



Thatch-look roofing created with KYNAR resin.

*KYNAR inspires innovations in Japan,
Europe and America*

KYNAR® ROOFING COMES OUT ON TOP

It's the best of three worlds: Japanese ingenuity and French taste combined with American technology for one of the most appealing of KYNAR's applications.

Courte Paille, a French country restaurant chain, looked like a winning formula for Japan. The exterior design, a circular white cottage topped with quaint thatch roofing, was distinctively French and cozy. The menu offered authentic French food at affordable prices in a market where "French" usually means "classy — but expensive." Designed to run as a franchise operation, Courte Paille seemed to have the potential for spreading all over Japan.

But the good concept had a technical hurdle to leap: Japan's stringent fire regulations prohibited the use of thatch, an essential element in the Courte Paille formula.

Engineers in Tokyo went to work on the challenge: how to re-create the conical shape and layered straw "look" of real thatch and prevent the "flambé" from bringing the house down — literally.

Japan Synthetic Rubber Co., Ltd., foremost producer of synthetic rubber in Japan and well-known innovator in rubber, emulsions and plastics, came up with the idea.

JSR had worked extensively with KYNAR. Their research laboratories had spawned JSR KR® sheet for high temperature, corrosion-resistant linings, KYNAR tubes, pipes and

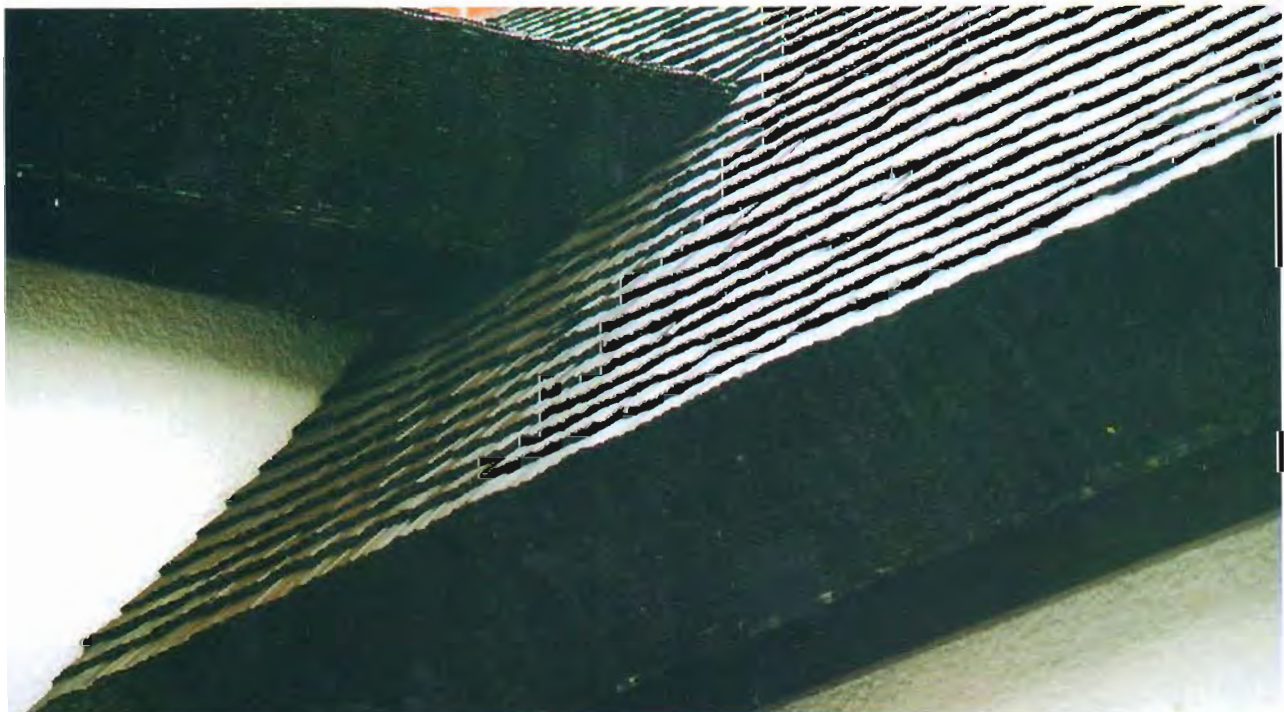
joints, KYNAR packing materials, vessels for chemical processing industries and other demanding applications.

"The paramount need for fire safety clearly indicated KYNAR for the job. Also, it is ideal for creating new shapes — through extrusion — and takes color readily without fading," said a spokesman from JSR. By extruding KYNAR pellets in tubular "reeds" connected on two sides to form sheets, JSR fused form and function.

After laboratory testing, weather- and fire-proof KYNAR polyvinylidene fluoride colored a rustic brown was made to look like freshly cut reeds layered and splayed. At the eaves overhanging Courte Paille's white walls, the KYNAR reeds lie thick just like real thatch, shedding rainwater in droplets in the traditional country way.

In fact, KYNAR's properties out-perform the traditional thatch. In addition to its extreme resistance to heat and flame, KYNAR's tensile strength, color-fastness and resistance to deterioration by even the harshest pollutants protect Courte Paille from outside elements as well as internal fire hazard.

Behind the shuttered windows, fires blaze and sizzle the steak au poivre, brown the crêpes and flambé the pudding. With protection from KYNAR, Courte Paille could catch on in Japan like a house on fire.



KYNAR "reeds" thickly layered at the eaves create the authentic thatch look.

KYNAR® FILM HIGHWAY BARRIERS BEAUTIFY JAPANESE NEIGHBORHOODS

High-speed motorways run side by side with suburban neighborhoods in densely-populated Japan. Steel barriers, erected to shield residential areas from road noise and heavy traffic, help preserve quality of life.

Denka (Denki Kagaku Kogyo Kabushiki Kaisha), one of Japan's oldest chemical companies, has come up with a new way to improve the modern living conditions: highway barriers that remain clean and bright for decades.

Denka began with a 40-micron thick double-layer alloy film formulated with Pennwalt's hardy all-weather fluoropolymer, KYNAR. Kawatetsu Galvanising Co. Ltd. applies the film to galvanised steel panels which are used in highway barriers throughout Japan.

KYNAR's Lasting Looks

The simple lamination process ensures only the KYNAR-rich upper surface of the film is exposed to the constant bombardment of smog, exhaust and all nature's elements.



KYNAR film on Japanese highway barriers.

Protected from dirt and grime, the neighborhood barriers will continue to look like new for many years.

Smooth Surface, Simple Maintenance

"KYNAR film barriers are both easy to form and simple to maintain," says Mr. M. Sano, Plastics Products Division of Denka. "KYNAR's flexibility — because it is not oriented chemically — means easy shape conformation to the metal. It also has excellent adhesion properties because of KYNAR and PMMA alloy. As a result, it seals securely and won't blister or peel, even after long exposure, like other films.

"Because we can source KYNAR locally, there's no delay in supply. To the construction companies, that's a definite advantage, for orders and re-orders," Mr. Sano said.

Weatherproof, chemical resistant KYNAR film is also easy to clean. Homes along the Shinshonan Bypass, connecting Fujisawa to Samukawa on Japan's main island, are assured of clean and smooth protective walls for decades to come.

Tapping the Market

KYNAR film-coated steel panels, which have already captured an estimated 30% of the highway barrier market since their introduction in 1987, have tremendous potential in other construction applications as well.

The pedestrian overpass at Yokohama's new traffic system has used the panels for the exterior of its new station building. Architectural curtainwalls and building sidings are the company's next market opportunities, Mr. Sano believes.

KYNAR® ROTOMOLDING A BOON TO SEMICONDUCTOR MANUFACTURERS

Large KYNAR-lined tanks are introducing new economies of scale to cost- and purity-conscious chemical manufacturers and processors. The highly corrosion-resistant larger tanks out-perform all non-KYNAR alternatives and save manufacturers as much as 50% on materials.

Mitsubishi PetroChemical Co. Ltd. of Japan has devised a cost-saving rotomolding process to produce the multi-layer KM tanks. Outside is a polyethylene layer to shape the vessel and to complement the mechanical strength of the

KYNAR layer. Next comes a layer of newly developed adhesive resin which holds fast to the tough inner layer of pure KYNAR PVDF.

The three-layer construction puts KYNAR where it's most needed: surface-to-surface with corrosive chemicals that ravage ordinary materials.

KYNAR's Competitive Advantage

"Semiconductor manufacturers stand to benefit the most," according to Mr. T.

Yoshizumi, Managing Director, Specialty Polymer Department of Mitsubishi PetroChemical.

"Competitive pressure on integrated circuit (IC) manufacturers to lower production costs is fierce. The larger KYNAR tanks maintain the strictest international standards for purity, retaining quality while lowering vessel costs," he said.

KYNAR withstands the caustic chemicals used in IC manufacture to temperatures as high as 120-130 degrees centigrade, and is easily cleaned to its original purity for use with the same or other chemicals.



One cubic meter to six cubic meter KYNAR tanks preserve chemical purity.

Larger Size, Best All-Around Performance

Mitsubishi PetroChemical first created one cubic meter tanks, five times the size of the more commonly rotomolded 200 liter size used in chemical and semiconductor

industries. They discovered a new market. Now the company is marketing KM tanks up to six cubic meters in size.

No other tank combines KYNAR's most resilient properties: resistance to permeation, abrasion, and other forms of deterioration, with such a relatively lightweight and large-sized construction.

Large polyethylene tanks cannot withstand corrosive chemicals such as hydrogen chloride, hydrogen fluoride and hydrogen sulfate — primary materials to semiconductor manufacturers.

Even manufacturers already using fluoropolymer surfaces — in the form of glass-backed fluoropolymer sheet welded to steel tanks — can benefit through multi-layer rotomolding's cost-efficiency.

"We see vast market potential in Japan and abroad for KM tanks, which allow larger batch processing and storage with absolutely no sacrifice of purity, safety or durability," says Mr. T. Yoshizumi.

Based on growing market acceptance in Japan, Mitsubishi is planning to show KM tanks in trade shows in America this year.



Safety gauges, valves and closures of molded KYNAR.

AT SGS-THOMSON, KYNAR® PVDF PIPES ARE COMPATIBLE IN ULTRAPURE DEIONIZED WATER, DEFYING MICROHOLES AND BACTERIA

SGS-Thomson Microelectronics, the European based multinational semiconductor manufacturer jointly owned by the French conglomerate Thomson CSF and the Italian Istituto per la Ricostruzione Industriale (IRI), was formed in July 1987 as the result of a merger between Thomson Semiconducteurs

and SGS Microelettronica. The company is currently ranked thirteenth in the world list of merchant semiconductor manufacturers. In a year of major reorganizations, SGS has now positioned itself as a broad-range, state-of-the-art semiconductor supplier.

Advanced Production Facilities in Agrate Brianza

The new R1 development center, located in the industrial complex of SGS-Thomson in Agrate Brianza (20 kilometers northeast of Milan), is one of the world's most sophisticated semiconductor facilities. Many of the most advanced production processes used by the company are developed and tested in the new building, which has been equipped with plant and infrastructure aimed at producing integrated circuits in the submicron area. The R1 research and development laboratory plays a major role within the SGS-Thomson manufacturing strategy.

The supply of water, chemical products, and gases to the R1 production and development site is critical. "We have to be 100 percent sure," said Giovanni Redaelli, Facility Engineering Manager for the Agrate complex, "of the quality and purity of any single chemical product or gas that we supply to the wafer fabrication lines. Every dust particle could have a negative impact on the production of our silicon wafers, and the final result could be poor production yields or major quality and reliability problems."

KYNAR Pipes Defy Dirt Particles and Bacteria

Hundreds of meters of PVDF steel piping systems are used in the R1 module, especially for the supply of deionized and demineralized water to the diffusion and masking areas. "The choice of KYNAR PVDF (polyvinylidene fluoride) piping systems is due to the fact that this material is very resistant to corrosion, even at relatively high temperatures." One of the most significant differences between KYNAR PVDF and stainless steel pipes, or even PVC piping, is resistance to corrosion. Deionized and demineralized water has a very aggressive nature and a high intrinsic turbulence. This fact could create some problems. If standard pipes were used (such as PVC), dirt particles (e.g. pigmentation particles from the wall of the piping system) could leach into the ultrapure water and damage the silicon wafer.

This, however, is not the major problem that must be faced. SGS could have used absolute filters capable of filtering any undesired impurity with a diameter as small as 0.2 micrometers. This could be enough to clean off the deionized water. But if the wall of the piping system were not resistant enough, after



KYNAR PVDF pipes at SGS-Thomson Microelectronics' laboratory in Agrate Brianza, Italy, preserve purity.

(Photo credit: SGS-Thomson Microelectronics)

a period of time, microscopic holes would be generated. These could become perfect shelters for any kind of bacteria. And there is no practical way to filter bacteria out of the water.

KYNAR PVDF for UPDI Water and Transport Gases and Acids

Recent tests of PVDF pipe have shown that this material is totally compatible in UPDI (Ultra Pure Deionized) water facilities for semiconductor manufacturing. Specific research on PVDF in semiconductor applications has centered around the study of extractable ions that could add impurities to UPDI water: the results, according to SGS-Thomson Microelectronics, are outstanding. In addition, microscopic examination of the inner pipe surface, performed after a couple of months of contact with the hot ultrapure water, showed no relevant sign of degradation. Multiple tests, performed where KYNAR PVDF has been used in deionized water systems for electronic grade water, have proved low levels of cations (<0.2 ppb w/v), anions (0.5 ppb w/v) TOC and bacteria (<20 ppb w/v).

KYNAR piping systems are not only used for UPDI water in the R1 research centre. KYNAR PVDF is hard, tough and has only successfully utilized in places where there was the need to transport high-temperature or high-purity gases and acids. One of the major advantages of PVDF versus some of its biggest competitors is the ability to use it over a wide temperature range, from -40 to +140°C: that makes it very useful in the case of some hot acid exhausts.

"We considered other issues before selecting KYNAR PVDF as the preferred material for many applications in our new state-of-the-art facility: the availability of different sizes and shapes, the ease of joining different segments of pipes by means of a simple welding technique, etc." continues Mr. Redaelli. "But, believe me, one of the major points to us was the excellent results achieved with UPDI water: no microholes on the inner surface of the pipe; no bacteria. That was of the utmost importance to us."

SHOWCASE PURE WATER PLANT IS KEYSTONE OF NEW SPAN AMERICA PACKAGING FACILITY

For many years, Span America Medical Systems, Inc., Greenville, S.C., has been a major supplier of polyurethane foam rubber patient positioning devices for medical use.

Now the company has decided to build a major stake in the growing field of flexible packaging of pharmaceutical products. This required that Span America build an entirely different 60,000 sq. ft. pharmaceutical manufacturing operation in Greenville for high-volume production and packaging of sterile and non-sterile swabs, prep pads, antiseptic fluids, and other medical solutions.

Company president Don Spann's goal in this new endeavor is no less than the following: to build a unique flexible packaging facility with a versatility and capability unequaled in the contract field.

When it came to the high-purity water generating system, nothing but the best and most complete system would do. Spann commissioned Millipore Corporation to design and build a unique showcase water purification room capable of producing a wide range of water qualities all the way up to the highest WFI (water for injection) and USP (U.S. Pharmacopoeia) standards for bacteria and pyrogen free H₂O.

The system employs 600 feet of high-purity Sani-Tech Sani-Pro K[®] sanitary tubing. This tubing, made of KYNAR[®] fluoropolymer, not only maintains the integrity of the water, but also accommodates a wide range of chemical sanitizing and steam sterilization options, and provides Span America with a high degree of

flexibility in meeting future changes and expansion.

Don Spann has enshrined the impressive new \$500,000 WFI facility behind a floor-to-ceiling glass wall and in full view of the operational flexible packaging lines and the soon-to-be installed mixing area. The location underscores the importance to Span America of ultra-high purity water for the sterile washing and mixing of ingredients, and stresses the company's commitment to the finest in production facilities.

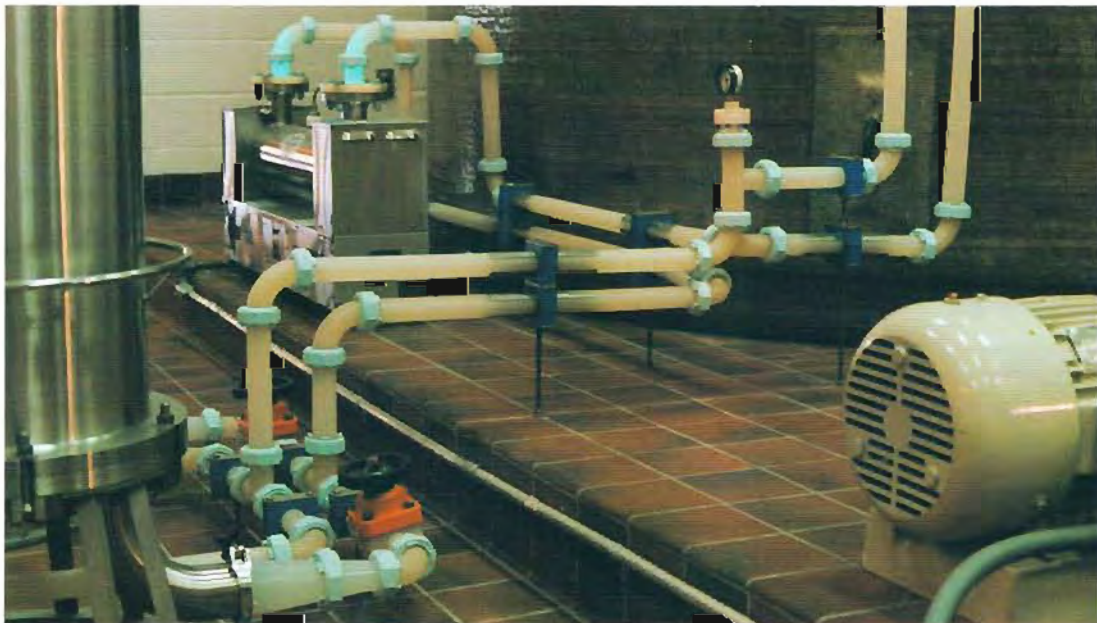
Span America currently purchases certified ingredients for the manufacturing of its pharmaceutical products. These now include some 31 items, such as castile soap, alcohol, povidone iodine, lemon glycerine, lubricating jelly, and various antiseptic and hygienic cleansing solutions.

Just as soon as its high-purity water system is validated however, and the mixing section installed, the company will begin producing many of the pharmaceutical ingredients to be packaged.

The Water Purification Room

Incoming feedwater passes first through a sand filter, then a carbon filter to remove organic contaminants, and a five micron prefilter. The pH is next chemically adjusted, if necessary, and the water moves on to the industrial ultrafilter (IUF).

The 36 gpm IUF unit removes 99% of bacteria and also reduces colloidal content that would affect subsequent processing. The only



High-purity water lines made of Sani-Tech Sani-Pro K[®] KYNAR fluoropolymer.

water to be "wasted"; a small fraction of the total processed in Span America's WFI facility, is drawn off with the impurities at this point. The processed water then passes through an ultraviolet (UV) sterilizer and into the 2500-gallon IUF water storage tank. Water of this quality can be tapped for use or moved on to more refined processing.

In the second major stage of processing, the IUF water is pumped through a reverse osmosis (RO) unit. This takes out what little bacteria remains, but is primarily intended to reduce ionic content of the water. The 10 gpm, dual-pass RO system at Span America is rated to reject 99.5% of ionic content and better than 99.99% of particulates, microorganisms and organics larger than 300 NMW, including pyrogens.

After a trip through a second UV sterilizer and two final 0.22-micron polishing filters, the ultimate product flows into the 2500-gallon RO water storage vessel.

Millipore has provided the necessary lines and space for the addition of a second RO unit, giving Span America the potential for rapid expansion of its ultrapure water capacity.

From the WFI generating facility, a constantly circulating stream of purified water flows out through the Sani-Pro K distribution loop to drops in the laboratory and the planned mixing room. The pumps and lines in this loop have been designed and sized to maintain a minimum flow rate and velocity — to prevent any dormant residual bacteria from propagating.

Water for process use will be drawn off at these drops through special zero-deadleg valves designed by Sani-Tech to further remove any potential for bacterial growth.

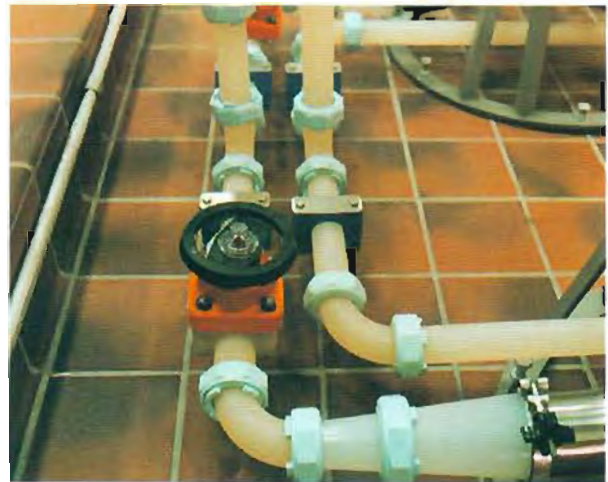
The planned future addition of 18-megohm deionized (DI) water units at one or more of the drops in the mixing room will make available to Span America a complete range of purified waters — IUF, RO and DI to meet all requirements for USP and WFI processing. One such DI unit — the Millipore Milli-Q® — has been installed at the drop supplying water to the analytical control laboratory on the production floor.

The Choice of Sani-Pro K and KYNAR

Sani-Tech's Sani-pro K system made of KYNAR fluoropolymer is used for all the high purity water lines beginning with IUF processed water and continuing out through the circulating distribution loop and drops serving the mixing room and laboratory.

Approximately 600 feet of 1-1/2" diameter Sani-Pro K sanitary tubing, fittings, and valves made of KYNAR resin are involved.

Both Span America and Millipore are in complete agreement over the choice of the Sani-Pro K sanitary tubing system. Foremost among the reasons is the ease of installation and change provided by the Sani-Tech method of tri-clover clamped connections. It insures a degree of flexibility in meeting layout alterations and future growth not available in any other system, according to Don Spann.



Tri-clover clamped KYNAR connections for flexibility.

Natural KYNAR resin provides the contaminant-free, high-purity material of construction essential for a system capable of meeting the highest water quality standards. KYNAR resin also has other characteristics that will greatly increase process flexibility at Span America. Its broad spectrum chemical resistance will permit use of a variety of sanitizing options. Its elevated temperature properties will also permit the steam cleaning and sanitizing of lines and fixtures.

Welded stainless steel has been the traditional sanitary tubing material in the pharmaceutical and medical supply fields. But use of conventional stainless steel lines at Span America would have meant built-in inflexibility to change, would have added greatly to installed cost, and would have been vulnerable to internal surface attack by some chemical treatments used for sanitizing. According to Phil Munden, who designed and supervised the installation of Span America's WFI facility, "the Sani-Pro K sanitary tubing made of KYNAR fluoropolymer is currently the best choice for ultra high purity water systems of this type."

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