

Dr. Marcelo M. Hirschler, Ph.D., M.R.S.C., C.Chem.

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Dr. Marcelo M. Hirschler has a background in university, industry and as a private fire safety consultant (on product liability, research and codes/standards). He graduated from the University of Buenos Aires, where he obtained a first degree in Physical chemistry and a PhD in Polymer Chemistry, in 1975. He has worked in three continents (South America, Europe and the USA).

Dr. Hirschler has also been involved, since 1984, in fire litigation, mainly in terms of the fire performance of combustible materials and the products into which they are made. Experience in that area has focused on fire safety of consumer products (cars, mattresses, upholstered furniture, textiles, including apparel and protective clothing), fire testing, results interpretation and analysis of fire consequences by comparison with known information and with the scenario in question. He has worked on a large number of product liability fire cases.

Dr. Hirschler has specialized in fire issues for over 20 years (mainly fire testing, fire hazard, smoke toxicity and smoke corrosivity) and has published over 400 papers and five books: "The Combustion of Organic Polymers" (Oxford University Press, with Charles F. Cullis), "Fire Hazard and Fire Risk Assessment", ASTM STP 1150, "Carbon Monoxide and Human Lethality: Fire and Non Fire Studies", Chapman & Hall), "Fire Calorimetry", NTIS, (Edited by Richard Lyon and Marcelo Hirschler) & ASTM STP 1376, "Electrical Insulating Materials, International Issues". Major applications of his publications are plastic materials, electric cables, furniture and furnishings, textiles, fabrics and cigarette smoldering.

Dr. Hirschler is involved with proposals for the development and amendment of codes, including the building code (IBC and NFPA 5000), the life safety code (NFPA 101), the national electrical code (NEC, NFPA 70), mechanical codes (IMC, UMC), fire codes (IFC, NFPA 1) and the residential code (IRC). Dr. Hirschler is also very active in developing fire standards (nationally and internationally) within ASTM, NFPA, CSA and IEEE. He has been appointed to a number of positions of responsibility within codes and standards committees and has received several awards.

GBH International

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

CURRICULUM VITAE

PERSONAL

Date of Birth: May 8, 1947
Place of Birth: Buenos Aires, Argentina

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, E. Sussex, 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

MEMBERSHIP PROFESSIONAL SOCIETIES

- Amer. Soc. for Testing and Materials (ASTM): Subcommittees: E-5 (Fire Standards), C-16 (Thermal Insulation), D-7 (Wood), D-9 (Electrical Materials), D-11 (Rubber), D-13 (Textiles), D-20 (Plastics), E-34 (Occupational Health & Safety), F-7 (Aerospace), F-8 (Sports Equipment and Facilities), F-15 (Consumer Products), F-23 (Protective Clothing), F-25 (Shipbuilding) and F-33 (Correctional Facilities)
- Canadian Standards Association (CSA)
- Combustion Institute (Western States Section)
- Int. Assoc. for Fire Safety Science
- Int. Assoc. Of Plumbing and Mechanical Officials (IAPMO)
- Int. Heat Release Association
- National Fire Protection Association (NFPA) (Various Sections)
- International Code Council (ICC)

LANGUAGES

English, German, Spanish, French

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

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 (1992 -), Materials for Increased Fire Safety at Int. Conf. Fire Safety (Dr. C.J. Hilado) (1987-98), BCC Flame Retardancy (1990-2005), Int. Assoc. 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.

Codes and standards:

- **ASTM E05:**
- * Chairman ASTM E-5.15: Subcommittee on Fire and Interior Furnishings and Contents (1990-95)
- * Chairman ASTM E-5.31: Subcommittee on Fire Terminology and Editorial (2000-5)
- * Chairman ASTM E-5.21: Subcommittee on Smoke and Combustion Products (2004-9)
- * Chairman ASTM E-5.17: Subcommittee on Fire and Transportation (2010-)
- * 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-)
- * Recording Secretary ASTM E-5.15: Subcommittee on Fire and Interior Furnishings and Contents (1988-90 and 1996-)
- * Recording Secretary ASTM E-5.91: Subcommittee on Planning and Review of Fire Standards (1990-1999 and 2000-)
- * Recording Secretary ASTM E-5.17: Subcommittee on Fire and Transportation (2003-2009)
- * Chairman ASTM E-5.22.02: Task Group on ASTM E 84 Steiner Tunnel Mounting Methods (2002-). Developed practices ASTM E 2231 and ASTM E 2404.
- * 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 test method ASTM E 2257.
- * 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 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-). Developed ASTM E 2280, 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). Developed new version of standard.
- * Chairman ASTM E-5.21.34: Task Group on Intermediate Scale Calorimeter (1997-2004). Managed interlaboratory round robin for ASTM E 1623 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 E 2102.
- * 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 & updated ASTM E 662.
- * Chairman ASTM E5.21.60: Task Group on cone calorimeter (ASTM E 1354) (2009-)
- * Chairman ASTM E5.21.80: Large scale heat release (2009-)
- * Chairman ASTM E5.31/91 Task Group on Uncertainty (2002-)
- * 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-)
- * Chairman NFPA Technical Committee on Glossary of Terms (2007 -)
- * Member NFPA Life Safety Technical Committee on Furnishings and Contents (1991-)
- * 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**

- * Chairman ASTM D-9.94: Subcommittee on Editorial (2008-)
- * 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:**

- * Chairman ASTM D20-20: Subcommittee on Plastic Products (2009-)

- **ASTM F33**

- * Chairman ASTM F33.05 Task Group on Furnishings within Detention Occupancies (1997-). Developed new test methods ASTM F 1534 and F 1550 and new guide ASTM F 1870.

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

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 -)
- * Member Committee CSA C22.2 No. 239 Control & Instrumentation Cables (1995 -)

- **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)

- **International Code Council**

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

- **Fire Safety Industrial Consultant (Public Information)**

- Consultant to the Vinyl Institute on fire and PVC (1991-96)
- Consultant to the Fire Retardant Chemicals Association/American Fire Safety Council 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: participation and presentation of scientific work. Carried out full scale fire demonstrations, for research and public relations purposes. Support of 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. Assoc. 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 protiodetrutiation 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, 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, 1984.
- 3) "Fire hazard and fire risk assessment", ASTM STP 1150, Amer. Soc. Testing and Materials, Philadelphia, PA, 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, 1993.
- 274) "Fire Calorimetry", Editors: M.M. Hirschler and R.E. Lyon, DOT/FAA/CT-95-46, NTIS, 1995.
- 345) "Electrical Insulating Materials - International Issues", ASTM STP 1376, Amer. Soc. Testing and Materials, West Conshohocken, PA, Editor: M.M. Hirschler (2000).

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. Protiodetrition 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-o-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).
- 41) "The significance of thermoanalytical measurements in the assessment of polymer flammability", C.F. Cullis and M.M. Hirschler, Polymer, 24, 834-40 (1983).
- 42) "The influence of metal chelates on the oxidative degradation of polypropylene", C.F. Cullis and M.M. Hirschler, in Proc. Fifth Ann. Int. Conf. Advances in the Stabilisation and Controlled Degradation of Polymers, Zurich (Switzerland), June 1-3, pp. 195-207 (1983).
- 43) "Metal oxides as flame retardants-smoke suppressants: recent developments", M.M. Hirschler, Seventh Europ. Conf. on Flammability and Fire Retardants, Alena Enterprises of Canada, London (U.K.), June 9-10, 1983.
- 44) "A novel dilution tunnel-flame burner system for studying the effects of automotive diesel fuels on air quality", C.F. Cullis, M.M. Hirschler and M.A.M. Stroud, Sixth World Congress on Air Quality, Paris (France), May 16-20, Int. Union Air Pollution Prevention Assocs, Vol. 4, pp. 265-72 (1983).

- 45) "Effects of organic sulphur compounds on the ignition of unleaded and leaded hydrocarbon fuels", C.F. Cullis, M.M. Hirschler and G.O.G. Okorodudu, 19th. Symp. (Int.) on Combustion, pp. 1475-86, The Combustion Institute, Pittsburgh, 1983.
- 46) "The effects on alkane combustion of added sulphur compounds", C.F. Cullis, M.M. Hirschler, G.O.G. Okorodudu and H.A.G. Okuns, *Combust. Flame* 54, 209-24 (1983).

1984

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Some of the Main Subjects of Publications

1. Fire Hazard and Fire Testing
2. Codes and Standards
3. Fire Retardants and Smoke Suppressants
4. Fire and Furniture or Furnishings, including Mattresses
5. Fire and Electrical Cables
6. Fabric Flammability
7. Fire and Transportation Vehicles, especially Automobiles
8. Smoke Toxicity
9. Smoke Corrosivity
10. Poly(vinyl chloride) Issues
11. Hydrogen Chloride Decay
12. Atmospheric Pollution
13. Cigarette Combustion