
MARCELO M. HIRSCHLER, Lic., Ph.D.

CURRICULUM VITAE

EDUCATION

University: University of Buenos Aires 1966-70
Licentiate in Chemistry - Major: Physical Chemistry

Post-graduate: University of Buenos Aires 1971-75
Doctor in Chemistry - Major: Polymer Physical Chemistry

EMPLOYMENT HISTORY

- September 1995 -
Fire Science Consultant/President
GBH International, Mill Valley, California
- March 1995 - September 1995
Fire Science Consultant
GBH International, Rocky River, Ohio
- March 1991 - February 1995
Fire Science Consultant
Safety Engineering Laboratories, Inc., Rocky River, Ohio
- December 1986 - February 1991
R & D Manager - Fire Sciences
BFGoodrich Co. - Geon Vinyl Division, Avon Lake, Ohio
- June 1986 - December 1986
Sr. R & D Associate - Flammability
BFGoodrich Co. - Geon Vinyl Division, Avon Lake, Ohio
- August 1984 - June 1986
R & D Associate - Flammability
BFGoodrich Co. - Chemical Group, Avon Lake, Ohio
- October 1977 - July 1984
Temporary Lecturer (Physical Chemistry)
Department of Chemistry - The City University, London, England
- October 1975 - October 1977
Post Doctoral Research Fellow
School of Molecular Sciences - University of Sussex, Brighton, England

- June 1975 - October 1975
Researcher - Physical Chemistry of Carbons
R & D Department - ALUAR Aluminio Argentino, Buenos Aires, Argentina
- March 1971 - June 1975
Post-graduate Research Assistant, Department of Physical Chemistry
School of Pharmacy and Biochemistry - University of Buenos Aires
Buenos Aires, Argentina
- March 1970 - December 1971
Undergraduate Teaching Assistant, Department of Physical Chemistry
School of Exact and Natural Sciences - University of Buenos Aires
Buenos Aires, Argentina

SOME AWARDS

- Interflam Trophy (UK): 1988
- ASTM E-5 Certificate of Appreciation: 1989
- Wire Association International: Best Electrical Paper 1989
- ASTM Society Frank W. Reinhardt Award for Fire Terminology: 1990
- ASTM E-5 Award of Recognition: 1995
- ASTM E-5 Award of Recognition: 1998
- Canadian Standards Association: Award of Merit: 1999
- ASTM D-9 Award of Appreciation: 2001
- ASTM E-5 Wayne Ellis Award from Society Chairman: June 2002
- ASTM E-5 Award of Appreciation: 2005
- ASTM E-5 Award of Special Recognition: 2006
- ASTM D-20 Award of Appreciation: 2006
- ASTM E-5 Award of Appreciation: 2007
- ASTM E-5 Certificate of Appreciation: 2008
- ASTM E-5 Award of Recognition: 2009
- NFPA Committee Service Award: 2011
- ASTM D-20 Award of Recognition: 2012
- ASTM E-5 Award of Recognition: 2012
- NFPA Certificate of Appreciation: 2013
- ASTM E-5 Award of Recognition: 2013
- ASTM E-5 Special Recognition Award: 2015
- ASTM E-5 Award of Recognition: 2015
- ASTM Society: Award of Merit: 2017
- ASTM D-20: Outstanding Achievement Award: 2017

LANGUAGES

English, German, Spanish, French

MEMBERSHIP PROFESSIONAL SOCIETIES

- American Society for Testing and Materials (ASTM): (See below for committee details)
- Canadian Standards Association (CSA)
- Combustion Institute (Western States Section)
- Institute of Electrical and Electronics Engineers (IEEE)
- International Association for Fire Safety Science
- International Association of Plumbing and Mechanical Officials (IAPMO)
- International Code Council (ICC)
- International Heat Release Association (IHRA)
- National Fire Protection Association (NFPA) (Various Sections and committees)

ACTIVITIES

Marcelo Hirschler Provides Technical Expertise in Fire Safety Including:

- **Product Liability Expert Witness**
- **Codes and Standards**
- **Fire Safety Research and Testing Projects**

WORK ACCOMPLISHED

- **Consultancy**

Product Liability: Expert Witness on Fire Safety Subjects

- Fire safety of mattresses
- Fire safety of upholstered furniture
- Flammability of textiles, including apparel and protective clothing
- Fire safety in transportation, including especially automobiles and trains
- Fire properties and fire testing of plastics
- Fire properties and fire testing of cables
- Smoke toxicity
- Smoke corrosivity
- Fire hazard
- Codes and standards

Fire Research (Public Activities)

- Manager Program for Interlaboratory Precision of Intermediate Scale Calorimeter Test Method (ASTM E1623) (1997-1998)
- Technical Coordinator, Fire Protection Research Foundation (NFPA, FPRF) Research Advisory Council on Transportation Vehicles (2002-06)
- Member of NIBS Smotox Steering Committee (1987-91)
- Member of NFPRF Risk Assessment Advisory Committee (1987-91)

- Session chairman at many fire conferences, including: Fire and Materials, Materials for Increased Fire Safety at Int. Conf. Fire Safety (Dr. C.J. Hilado), BCC Flame Retardancy, Int. Association Fire Safety Science, Combustion Institute, American Chemical Society Fire & Polymers, Fire Retardant Chemicals Association.

Editorial

- Associate Editor, Fire and Materials Journal (1991-)
- Editor: Flame Retardancy News (2005)
- Editor: Fire Safety & Technology Bulletin (2006 -)
- Member Editorial Board Journal Fire Sciences, Fire Safety Journal, Fire & Flammability Bulletin (1995 to 2003), Journal of Testing and Evaluation

California State Fire Marshal Advisory Committees:

- * Member California State Fire Marshal Flame Retardant Advisory Committee (2013-)
- * Member California State Fire Marshal Working Group on Implementation of Assembly Bill 127 regarding flammability testing for insulation (2014)
- * Member California State Fire Marshal Working Group on Wildland Urban Interface Code (2016, 2017)

Codes and standards:

- **International Code Council**

- * Member International Building Code Fire Safety Code Committee (2006-7, 2008-9 and 2010-11)
- * Proponent of code changes for IBC, IEBC, IFC, IMC, IPC, IRC, IWUIC, IgCC, at various code development cycles

- **ASTM Committee Memberships**

C16: Thermal Insulation
D07: Wood
D09: Electrical and Electronic Insulating Materials
D11: Rubber and Rubber-like Materials
D13: Textiles
D20: Plastics
E05: Fire
E34: Occupational Health and Safety
F07: Aerospace and Aircraft
F08: Sports Equipment, Playing Surfaces, and Facilities
F15: Consumer Products
F23: Personal Protective Clothing and Equipment
F24: Amusement Rides and Devices
F25: Ships and Marine Technology
F33: Detention and Correctional Facilities
F44: General Aviation Aircraft

- **ASTM E05 (Fire Standards):**

- * Chairman ASTM E-5.91 and First Vice-Chairman Committee E05: Subcommittee on Fire and Planning and Review (2014 -)
- * Chairman ASTM E-5.15: Subcommittee on Fire and Interior Furnishings and Contents (1990-95)
- * Chairman ASTM E-5.17: Subcommittee on Fire and Transportation (2010-15): developed ASTM E2574, new standard fire test for school bus seating
- * Chairman ASTM E-5.21: Subcommittee on Smoke and Combustion Products (2004-9)
- * Chairman ASTM E-5.31: Subcommittee on Fire Terminology and Editorial (2000-5)
- * Recording Secretary ASTM E05: Committee on Fire Standards (2000-5)
- * Member-at-large of executive subcommittee of ASTM E05 (2006 - 07)
- * Membership Secretary ASTM E05 (2008-13)
- * Recording Secretary ASTM E-5.15: Subcommittee on Fire and Interior Furnishings and Contents (1988-90 and 1996-2015)
- * Recording Secretary ASTM E-5.91: Subcommittee on Planning and Review of Fire Standards (1990-1999 and 2000-14)
- * Recording Secretary ASTM E-5.17: Subcommittee on Fire and Transportation (2003-2009)
- * Recording Secretary ASTM E-5.21: Subcommittee on Smoke and Combustion Products (2010-17)
- * Chairman ASTM E-5.22.02: Task Group on ASTM E84 Steiner Tunnel Mounting Methods (2002-). Developed several tunnel testing mounting practices - including ASTM E2231, ASTM E2404, ASTM E2573, ASTM E2579 and ASTM E2599
- * Chairman ASTM E-5.13.1: Task Group on ASTM E603, Standard Guide for Room Fire Experiments (1992-2009).
- * Chairman ASTM E-5.13.8: Task Group on New Practice for Large Scale Heat Release Tests (1997-2009). Developed practice ASTM E2067 and test method ASTM E2257
- * Chairman ASTM E-5.15.3: Task Group on Fire Hazard Assessment of Floor Coverings (1987-92)
- * Chairman ASTM E-5.15.8: Task Group on Full Scale Fire Testing of Upholstered Furniture (1989-). Developed full scale fire test methods: ASTM E1537, ASTM E1590 and ASTM E1822
- * Chairman ASTM E-5.15.12: Task Group on Vandalized Mattresses for Correctional Institutions (1991-93).
- * Chairman ASTM E-5.15.13: Task Group on Fire Hazard Assessment of Upholstered Furniture (1994-2009). Developed ASTM E2280, Standard guide on fire hazard assessment for health care occupancies
- * Chairman ASTM E-5.17.94: Task Group on Fire Hazard Assessment of Rail Transportation Vehicles (1991-). Developed ASTM E2061, new guide on fire hazard assessment of passenger rail vehicles
- * Chairman ASTM E-5.21.13: Task Group on Smoke Toxicity for Flashover Fires (1993-)
- * Chairman ASTM E-5.21.33: Task Group on ASTM E906 (Ohio State University Rate of Heat Release Apparatus) (1994-2004).
- * Chairman ASTM E-5.21.34: Task Group on Intermediate Scale Calorimeter (1997-2004). Managed interlaboratory round robin for ASTM E1623 and updated standard

- * Chairman ASTM E-5.21.35: Task Group on Rate of Heat Release Apparatus by Thermopile Method (1995-). Developed new test method ASTM E2102
- * Chairman ASTM E-5.21.3: Task Group on ISO (5659-2) Smoke Chamber (1995-2004) and NBS Smoke Chamber. Developed new test method ASTM E1995
- * Chairman ASTM E-5.21.60: Task Group on cone calorimeter (ASTM E 1354) (2009-)
- * Chairman ASTM E-5.21.80: Large scale heat release (2009-)
- * Chairman ASTM E-5.23.1: Task Group on Non Combustibility (2008 -12) (merged into ASTM E-5.23.2)
- * Chairman ASTM E-5.23.2: Task Group on Alternate Method of Non Combustibility (2007 -): Developed Test Method ASTM E2652
- * Chairman ASTM E-5.31/91 Task Group on Uncertainty (2002-)
- * Chairman ASTM E-5.31 Task Group on Terminology (2014-)
- * Chairman ASTM E-5.31 Task Group on Services/Functions Standards (2014-)
- * Chairman ASTM E-5.32.2: Task Group on 1990 Symposium on Fire Hazard and Fire Risk Assessment (1988-1992). Editor of ASTM STP 1150 (Fire Hazard & Fire Risk Assessment)
- * Chairman ASTM E-5.35.2: Task Group on Examples of Fire Hazard Assessment Standards (1989-91)

- **NFPA**

- * Chairman NFPA Technical Committee on Hazard and Risk of Contents and Furnishings (2001-2013). Developed new NFPA 556, Guide on Vehicle Fire Safety, & NFPA 557, Standard on Fire Loads
- * Chairman NFPA Technical Advisory Committee on Glossary of Terminology (2007-15)
- * Member NFPA Life Safety Technical Committee on Furnishings and Contents (1991-)
- * Member NFPA Building Code Technical Committee on Structures, Construction, and Materials (2014 -)
- * Member NFPA Technical Committee on Hazard and Risk of Contents and Furnishings (1991-)
- * Member NFPA National Electrical Code CMP 15: National Electrical Code Panel on Places of Assembly (1993-2001)
- * Member NFPA Technical Committee on Fire Tests: (1996-)
- * Member NFPA Technical Committee on Merchant Vessels: (1998-)
- * Member (Alternate, for Society of the Plastics Industry) of NFPA Technical Committee on Fixed Guideway Transit Systems [Trains]: (2001)
- * Member (for American Fire Safety Council/Plenum Cable Association) of NFPA Technical Committee on Air Conditioning [NFPA 90A-B]: (2002-)

- **ASTM D09 (Electrical Insulation Materials)**

- * Chairman ASTM D09: (2017-)
- * Chairman ASTM D-9.94: Subcommittee on Editorial (2008-)
- * Chairman ASTM D-9.21: Subcommittee on Fire Performance Standards (2010-6)
- * Chairman ASTM D-9.17: Subcommittee on Fire and Thermal Properties (2016 -)
- * Secretary ASTM D09: (2016-2017)
- * Secretary ASTM D-9.94: Subcommittee on Terminology and Editorial for Electrical Insulation Materials (1994-2008)

- * Chairman ASTM D-9.21.3: Task Group on Smoke Obscuration on Burning of Electrical Cables (1987-). Developed ASTM D5424
- * Chairman ASTM D-9.21.7: Task Group on Rate of Heat Release from Electrical Cables (1992-). Developed ASTM D5537 and ASTM D6113
- * Chairman ASTM D-9.21.1: Task Group on Fire Hazard Assessment of Electrotechnical Products (1995-). Developed Guide ASTM D5425
- * Chairman ASTM D-9.97-1: Task Group on March 1999 "90th Anniversary Symposium on Electrical Insulating Materials: International Issues" (1997-1999). Editor of ASTM STP 1376 (1999)
- * Chairman ASTM D-9.97 Task Group on ASTM D9 Symposium on Electrical Materials and Fire October 2004.

- **ASTM D20 (Plastics)**

- * Chairman ASTM D20-20: Subcommittee on Plastic Lumber (2009-) [Originally subcommittee on Plastic Products]
- * Vice-chairman ASTM D20.20.03: Section on Plastics and Combustibility (2013-2017)
- * Chairman Task Group on ASTM D4968 (Practice for Review of Test Methods and Specifications for Plastics (2015-))

- **ASTM F33 (Detention and Correctional Occupancies)**

- * Chairman ASTM F33.05 Task Group on Furnishings within Detention Occupancies (1997-). Developed test methods ASTM F1534 and F1550 and guide ASTM F1870.

- **ASTM F15, ASTM F08 and other ASTM committees:**

- * Chairman ASTM F15.15: Subcommittee on Wall Coverings (Responsible for a standard specification and a standard classification for wall coverings)
- * Task group chair and member various task groups.

- **CSA (Canadian Standards Association)**

- * Chairman Task Group on Circuit Integrity for CSA C22.2 No. 0.3 (1997-2000)
- * Member Committee CSA C22.2 No. 0.3 Wiring Test Methods (1992 -2010)
- * Member Committee CSA C22.2 No. 239 Control & Instrumentation Cables (1995 -2010)

- **IEEE (Institution of Electrical and Electronic Engineers)**

- * Member IEEE Technical Committee on Electrical Installations in Ships (IEEE 45) (1999-2007)
- * Member IEEE Technical Committee on Shipboard Wire and Cable (IEEE 1580) (2000-07)
- * Member IEEE Technical Committee on Environmental Assessment of Computer Products, Imaging Equipment and Television (IEEE 1680) (2010-)

- **ISO (International Organization for Standardization)**

- * Convenor ISO TC 61 SC4 WG8 (Plastics – Burning Behavior - Ignitability and fire growth tests) (2013 -)
- * Convenor ISO TC 92 WG8 (Fire Safety – Fire terms and definitions) (2013 -)
- * Member ISO TC61 SC4 (Plastics Burning Behavior)
- * Member ISO TC61 SC4 WG2 (Smoke and corrosivity) (2017 -)
- * Member ISO TC61 SC4 WG11 (PVC Products) (2015 -)
- * Member ISO TC92 SC1 (Building Products - Reaction to fire)
- * Member ISO TC92 SC3 (Building Products – Toxicity)

- **IEC (International Electrotechnical Commission)**

- * Member US TAG IEC TC89 (Cables and Fire)

Fire Safety Industrial Consultant (Public Information)

- Consultant to the Vinyl Institute on fire and PVC (1991-)
- Consultant to the Fire Retardant Chemicals Association/American Fire Safety Council/North American Flame Retardants Alliance on codes and standards (1997 -)
- Consultant to the National Cotton Council on code issues (2003 -05)
- Expert on various fire issues, for a variety of industrial clients

EMPLOYMENT RESPONSIBILITIES IN PREVIOUS WORK

■ BFGoodrich - Geon Vinyl Division (Fire Sciences Manager)

- Head of BFGoodrich fire testing laboratory: routine small-scale tests.
- Head of BFGoodrich fire research: smoke toxicity and fire hazard assessment; combustion and thermal analysis of poly(vinyl chloride) and other polymers; generation, transport and decay of hydrogen chloride; smoke corrosivity; analytical techniques for measuring combustion products. Provided a presence at national and international fire conferences, for participation and presentation of scientific work. Carried out full scale fire demonstrations, for research and public relations purposes. Supported line groups in the development of new commercial compounds.
- Technical consultant for BFGoodrich on litigation and other external affairs regarding fire and combustion toxicity
- Standards activities representing BFGoodrich: e.g. ASTM, NFPA, Canadian Standards Association.
- Vinyl industry spokesperson
- Chairman Technical Fire Sciences Subcommittee, Coordinating Committee for Fire Safety, Society of the Plastics Industry. Main spokesperson on fire activities for the plastics industry. Liaison with Center for Fire Research (National Bureau of Standards), NFPA, NIBS, etc.
- Technical Monitor SPI Carbon Monoxide and Fire Fatalities Project, etc. (1987-91)
- Chairman Combustibility Subcommittee, Vinyl Institute Technical Committee. Technical monitor of projects at Center for Fire Research (NBS), Southwest Research Institute
- Chairman ASTM E-5.15: Subcommittee on Fire and Interior Furnishings and Contents
- Secretary ASTM E-5.91: Subcommittee on Planning and Review of Fire Standards
- Chairman ASTM E-5.15.3: Task Group on Fire Hazard Assessment of Floor Coverings
- Chairman ASTM E-5.15.8: Task Group on Full Scale Fire Testing of Upholstered Furniture
- Chairman ASTM E-5.31.3: Task Group on Smoke Toxicity Definitions
- Chairman ASTM E-5.32.2: Task Group on 1990 Symposium on Fire Hazard and Fire Risk Assessment
- Chairman ASTM E-5.35.2: Task Group on Examples of Fire Hazard Assessment Standards
- Chairman ASTM D-9.21.3: Task Group on Smoke Obscuration on Burning of Electrical Cables
- Member of NIBS Smotox Steering Committee (1987-91)
- Member of NFPRF Risk Assessment Advisory Committee (1987-91)
- Session chairman on Materials for Increased Fire Safety at Int. Conf. Fire Safety (Dr. C.J. Hilado) (1987-91)
- Session chairman at Combustion Institute Eastern Section meetings
- Session Chairman at Fire Retardant Chem. Association meetings
- Member of ASTM Task Groups E-5.21.70 and D-9.21-4 (smoke corrosivity test development), ASTM E-5.21.02 and E-5.21.03 (smoke obscuration test development), and E5-21.11 (quick toxic fire hazard assessment)

■ **BFGoodrich - Chemical Group & Geon Vinyl Division**

- As subsequent job, at a lower level of responsibility.

■ **Department of Chemistry - The City University**

- Supervision of post-graduate and undergraduate research students
- Research in combustion and air pollution: medium and high molecular weight hydrocarbons, liquid fuels (gasoline, diesel efficiency and effects of additives), polymers (thermal decomposition, flammability and flame retardance: efficiency and mechanism), cellulosic materials (cellulose, cotton, cigarette paper: mechanisms and means of decreasing emissions), emission processes of gaseous pollutants, etc.
- Consultant to the "Unit for Oxidation and Combustion Technology": Ministry of Defense and industrial contract research organization.
- Consultant to the OECD (Organization for Economic Cooperation and Development; Paris, France): industrial and automotive pollution issues.

■ **School of Molecular Sciences - University of Sussex**

- Research in physical organic chemistry: syntheses and kinetics of radioactive decay by protiodetritiation of polycyclic aromatic hydrocarbons.

■ **R & D Department - ALUAR Aluminio Argentino**

- Planning for setting up a laboratory and literature search

■ **Department of Physical Chemistry - School of Pharmacy and Biochemistry - University of Buenos Aires**

- Research into polymerization mechanisms, leading to Ph.D.

PUBLICATIONS

Books:

- 1) "The Combustion of Organic Polymers", C.F. Cullis and M.M. Hirschler, Oxford University Press, Oxford, UK, 1981.
- 2) "Oxidation of Organic Compounds. Solvent Effects in Radical Reactions", N.M. Emanuel, G.E. Zaikov and Z.K. Maizus, translators: A.K. Henn and I.G. Evans, translation editor: M.M. Hirschler, Pergamon Press, Oxford, UK, 1984.
- 3) "Fire hazard and fire risk assessment", ASTM STP 1150, Amer. Soc. Testing and Materials, Philadelphia, PA, US, Editor: M.M. Hirschler, (1992).
- 228) "Carbon monoxide and human lethality: Fire and non fire studies", Editor in Chief: M.M. Hirschler, Associate Editors: S.M. Debanne, J.B. Larsen and G.L. Nelson, Elsevier, New York, US, 1993.
- 274) "Fire Calorimetry", Editors: M.M. Hirschler and R.E. Lyon, DOT/FAA/CT-95-46, NTIS, Alexandria, VA, US, 1995.
- 345) "Electrical Insulating Materials - International Issues", ASTM STP 1376, Amer. Soc. Testing and Materials, West Conshohocken, PA, US, Editor: M.M. Hirschler (2000).
- 453) "Practical Guide to Smoke and Combustion Products from Burning Polymers – Generation, Assessment and Control", M.M. Hirschler, S. Levchik and E.D. Weil, Smithers Rapra Technical Publications, Shawbury, UK, 2011.

Other Scientific Publications and Presentations:

1974

- 4) "Free radical polymerization of methyl methacrylate in the presence of benzoquinone and triethyl aluminium", J. Grotewold and M.M. Hirschler, Int. Symp. On Macromolecules, Rio de Janeiro, Brazil, July 26-31, 1974.
- 5) "Formation of a methyl methacrylate oligomer by combining triethyl aluminium and azobisisobutyronitrile", J. Grotewold and M.M. Hirschler, Kinetics and Photochemistry Symposium, Rio Cuarto (Argentina), August 6-10, 1974.

1975

- 6) "Mechanism of polymerization of methyl methacrylate in the presence of triethyl aluminium together with a typical free radical inhibitor or an initiator", Doctoral Dissertation, University of Buenos Aires.
- 7) "Report on carbons, carbonization, additives (oxidative and reductive) and polycyclic aromatic hydrocarbons", M.M. Hirschler, Internal Publication, ALUAR Aluminio Argentino, 1975.

1977

- 8) "Stoichiometric formation of methyl methacrylate oligomer by triethyl aluminium in the presence of azobisisobutyronitrile", J. Grotewold and M.M. Hirschler, J. Polymer Sci., A-1 (Polymer Chemistry), 15, 383-91 (1977).

9) "Triethyl aluminium as a concentration-dependent coinitiator and chain-transfer agent of free radical polymerization of methyl methacrylate in the presence of benzoquinone", J. Grotewold and M.M. Hirschler, *J. Polymer Sci., A-1 (Polymer Chemistry)*, **15**, 393-404 (1977).

10) "Electrophilic aromatic substitution. Part 18. Protiodetritiation of anthracene, coronene and triphenylene in anhydrous trifluoroacetic acid", H.V. Ansell, M.M. Hirschler and R. Taylor, *J. Chem. Soc., Perkin II*, 353-5 (1977).

1978

11) "The formation and destruction of pentenes during the combustion of pentane", C.F. Cullis and M.M. Hirschler, *Proc. Royal Soc. (London) A* **364**, 75-88 (1978).

12) "Isotopic tracer studies of the further reactions of pentenes in the combustion of pentane", C.F. Cullis and M.M. Hirschler, *Proc. Royal Soc. (London) A* **364**, 309-29 (1978).

1979

13) "Sulphur emissions into the atmosphere", C.F. Cullis and M.M. Hirschler, *Int. Symp. On Sulphur Emissions and the Environment, London (U.K.), May 8-10, Soc. Chem. Industry*, pp. 1-23 (1979).

1980

14) "Atmospheric cycles of some common elements: II. Man's activities", C.F. Cullis and M.M. Hirschler, *Educ. Chem.* **17**, 40-3 (1980).

15) "Sulphur emissions, the environment and chemical industry", M.M. Hirschler, *Introductory Lecture, Int. Symp. On Sulphur Emissions and the Environment, London (U.K.), May 8-10, 1979, Soc. Chem. Industry*, pp. 445-55 (Discussion Volume) (1980).

16) "Atmospheric sulphur: natural and man-made sources", C.F. Cullis and M.M. Hirschler, *Atmos. Environ.*, **14**, 1263-78 (1980).

17) "Ignition of Kynar oxygen valve material", M.M. Hirschler, *Report for Health and Safety Executive, U.K., Contract No. 1186-46.04, November 1980*.

18) "The effect of atropisomerism upon electrophilic aromatic reactivity: detritiation of hexa- and tetra-phenylene", M.M. Hirschler and R. Taylor, *J. Chem. Soc., Chem. Comm.*, 967-9 (1980).

1981

19) "Man's emission of carbon dioxide into the atmosphere", M.M. Hirschler, *Atmos. Environ.*, **15**, 719-27 (1981).

20) "Smoking and air pollution", C.F. Cullis and M.M. Hirschler, *Seventh Int. Clean Air Conf., Clean Air Soc. Australia and New Zealand, Adelaide (Australia), August 21-27*, pp. 115-29 (1981).

21) "Biogenic sulphur emissions", M.M. Hirschler, *Atmos. Environ.* **15**, 1336 (1981).

22) "The oxidative thermal stability of plastic propellants", A.W. Benbow and M.M. Hirschler, *Report for Procurement Executive, Propellants, Explosives and Rockets Motor Establishment, Ministry of Defence, U.K., Contract No. D/RM 1/11/240, February 1981*.

23) "The combined action of aluminium oxides and halogen compounds as flame retardants", F.K. Antia, C.F. Cullis and M.M. Hirschler, *Europ. Polymer J.*, **17**, 451-5, (1981).

24) "The inhibition of polymer combustion by metal oxides", F.K. Antia, C.F. Cullis and M.M. Hirschler, *First Specialists' Mtg Combustion Institute, Bordeaux (France), July 20-25*, pp. 602-7 (1981).

- 25) "Experimental techniques for the combustion of fuels of low volatility and high reactivity", C.F. Cullis, M.M. Hirschler and R.L. Rogers, 18th. Symp. (Int.) on Combustion, pp. 1575-82, The Combustion Institute, Pittsburgh, 1981.
- 26) "The oxidation of decane in the gaseous and liquid phases", C.F. Cullis, M.M. Hirschler and R.L. Rogers, Proc. Royal Soc. (London), A 375, 543-63 (1981).
- 1) "The Combustion of Organic Polymers", C.F. Cullis and M.M. Hirschler, Oxford University Press, Oxford, 1981.

1982

- 27) "The cool-flame combustion of decane", C.F. Cullis, M.M. Hirschler and R.L. Rogers, Proc. Royal Soc. (London), A 382, 429-40 (1982).
- 28) "Recent developments in flame-retardant mechanisms", M.M. Hirschler, in "Developments in Polymer Stabilisation, Vol. 5", Ed. G. Scott, pp. 107-52, Applied Science Publ., London, 1982.
- 29) "Binary mixtures of metal compounds as flame retardants for organic polymers", F.K. Antia, C.F. Cullis and M.M. Hirschler, Europ. Polymer J., 18, 95-107 (1982).
- 30) "Comprehensive study of the effect of composition on the flame-retardant activity of antimony oxide and halogenated hydrocarbons in thermoplastic polymers", F.K. Antia, P.J. Baldry and M.M. Hirschler, Europ. Polymer J., 18, 167-74 (1982).
- 31) "Effect of oxygen on the thermal decomposition of poly(vinylidene fluoride)", M.M. Hirschler, Europ. Polymer J. 18, 463-7, (1982).
- 32) "Relation between the thermal behaviour and flame-retardant effectiveness of metal oxides in halogen-containing thermoplastics", M.M. Hirschler, Sixth European Conf. on Flammability and Fire Retardants, Alena Enterprises of Canada, June 24-25, Nice (France), 1982.
- 33) "Thermal stability and flammability of organic polymers", C.F. Cullis and M.M. Hirschler, I.U.P.A.C. Macro '82, Polymer Degradation and Stabilisation, July 12-16, Amherst (U.S.), p. 286, 1982.

1983

- 34) "The role of specific elements in flame-retardant mechanisms", M.M. Hirschler, Polymer Flammability: Mechanistic and Practical Aspects, P.D.D.G. Conf., Macro Group U.K.(Royal Soc. Chemistry), September 2-3, Cambridge (U.K.), 1983 (Industrial Chemistry Bulletin, 2, 52 (1983)).
- 35) "The pyrolysis of cellulose under conditions of rapid heating", C.F. Cullis, M.M. Hirschler, R.P. Townsend and V. Visanuvimol, Combust. Flame 49, 235-48 (1983).
- 36) "The combustion of cellulose under conditions of rapid heating", C.F. Cullis, M.M. Hirschler, R.P. Townsend and V. Visanuvimol, Combust. Flame 49, 249-54 (1983).
- 37) "Flame retardance and smoke suppression by tin (IV) oxide phases and decabromobiphenyl", J.D. Donaldson, J. Donbavand and M.M. Hirschler, Europ. Polymer J. 19, 33-41 (1983).
- 38) "Thermal analysis and flammability of polymers: Effect of halogen-metal additive systems", M.M. Hirschler, Europ. Polymer J. 19, 121-9 (1983).
- 39) "The effect of combinations of aluminium (III) oxides and decabromobiphenyl on the flammability of and smoke production from acrylonitrile-butadiene-styrene terpolymer", M.M. Hirschler and O. Tsika, Europ. Polymer J., 19, 375-80 (1983).

- 40) "Mechanism of action of pyrogenic silica as a smoke suppressant for polystyrene", R. Chalabi, C.F. Cullis and M.M. Hirschler, *Europ. Polymer J.*, 19, 461-8 (1983).
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