PLASTICS ENGINEERING

AN OFFICIAL PUBLICATION OF SPE

JULY/AUGUST 2022

80

SPE'S 80TH ANNIVERSARY SPECIAL ISSUE

spe INSPIRING PLASTICS PROFESSIONALS

CHAMPION FOR CHANGE

Sal Monte continues to challenge conventional thinking about coupling agents and catalysts

BY PAT TOENSMEIER

In 1979, shortly before his 40th birthday, a hard-charging chemical executive named Sal Monte attended a communications development seminar in White Plains, a suburb just north of New York City.

During a break, he discussed his business with one of the speakers, James Cusimano. Monte told Cusimano that he helped his company, Kenrich Petrochemicals Inc. of Bayonne, N.J., develop organometallic coupling agents for titanate, zirconate and aluminate technologies. The additives, which also have value as catalysts, improved the properties and processability of numerous materials, such as thermoplastics, composites, color concentrates, coatings, adhesives and rubber.

Monte, who was vice president of the company at the time, believed the coupling agents were suitable for use with all sorts of materials, not just plastics and rubber, and had the potential to upgrade resin properties in diverse applications. Cusimano probably didn't follow all the technical aspects of the conversation, but he did recognize Monte's enthusiasm for and commitment to the products.

"Sal Monte," Cusimano said, "what if I told you your mission in life is to teach people how to use raw materials more efficiently through titanium? Does that mean anything to you?"

For Monte it sounded like affirmation of the work he started in 1973. "The Holy Spirit gave me a message, and

Sal Monte and wife, Erika, strike a familiar pose while promoting Kenrich products at yet another trade show or conference: this time at ANTEC 2013. Photos courtesy of Sal Monte

1953

General Motors and Morrison Molded Fiberglass Products Co. launch an exploratory program to produce a glass fiber/thermoset polyester car body that will eventually use vacuum bag molding for fabrication.

1954

Lowell (Mass.) Technological Institute (now UMass-Lowell) launches a four-year undergraduate program in plastics. HDPE, polymerized by Ziegler-Natta process, is commercial.

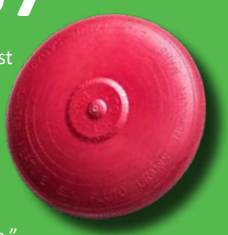
1955

GE commercializes polycarbonate resin.

1956

ANTEC draws a record 2,500-plus attendees. The Third Industrial Revolution begins to emerge, characterized by manufacturers adding more electronic technology to their factories. This technology eventually evolves to include computers.

1957



SPE awards first President's Cup to Frank Martin. The "Pluto Platter," better known as the "Frisbee," is marketed by toy maker Wham-O. The aerodynamic PE device, popular as a toy and for sports, racks up sales of 300 million units over the years.

Monte has been a tireless promoter of Ken-React coupling agents and catalysts, detailing their benefits to audiences worldwide.

that was my job—and I stuck to it," he says.

Forty-three years later, Sal Monte, now president of Kenrich Petrochemicals, still enthusiastically promotes the benefits of titanate, zirconate and aluminate technologies in many forums—conferences, trade shows, meetings with potential clients and R&D personnel, as well as the occasional interview and article in industry publications.

Applications for the technologies, meanwhile, continue to grow. The coupling agents and catalysts find use in cosmetics, coatings, paints and inks, and a range of consumer and industrial products, as well as military applications in energetics and pyrotechnics.

Among his latest targets for the coupling agents and catalysts—tradename Ken-React—is what he terms advanced mechanical recycling of post-consumer plastics. He believes that with the chemistry of the additives mechanical recycling can be as effective at repolymerizing/copolymerizing commingled waste streams generated by curbside collection as advanced recycling (also called chemical recycling) that uses depolymerization processes. Mechanical recycling also does not require huge processing plants and large amounts of energy like advanced recycling does. More on this later.

The Ken-React titanate, zirconate and aluminate coupling agents come as powders, liquids or pellets. According to the Kenrich website, they form a less than 2-nanometer monomolecular layer on the surface of any organic or inorganic material and chemically bridge non-silane reactive fillers such as calcium carbonate ($CaCO_3$), carbon black, silica, metal oxides and other chemicals with polymers. As an example, the website notes that an organotitanate nano coating on carbon black will act as a metallocene-like catalyst in a polymer and lower Mooney viscosity, resulting in increased flow and greater mechanical properties.

The benefits of using the additives are considerable. According to the website, adding just 0.2 to 0.6 phr of titanate to a polymer compound can yield up to 40 percent faster molding cycles and 10 percent lower process temperatures; viscosity can be reduced 20 percent or more; mechanical properties improve; high filler loadings of carbon black, $CaCO_3$, ATH and magnesium hydroxide can be used with no tradeoffs in processability or part flexibility; polymer adhesion to aramids, polyamides, graphite and glass-fiber reinforcements increases significantly; and part smoothness, pigmentation and paintability improve.

These may sound like miracle materials, but there's nothing miraculous about them; it's all nano-chemistry, and their development owes to Monte's original idea in the early 1970s that transesterification of isostearic acid with a tertraalkoxy titanium compound

Monte's standing in the industry was recognized when he was inducted into the Plastics Hall of Fame in 2021. Sal and Erika stand by the list of his accomplishments at the ceremony.

1958

The Hula Hoop from Wham-O debuts. The toy is so popular—for a little while, at least—that demand surges for extruded PE. 24 million are bought in the first four months of sales. The first blow molded Coca-Cola bottles are made in an experimental program by Monsanto using acrylonitrile.

1959

SPE creates Professional Activity Groups, a precursor to SPE Divisions. B.F. Goodrich commercializes thermoplastic polyurethane. DuPont adds Delrin acetal homopolymer. Mattel introduces plastics-rich Barbie dolls.

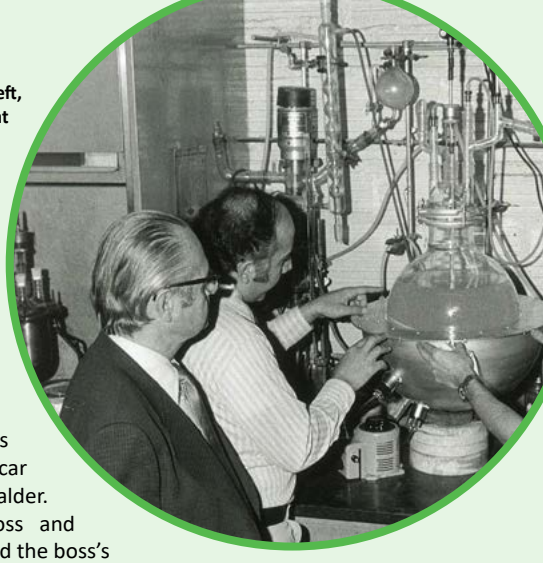
1960

16th ANTEC includes a number of papers on blow molding, a first. Dow Smith Co. produces filament wound pressure pipe. Borg-Warner builds prototype "Formacar" with most components thermoformed of ABS. OPEC, Organization of the Petroleum Exporting Countries, is formed with headquarters in Baghdad.

1961

Plastics Institute of America

SPE forms the Plastics Institute of America to increase attention on science. Gussoni of Italy is first to patent horizontal indexing system for blow molding. Gatto Machinery develops large pipe pullers for extrusion lines.



Monte, second from left, helps synthesize titanate at Kenrich in the 1970s.

would improve the dispersion of zinc oxide and hence the properties of wire-and-cable compounds.

At the time, Kenrich Petrochemicals was owned by brothers Oscar and Eric Spiegelhalder. Eric was Monte's boss and father-in-law. "I married the boss's daughter, Erika," says Monte. The two had known each other since they were teenagers. Monte joined the company in April 1966 as vice president with solid academic and professional credentials. He had an undergraduate degree in civil engineering and was a licensed PE (professional engineer). Once he began working with chemicals at Kenrich, he went back to college and earned a master's degree in polymer materials at New York University's Tandon School of Engineering. His wife, Erika, meanwhile, was a director of the company and excelled in sales, travelling to trade shows and other venues with Monte for many years promoting the Kenrich line.

In the 1950s, Oscar and Eric, who owned two sucro-chemical companies, purchased the license to a product called Kenflex A, which was developed toward the end of World War II in Socony-Mobil labs in Paulsboro, N.J., by three graduate scientists from the University of Kentucky, who planned to get rich by making use of the bottoms cut from the distillation of gasoline via a formalite condensation polymerization to produce an oligomer plasticizer of polycyclic aromatic hydrocarbons. By 1961, Kenflex A had been approved by DuPont for use in its high-voltage Neoprene and Hypalon wire-and-cable insulation. The added demand led the Spiegelhalders to move operations to a plant in Bayonne, N.J., which had the manufacturing capacity they needed for the product.

In 1973, Monte developed the initial material in the Ken-React line.

1962

SPE presents its first International Award to polymer scientist Dr. Herman F. Mark in Pittsburgh at 18th ANTEC. Shell launches program promoting HDPE milk bottles. DuPont adds high-heat polyimide resin.

1963

Dr. Giulio Natta receives International Award for polymer catalyst development work the year before he wins the Nobel Prize for chemistry. F.J. Stokes Co. develops "Injectoset," a 50-ton automatic transfer molding machine with reciprocating screw plasticator.

At first it was intended to be a better way of dispersing zinc oxide in naphthenic oils. He suggested the company make an isostearic acid-based titanate ester to do this. "I knew enough chemistry to be dangerous," he says. But his idea "worked like gangbusters. I came up with a better coupling/catalyst system for metal oxides."

The formula was tried on silicas, $CaCO_3$ and numerous other minerals and metal oxides, and worked well in all these applications. During the Arab oil crisis of the early 1970s, he says, "Everyone was trying to stretch out polyolefins [in masterbatches] with calcium carbonate [to save money], and the Ken-React formula worked great [for that]." Monte wrote up this finding in an article he submitted to Gordon Kline, an editor at *Modern Plastics* magazine. MP published it as a feature article in December 1974. "That was a big deal back then," he adds. Once the issue was out, the phones at Kenrich started ringing off the hook, as readers sought more information about the Ken-React material. "We were getting six phone calls per hour about the 'miracle stuff' that stretched plastic."

From that point on, Sal Monte became the chief salesman—some would say apostle—for titanate, zirconate and aluminate coupling agent and catalyst technologies. Along the way he's dealt with resistance from companies accustomed to using established coupling agents, notably silanes. "I spent 10 years trying to undo the mindset of silane coupling," Monte remarks.

Nevertheless, he's made considerable gains over the years. "There are over 8,000 patented applications for our materials," Monte says.

The latest work he's focusing on is enhancing the mechanical recycling of plastics waste. Monte believes that the Ken-React coupling agents and catalysts can effectively compatibilize commingled plastics waste from curbside consumer collection.

Sal and Erika relax at home in New York City.

"The reason why advanced recycling has value is you take material with a known quality and reuse it," he explains. "But you need a chemical plant to do this, and regulators don't want chemical plants that consume lots of energy. My concept uses advanced mechanical recycling and titanium aluminum chemistry."

Mechanical recycling, says Monte, is currently being done wrong. "They try and mix incompatible plastics from curbside collection. But if they put some titanium aluminum additive in the mix, they can improve performance of the recyclate and reuse it in new products."

Monte says the scrap would need to be in powder or flake form prior to mixing with the titanium and aluminum coupling agent and transferring the blend to a twin-screw extruder for processing and pelletizing. "You need to learn how to prepare a masterbatch in a certain way," he remarks. "There's a whole science to mixing that many don't understand. To work in the melt phase [with coupling agents and catalysts] at the nano level means all the temperature settings, rheology and other parameters are different." Profile temperatures, for example, might need to be 10 to 20 percent lower than usual to get complete coupling via reactive compounding shear with the Ken-React materials.

Monte has experimented with commingled scrap consisting of polypropylene, high-density PE and PET soda bottles. They were ground up together and the coupling agent and catalyst were added during extrusion. Pellets from the process had higher properties than conventional mechanically recycled plastics. But the experimental process tests

1964

SPE offers limited-registration educational seminars at ANTEC. GE introduces polyphenylene oxide. R.G. Angell of Union Carbide develops low-pressure structural foam molding process.

1965

3,651 people attend 10 RETECs during the year. Nathaniel Wyeth of DuPont produces injection stretch blow molded beverage bottles using a version of PET that withstands the pressure of carbonated liquids; patent is granted in 1973. Union Carbide introduces polysulfone. OCF begins fabricating reinforced polyester underground gasoline tanks.

1966

ANTEC becomes an international event with six technical papers presented in French and simultaneous translations in English. Shell Chemical unveils Kraton styrenic TPE.

1967

SPE celebrates 25th anniversary; ANTEC attendance tops 3,500, features 56 sessions. Dow Chemical makes patented "black box" control available. Device meters preprogrammed amounts of chopped glass fiber and polymer into an injection molding machine for mixing.

cost $25,000 to develop initial data, and the additive has a cost that raises a red flag for potential users who say they can't even add a penny to the cost of a pound of recyclate. "Right now, recycled material is more expensive than virgin," Monte notes. "There'd only be a market if there's a mandate to use recyclate in products."

The high cost of developing, testing and certifying new chemical formulations is a major problem affecting the plastics industry, he says. "It's very expensive to introduce a new chemical today. You can't just willy-nilly create and innovate. I did one modification on a molecule, and it cost $45,000 to go through the U.S. EPA Pre-Manufacture Notification process. You can't get approvals in one year in this business. It takes a 3- to 5-year cycle. You have to be in for the long term. I send a 200-gram sample to an R&D guy, and he tries to make it solve problems that he could never do before, then he has to go to management to get approval, then to UL and others for their approvals. You need all sorts of approvals."

In Europe, Monte adds, it can cost over $100,000 to certify a new chemical grade under the European Union's REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) compliance program. Expenditures at that level usually require corporate backing, but that means confidentiality, non-disclosure agreements and other restrictions.

Ready to go: 5-gallon pails of Ken-React coupling agents are packaged for shipping to customers.

It's a changing world, to be sure, with product development far more regulated than it used to be. But that hasn't stopped Sal Monte from continuing to develop technologies for various applications. In 2020, he received his 32nd U.S. patent for developing a way of making ordinary Portland cement composites from oil-soaked seawater sand—a hazard of offshore oil spills—by using a nano-level titanate surface modifier.

54-Year SPE Man

Meanwhile, Monte has been a stalwart member of SPE since joining in 1968, and a leading figure in the plastics industry. The honors he earned in SPE include being named a Fellow of the Society, an Honored Service Member, past president of the New Jersey Section, past chairman of the Thermoplastics Materials & Foams Division, and co-founder of the SPE International Foams Conference in 1999.

He is also a member of the Plastics Pioneers Association and of the Plastics Industry Association's Recycle Subcommittee-Compatibilizers. In 2021, he was inducted into the Plastics Hall of Fame.

Sal Monte has come a long way since joining Kenrich Petrochemicals. He's made a lasting name for himself in plastics and as a tireless advocate for the products that emerged from his idea in 1973 to make an isostearic acid-based titanate-coated zinc oxide.

As the seminar speaker told him so many years ago, his mission in life has indeed been to teach people how to use raw materials more efficiently through titanium, and that doubtless will be one of his most important achievements and his legacy in the plastics industry. ■

1968

Owens-Illinois produces PVC liquor bottle with hollow handle for American Distilling Co. Bottle is eventually removed by U.S. government over concerns about PVC. Plastics will not reappear in U.S. liquor bottles until early 1980s in biaxially oriented PET containers.

1969

U.S. lands two men on the moon with Apollo 11 flight. Plastics play important roles in vehicle design, electronics and space suits.

1970

SPE forms first nine Technical Divisions, with Color & Appearance the first. Canadian Ralph Noble is the first non-U.S. citizen to become SPE president. SPE and SPI jointly form the Plastics Education Foundation to develop vocational training courses and materials. DuPont introduces Kevlar aramid fibers. Coca-Cola test markets first plastics beverage bottle, an acrylonitrile (AN) container made by Monsanto. AN soda bottles are withdrawn in 1977 after the FDA doesn't approve them for carbonated beverages; it is replaced by PET which will, in three years, almost entirely replace glass in U.S. beverage bottles.

1971

This is a big year for resin developments. Among the new grades: 3M's Astrel polyaryl sulphone; Phillips's Ryton polyphenylene sulphide; and Uniroyal's Arylon T polyaryl ether.

1972

The Plastics Hall of Fame is established by SPI and by Sid Gross, editor-in-chief of *Modern Plastics* magazine. ICI introduces polyethersulfone.