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Recent Advances in Flame Retardancy of Polymeric Materials

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(The Seventh Annual BCC* Conference on Flame Retardancy)
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The Seventh Annual Conference on Flame Retardancy was held in International Plaza Hotel in Stamford, Connecticut, USA on May 20–22, 1996, As before it was organized and sponsored by Business Communications Company (BCC). Scientists from 15 countries (USA, Canada, Germany, Israel, Russia, Belorussia, Italy, UK, China, Taiwan, Japan, France, South Korea, Sweden, Ireland) contributed in the conference. The meeting was aimed to:

- Create a forum for introducing new technological achievements and development in the field of flame retardancy
- Review the current state of science and technology in FR
- Review in applications and markets for FR products
- Present recent development in local and global standardization and in testing technology
- Discuss toxicity and environmental issues
- Provide a unique opportunity for newcomers to FR research technology and marketing to become acquainted with the FR field in all its aspects
- Discuss halogen-based and non-halogen-based flame retardant chemicals, synergism, intumescence, FR mechanism, modeling, flame parameters, inherently FR polymers and polymer blends. 35 plenary

*BCC – Business Communications Company, Inc., 25 Van Zant St., Norwalk, CT 06855, USA.

lectures were presented at the conference which also included 2 Poster sessions and Exhibition of industrial chemical additives for polymers, reducing flammability of materials. Several leading US companies demonstrated their promotion in the exhibition. The work was organized in 6 sessions. The meeting was opened with remarks of Prof. Menachem Lewin (Polymer Research Institute at Brooklyn Polytechnic University, New York, USA), who emphasised the present interest of science and practice of the aforesaid problems.

The first session considered New Directions in FR Technology and FR Industry. There were 6 main lectures which presented the development of fundamental research in field of flammability of polymeric materials and flame retardancy, and new ways of the creation of environmentally friendly additives for polymers. The chairman of this session was Dr. Gerald S. Kirshenbaum (Hoechst Celanese Corporation, Summit, New Jersey).

The first lecture of Prof. Giovanni Camino (Dipartimento di Chimico Inorganica, Chimica Fisica e Chimica dei Materiali, Torino, Italy) reviewed work in the area of intumescence mechanisms. He showed that the "intumescent" behavior resulting from combination of charring and foaming of the surface of the burning polymers is being widely developed in fire retardancy because it is characterized by a low environmental impact.

Group of scientists from Building and Fire research laboratory, National Institute of Standards and Technology, Washington DC (Drs. Takashi Kashiwagi, Jeffrey Gilman and Anthony Hamins) reported about Polymer combustion and New Flame Retardants. The physical and chemical mechanism of polymer combustion were discussed. The coupling between the gas phase processes and the condensed phase processes were distributed.

XXV Years of Flame Retarding Plastics was a topic of the lecture of Dr. Joseph Green (FMC Corporation, Princeton, New Jersey). The development of flame retardants for plastics were traced from 1970 to 1995, showing types of flame retardants and applications.

Flammability Issues in Broadband Telecommunications Equipment was presented by Dr. William R. Lambert (Bell Laboratories, Murray Hill NJ). The new telecommunications network products which comprise the various broadband infrastructures must be designed to mini-

mize the potential for fire hazard and face evolving flammability requirements.

The lectures "New Frontiers of Polymer Flammability Depression" (Prof. G. E. Zaikov, Dr. S. M. Lomakin, Institute of Biochemical Physics of Russian Academy of Sciences, Moscow) and "New Mechanism Considerations for FR Polyimides (Dr. S. A. Lewchick, Institute of Organic Chemistry Belorussian Academy of Sciences, Minsk) showed the possibility of substituting the well-known common halogenated and phosphorus flame retardants with different types of ecologically safe flame depressant systems.

Inherent FR Systems were the topic of the Session II (Prof. G. Camino was chairman of this session). The lecture "Char Formation in Halogen-Based Polymer Systems" was given by Dr. Peter Carty (University of Northumbria, Newcastle, UK) and Dr. Stewart White (Anzon Ltd., Newcastle, UK). It was shown that polymer blends are becoming important polymers because of easy recycling. Prof. Charles A. Wilkie (Marquette University, Milwaukee, Wisconsin) gave the lecture entitled Grafting onto Polystyrene: An Effective Approach to Flame Retardancy. A significant success for ABS and styrene-butadiene copolymers was reported. The last report of this session was prepared by the Russian group: Drs. V. V. Bagin, A. C. Burrev (Legion Construction Co., Chelyabinsk, Russia) and Dr. B. B. Serkov (Research, Develop and Consulting Co "Antip Ltd", Higher Engineering Fire Technical School, Moscow, Russia) and was dedicated the dehydrating fire-protective coatings for plastics, foamed plastics, wooden structures and electrical cables.

Seven lectures were presented in the Session III (Important Trends in Halogenated FR Polymer Technology, Prof. Ch. A. Wilkie was chairman). Drs. B. A. Howell, K. F. Johnston and S. Frahlicher (Center for Applications in Polymer Science, Central Michigan University, Mount Pleasant, Michigan) gave information about high Phosphorus/Bromine content compounds as polyolefin flame retardants.

Prof. Menachem Levin reported new results on flame retardancy of wood by chemical modification with bromate-bromide solutions. Drs. Edward A. Myszak, Jr. (Market Development Project Manager) and Michael T. Sobus (Business Manager, PQ corporation, Valley Forge, PA) spoke about new generation of inorganic colloids for flame retardancy and UV stabilization of polymers.

The information about iodides as halogen-donor flame inhibitors was given in the report of Drs. Stephanie R. Skaggs and Douglas S. Dierdorf (Pacific Scientific NTL/Kin-Tech Division, Albuquerque, NM).

The flame retardance of polypropylene with tetrabromobisphenol A analogs (a high efficiency mechanism) was proposed in the lecture of Japanese scientists Masahiro Oba and Michio Fujii (Tosoh Corp., Yamaguchi). Drs. I. Finberg, S. Scheipert and P. Georlette (Dead Sea Bromine Group Ltd, Israel) spoke about a new brominated cyanurate as flame retardant for application in styrenics. The review of Dr. Jose D. Reyes (Dead sea Bromine Group) was dedicated to the flame retardants market for applications in polypropylene.

The session IV considered important trends in non-halogen polymer technologies (8 lectures, Prof. Eli Pearce was chairman). Recent progress in flame retardancy of polyurethane foams was included in the report of Drs Edward D. Weil, M. Ravey and G. Gertner (Polymer Research Institute, Polytechnic University in Brooklyn, New York). Drs. Serge Bourbigot, Michel Le Bras, Rene Delobel (Laboratoire de Physicochimie des Solides, E.N.S.C.L., Université des Sciences et Technologies de Lille), Bertrand Revel (Centre Commun de Mesures RMN, USTL, Jean-Michel Tremillion, GRL (Elf-Atochem), France gave information about comparative structural study of intumescent coatings formed from E-BuA-MAH-ammonium polyphosphate-pentaerythritol formulations with and without zeolite. Drs. Stephanie R. Skaggs and Douglas S. Dierdorf. Pacific Scientific HTL/Kin-Tech Division, Albuquerque, NM) presented research data about phosphonitriles: a working example of the crossover between flame retardants and flame extinguishants. The effect of phosphorus compounds on flame retardancy of polymeric materials was discussed in the lecture of Dr. H. Von Gentzkow (Siemens AG Corp., Germany) and new UV curable phosphazene compounds as flame retardant surface coating materials were presented by Y. W. Chen-Yang, J. R. Chung and Y. C. Yang (Department of Chemistry, Chung Yuan Christian University, Chung Li; C. Y. Li and Y. S. Chiu, Department of Chemistry, Chung Shan Institute of Science Technology, Taiwan, R.O.C).

Three last lectures of this session were devoted to the problems of zinc borate in conjunction with ammonium molybdate or zinc stannate as a smoke suppressant in flexible PVC (Donald J. Ferm and Kelvin K. Shen, US Borax Inc., Valencia, CA), halogen-free flame retardant PBT

(Dr. Sung Kim, Petrochemicals and Polymer Research Park, LG Chemical Research Ltd/Research Park, South Korea) and new results on mechanisms and performance of molybdenum and Zinc containing flame and smoke suppressants for PVC and other polymers (Larry L. Musselman and Philip Cook, Polymer Additives Group, Ridgeville, CT).

The consumer focus and industrial applications were the topics of the session V (Dr. Marcello M. Hirschler from GBM International, California was chairman of this session).

Five lectures were presented. Fire and smoke-resistant interior materials for commercial transport aircraft was presented in very interesting lecture of Prof. Eli M. Pearce (Director, Herman F. Mark Polymer Research Institute, Polytechnic University, Brooklyn, NY). This was a review of the National Material Materials Advisory Board Report of the same name prepared by the Committee on Fire and Smoke-Resistant Materials for Commercial Aircraft Interiors. Prof. Pearce was the Chairman of this Committee.

In the lecture about fire suppression systems: Alternatives to halon Dr. James B. Murphy (Foam/Engineered Systems Manager, Ansul Incorporated) reviewed the new possibility for fire suppressions. Fire retardant application in a phenolic resin-glass cloth composite for aerospace application was discussed in report of Peter Brownell and John J. Farrell (Albany International Research Co., Albany, NY), fabric flammability: survey of flame spread of modern fabrics overreviewed in lecture of Drs. Marcelo M. Hirschler and Timothy Piansay (GBH International, Mill Valley, CA) and update on regulations affecting brominated flame retardants were presented in the report of Dr. Marcia L. Hardy (health and Environment, Albermarle corp., Baton Rouge, LA).

The final session was directly related to environmental issue and toxicity (testing, standardization, toxicity). The chairman of this VI session was Dr. Marcia L. Hardy.

Six lectures were included in this session. Prof. Wang Jianqi, School of Chemical Engineering and Materials Science, Beijing Institute of Technology, Beijing, China) spoke about an XPS Investigation of the thermal degradation and charring processes of poly (vinyl chloride) in the condensed phase in the presence of the transition metals (copper and molybdenum) during combustion. Prof. D. Lenoir in his lecture with Prof. A. Tettrup and Dr. K. KampkeThiel (Institute of Ecological Chemistry, GSF Research Centre for Environment and Health, Oberschleissheim, Germany) gave

information about new duroplastic materials with phosphorus compounds as flame retardant. Problems of modeling the combustion of Solid-Phase Fuels in Cone Calorimeter Experiments were explained in the report of J. E. J. Staggs, Raychem Ltd., Corporate Technology, Europe Swindon. Peter K. S. Wu (Factory Mutual Research Corp., USA) presented lecture on application of the FM model based methodology for flammability assessment of FR polymers.

The last two lectures were devoted to a laboratory-scale jet fire procedure for testing composite systems used in the petrochemical industry (Alex B. Wenzel and Arthur J. Parker, Southwest Research Institute, San Antonio, TX) and standards and fire testing for materials in Russia (Dr. B. B. Serkov, "Antip Ltd" Research, Developing and Consulting Co, Higher Engineering Fire Technical School, Moscow, Russia).

The two most important poster session presentations were: A unique magnesium hydroxide (Tom Harrington, Amenbrom, inc. USA) and Structural study of the polymer phases in a PAG-EVA-FR additive blends (Serge Bourbigot, Catherine Siat and Michel Le Brus, Laboratoire de Physicochimie des Solides, E.N.S.C.L., Université des Sciences et Technologies de Lille, France).

The conference was very successful and showed that both the fundamental research on polymer flammability or practical applications of novel flame retardants can lead to new technological developments. However the number of participants (100) reduces from year to year.

The next conference on flame retardants is scheduled for 1997.