Curriculum vitae

Louis J. DeFilippi, Ph.D.
President,
Louis DeFilippi LLC
Founded July 29, 1999

Independent Consulting since October 1995

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TECHNICAL ACCOMPLISHMENTS & EXPERIENCE
Expert Consulting

EXECUTIVE SUMMARY

Senior consultant, domestic and international, in the following major areas:

1. Classical chemistry, biochemistry and biotechnology, especially the separation, purification, characterization and analysis of small molecules, enzymes and proteins and related processes. Adept at assessing and evaluating current processes and procedures!
2. Biologics, injectables and biosimilars, esp. polypeptides, proteins and enzymes with pharmaceutical applications
3. Chemical and biochemical processes, their development, evaluation, optimization, including biocatalysis and applied biotechnology
4. Environmental science, especially bioremediation and related treatment chemistries and analysis
5. Applied microbiology & fermentation science
6. Regulatory compliance (OSHA, EPA, Groundwater, USDA, Food Safety, Sanitation, Homeland Security, etc.)
7. Expert witness & consultant; patent infringement, claim construction, trade secrets · *Inter partes* review, depositions, sworn testimony, evidentiary hearings, trials, International Trade Commission (ITC)

LABORATORY AND APPLIED CHEMISTRY, PROCESSES, ANALYSIS AND SEPARATIONS SCIENCE:

Broad experience and understanding of physical, chemical and biochemical processes and related analytical methods (assay development) and: spectroscopy, electrophoretic and chromatographic separations esp.

protein purification, protein chemistry / protein modification, ligand binding, enzyme assay and kinetics, thermodynamic calculations, polymer chemistry and polymerization processes, etc.

- Analytical chemistry
  - Bioassays and separations science (especially chromatography, liquid-liquid extractions, countercurrent separations; electrophoresis)
  - Enzyme assays and kinetics
  - Environmental
- Calorimetry: studies to assess reaction progress.
- Biochemistry and biophysics combined with physical chemistry, especially through the use of UV/Vis (Ultraviolet / Visible) Spectrophotometry
- Small molecule and ion binding studies / SAR (Structure Activity Relationships) / complexation / ligands / inhibitors, especially involving enzymes, hemes, hemoproteins, porphyrins with focus on spectroscopic techniques; protein modification (e.g., reaction with iodoacetamide).
- Separations technology for purification and analysis of numerous small molecules, proteins, peptides, carbohydrates, and natural products used in commercial applications; adsorbents, ion exchange and activated carbon
- Removal of HCP (host cell protein) from protein-based injectables/biologics/biosimilars
- Separations science experience includes extensive application of:
  - Chromatographic separations (column chromatography, liquid chromatography, cation-exchange, anion-exchange, adsorptive, size exclusion, etc.): purification of proteins, enzymes, polypeptides, small molecules, natural products
    - DEAE cellulose
    - CM cellulose
    - DEAE Sephadex
    - CM Sephadex
    - Phenyl Sepharose [Hydrophobic interaction chromatography (HIC)]
    - CG-50
    - Sepharose
    - Size exclusion (Sephadex)
    - Hydroxyapatite
    - Alumina
    - Silica
    - Centrifugal separations
    - HPLC (reverse phase, etc.)
    - HPLC of hemes and heme derivatives.
    - Ion chromatography
    - Detectors (esp. UV/Vis)
    - SORBEX: Industrial-Scale Adsorptive Separation
    - Supervisory experience with GC-MS, HPLC-MS and LC-MS.
  - Expanded and fluidized bed chromatography for protein / enzyme purification, esp. as applied for cellular homogenates
  - TLC (Thin layer chromatography / small molecules, including hemes, hemin, dyes, amino acids)
    - Alumina
    - Silica
    - Polyamide
  - Electrophoresis
    - Polyacrylamide gels (PAGE)
    - SDS
    - Cellulose acetate
  - pH-stat and autotitrator operation and application (enzyme assay)
  - Membrane separations involving proteins, carbohydrates, small molecules, etc. & lyophilization
    - Temperature effects on protein aggregation and separation efficiency
    - Reverse Osmosis
    - Nanofiltration

        - Ultrafiltration
        - Microfiltration
        - Filter sterilization
        - Protein concentration and lyophilization
    - Liquid/liquid, liquid/solid separations, supercritical fluid extractions
    - Enzyme purification / separation / solubilization / precipitative processes using…
        - Chaotropic agents (altering solubility, salting in, salting out, precipitations)
        - Precipitation of nucleic acids and cell debris, esp. using PEI / flocculents
        - Salts as precipitating agents, esp. $(NH_4)_2SO_4$
        - Organic solvents (acetone, ethanol) for low temperature protein precipitations/purification
        - Buffering and pH effects
    - Distillation
        - Ambient pressure
        - High-vacuum, spinning band, sub-mTorr
- Polymers & adhesives
    - Polymerization processes, especially involving acrylamide, polyimines, polyacrylates and methacrylates; cellulose acetate, starch dialdehyde, etc
    - Conjugation, crosslinking, derivatization and surface activation
    - Application of polymer properties and chemistry to control migration of oxygen, other small molecules (organic and inorganic) and natural products involving surfaces and seals
    - Effect of Tg (glass transition temperature) of polymers and adhesives on molecule movement through barriers
- Surface modification
    - Application of functionalized silanes for surface modification of glasses and polymers
    - Use of electron beam for surface modification and application to immobilization of biological materials
    - PEI/Glutaraldehyde surface adsorption and polymerization , esp. involving enzyme immobilization

PROCESS EVALUATION

- Adept at hands-on evaluating of current processes at customer facilities in the Chemical, Biochemical, Microbiological and Food industries and suggested improvements to increase efficiency and reduce costs.

CHEMISTRY, BIOTECHNOLOGY, PHARMACEUTICAL SCIENCE & MICROBIOLOGY

Expert in applied industrial organic chemistry and inorganic processes and pharmaceutical chemistry; purification, enzymology, biocatalysis, biotransformations & bioprocessing, and thermostable enzymes with industrial application; emphasis on practical aspects of research, development, scale-up, pilot plant and commercialization, especially for proteins and peptides; adept at working with both laboratory personnel & development engineers; hands on when needed. In the microbiology area (applied microbiology), have fermented and tested numerous microorganisms, employed microorganisms for the production of various products (especially enzymes), tested antimicrobials and antimicrobial surfaces against Gram-positive, Gram-negative bacteria and fungi (susceptibility testing), employed above (plus archaebacteria [archaeans]) for small molecule transformations.

- Inorganic processes, including
    - Anhydrous and aqueous ammonia
    - CO_2 (carbon dioxide) capture from air, including carbonic anhydrase-catalyzed processes
    - Efficient evaporative process for brine dewatering (concentrating) especially for "produced water."
    - Chlorine dioxide (ClO_2), ozone (O_3) and peroxides (H_2O_2) for disinfectants and biochemical interactions.
    - Hydrogen sulfide (H_2S) and hexavalent chromium [Cr(VI)], including SRB alterations.
    - Heteroatoms

- Synthetic organic and medicinal chemistry; synthesis and chemical modification of heteroatom organic molecules/compounds, including those containing phosphorous, oxygen, chlorine, sulfur and nitrogen,
- Protein production, post-translation modification, purification and analysis, stability, parenterals and injectables, polysaccharide-protein coupling (vaccine development), excipients and stabilizers, and related formulations
    - Topicals
    - Biosimilars
    - Injectables (e.g., subcutaneous)
    - Growth/fermentation/media selection for bacteria, yeast, fungi and mammalian (e.g., CHO) cells
    - Enzyme production from native and recombinant (genetically transformed) sources: mammalian and microbial
    - Hydrolases: esterases and proteases
    - Conditions affecting protein stability and methods to effect protein stabilization, especially ionic and organic crosslinking, and primary structure
    - Production, formulation and compounding of clinically useful proteins and peptides, including pharmaceutically important glycoproteins and enzymes for use as injectables in enzyme replacement therapy and neurological applications
    - Purification and formulation of polypeptides for use as parenterals or biologics including neutral, hydrophilic or hydrophobic species and ionic species with choice of counter-ion and excipients (e.g., mannitol and other non-reducing sugars and polyols) for injection
    - Synthetic polypeptides with clinical application (preparation, purification and formulation of glatiramer acetate / Copaxone formulations used as an injectable for MS [multiple sclerosis] treatment)
    - Use of excipients and stabilizers (e.g., mannitol), surfactants (ionic and non-ionic) and buffers in parenteral formulation development; solubilizing agents
    - Post-translational modification of proteins useful for both cellular export and uptake, especially involving carbohydrates, and stabilization
    - Addressing and minimizing Host Cell Protein (HCP) contamination issues
    - Vaccine development: employing a statistical DOE approach for optimizing coupling of peptide with microbial (bacterial) polysaccharide for commercial vaccine production (vaccine conjugation conditions effect on valency, tetanus toxoid conjugation with meningococcal capsular polysaccharide [e.g., immunogenic saccharide-polypeptide conjugate] with internal adjuvant-like properties)
    - Antibodies (polyclonal IgG [immunoglobulin]) elicitation using adjuvants; isolation, purification, and characterization
    - Therapeutic monoclonal antibodies (mAbs) purification, isolation, characterization, formulation and application as an injectable biologic (e.g., Ranibizumab [Lucentis] blocking VEGF [Vascular Endothelial Growth Factor])
    - Serum Albumin fatty acid binding properties;
    - Recombinant Mammalian Proteins (e.g., Human Serum Albumin [rHSA]) produced in microbes (Pichia/yeast) and plants (rice "pharming") for use as cell culture media (growth) supplement and plasma substitute component, i.e., single animal protein (albumin) free of toxins, pyrogens and other animal proteins.
- <u>Clinical test strips</u>, especially involving separations science (chromatographic and size exclusion) and enzymatic / spectrophotometric cholesterol quantitation in bodily fluids (blood) cholesterol, LDL and HDL; HRP for H_2O_2 quantitation
- <u>Occult blood tests,</u> sample collection and stabilization of protein and nucleic acid markers; clinical testing for fecal hemoglobin and cancer marker nucleic acids / genes
- <u>Formulations</u>, in addition to therapeutic applications
    - Formulations involving natural product / nature-inspired UV absorbers used in topical application
    - Formulations involving surfactants and adhesives, mostly with microbiological applications
- <u>Applied enzymology</u>: Marriage of organic chemistry and enzymology… use of enzymes to make products in high yield with little waste (see examples below).
- <u>Industrial enzyme, especially thermostable industrial processes;</u> Expert in continuous, heterogeneous biologically catalyzed processes (immobilized enzymes and immobilized whole cells).
    - Carbohydrate-altering enzymes
    - Preparation and application of immobilized whole cell hydantoinase suite of enzymes for industrial biotransformation process for production of enantiomerically-pure amino acids

- Pilot-scale chemical conjugation / immobilization of pig liver esterase (ImPLE) for production of anti-AIDS drug and subsequent project management for scale-up
- Development of full-scale commercial process for ImPLE (above); implementation and supervision of production, quality control and international shipping
- Employing a statistical DOE approach for optimization of conditions for efficiently coupling of enzyme to chemically-modified polymer surface
- Use of salts for commercial enzyme/protein purification
- Development and testing of novel hydrophobic enzyme support for industrial lipase, esterase application in production of pharmaceuticals
- Fermentation, *E. coli* producer strain, optimization of cell yield
- Immobilization and application of genetically modified Pseudomonas sp lipase for enantioselective hydrolysis of pharmaceutical intermediates
- Research and commercial development of novel, incompressible, high-throughput immobilized enzymes (pharma and food industries).
- Invention, application, and development of new method for enzyme stabilization applied to starch and sugar converting enzymes (glucoamylase, alpha amylase) for corn syrup production
- Invention of novel magnetic support for enzyme immobilization
- Commercial application of thermodynamics of activation vs. deactivation (Arrhenius plot) to increase industrial enzyme process efficiency by 20-30%

- Industrial bioprocessing, enzyme transformation and biochemical projects include:
  - Chemical modification of hydrocolloids for metal binding application (food and environmental applications)
  - Hydrocolloids for enzyme immobilization (food application)
  - Transesterification: Lipases for making bio-synthetic cocoa butter
  - Transesterification: Lipases for mono- and diglyceride production and transesterification into value added products (see next)
  - Transesterification: Lipases (Cal B; thermostable) for transesterification / interesterification of triglycerides and ferulate esters for skin treatment / topically-applied sunscreen and skin care consumer product application, especially employing soy/soya lipids/oils and fish oils.
  - Transesterification / interesterification: Lipases for modification of jojoba oil (neat and hydrogenated) as sperm whale oil replacement and cosmetic applications
  - Lactase /protease combination employed for whey treatment
  - Redox enzymes
  - Yeast alcohol oxidase for methanol oxidation
  - Horseradish peroxidase, including use in detection systems (peroxides) and for enzyme stabilization
  - Glucose oxidase for production of D-glucono-δ-lactone
  - Glutaraldehyde as an enzyme immobilizing agent and as sterilant for food applications
  - Biochemical fuel cell
  - Effects of organic peroxides on stability of metal-containing biomolecules
- Plant-derived natural products in cosmetics, nutraceuticals and pharmaceuticals and… see preceding, plus…
  - Mechanisms and prevention of free radical oxidation of natural waxes (e.g., jojoba oil), oils, and other lipids
  - Proximity and juxtaposition acceleration and mitigation effects on chemical and free radical reactions
  - Ferulic acid, transesterified with soybean oil for novel sunscreen production
  - Engineered rice for human serum albumin production
  - Berberine and dihydroberberine for managing glucose levels
- Pharmaceutical industry, additional clinical and related items:
  - Use of applied enzymology for the production of pharmaceutical intermediates
  - Wound healing, especially the involvement of platelet-rich/poor plasma; effect of metal ions
  - Patent holder, peptide-based anti-microbial (biocide, e.g. polymyxin, bacitracin, etc) pharmaceuticals employed in wound dressing applications
  - Reperfusion injury reduction (ischemic stroke and heart attack) and anti-inflammatory effects of riboflavin (vitamin b2)
  - Test strips, especially involving enzymes for blood component analysis, including lipoproteins, HDL, LDL, cholesterol
  - Water purification and sterile systems for pharmaceutical applications
  - Ozone (O_3) for water purification applications esp. as it relates to pharmaceutical products and biological sample preparation, esp. blood and plasma
  - Research on blood proteins

- Blood collection tubes for cell-free DNA and RNA analysis, esp. for use in liquid biopsy
- Blood collection tube addition / use of stabilizing agents (e.g. K,EDTA) for stabilization of cellular and cell-free DNA / RNA / biomarkers in blood during storage (i.e., *ex-vivo*) applied to maternal-circulating fetal DNA and related sample preparations related to liquid biopsy
- Bodily fluid long term stabilization, esp. for later nucleic acid (DNA & RNA) analysis, employing surfactants, chaotropes and denaturing agents included for later forensic analysis
- Occult blood tests (see above)
- Separation of leucocytes and erythrocytes (white and red blood cells) from plasma via centrifugation
- Optimization of ethanol precipitation of plasma proteins for industrial plasma fractionation
- Acetone precipitation and purification of proteins

- Applied microbiology; In the microbiology area see elsewhere in this CV plus the following:
  - Fermentation, growth and testing of numerous microorganisms,
  - Microorganisms for the production of various products (especially enzymes),
  - Use of microorganisms in testing of liquid, vapor and gaseous preservatives, antiseptics, disinfectants (antimicrobials, antibacterials, antifungals) and antimicrobial surfaces against gram positive bacteria, gram negative bacteria, fungi and viruses
  - Preservation of bodily fluids (e.g., blood plasma, sputum) and nucleic acids therein, and reduction of infectivity, through the use of chemical agents (e.g., bacteriostats, bacteriocides) to inhibit or kill pathogenic microorganisms and degradative enzymes
  - Examples include: povidone-iodine (PVP, polyvinylpyrrolidone iodine), isopropyl alcohol, benzalkonium chloride, peroxides, formaldehyde release agents, surfactants, denaturing agents
  - Above microorganisms (plus archaebacteria [archaeans]) for small molecule transformations.
- Extracellular vesicles:
  - Production and stabilization of exosomes and other cell-free extra-cellular vesicles, including perinatal mesenchymal stem cell (MSC)-derived exosome products
  - Stabilization of nucleic acids present in extracellular vesicles (cell-free DNA)

- Commercialization: Multiple patent holder, biologically-based reactor development and commercialization (especially fixed-film reactors).

ENVIRONMENTAL CHEMISTRY and BIOTECHNOLOGY, INDUSTRIAL EFFLUENT PRETREATMENT, BIOREMEDIATION AND EMISSIONS TREATMENT, SANITATION AND STERILIZATION

- Nationally recognized consultant in biological and chemical treatment of hazardous waste, hazardous chemicals, water pollution, drinking/potable water
- Microbial ecology approach to waste treatment and bioremediation
- Extensive field experience… pilot plant direction, data analysis, scale-up estimation
- Developed structured adsorbent used as microbial support in bioremediation of industrial effluent, groundwater and vaporous emissions (patented/commercial)
- Use of microbiological films (biofilms) in multiple applications
- Remediation and bioremediation of a wide range of groundwater pollutants, including petroleum, coal tar, halogenated, chlorinated (esp. TCE, PCBs), aromatic compounds
- Developed mixed media employed as plugging-free microbial support in bioreactor packing (patented/commercial)
- Developed *in situ-ex situ* bioremediation method for detoxification of metals, especially hexavalent chromium, Cr(VI), by combining inorganic chemistry and microbial ecology (sulfate reducing bacterial consortia); patented
- Chemically modified natural polymers for use as heavy metal adsorbers, chelating agents.
- Developed Biological Air Treater (BAT) for low-cost destruction of vaporous organics, air pollution (patented/commercial)
- On-site international experience (China [PRC], Taiwan [ROC], UK)
- On-site sample collection, analysis and interpretation of agricultural contaminants, including pesticides and herbicides
- Sampling of molds in occupied areas; analysis and interpretation
- Designed and implemented numerous waste treatment and remediation strategies for diverse industrial effluents, impacted groundwaters, drinking water, soils, and air emissions
- Supervised replacement of PCB (polychlorinated biphenyl) -Transformer and replaced with non-toxic, biodegradable electrolyte-containing transformer

- Antimicrobial / biocidal / bactericidal agents for sanitation / sterilization / preservation, including parabens, glutaraldehyde, chlorinated antiseptics and disinfectants (chlorine dioxide [ClO_2]), ozone (O_3) and peroxides (H_2O_2) with wide ranging applications including well-screen sanitation, sterilization of containers for pharmaceuticals, bodily fluids for nucleic acid evaluations, and area disinfectants.

FOOD and NUTRITIONAL SUPPLEMENTS and SWEETENERS

- Starches and starch metabolizing enzymes (amylases)
- Sugars and beverages, including HFCS
- Artificial sweetener (acesulfame potassium), production and purification
- Fish oil and Omega-3 fatty acids
    - Patent infringement involving DHA purification and analysis
    - New product technology (transesterification) involving vegetable oils, fish oils (triacylglycerides) and anti-oxidants

FOOD SAFETY USDA and FDA

- Food storage and handling
- Measurement of rates of lipid (fats, oil) degradation rates by oxygen using Rancimat (also for cosmetics) oxidation stability index, OSI
- Odor reduction, sanitation, reduction of infection potential using various chemicals (including chlorinated)
- HACCP plans (Hazard Analysis and Critical Control Point) and process flow charts, especially for ready to eat foods [9cfr PART 417]
- SSOP (Sanitation Standard Operating Procedures); Regulatory requirements under the federal meat inspection act and the poultry products inspection act, especially 9cfr PART 416—SANITATION) with focus on procedures (use of antiseptics, disinfectants) for reductions of pathogenic microorganisms on food preparation surfaces and utensils

REGULATORY, OSHA & EPA

- Multiple private consulting projects to achieve compliance with Federal & State regulations, including:
    - ⇒ OSHA 1910.119, Process Safety Management (PSM)
    - ⇒ EPA New Product Registration
    - ⇒ EPA 112r, Risk Management Planning (RMP)
    - ⇒ SARA Title III Emergency Planning and Community Right to Know Act (EPCRA)
    - ⇒ TSCA (Toxic Substances Control Act) 40cfr §761 Polychlorinated Biphenyls (PCBs)
    - ⇒ Storm Water Pollution Prevention Plans (SWPPP)
    - ⇒ Releases of toxic substances, anhydrous ammonia, ruptured pipeline, etc.
- Drinking water standards

TECHNICAL MARKETING, SALES, MANAGERIAL & BUSINESS ACCOMPLISHMENTS & EXPERIENCE

- Experienced in all phases of commercialization business, from research to development to marketing and sales;
- Successfully commercialized laboratory scale reactor (biological waste treatment) through rapid development phase into commercial product; business profitable at 13 months; ten-fold increase in sales.
- Account manager, proposal generation, expert in managing numerous $100K to $1000K projects from conception to commercialization.
- Budgetary estimation.
- Technical sales presentations directly to customers; responsible for visiting outside customers to determine their actual needs and then partnering/ bridging with internal experts to achieve technical and commercial goals.
- Technical marketing and sales, environmental area.

- Excellent communication skills.
- Professional corporate recruiting (fourteen years).
- Long-term experience in TQ approach to solving cross-disciplinary problems with teams of 2 to 10 individuals, on and off site.

EXPERT WITNESS and PATENT INFRINGEMENT

- Insurance investigations
- Toxic tort
- Root cause analysis
- Patent infringement
- Claim construction
- Deposition
- Preparation for trial
- Evidentiary hearing testimony
- International trade commission (ITC) testimony
- Jury trial experience
- *Inter partes* review
- Trade secrets
- Laboratory testing supervision / data collection / analysis (statistics)
- Litigation-related experience supplied upon request

EDUCATION

- **Postdoctoral Fellow** under Prof. Quentin H. Gibson, Cornell University, 7/76 - 7/78.
- **Postdoctoral Fellow** under Prof. Donald E. Hultquist, The University of Michigan, 1/76 - 6/76.
- **Ph.D.**, Biological Chemistry, The University of Michigan, 9/71 - 1/76.
- **BA**, Chemistry (Honors), Queens College, The City University of New York 5/71.

SELECT TRAINING/DEVELOPMENT/PRESENTATIONS

- HAZWOPPER Emergency response Refresher Training (40 hour initial training, 8 hour Haz. Waste Operations Management continuing yearly), 1991 to current.
- Invited speaker, Prof. Robert Engel Symposium, Queens College, CUNY, November 2019
- Emergency Notification Release Reporting Training, EPCRA 304; CERCLA 103 (EPA Region 5), 1999
- Risk Management Program Assistance (IEMA), 1999
- Basic Ammonia Refrigeration, 1998
- Statistical Design of Experiments (DOE), 1996
- Scorecard Training, 1996
- Convenor, *Pollution Prevention Biotechnology*, Summer Biotechnology Institute, Northwestern University Center for Biotechnology, 1995
- Sales Training Workshop (Institute for Business and Interpersonal Strategies) 1995
- Customer Linked Commercialization & Customer Partnering, 1994

EMPLOYMENT HISTORY

Industrial

- Independent Consultant, President and Member, Louis DeFilippi, LLC, 1999 to present
- Independent Consultant, Sole proprietorship, 1995 to 1996 and 1997 to 1999
- Project Leader, AlliedSignal Aerospace Sector, Extended Consultation Assignment (Space Station / Mars Lander / Lunar Base), Life Support Systems, '96 to '97; manager biotech and environmental laboratory.
- Manager Biochemical Technology (Technical Marketing and Sales), AlliedSignal Environmental Systems and Services, '94-'95
- Research Scientist, AlliedSignal Research & Technology, '85-'94
- Research Specialist, Biochemistry, Signal-UOP Research Center, '82-'85
- Senior Research Biochemist, Biotechnology Department, UOP Research Center, '78-'82

Academic

- Adjunct Professor (Evening Faculty Member), Columbia College, Dept. of Science, '84-'85.
- Postdoctoral and Teaching Fellow (General biochemistry), Cornell University, Department of Biochemistry, Molecular and Cell Biology, '77-'78.
- Teaching Assistant (General biochemistry, Medical Technology & Nursing) The University of Michigan, '71-'75.

HONORS

- Special (Team) Recognition Award, AlliedSignal (Honeywell), April '95
- Special (Individual) Recognition Award, AlliedSignal (Honeywell), May '92
- Rackham Dissertation Grant, The University of Michigan, '74-'75
- Graduated (BA, Queens College), Chemistry, with honors, '71
- Elected to Beta Delta Chi, Chemistry Honor Society, Queens College, CUNY, '71
- New York State Regents Scholarship, '67-'71

SOCIETY MEMBERSHIPS, ELECTED AND APPOINTED POSITIONS

- American Chemical Society (elected Director, Chicago Section, Dec. 2014 for a two-year term; reelected Dec. 2016 for a one-year term through Dec. 2017; co-chair Senior Chemists, 2017 to 2019)
- Appointed Trustee by Cook County, Illinois Commissioners, Plum Grove Estates Sanitary District, 2004 to current; performed duties as Clerk, acting Treasurer and President; currently President

PATENTS AND PUBLICATIONS

Authored approximately 22 publications, 3 book chapters, and is an inventor on approximately 15 issued patents in biotechnology, chemical, food, cosmetic, pharmaceutical industries, and biological wastewater treatment areas; co-Editor and chapter author, John Wiley & Sons text, "Biological Treatment of Hazardous Wastes."