CAREER SUMMARY

Consultant has 35 years of technical and management experience in the chemical industry. Proven ability to commercialize new products and processes in a cost-effective and schedule-driven manner. Managed process development and projects from invention to commercial success. This includes process concept, pilot plant, plant design, construction, operator training, start-up and commercial operation. Broad development, engineering, manufacturing base in polymers (both plastics and elastomers), organic chemicals, food and pharmaceutical processes.

CONSULTING COMPETENCIES

- Technology development
- Pilot plant design and operation
- Front-end conceptual estimate
- Feasibility studies
- Economic scale-up
- Plant operations – maintenance
- People development
- Polymer devolatilization
- Polymerization: all media
- Viscous processing
- Extrusion and compounding
- Rubber and plastics processing
- Unique unit operations
- Innovate with simplicity

EXPERIENCE & ACCOMPLISHMENTS

- Process Consultant and Lead Process Engineer for the front-end engineering of a large new PMMA resin and compounding plant.
- Provided conceptual design and estimate for a large-scale pilot plant to process agricultural materials into higher value chemicals.
- Evaluated a novel new technology to detoxify cyanide waste steams at gold mines.
- Evaluated a novel new technology to convert scrap tires into diesel fuel.
- Provided engineering services to develop a unique new delivery system for swimming pool chemicals.
- Provided several front-end design packages and estimates for a developing technology that converts chemical components in waste streams to saleable products. This has brought commercial viability to a small entrepreneurial company.
- Provided two front-end studies demonstrating lower cost equipment and layout options. Study included polymer handling equipment options and centralized Dowtherm system options.
- Managed a process technology group that supported the reduction of the client's capital and startup costs by 30% for major textile facilities around the world.
- Provided the detail design for a micro-plant for spinning trials of new developmental spandex products. Unit is providing the client with rapid product change capability, which has shortened the product development cycle.
- Provided process lead for team of 4 process engineers for an upgraded vaccine cell culture facility. Project scope included front-end definition, basic engineering, detail design and procurement support. Facility modifications included process changes to

Buffer Preparation, Chromatography, Ultrafiltration / Diafiltration, Liquid Filling, CIP Skid, RODI system, WFI still, process chiller, bio-waste treatment and chemical waste treatment.

- Managed two front-end studies and estimates for a major pharmaceutical company. One study involved layout upgrades and additional equipment for improved cGMP compliance for a lipid product. The second involved demonstration scale producing chromatograph for peptides. One project is proceeding and the other was proved to be unsupportable.
- Provided a central utility plant study for the conversion of a major research facility into 200,000 sq. ft. office facility. Substantial capital and operating cost savings options were demonstrated prior to project cancellation.
- Client's batch fragrance process would require $8MM capital for a new plant, which would not meet the company's financial hurdle. Provided a conceptual design and estimate for a continuous process with a capital cost under $6MM which met the financial targets.
- Provided expert input to a Function and Value engineering study for a new EPDM plant. Study resulted in ideas generating about 5% capital reduction. All meetings were conducted in the Dutch language.
- Provided project engineering input to a movie film manufacturing consolidation project. In support of the client project manager deliverables were provided on time and in far more details than he received from his own central engineering staff.
- Managed process with a peak of 22 process engineers for a $800MM photographic film plant in the People's Republic of China (PRC). Coordinated five lead process engineers in three engineering locations for consistency, technology and value awareness. Over $17MM in capital savings were achieved by the process team.
- Provided technical support and vendor liaison for a licensor package for a new ultra-high-cis polybutadiene plant in Saudi Arabia. A +/- 25% estimate provided the client with the lowest cost plant of those competing for the license.
- As lead process engineer for a major PET film plant, provided preliminary and detail design of major utilities and process auxiliaries to support the film making process. The major complexity was the need to supply large amounts of steam to HVAC systems at pressures as low as atmospheric pressure and still obtain complete condensate recovery. This system design worked extremely well and startup was less time consuming than previous projects.
- Managed a front-end design and estimate for a major grassroots photographic and food grade gelatin in the PRC. A new conceptual design for a modern plant was developed from an existing plant that was over 100 years old. Over 40 completely new PFD's were generated using low cost drafting techniques. The study and estimate were completed in 8 weeks and provided the client with investment guidance for future expansion of this business in the PRC.
- Provided a front-end design and estimate for a licensing package for SB and PB Rubber on a Gulf Coast basis. Design incorporated the "best of the best" technology and equipment from the client's three operating units. Estimate included the battery limit plant, utilities and infrastructure.
- Provided overall technology input to the engineering team for a new polystyrene facility. Process includes multiple back-mix reactors and "falling strand"

devolatilization. Project included a dual-execution strategy with portions executed in the US office and portions in the contractor's low-cost office in Mexico. Both offices required training in the special features of the technology.

- Provided front-end process design, vendor selection, and detailed engineering for a new fluid bed polyurethane aging process.
- Provided process design and scale-up from lab to commercial scale for a new acrylic polymer. Shortened the client's time to commercial trials by one year by qualifying a toll manufacturer to produce the material rather than adapting a client pilot plant.
- Provided font-end process engineering for client's styrene-butadiene block copolymer. By conducting extensive lab trials in the contractor's lab, identified the root cause of the single largest quality defect experienced by the product.
- Assisted the R&D effort, analyzed data and provided conceptual design and estimates for a novel solvent-based plastics recycling facility. Preliminary design was completed for a pilot plant and conceptual design for a commercial scale plant was provided.
- Proved the use of a low-cost extruder to mix surfactant paste for blending off-spec material.
- Provided consulting services to a major oil company that was unfamiliar with polymer process development. Provided input to the design and budgeting of a pilot plant. This pilot plant developed a new family of polymer lubricant additives.
- Managed and conducted a major hazards and operability review (HAZOP) for a PVC plant in response to a state mandated decree. The final report was personally presented to the State authorities and accepted for implementation.
- Managed a process team of 5 engineers for a new specialty rubber plant. The scope included hydrogen fluoride catalyst handling, monomer preparation, reaction, solvent recovery, rubber drying and baling, and utilities.
- Managed the process design of a new Polyester (PET) Solid State Polymerization two-train plant. Expansion included pellet handling (crystallized and uncrystallized), reaction, nitrogen heating and recovery, hot oil systems and utilities.
- Provided the preliminary and detail design of a new HDPE facility including polymer degassing, compounding, solids handling, waste water and utilities. Client named the consultant the 'engineer of the project'.
- Commercialized and entire new family of liquid elastomers. This project is a major milestone in the consultant's career. Provided all of the engineering and operations management to convert a pilot plant built for the production of solid rubber and converted it to the semi-works production of liquid rubber. The process had only a small amount of research data available. In **8 weeks** a pilot scale recipe was developed. **Six weeks later the first commercial quantity of material was shipped to a customer.** The pilot facility was continuously upgraded over the next two years to produce higher rates, more products and better quality. This product line continues as the only liquid EPDM polymer and the owner has built a new larger plant. The consultant received an technical achievement award for his effort.
- Produced possibly the first commercially sold polymer produced using metalocene catalyst.
- Provided process design, technical and operations support for a novel slurry EPDM process at the pilot plant scale. The process included reaction, finishing and recovery.

After two years the process did not meet its objectives and the pilot plant was converted to the process referred to in the previous item.

- Commercialized a complete new process to color SAN co-polymer directly in the continuous polymerization plant. This technical and business development was done nearly single-handedly by developing and proving the concept in the commercial scale equipment; no outside R&D input was given. Market data was converted into a business model and justification provided for management approval. The process required many detail problem solutions including new color carriers and specialized micro metering pumps. The commercialization of this process allowed the company to eliminate an entire extrusion plant at another location and eventually the sale of that plant. The operations and transportation cost savings were enormous for the business unit. All of this was done in a Belgium for an American company that would normally resist major developments outside the US. Plant is in Antwerp, Belgium. The consultant received an outstanding achievement award for his effort.
- Provided process design lead for an ABS emulsion expansion, supervising 3 engineers. Plant included, reaction, coagulation, centrifugation and drying. Drying system included two dryers with complex recycle for optimum energy use and explosion panels per strict NFPA guidelines. Besides the process design the consultant directly wrote the PLC control schematic. On site participation included construction support, commissioning and start-up services. Plant is in Antwerp, Belgium.
- Provided front-end scope and preliminary engineering for an upgraded ABS plant, including SAN reactors, polymer storage, blending, extrusion and packaging. Plant is in Newport, Wales, UK.
- Represented the manufacturing organization for a major continuous SAN co-polymer production facility. This included review of all engineering documents, management reviews, coordination with marketing and R&D, training of plant personnel. Project under ran its capital budget by 25% and started up in the shortest time a similar plant had previously started. Plant included continuous reaction, devolatilization, palletizing and storage. Plant is in Antwerp, Belgium.
- Provided construction support, maintenance training and startup assistance for two new continuous polystyrene trains at a site that previous only had batch processes. Plant is in Wingles, France and all support was done in the French language. The consultant received an outstanding achievement award for his effort.
- Coordinated all startup activities for company's first commercial continuous SAN co-polymer plant. This included engineering and construction input, writing the complete operating procedure, and coordinating R&D, plant technical service, instrumentation and maintenance during the actual startup phases. This process represented a major milestone for the company's technology effort and overall cost reduction. The consultant received an outstanding achievement award for his effort. See next item for prior work with this process.
- Conducted SAN pilot plant experimentation to produce scale-up data for the company's first commercial plant using new technology that employed unique in-house designed wiped film evaporators (WFD). The consultant's particular part of the team effort included a substantial improvement in the mechanical reliability of the

existing pilot plant. This allowed development time to be reduced and allowed the unit to meet a management dictated milestone for continuous run time.

- Provided startup support for company's first-ever continuous mass polymer plant. The plant was restarted in two further configurations until project objectives were achieved. Support included construction punch-listing, operator training and process decision making.
- Upgraded and debottlenecked processes and equipment making PS, SAN and ABS plastics. Processes were batch, both mass and suspension, and included reaction, slurry dewatering and drying. Process improvements included 20+% capacity increases, new product introductions, reduction in labor and quality improvements.

POSITIONS & JOB TITLES

KEN BATTLE SERVICES, Shamong, NJ
- Owner – Process Consultant 2003-present

DAY & ZIMMERMANN INTERNATIONAL, Newark, DE and Philadelphia, PA
- Director Process Technology 2000-2003

FLUOR DANIEL
- Director of Chemicals Technology, Marlton NJ 1996-2000
- Process Director, Houston , TX 1994-1996

M.W.KELLOGG, Houston, TX
- Process Manager 1990-1994

JOHN BROWN, Houston, TX
- Process Manager 1988-1990

UNIROYAL CHEMICAL, INC., Geismar, LA
- Manager of Pilot Plant Operations 1986-1988
- Engineering Associate 1984-1986

MONSANTO CHEMICAL COMPANY
- Process Specialist, Antwerp, Belgium 1980-1984
- Principal Engineer, London, England 1978-1980
- Process Specialist, Antwerp, Belgium and Wingles, France 1974-1978
- Senior Process Engineer, Springfield, MA and Addyston, OH 1972-1974
- Plant Technical Service Engineer, Addyston, OH 1968-1972

PATENTS & PUBLICATIONS

- "Plastics Recycling by Selectivce Dissolution" by Dr. E.B. Nauman, J.C. Lynch, A.P. Moore, **K.E. Battle**, presented by K. Battle at the DeWitt Petrochemical Review, Houston, TX, March 26, 1991.
- "Economic flow-sheet development for conversion of toxic byproducts to saleable products in 4 continuous Phase Transfer Catalysis processes." By P.J. Joyce, K. Dahm, W. Engisch, M. Moran, F. Panna, G. Speck, **K. Battle**, AIChE Green Technology Symposia, New Orleans, LA. March 2003

GEOGRAPHIC EXPERIENCE

- Antwerp, Belgium 1980-1984
- London, England 1978-1980
- Antwerp, Belgium 1974-1978
- Wingles, France 1974-1977 (lived in Antwerp and worked at both locations)

AWARDS AND HONORS

- Technical Achievement Award, Uniroyal Chemical, Inc., 1987. Award for the development of Trilene liquid EPDM product.
- Outstanding Achievement Award, Monsanto Chemical Company, 1983. Award for the development of an in-line continuous SAN polymer coloring process.
- Outstanding Achievement Award, Monsanto Chemical Company, 1975. Award for the successful startup of company's first continuous polystyrene plant in Europe.
- Outstanding Achievement Award, Monsanto Chemical Company, 1972. Award for the successful startup of company's first ever continuous SAN polymer plant.

PROFESSIONAL ASSOCITATION

- Rubber Division, American Chemical Society
- Registered Professional Engineer, Texas No. 70568

EDUCTAION AND TRAINING

- Graduate studies in Chemical Engineering, University of Cincinnati, 1968-1971.
- B.S. with Distinction, Chemical Engineering, Worcester Polytechnic Institute, 1968

- Polymer Devolatilization Course, Polymer Processing Institute, 1986
- Reactive Extrusion Course, Polymer Processing Institute, 1989