot of water!

Current Production Methods:

The traditional method used by processors worldwide involves the use of Multiple Effect Forced Circulation Evaporators. This technology involves the use of multiple evaporation vessels, each with its own heat exchanger and recirculation pump arranged in a series configuration along with a single barometric condenser. Each evaporation vessel, heat exchanger, pump combination is called an "Effect or Stage", depending on context of product flow versus vapor flow. During operation, heat is applied to the product while it is being recirculated, and vapor (evaporated water) is evolved in the evaporation chamber which is under vacuum. Live steam is generally added to the first stage, and vapor from that stage is used to deliver heat to each subsequent stage at progressively lower temperatures. The condenser is then used to collect and collapse all remaining vapor evolved from the product, and serves as the main source of vacuum for the system. Most units in operation today generally consist of 3 or 4 Effects/Stages and have energy efficiency typically on the order of 1:3, or 1 pound of live steam to evaporate 3 pounds of water.

Pre-Concentration:

Multi Effect Forced Circulation Evaporators are ideal for processing highly viscous products at high concentrations such as finished tomato paste. Various aspects of their design are



optimized for the “thickness” of the product and inherently low heat transfer coefficients. To augment Multi Effect Forced Circulation Systems, a Pre-Evaporator can be installed to deliver a semi concentrated product to the existing Multi Effect Forced Circulation unit. Pre-Evaporators typically take advantage of the products initially lower viscosity and are able to evaporate more water with lower comparative energy consumption. This improves the overall efficiency of the system.

Falling Film Technology:

A few processors in California have successfully installed efficient Pre-Evaporator technologies such as Falling Film, with or without MVR (Mechanical Vapor Recompression), and have realized energy savings that are well documented. In general, Falling Film Technology involves dispersing the product into a thin film resulting in a very high surface area. This allows for higher heat transfer coefficients and allows evaporation to take place more readily with reduced energy consumption. As the name implies, evaporation takes place while the product “film” falls downward through heat exchanger tubes. MVR is sometimes combined with Falling Film to capture the vapor (evaporated water) and recompress it to higher pressure/temperature steam that can be used by the evaporator itself. Falling Film technology, while successful in reducing energy consumption and GHG Emissions, has a significant drawback of frequent fouling with tomato due to the fiber content. This forces the processor to take the unit offline for cleaning as frequently as once a week, during which operation reverts to all evaporation through the lower efficiency Forced Circulation system for many hours. This can be a labor-intensive undertaking and reduces the overall efficiency of the operation, and is one of the primary reasons why the technology has not been widely adopted by California processors.

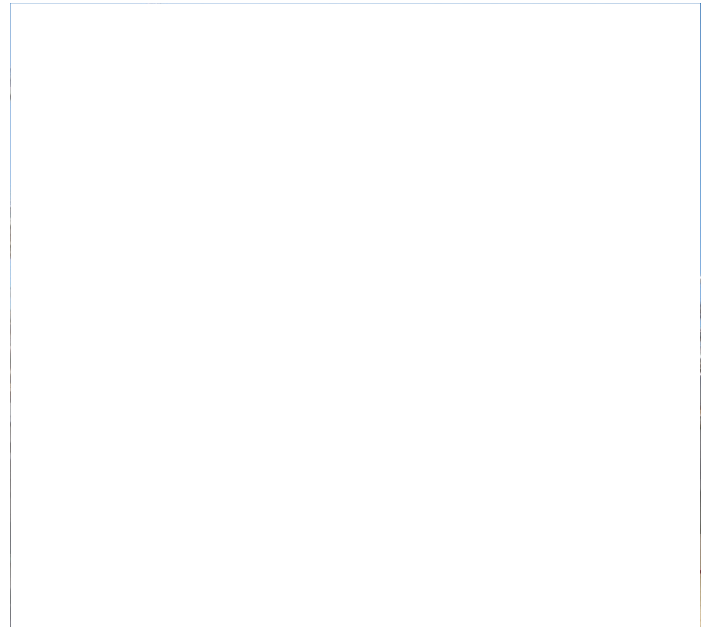
Ing. A. Rossi THOR Hybrid Flow MVR Pre Evaporation

To deliver a solution to the fouling problem, and enhance overall operational efficiency, Ing. A Rossi of Parma, Italy has developed a new, breakthrough, technology called THOR Hybrid Flow which combines the benefits of Multi Stage Forced Recirculation, High Flow Rate Recirculation and MVR concepts. The THOR system consists of multiple evaporation stages in a series configuration, each having its own heat exchanger, recirculation pump and evaporation chamber (separator). In addition, an MVR system is used to recompress all product vapor which is then directed back to the evaporator heat exchangers as their sole energy source. Unlike other Pre Evaporation technologies such as Falling Film, the careful utilization of High



Flow Rate Recirculation allows product flow rates within the heat exchanger tubes to be managed in such a way to greatly reduce the rate of fouling, thereby increasing the time between cleaning to a minimum of once every 40 days. This feature clears the way for wider overall acceptance of the technology within California, and elsewhere.

In terms of energy efficiency and GHG reduction, THOR will reduce the energy consumption required for evaporation to essentially zero, provided the steam system and other equipment at the facility are properly configured. This is accomplished by powering the MVR Compressor, as well as some of all of the Recirculation Pumps with Steam Turbines. All exhaust vapor from the turbines can then be directed to a low pressure steam header to deliver energy to other equipment such as hot breaks, cookers, etc which typically are powered by live steam from the plant boiler. Essentially, this configuration allows boiler steam to be used twice, first at high pressure by the turbines, then again at lower pressure at suitable consumption points.



The THOR Hybrid Flow system was introduced by Ing. A. Rossi in 2013. Since then, 5 units are in operation at European facilities, and as of 2020 two units have successfully performed in California at the Pacific Coast Producers Woodland CA facility. These units, with challenging California tomato varieties, both ran for over 60 days without cleaning intervention.

Further information can be provided on request by contacting Paul Favia of Crystal Process Equipment at 209 840 7260