



# The APV™ Cavitator



Based in Charlotte, North Carolina, SPX Corporation (NYSE: SPW) is a global Fortune 500 multi-industry manufacturing leader. The company's highly-specialized, engineered products and technologies serve customers in three primary strategic growth markets: infrastructure, process solutions, and diagnostic systems. Many of SPX's innovative solutions are playing a role in helping to meet rising global demand, particularly in emerging markets, for electricity, processed foods and beverages and vehicle services. The company's products include thermal heat transfer equipment for power plants; power transformers for utility companies; process equipment for the food & beverage industry; and diagnostic tools and equipment for the vehicle service industry. For more information, please visit [www.spx.com](http://www.spx.com).

Mixing and dispersing have never been more challenging. Margins are being squeezed, safety is paramount and consumer demands for new products make formulation changes a regular occurrence. The ability to improve process efficiencies, enhance product quality and to heat liquids efficiently and without scale build-up is a must.

To meet these challenges head on, you need a partner with a deep understanding of process engineering and a broad portfolio of equipment. Look to SPX and its industry leading brands to provide extensive technical support, equipment versatility and mixing and processing expertise. Explore the diverse solutions that SPX has to offer. You're sure to find answers that will improve plant performance, increase profitability and enhance the value of your brand.

## The Innovative APV™ Cavitator

### THE NEXT GENERATION IN MIXING AND HEATING TECHNOLOGY

SPX offers an innovative new next generation technology called the APV™ Cavitator. The patented technology offers breakthrough benefits for the heating of liquids without scale buildup and/or the mixing of liquids with other liquids, gases or solids at the microscopic level to improve product quality and functional performance. The breakthrough results are obtained by using the forces of cavitation in a controlled manner rather than typical impellers or blades to process materials. With the APV™ Cavitator, the mass transfer rate can be increased and results are obtained that far exceed those of any technology in the market today. The controlled cavitation process is being considered a paradigm shift in the mixing industry where process intensification, process acceleration and the replacement of batch processing with continuous processing are necessary to compete in a global economy.

The APV™ Cavitator can heat liquids in seconds, whether in batch or continuous systems. This heating can be done accurately and consistently by varying rpms through a temperature controller and variable frequency drive. There is no temperature gradient or hot or cold spots. The unit does not have a heat transfer surface at elevated temperature, so there is no scaling or fouling. The system is flameless and can be totally automated.

The APV™ Cavitator has an elegantly simple and robust design that is proven through years of commercial operation in the chemical, petroleum, and food industries. The robust stainless steel construction, easy to use control system, small footprint, and quiet operation make the APV™ Cavitator an unparalleled heating and mixing system.

### PRODUCT BENEFITS AND FEATURES

This advanced technology can be used for a multitude of sanitary applications ranging from pasteurization to low pressure homogenization.

- Scale-free thermal processing of thick and viscous fluids
- Fast processing
- Improved yield with less off-spec product
- Expanded capacity
- Improved quality
- Easy retrofitting for existing operations
- Improved process efficiencies (time, operating costs, and/or capital costs)
- Enhanced product quality, yield and/or raw material savings from increased mass transfer
- Elimination or reduction of process downtime from maintenance requirements
- Smaller footprint than traditional technology
- Efficient liquid heating without performance loss over time due to fouling
- Produces homogeneous gel, gum or polymer hydration at the proper viscosity without "fish eyes" or other unhydrated powder
- Makes high quality emulsions at the desired particle size

## THEORY OF OPERATION

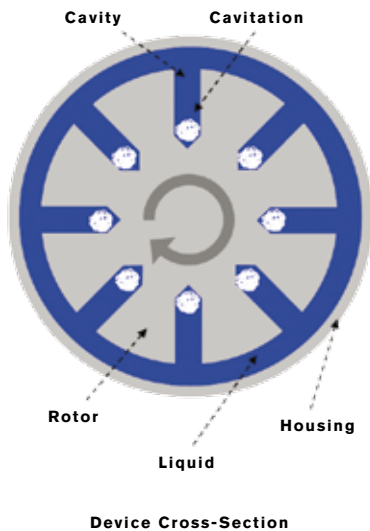
Every engineer is familiar with the sound of banging pipes or pumps, called "cavitation." Cavitation is the sudden formation and collapse of low-pressure bubbles in liquids by means of mechanical forces. The bubbles release an energy wave into the surrounding liquid. This energy wave is commonly known as a shockwave. Uncontrolled, cavitation can be very destructive to process equipment such as pump impellers.

This "destructive force" has now been harnessed and controlled. The technology is embodied in a patented device called the APV™ Cavimator.

## HOW THE APV™ CAVIMATOR HARNESSSES CAVITATION

The heart of the technology is a specialized rotor with cavities. The spinning action generates hydrodynamic cavitation within the cavities away from the metal surfaces. The cavitation is controlled, therefore there is no damage.

As a liquid passes through the APV™ Cavimator, it is subjected to controlled cavitation. Microscopic cavitation bubbles are produced, and as they collapse, shockwaves are given off into the liquid which can emulsify and prevent scaling. During heating, temperature is created uniformly throughout the entire liquid without any heat transfer surfaces. There are no hot or cold spots.



## Typical product applications

The potential markets for applications of the APV™ Cavimator technology are numerous. SPX has identified these key markets where there is a clear need for the breakthrough benefits in time, cost and sustainability considerations.

### Beverage Processing

Pasteurization of milk and fruit juices. Hydration of powdered mixes.



### Food Processing

Heating eggs, pudding, gels, cheeses, sauces, and high protein food products without scorching. Emulsification of fine foods and mayonnaise. Hydration of gums.



### Personal Care Products

Hydration of gums and polymers. Heating without scale. Mixing viscous liquids. Aeration, emulsification and gas/liquid mixing. Mixing solids and particulates. Adding coloring and flavor to viscous fluids such as toothpaste, adding fragrance and active ingredients to lotions and creams.



# The APV™ Cavitor Compared to Conventional Technology

## EFFICIENT AND PRACTICAL MIXING

Inside the APV™ Cavitor, there is a spinning rotor producing millions of microscopic cavitation bubbles. When these bubbles collapse and produce shockwaves, powerful forces are generated that cut up the process material into microscopic sizes. This increases the surface contact area between the liquids, gases and/or solids being mixed and maximizes the efficiency of the process for processes such as hydration, emulsification and gas/liquid mixing.



Conventional batch mixing normally occurs in large tanks containing an impeller that constantly stirs the contents in hopes of achieving uniformity.

Because the tanks are normally very large, it requires long process times in order to achieve uniformity. In many cases, a completely homogeneous mixture cannot be achieved. The APV™ Cavitor can normally mix the same amount of liquid as the conventional tank in less time while achieving uniformity. This occurs because powerful forces of cavitation are applied to a limited volume of liquid inside the APV™ Cavitor as it passes across the cavitation zone.

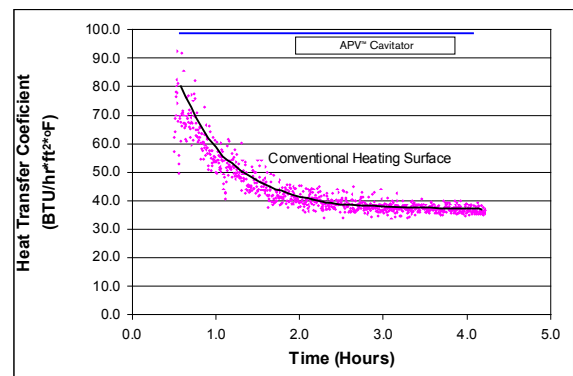
In a commercial APV™ Cavitor, a typical rotor contains a number of cavities with a volume of approximately one gallon in which cavitation occurs. As material passes through the APV™ Cavitor, the volume is equally divided into all of the holes. Each cavity performs like a miniature agitator cell that treats a small portion of the liquid, whereas a conventional tank has a single agitator that attempts to mix the entire volume. This level of mixing is not obtainable using conventional technology. The APV™ Cavitor makes it practical.

## UNIQUE ADVANTAGES OF THE APV™ CAVITATOR:

### Scale-Free Heating

The APV™ Cavitor can heat liquids in seconds. Because the heat is created inside the liquid rather than transferred through high temperature metal surfaces, there is no scaling of equipment and no scorching of product. This is particularly important in high protein dairy products such as cheese and puddings. Equipment shutdowns and maintenance problems are greatly reduced, improving product yield and product quality and reducing overall costs associated with production. In many cases, product taste is also improved.

The APV™ Cavitor unit eliminates scaling and generates heat instantaneously within the processed product. Eliminating scaling during heating allows for uniform processing of the product, while minimizing the surface fouling commonly associated with conventional heating equipment.



## MIXING

**Mixing Thick Liquids:** The efficient mixing of the APV™ Cavicator has been proven in applications such as processed meats, where the even mixing of meat and fillers maximizes raw material cost savings. The APV™ Cavicator creates a much more homogeneous gel compared to conventional mixers or homogenizers.

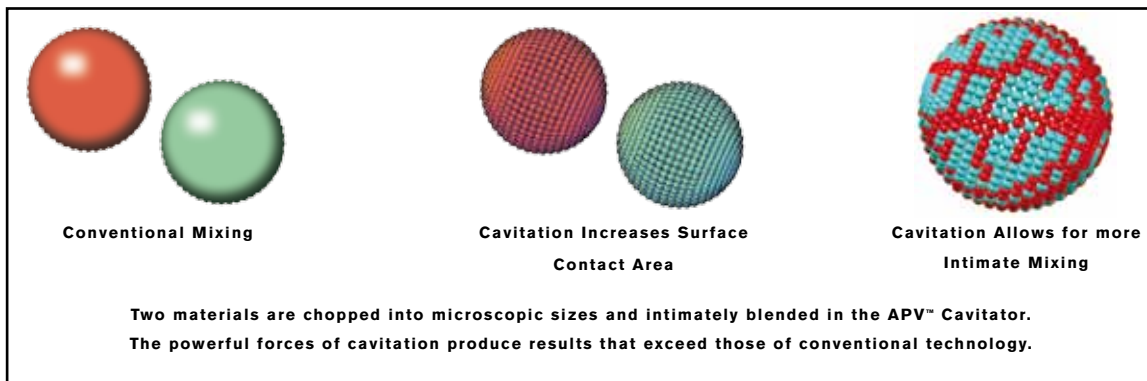
**Mixing of Shear Sensitive Compounds:** This technology can be configured for low shear mixing, allowing for gentle handling of shear sensitive compounds such as proteins, polymers, and citrus pulp without damage.

**Mixing of Particulates:** The APV™ Cavicator excels at mixing solids and particulates. The device has large clearances and minimally damages fibers, vegetable chunks, spices and other particulates normally damaged in homogenization. This also allows effective mixing after particulate addition.

**Microscopic Mixing:** The APV™ Cavicator can mix gases and liquids, liquids and liquids, and solids and liquids at the microscopic level which increases the mass transfer rate and accelerates processing.

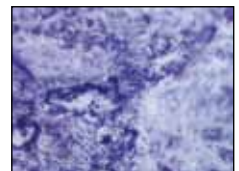
When cavitation bubbles collapse and produce shockwaves, powerful forces are generated that cut the process material into microscopic sizes. This increases the surface contact area between the liquids, gases and/or solids being mixed and maximizes the efficiency of the procedure for processes such as hydration, emulsification and gas/liquid mixing.

Cavitation is a unique mixing mechanism and can often be used to effectively mix shear sensitive compounds. Cavitation can produce superior results when mixing liquids with gases, solids, or other liquids.



## CONTINUOUS POWDER HYDRATION

The APV™ Cavicator can be used for the hydration of gums, gels and thickening powders to create a more even product. Applications include powdered cheeses, icings, and powdered drinks. The pictures to the right show a gum that has been stained. The dark areas indicate unhydrated gums. Full hydration results in reduced raw material costs, shorter processing time, and a more homogeneous product than those made with conventional technology.



**Conventional**

## ONE-STEP DISPERSION AND PASTEURIZATION

The APV™ Cavicator can be used to heat and disperse in a single step with a single piece of equipment. This allows for process simplification and minimizes footprint.



**APV™ Cavicator Treated**

## EMULSIFICATION

The APV™ Cavitator can be used to “tune” emulsion particle size by varying mixing intensity. This can be accomplished continuously and with no air entrapment. The particle size distribution is very fine and uniform.



## AERATION

The gas/liquid mixing of the APV™ Cavitator allows it to be used for aeration.

Uniform aeration with small or large volumes of gas is easily achieved, making the APV™ Cavitator perfect for viscous gums and liquids.



## PARTICLE SIZE REDUCTION

This is an example of particle size reduction in a recombined milk sample exposed to controlled cavitation compared to a reference sample.

Before



After



## TESTING CAPABILITIES

SPX lab and test facilities around the world are known for their state-of-the-art, technically-driven capabilities. Our labs are designed with flexibility in mind in order to accommodate a broad range of test requirements and operating conditions.

Research and development are important elements in SPX's activities. Processors are increasingly seeking cost-effective, engineered solutions for the production of high quality, innovative products. Our facilities and services are designed to provide added value by minimizing waste and energy requirements in your process. SPX is able to assist your product trial requirements, whether by trouble shooting, making your operation more flexible, cutting energy costs, increasing production volumes, or meeting new environmental regulations without sacrificing your product quality.

SPX lab facilities are highly sophisticated and equipped with leading edge technology. They are specifically designed to accommodate a broad range of tests while maintaining complete confidentiality. This may range from a simple rheology definition to the preparation of a complete recipe in our laboratory, or a full scale test.



# Innovation Center

The APV™ Cavitator has been extensively tested at SPX's Innovation Center in Silkeborg, Denmark. The center is an active participant in all types of development, testing and application of SPX equipment, systems and processing lines.

## TECHNICAL FACILITIES

The Innovation Center has the facilities to test and demonstrate profitable solutions for all types of production problems. The center can also participate in trouble shooting, making the customer's operations more flexible, cutting energy costs, increasing production volumes or meeting new environmental regulations without sacrificing the quality of the final product.

## FLEXIBILITY OF THE EQUIPMENT

The Innovation Center is designed for maximum flexibility. All equipment can be interconnected and new equipment is easily installed. Some of the equipment is mounted on frames for mobility and easy connection to other units, and most of it is controlled by variable speed controllers (VLT) or fully automated. Specialized equipment can be brought in as required and process lines configured to suit individual requirements.

## PROCESS HALL

The process hall is well-equipped and is laid out so as to provide for maximum flexibility in conducting tests, trials and training. We have several semi-industrial scale plants and have found that up scaling to industrial scale is easily done from this plant size. We also have small scale and industrial scale plants.

## SERVICE FACILITIES

Water, ice water, air, glycol, power (380 V, 220 V) and steam are available.

## TANK FACILITIES

According to customer's request, various mobile tanks are available.

## STORAGE FACILITIES

Temperature controlled storage rooms are available with both cooling and heating possible (32° F/0° C to 104° F/40° C).

## WORKSHOP

Our experienced fitters are involved in the installation of trial plants, building new plants or modifying existing equipment for special trial runs. To allow for maximum flexibility and rapid response, a fitter is always available during trial runs to undertake any on-site modifications.

## LABORATORY FACILITIES

Our laboratory performs chemical, microbiological and functional analyses of all kinds of food products. All analysis is carried out in accordance with international standards.

## RENTAL FACILITIES

Customers running trials on their own premises can choose to rent whatever new plant and equipment they need to complete their testing. Rentals cover both pilot and full production-scale plant equipment.

For more information please visit [www.spxft.com](http://www.spxft.com).



Testing of the APV™ Cavitator.



## Global locations

### SPX FLOW TECHNOLOGY

611 Sugar Creek Road  
Delavan, WI 53115  
Phone: (888) 278-4321  
Fax: (262) 728-4950  
Email: wcb@spx.com

### SPX FLOW TECHNOLOGY - DANMARK A/S

Pasteursvej 1  
Silkeborg 8600  
Denmark  
Phone: +45 70 278 278  
Fax: +45 70 278 330  
E-mail: apv.nordic@apv.com

### SPX FLOW TECHNOLOGY - SINGAPORE PTE LTD

25 International Business Park  
#03-03/12, German Centre  
Singapore 609916  
Phone: + 65 6264 4366  
Fax: + 65 6265 9133  
E-mail: asia.pacific@spx.com

**SPX FOOD+BEVERAGE** develops and implements processing technologies and other measures to help companies manage critical issues in food and beverage processing.

**SPX POWER+ENERGY** offers solutions for building and updating energy infrastructure, as well as for processes ranging from fuel extraction to electricity distribution.

**SPX VEHICLE+TRANSIT** devises products and technologies for the service and repair of automobiles and recreational vehicles, rail, heavy equipment, marine craft and mass transit.

**SPX INDUSTRIAL PROCESSES** creates equipment and technologies to help customers transform materials efficiently, safely and with low downtime or environmental impact.

**SPX INFRASTRUCTURE** serves the many market sectors involved in building and ensuring the reliability of the infrastructure, ranging from utilities to communications and broadcast.

### SPX FLOW TECHNOLOGY

611 Sugar Creek Road  
Delavan, WI 53115  
Phone: (888) 278-4321  
Email: answers.us@apv.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](http://www.spx.com).

The green ">" is a trademark of SPX Corporation, Inc.