KYNAR®
BY ARKEMA

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Kynar® PVDF for Nuclear Applications

KYNAR PVDF ASSISTS LOS ALAMOS LABS WITH PLUTONIUM RECOVERY PROCESS

The Los Alamos National Laboratory, Los Alamos, New Mexico, is conducting a plutonium recovery project in which KYNAR polyvinylidene fluoride (PVDF) is playing an active role. KYNAR components are used in a variety of acid-based and chloride-based aqueous plutonium recovery operations due to the resin's inherent resistance to creep, corrosion, radiation and flame retardant capabilities.

Operated by the University of California for the U.S. Department of Energy, the lab has the task of recovering small amounts of plutonium from chloride salts (i.e., NaCl, KCl, MgCl and $CaCl_2$). When it began using hydrochloric acid as the medium for extraction, the lab sought a corrosion-resistant glovebox material.

Historically, aqueous plutonium residue recovery processes had used nitric acid in stainless steel-lined gloveboxes. Because of the switch to hydrochloric acid, stainless steel linings were no longer practical because of their inability to withstand corrosion.

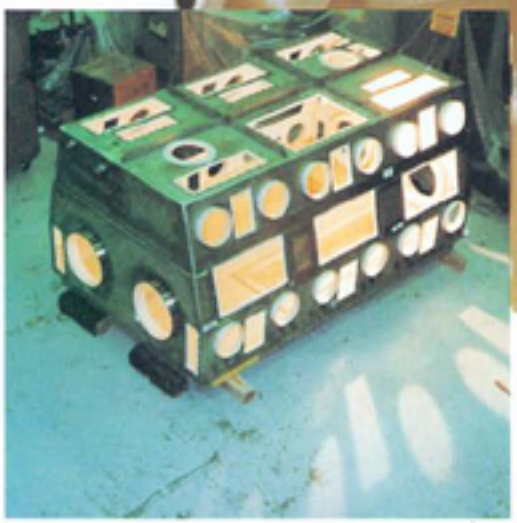
The corrosion caused by hydrochloric acid in the traditional stainless steel-lined gloveboxes would have added unwanted impurities, especially iron, which would not separate from the plutonium. The new gloveboxes were lined instead with KYNAR PVDF, with stainless steel forming an outer shell. PVDF was also specified for the equipment used inside the gloveboxes because only non-metallic materials were allowed. Components formed from KYNAR PVDF lack metal particulate contaminants.

Even more critical than metal contamination concerns is the durability and longevity of the protective lining in the glovebox. A break in the interior lining can lead to rapid corrosive deterioration of the stainless steel substrate, with loss of containment. A failure that renders the very costly glovebox useless would add the even greater expense of dismantling and disposing of the radioactive structure.

Currently, KYNAR PVDF has a number of applications at Los Alamos including: solid sheet lining the interior of gloveboxes, brackets, pipe supports, vacuum traps, flanges and end plates for glass columns, piping used in solution transfers between gloveboxes, pumps, valves and flowmeters.

Commonly, the chemicals used in the recovery operations are hydrochloric acid, oxalic acid, nitric acid, potassium hydroxide, hydroxylamine hydrochloride and sodium nitrite.

Most of these chemicals are stored within the glovebox in slab tanks constructed of PVDF. This design allows for greater storage volume within the glovebox, without sacrificing limited work space. KYNAR fluoropolymer can handle a wide range of acids and chlorides routinely found in nuclear processing. It can handle elevated temperatures up to 275 degrees Fahrenheit or more without significant loss of physical and mechanical properties.



The exterior of a KYNAR PVDF-lined glovebox illustrates the complexity of fabrication.

The surface of the KYNAR PVDF-lined gloveboxes is relatively "stick-free," which prevents build-ups of dust or grime. The fluoropolymer is easily cleaned to prevent any accumulation that might occur. This is important, because build-ups of radioactive dusts can increase radia-

A look inside a KYNAR PVDF-lined glovebox showing the PVDF roto-molded well. Gloveboxes like this one offer a combination of superior corrosion resistance and greater durability for improved handling of radioactive material.

A key component in the recovery process is this slab tank made from KYNAR resin which is used for holding corrosive chemical solutions.

INSET

Stainless steel exhibited rapid deterioration prior to using a KYNAR PVDF lining.

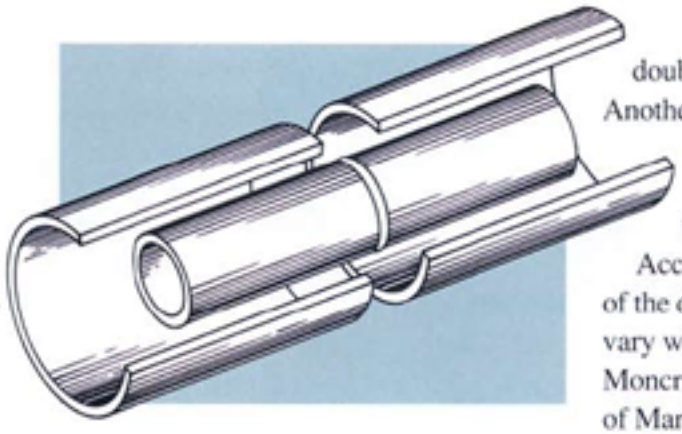
tion exposure to a worker's arm in the glove ports.

Polyvinylidene fluoride began finding applications in nuclear processing equipment and piping more than twenty-five years ago, when Elf Atochem North America, Inc., introduced its unique KYNAR fluoropolymer. KYNAR PVDF was installed in some of Los Alamos Labs' operations in early 1985, based primarily on its use in the nuclear material reprocessing industry since 1966.

KYNAR RESIN FINDS NICHE IN DOUBLE CONTAINMENT SYSTEM

With the growing concern over safety and environmental issues, chemical manufacturers have come to rely on the concept of double containment piping systems as a way of providing the maximum degree of safety in the handling of harsh chemicals. One company which is leading the way in the trend toward smarter, safer handling of corrosive material is Epsco Inc., of Deer Park, Texas, a fabricator and supplier of double containment systems.

Many companies in the CPI routinely use highly corrosive acids, halogens and chlorinated hydrocarbons. Because of the nature of the chemicals involved, KYNAR fluoropolymer piping is gaining popularity as the contact surface for handling these types of compounds. For added protection against any potential leakage, an outer shell of fiberglass reinforced plastic (FRP) is used as an additional safety measure. In the event of a leak, this outer shell would provide a safe containment area for the unexpected spillage, until such time as repairs can be made to the system.



A double containment piping system for handling highly corrosive material. KYNAR fluoropolymer piping and an outer shell of FRP provide the optimum in safety.

Plastics are finding a special niche in double containment systems like the ones supplied by Epsco for a number of important reasons including their excellent reputation for long-life chemical resistance and their ease of installation. The relative low-cost and high performance provided by plastics make them much more favorable than exotic metals for double containment applications. Another benefit, the low ionic extractability, helps eliminate the potential for contamination of the process system.

According to Epsco, the outer shell of the double containment system can vary with the application. John Moncrief, Jr., Epsco's Vice President of Marketing and Sales, notes that his company offers such combinations as KYNAR PVDF, FRP, polyethylene, PVC, polypropylene and CPVC in their double containment arsenal. Epsco chooses to use schedule 80 piping manufactured by the Chemtrol Division of Nibco Inc. for their KYNAR PVDF needs.

As a primary containment material, KYNAR PVDF offers the optimum performance in chemical resistance at elevated temperatures, abrasion resistance, radiation resistance and purity. Its excellent permeation resistance and high integrity fusion capabilities are added benefits. With such a wide range of performance characteristics, KYNAR PVDF will undoubtedly continue to play an important role in demanding double containment applications.

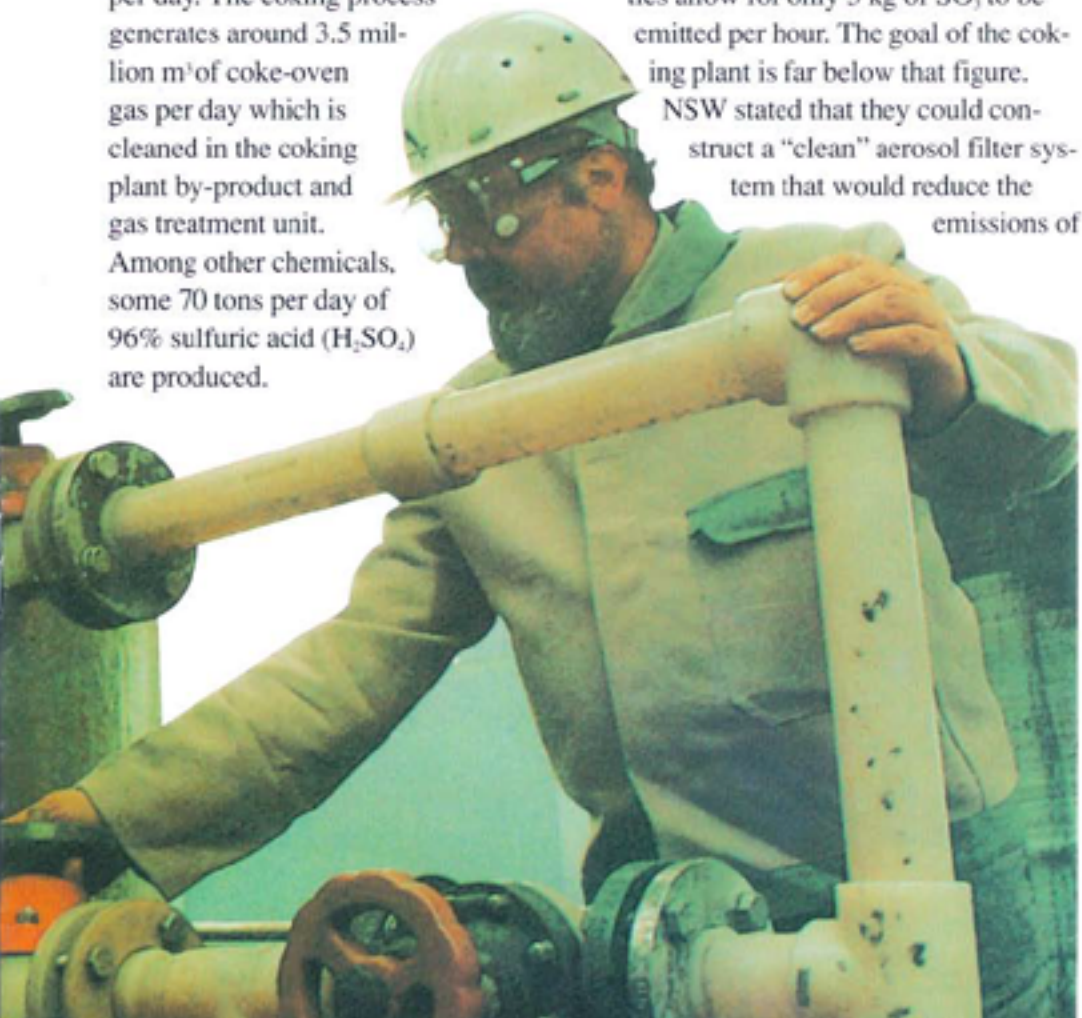
System showing welded support keeping internal pipe in place.

Fabrication of KYNAR double containment system in Epsco Facility in Deer Park, Texas.

KYNAR PVDF HELPS LOWER EMISSIONS AT THYSSEN STAHL COKING PLANT IN THE RUHR

At its main location in Duisburg, in the heart of Germany's industrial Ruhr, Thyssen Stahl AG operates three blast furnaces which contain a total of nine furnaces with an iron-making capacity of 993,000 tons per month. To supply its blast furnaces with blast furnace coke, Thyssen Stahl AG operates its own coking facility, the August Thyssen coking plant. This plant is equipped with six coke-oven batteries which produce some 45% of the coke required for the company's own blast furnaces.

Up to 9,700 tons of coal (wet) can be charged per day, corresponding to a production of 7,000 tons of coke (wet) per day. The coking process generates around 3.5 million m^3 of coke-oven gas per day which is cleaned in the coking plant by-product and gas treatment unit. Among other chemicals, some 70 tons per day of 96% sulfuric acid (H_2SO_4) are produced.



Concerned with protecting the environment, the August Thyssen coking plant has invested heavily in equipment for the desulfurization of the coke-oven gas and now operates almost emission-free. Charged with reducing the emissions to almost zero at its sulfuric acid by-product facility (or to a figure below German government requirements), the management of the coking plant turned to Norddeutsche Seekabelwerke AG (NSW) for a solution. NSW, a company specializing in aerosol separator systems, responded with a system designed to meet Thyssen's demands.

Regulations of the German authorities allow for only 3 kg of SO_3 to be emitted per hour. The goal of the coking plant is far below that figure. NSW stated that they could construct a "clean" aerosol filter system that would reduce the emissions of SO_3 to 0.5 kg per hour. After studying the sulfuric acid by-product plant of the August Thyssen coking plant, NSW developed a tailor-made, two-tank aerosol filter system that, among other things, incorporated high-performance components based on KYNAR PVDF.

This vital ingredient has a known resistance to corrosion in sulfuric acid processes. Installed at Thyssen in 1980, each filter handles around three liters of an SO_3-nitric acid mixture per hour. Some 13,000 m^3 of waste gas are produced per hour, 24 hours per day.

The filtering of sulfuric aerosols is carried out in 76 cartridges (filter candles). The filter candle body is constructed of solid extruded KYNAR PVDF mesh which is wrapped around a high concentration of glass fiber. The filtered SO_3-NO_x mixture, kept liquid by correctly adjusting the process temperature, is removed from the filter system by sulfuric acid rinsing, and is recycled back to the sulfuric acid by-product plant. The wastepipe and wastevalves are also made of KYNAR PVDF. The NO_x removed from the filter system is eliminated by a chemical process.

The reduction in sulfuric acid emissions have even surpassed NSW's original projections. Measurements have shown that the emission is only 0.4 kg of SO_3 per hour, 0.1 kg below NSW's design specifications, and far below Germany's strict requirements of 3 kg per hour. The KYNAR PVDF mesh-covered filter cartridges, pipe, and lined valves have contributed towards keeping the aerosol filter system virtually maintenance free, ensuring it a long operating life.

KYNAR PVDF INTALOX® SNOWFLAKE® PACKING INCREASES PRODUCTION CAPABILITY IN CORROSIVE APPLICATIONS

By simply switching from a ceramic tower packing to an Intalox Snowflake tower packing made of KYNAR PVDF resin, Elf Atochem has increased its chlorine drying capacity more than 25% at its Basic Chemicals plant in Portland, Oregon.

The Intalox Snowflake tower packing—manufactured by Norton Chemical Process Products, Stow, Ohio—provides excellent surface area with low pressure drop for removing moisture from chlorine gas. The packing's unique shape and customized design result in greater tower capacity and higher efficiencies, and offers material properties (because of the KYNAR resin) which enables it to be used with harsh chemicals such as acids and chlorine.

A broad range of packings are manufactured by Norton using KYNAR resin.

"The switch to Intalox Snowflake packing helped us increase chlorine gas flow capacity, while reducing the pressure through the towers," said Norm Hanson, manager of engineering and maintenance at Elf Atochem's Portland chlorine plant.

Tower packing must provide an intimate contact to baffle the downward flow of liquid and ascending vapor. A high performance packing, like Intalox Snowflake, permits greater tower capacity, higher efficiencies and lower energy consumption without restricting flow.

The absorption towers (or drying towers) at Elf Atochem contain concentrated sulfuric acid flowing countercurrent to the chlorine gas. "KYNAR PVDF packings provide chemical resistance against the sulfuric acid and wet chlorine, and the high efficiency of the packing results in a level of 50 parts per million (PPM) of water in the chlorine," says Hanson.

For the same amount of material transferred, the liquid hold-up of Intalox Snowflake packing is normally less than with standard packing, according to Norton. This not only reduces liquid inventory, but lowers the absorbate degradation due to oxidation or thermal instability, a significant benefit in situations where degradation products must be removed by a side stream purification system.

High-efficiency, Snowflake® packing made of KYNAR PVDF helped increase gas flow capacity at this chlorine plant in Portland, Oregon.

Cost plays a role in any decision-making process to switch products. KYNAR PVDF tower packings are higher in price, yet have allowed Elf Atochem "to increase our capacity without the cost of changing or adding to our present drying system," according to Hanson.

"We mold KYNAR resin because of its chemical resistance to corrosives, high temperatures, and the long-term savings it provides the customer," according to Jon Zeltman, marketing manager for mass transfer products at Norton. "Resin costs are higher, but when you balance that against lifespan, economics often favor PVDF."

Regardless of the gas or liquid loading application, tower packing made of KYNAR PVDF resin helps achieve optimum performance levels and can lead to a rise in production capacity.

Both Intalox and Snowflake are registered trademarks of the Norton Company.

KYNAR FLEX® FLUOROPOLYMER GAINING POPULARITY IN THE CPI

Flexible PVDF is becoming increasingly popular in the chemical processing industry for a host of applications. Long used as a jacketing material for plenum cable in the electrical market, KYNAR FLEX fluoropolymer resins are now also being used for cable jacketing in the CPI, as well as for several other applications where a flexible fluoropolymer is desired.

The same properties that make KYNAR FLEX resins an ideal jacket material for plenum cable—such as flexibility, clarity, elongation and strength—also make them a strong material contender for tubing. Such tubing is flexible enough to bend and wrap around stationary objects without leakage of materials inside the system and without flow restriction.

For sheet, vessel linings and stock shapes, KYNAR FLEX resins exhibit ease of fabrication, resistance to acids and chlorinated materials, and greater impact resistance at room temperature and colder.

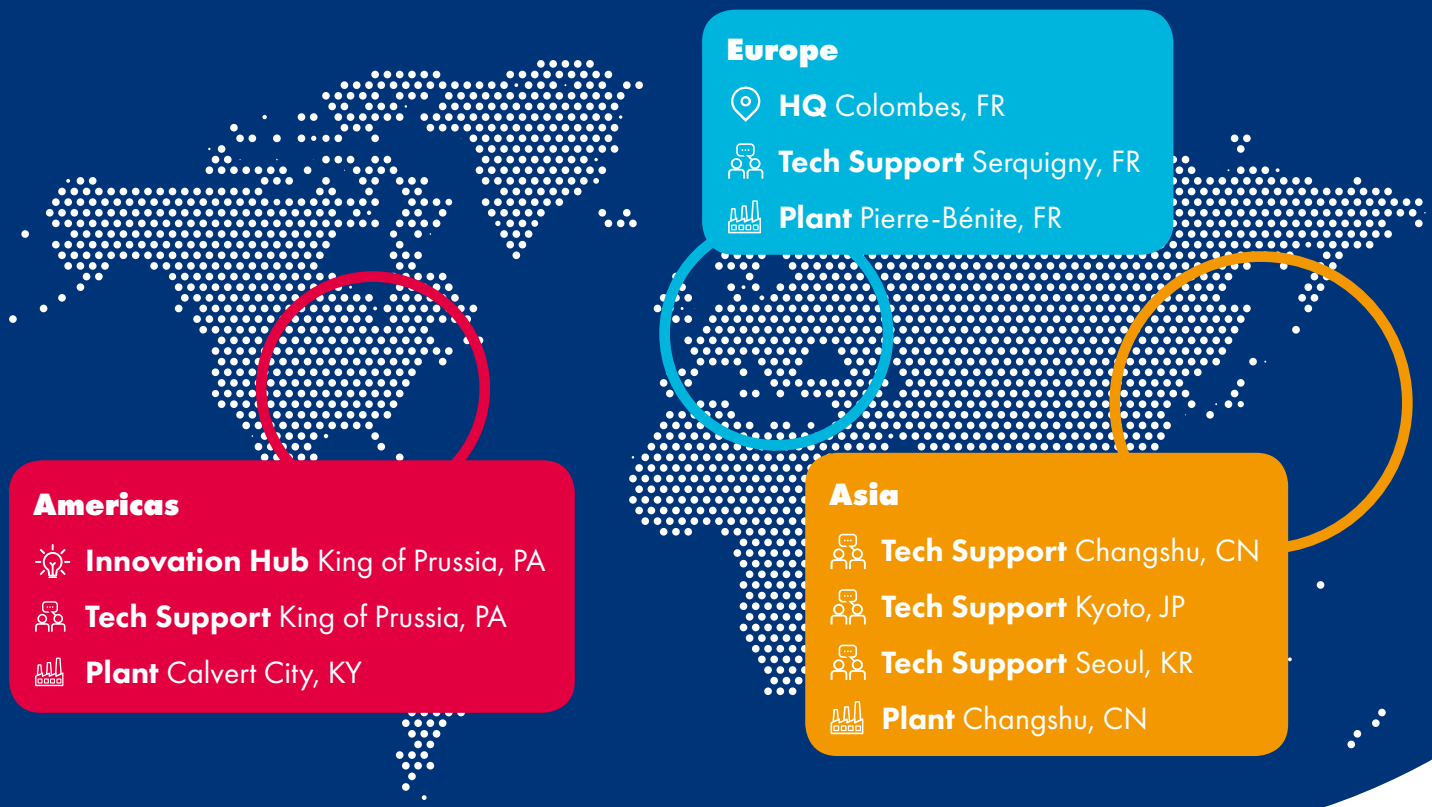
Because of their excellent melt characteristics, these resins are easy to mold in conventional compression, transfer and injection molding equipment. Also, they can be welded via butt fusion, bead and capstrip, and extrusion welding.

The benefits of a flexible fluoropolymer for the CPI are numerous.

Components manufactured from KYNAR FLEX resins offer inherent chemical and radiation resistance, impact strength, flame and smoke resistance, as well as excellent mechanical properties.

In fluid handling systems, KYNAR FLEX resins outperform other materials, such as polypropylene and PVC, and are less expensive than other fluoropolymer materials. The high degree of purity, combined with the absence of additives and processing aids, make KYNAR FLEX resins useful for most food and beverage applications. Their superior corrosion resistance mean KYNAR FLEX resins perform well in demanding environments like pulp and paper, automotive and aerospace, among others.

Global Manufacturing, Technical Support, and R&D



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